Cardiovascular Statistics – Brazil 2026

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Keywords

Cardiovascular Diseases; Cerebrovascular Disorders; Coronary Disease; Cardiomyopathies; Heart Valve Diseases; Heart Failure; Atrial Fibrillation; Atrial Flutter; Hypertension; Dyslipidemias; Diabetes Mellitus; Tobacco Use Disorder; Obesity; Overweight; Exercise; Diet; Congenital Heart Defects; Chronic Renal Insufficiency; Statistics; Brazil.

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ABOUT THESE STATISTICS

See Table 1 and Figures 1 and 2.

Abbreviations used in the introduction

CKD	Chronic Kidney Disease
CVD	Total Cardiovascular Diseases
DALY	Disability-Adjusted Life Years
ELSA-Brasil	The Brazilian Longitudinal Study of Adult Health (in Portuguese, *Estudo Longitudinal de Saúde do Adulto*)

GBD	Global Burden of Disease
IBGE	Brazilian Institute of Geography and Statistics (in Portuguese, Instituto Brasileiro de Geografia e Estatística)
IHME	Institute for Health Metrics and Evaluation
PNS	Brazilian National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
SIA	Outpatient Information System (in Portuguese, Sistema de Informações Ambulatoriais)
SIH	System of the Unified Health System (in Portuguese, Sistema de Informações Hospitalares)
SIM	Mortality Information System
SUS	Brazilian Unified Health System (in Portuguese, *Sistema* Único *de Saúde*)
YLD	Years Lived with Disability
YLL	Years of Life Lost

Cardiovascular Statistics – Brazil was established to provide a periodic, comprehensive, evidence-based assessment of cardiovascular health in Brazil and to support clinical practice, research, public health planning, and policy development.[1-3] Developed under the auspices of the Brazilian Society of Cardiology, the initiative brings together a multidisciplinary network of investigators from academic institutions across the country who are responsible for reviewing, analyzing, and interpreting data from multiple complementary sources. Since its first edition in 2020, Cardiovascular Statistics – Brazil has sought not only to quantify the burden of cardiovascular diseases (CVDs) and their risk factors but also to identify temporal trends, regional disparities, gaps in care, and emerging challenges for the Brazilian health system. The project is modeled on international initiatives such as the American Heart Association's *Heart Disease and Stroke Statistics Update,*[4] while incorporating data sources and perspectives that reflect Brazil's unique epidemiological, demographic, and healthcare characteristics.

The estimates presented in this report are derived from a broad range of data sources, including national mortality and hospitalization information systems, population-based health surveys, administrative databases, disease registries, the Global Burden of Disease 2023 Study,[5,6] and systematic reviews of scientific literature. These sources provide complementary information on mortality, morbidity, risk factors, healthcare utilization, costs, and disease burden. To maximize consistency across chapters, standardized methodological approaches were adopted whenever feasible. Economic estimates were harmonized by updating reported costs to December 2025 prices using country-specific inflation indices and subsequently converting them to U.S. dollars using the December 2025 exchange rates. Because differences in study design, costing methodology, and healthcare systems remain, economic findings should be interpreted primarily as indicators of the magnitude and trends of the cardiovascular economic burden rather than as direct comparisons of absolute costs. A summary of the principal data sources and their contributions is provided in Table 1, while Figure 1 illustrates the overall framework for integrating data from these multiple sources into the present report. Details regarding data sources and methodology are available in the previous editions of Cardiovascular Statistics – Brazil.[1-3] The methodological framework used to standardize and harmonize economic estimates across studies is summarized in Figure 2, providing an overview of the processes for cost collection, inflation adjustment, currency conversion, and interpretation.

Cardiovascular Statistics – Brazil 2026 is organized into 15 chapters. The report begins with an overview chapter describing the overall burden of CVD in Brazil, followed by chapters dedicated to specific cardiovascular conditions and to major cardiovascular risk factors and lifestyle-related determinants. Compared with previous editions, Cardiovascular Statistics – Brazil 2026 includes new chapters on chronic kidney disease (CKD), nutrition, and congenital heart disease, reflecting their growing relevance to cardiovascular health and the availability of new evidence. All chapters were extensively updated using the most recent data available from national and international sources, with priority given to newly released databases, recent estimates, and contemporary scientific evidence published since the previous edition.

Although all chapters follow a standardized framework, their structure varies according to the nature of the topic. Chapters addressing CVDs primarily focus on epidemiology, mortality, morbidity, disease burden, healthcare utilization, hospitalizations, procedures, and costs. In contrast, chapters devoted to risk factors and lifestyle behaviors emphasize prevalence, temporal trends, geographic variation, and the attributable burden of CVD associated with each exposure, including mortality and disability-adjusted life years attributable to the risk factor. Some risk factors for CVD are also diseases themselves, such as diabetes and CKD; in this case, we privileged reporting data of the condition as a risk factor. In addition, the data sources used differ across chapters, with greater reliance on health information systems, administrative databases, and hospital records in disease-focused chapters, and on population-based surveys and surveillance systems in chapters addressing risk factors and health behaviors.

Over successive editions, Cardiovascular Statistics – Brazil has become one of the most widely consulted sources of information on cardiovascular health in the country and one of the most cited publications in Arquivos Brasileiros de Cardiologia (ABC Cardiol). Beyond its role as a descriptive report, the initiative serves as a resource for multiple stakeholders, including clinicians, researchers, educators, healthcare managers, policymakers, and professional societies. The data presented throughout the report have been used to support scientific research, guide healthcare planning, inform policy discussions, identify knowledge gaps, and monitor progress toward national and international cardiovascular health goals. The 2026 edition is accompanied by a redesigned online platform that expands access to data visualizations, maps, figures, and supplementary materials. By integrating traditional scientific reporting with interactive digital resources, it seeks to improve the accessibility, dissemination, and practical application of cardiovascular data,

Table 1 – Principal data sources used in Cardiovascular Statistics – Brazil 2026

Data Source	Institution	Main Information Provided
Mortality Information System (SIM)	Ministry of Health	Mortality, causes of death, temporal and geographic trends
Hospital Information System (SIH-SUS)	Ministry of Health	Hospitalizations, procedures, length of stay, and costs
Outpatient Information System (SIA-SUS)	Ministry of Health	Outpatient procedures and healthcare utilization
National Health Survey (PNS)	IBGE / Ministry of Health	Cardiovascular risk factors, health status, and access to care
VIGITEL	Ministry of Health	Surveillance of behavioral and metabolic risk factors in Brazilian capitals
Global Burden of Disease 2023 Study (GBD 2023)	Institute for Health Metrics and Evaluation (IHME)	Incidence, prevalence, mortality, disability, DALYs, attributable burden, and risk-factor attribution
Disease Registries and Cohort Studies	Multiple institutions	Clinical characteristics, outcomes, and longitudinal data
Economic and Administrative Databases	Government agencies and research institutions	Healthcare expenditures, resource utilization, and economic burden
Systematic Reviews and Scientific Literature	Multiple sources	Epidemiological and clinical evidence

DALY: disability-adjusted life year; IBGE: Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística); PNS: National Health Survey (Pesquisa Nacional de Saúde); SIA-SUS: Outpatient Information System of the Unified Health System (Sistema de Informações Ambulatoriais do Sistema Único de Saúde); SIH-SUS: Hospital Information System of the Unified Health System (Sistema de Informações Hospitalares do Sistema Único de Saúde); SIM: Mortality Information System (Sistema de Informações sobre Mortalidade); SUS: Unified Health System (Sistema Único de Saúde); YLD: years lived with disability; YLL: years of life lost.

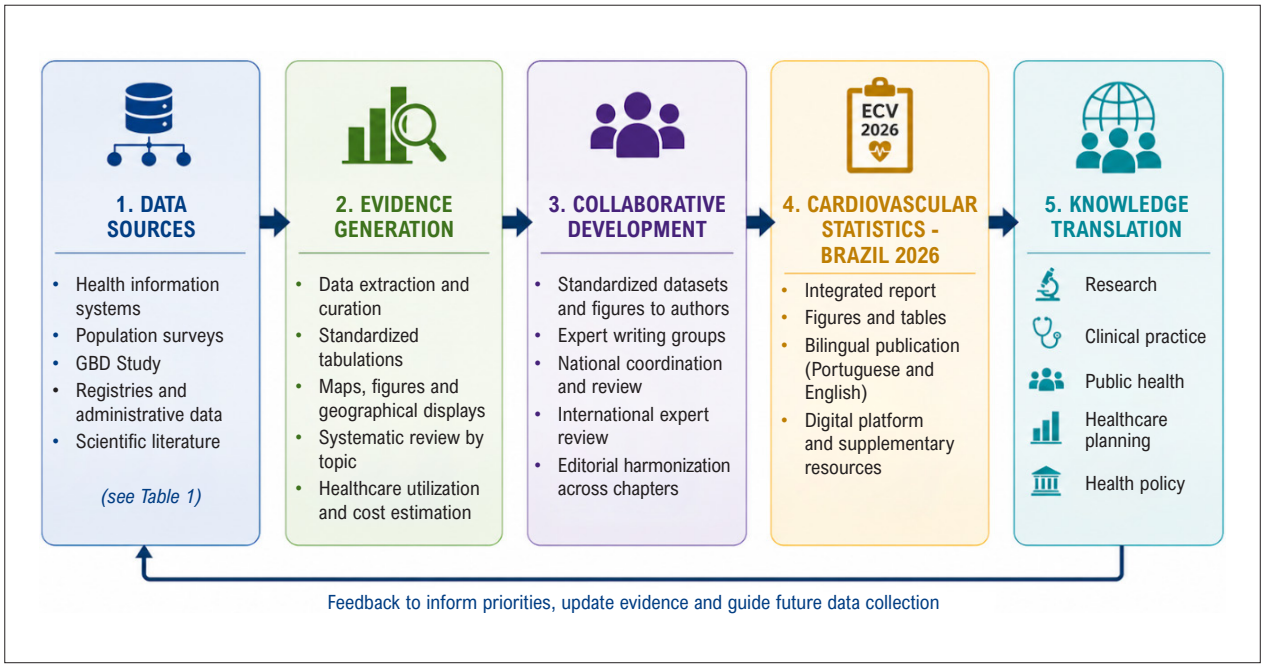

Figure 1 – *Development process and knowledge translation framework of Cardiovascular Statistics – Brazil 2026. GBD: Global Burden of Disease.*

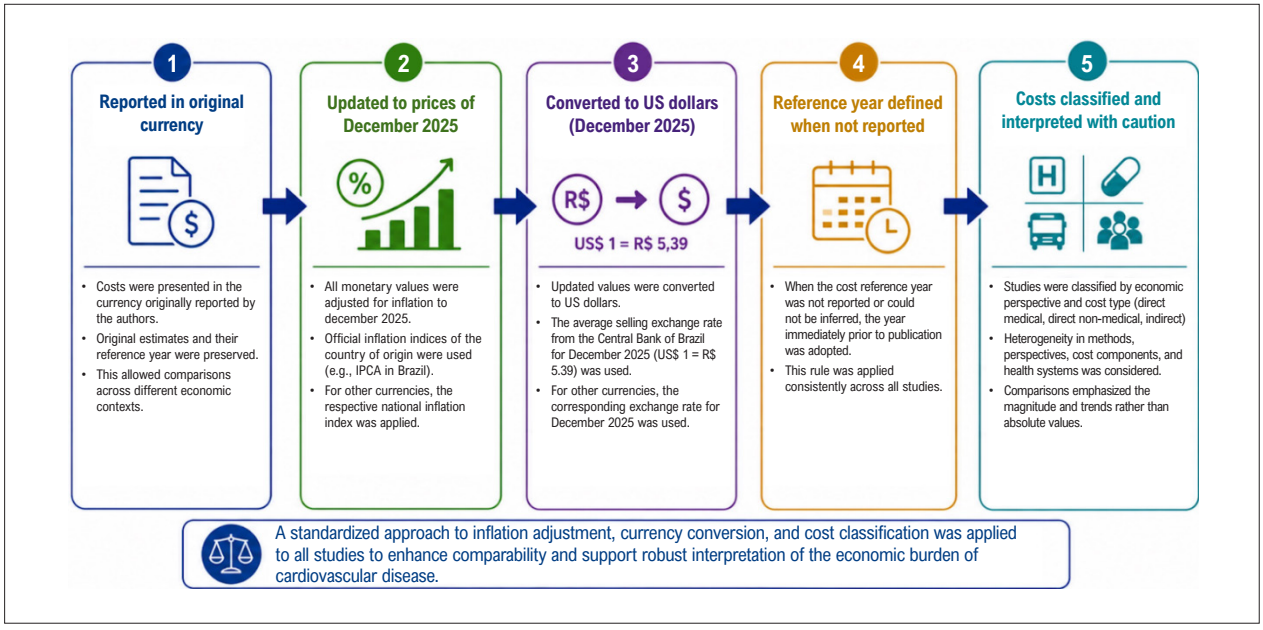

Figure 2 – *Standardized methodology for economic estimates in cardiovascular studies.*

facilitating evidence-based decision-making and strengthening cardiovascular surveillance, research, and policy development in Brazil.

HIGHLIGHTS

Chapter 1 – Total Cardiovascular Diseases

- Cardiovascular diseases remained the leading cause of death in Brazil in 2023. According to GBD 2023 estimates, from 1990 to 2023, the age-standardized CVD mortality rate declined by 54.8%, from 325.2 to 147.0 deaths per 100,000 population, although substantial regional inequalities persisted.
- GBD 2023 estimates indicate that 16,351,655 people were living with CVD in Brazil in 2023, a 50% increase since 1990, reflecting mainly population aging and growth.
- Over the same period, the age-standardized CVD DALY rate declined by approximately 52%, as estimated by GBD 2023; however, CVD remained a major cause of health loss in Brazil, imposing a substantial burden on the health system.

Chapter 2 – Stroke (Cerebrovascular Diseases)

- An estimated 2,694,436 people were living with stroke in Brazil in 2023, according to GBD 2023. Despite this large absolute burden, the age-standardized prevalence rate declined by 25.6% from 1990 to 2023.
- Over the same period, GBD 2023 estimates show that the age-standardized stroke mortality rate declined by 63.2%, reaching 49.4 deaths per 100,000 population in 2023; mortality remained higher among men and in the North region.
- Major gaps in post-stroke care persist: among 21,785 stroke survivors, only 33.1% received physical rehabilitation during hospitalization and 52.7% after discharge, with a mean distance of 79.1 km to rehabilitation centers.

Chapter 3 – Acute and Chronic Coronary Heart Disease

- According to GBD 2023 estimates, 3,781,434 people were living with ischemic heart disease in Brazil in 2023. Despite the increase in absolute numbers since 1990, the age-standardized prevalence rate declined by 53%, reaching 1,428 per 100,000 population.
- Ischemic heart disease remained the leading cause of death in Brazil in 2023, accounting for 158,100 deaths, 10.8% of all deaths and 41.6% of cardiovascular deaths, according to GBD 2023 estimates. The age-standardized mortality rate declined by 54% from 1990 to 2023, reaching 61 per 100,000 population.
- Use of coronary revascularization has increased in the Brazilian public health system. Primary PCI procedures more than doubled from 11,099 in 2019 to 24,695 in 2024, while CABG volumes recovered after the COVID-19 pandemic to approximately 21,000 procedures annually in 2023–2024.

Chapter 4 – Cardiomyopathy and Heart Failure

- GBD 2023 estimates indicate that the absolute number of people living with heart failure in Brazil more than doubled, from 0.79 million in 1990 to 1.69 million in 2023, despite a 14.5% decline in age-standardized prevalence, reflecting the effects of population growth and aging.
- From 1990 to 2023, the age-standardized mortality rate from cardiomyopathy and myocarditis declined by 61.8%,

according to GBD 2023 estimates, although the absolute number of deaths increased from 13,114 to 15,116.

- According to the RAISE study, Brazil has approximately 4.0 million people living with Chagas disease, the highest absolute burden in the Americas. Despite major declines in prevalence and mortality, Chagas cardiomyopathy remains a high-risk cause of heart failure, while the annual economic burden of chronic Chagas disease has been estimated at US$ 11.44 billion.
- Heart failure remains the leading cardiovascular cause of hospitalization in the Brazilian Unified Health System, accounting for 230,559 admissions in 2024. Brazilian Unified Health System payments for heart failure hospitalizations totaled R$ 583.8 million in 2024, with a mean reimbursement of R$ 2,532 per admission (values adjusted to December 2025).

Chapter 5 – Heart Valve Diseases

- Valvular heart disease in Brazil shows a dual epidemiological profile: data from the GBD 2023 study showed that rheumatic heart disease remains highly prevalent, with approximately 1.43 million cases in 2023 and little change in age-standardized prevalence since 1990 (−1.5%), while non-rheumatic valve disease is expanding, with prevalent cases increasing from 132,000 to 492,000 and age-standardized prevalence rising by 23.0%.
- Valvular procedures in the Brazilian Unified Health System were markedly disrupted by the COVID-19 pandemic. Surgical valve procedures fell from 12,771 in 2019 to 8,808 in 2021, but recovered to 12,784 in 2024; in contrast, percutaneous balloon mitral valvuloplasty showed a sustained long-term decline, from 477 procedures in 2008 to only 181 in 2024.
- Contemporary Brazilian studies of TAVI show improving short-term outcomes despite increasing age and comorbidity burden among treated patients, with in-hospital or 30-day mortality generally below 5–8%.

Chapter 6 – Atrial Fibrillation and Atrial Flutter

- According to GBD 2023 estimates, the age-standardized prevalence of atrial fibrillation in Brazil remained stable from 1990 to 2023 (from 813 to 806 per 100,000), while crude prevalence more than doubled (from 447 to 999 per 100,000), reflecting mainly population aging and the growing number of people living with atrial fibrillation.
- Over the same period, GBD 2023 estimates show that the absolute number of deaths due to atrial fibrillation increased almost fivefold (from 2,593 to 12,417), while the age-standardized mortality rate remained essentially stable (4.7 to 5.0 per 100,000).
- Atrial fibrillation imposed a substantial and growing burden on the Brazilian Unified Health System, accounting for 517,432 hospitalizations from 2008 to 2024. Inflation-adjusted hospitalization expenditures at the Brazilian Unified Health System totaled R$ 458.3 million over the period and increased by 63% between 2008 and 2024.

Chapter 7 – Hypertension

- GBD 2023 estimates indicate that high systolic blood pressure was responsible for 220,160 deaths in Brazil in 2023. Despite the increase in the absolute number of attributable deaths since 1990, the attributable age-standardized mortality rate declined by 52.9%, reaching 85 deaths per 100,000 population.
- Hypertension remains highly prevalent and inadequately controlled in Brazil. In the 2013 National Health Survey, which included direct blood pressure measurements, 32.3% of adults had hypertension; among those receiving antihypertensive treatment, only 54.4% had controlled blood pressure.
- Hypertension also imposes a substantial economic burden on the Brazilian Unified Health System. In 2018, hypertension accounted for 59% of the R$ 3.45 billion in the Brazilian Unified Health System costs attributable to hypertension, diabetes, and obesity, exceeding R$2 billion annually.

Chapter 8 – Dyslipidemia

- Dyslipidemia is highly prevalent among Brazilian adults. In the 2014–2015 National Health Survey, 32.7% had high total cholesterol, 18.6% high LDL cholesterol, and 31.8% low HDL cholesterol.
- GBD 2023 estimates indicate that 67,688 cardiovascular deaths in Brazil were attributable to high LDL cholesterol in 2023, up from 55,057 in 1990. Despite this increase in absolute deaths, the age-standardized mortality rate declined by 62.2%, from 68.2 to 25.8 deaths per 100,000 population.
- Important gaps in detection and treatment persist. In the ELSA-Brasil study, among participants with high LDL cholesterol, only 58.1% were aware of the condition and 42.3% were receiving lipid-lowering therapy; other Brazilian studies show particularly low achievement of recommended LDL cholesterol targets among individuals at high cardiovascular risk.

Chapter 9 – Diabetes mellitus

- According to the 2025 IDF Diabetes Atlas, an estimated 16.6 million Brazilian adults aged 20–79 years have diabetes, placing Brazil sixth worldwide in absolute number of cases; age-adjusted prevalence is 10.6%, and 31.9% are unaware of their condition.
- Despite improvements in access to treatment, diabetes control remains suboptimal. National Health Survey data show that only 46% of adults with diabetes achieved HbA1c < 7%, and only 12.5% simultaneously achieved glycemic, blood pressure, and LDL-cholesterol targets.
- When considered as a cardiovascular risk factor rather than as a disease, diabetes-related risk is captured in the GBD framework by high fasting plasma glucose. In 2023, 36,431 cardiovascular deaths in Brazil were attributable to high fasting plasma glucose, and, in 1990, they were 24,789. Although the absolute number increased from 1990 to 2023, the age-standardized cardiovascular

mortality rate declined by 57.1%, from 32.8 to 14.1 deaths per 100,000.

Chapter 10 – Smoking and Tobacco Use

- According to LENAD III, 26.8 million Brazilians aged ≥ 14 years used tobacco products in 2023, corresponding to 13.2% of the population. In Vigitel, which monitors adults in Brazilian state capitals using a different survey methodology, smoking prevalence increased from 9.0% in 2021 to 11.5% in 2024.
- GBD 2023 estimates indicate that 141,737 deaths from all causes in Brazil in 2023 were attributable to tobacco, including 50,160 cardiovascular deaths. Cardiovascular deaths attributable to tobacco declined by 16.6% in absolute numbers between 1990 and 2023.
- According to LENAD III, 8.8% of Brazilians aged ≥ 14 years had ever used electronic nicotine delivery systems and 5.6% reported use in the previous year, corresponding to approximately 9 million individuals. Among adolescents who had experimented with these products, nearly 80% continued using them.

Chapter 11 – Obesity

- The prevalence of obesity in Brazil shows a progressive increase. According to Vigitel, obesity affected 25.7% of adults in Brazilian state capitals in 2024, with prevalence almost doubling since 2006. The largest increase was observed among adults aged 35–44 years, from 12.8% in 2006 to 30.1% in 2024, and among those with complete secondary or incomplete higher education, from 10.9% to 25.9%.
- GBD 2023 estimates indicate that the age-standardized CVD mortality rate attributable to high body mass index declined by 18.1% in Brazil from 1990 to 2023, from 25.4 to 20.8 deaths per 100,000. Declines were greater in the Federative Units with higher sociodemographic development, particularly São Paulo, Rio de Janeiro, and Distrito Federal, whereas less favorable trends were observed in the Federative Units of the North and Northeast.
- The CVD burden attributable to high body mass index showed marked geographic and sex inequalities. From 1990 to 2023, age-standardized CVD DALY rates declined more markedly among women, with the largest reductions in the Southeast (−41.1%) and South (−40.7%), whereas rates increased among men in the Northeast (+39.0%) and North (+28.0%).

Chapter 12 – Physical Activity

- Despite a progressive decline in physical inactivity, 37.0% of Brazilian adults did not meet recommended levels of physical activity in 2023, according to Vigitel, down from 48.3% in 2013. Physical inactivity remained substantially more frequent among women (43.0%), adults aged ≥ 65 years (63.6%), and those with ≤ 8 years of schooling (47.7%).
- According to GBD 2023 estimates, the age-standardized CVD mortality rate attributable to low physical activity declined by 59.1% between 1990 and 2023, from 8.02 to 3.29 deaths per 100,000. The decline varied substantially across the Federative Units, ranging from 30.5% in Maranhão to 66.8% in Paraná, and was greater in the Federative Units with higher sociodemographic development.
- The COVID-19 pandemic temporarily reversed favorable trends in physical activity in Brazil: according to Vigitel, physical inactivity increased from 44.8% in 2019 to 48.2% in 2021, before declining to 37.0% in 2023. Other surveys also documented marked increases in sedentary behavior and screen time during the pandemic.

Chapter 13 – Cardiovascular Diseases Attributable to Dietary Risks

- According to the GBD Study, dietary risks result from the low intake of fruits, vegetables, pulses, whole grains, nuts and seeds, milk, fibers, calcium, omega-3 and polyunsaturated fatty acids, as well as the high intake of sodium, red and processed meats, sugar-sweetened beverages, and trans fatty acids. In Brazil, dietary risks remain the second major risk factor for CVD, surpassed only by high systolic blood pressure.
- Vigitel data show persistent low adherence to healthy dietary patterns among Brazilian adults. From 2007 to 2024, regular consumption of beans declined from 66.8% to 56.4%, while regular consumption of soft drinks and artificial juices decreased from 30.9% to 16.2%. Recommended fruit and vegetable consumption also declined from 23.1% in 2019 to 21.0% in 2024, while consumption of ultra-processed foods remained high, reaching 25.5% in 2024 and being particularly frequent among young adults (45.5%).
- According to GBD 2023 estimates, the age-standardized CVD mortality rate attributable to dietary risks decreased by 60.2% between 1990 and 2023, from 91.0 to 36.3 deaths per 100,000. Reductions were greater in the South and Southeast and smaller in the North and Northeast, and Federative Units with higher sociodemographic indices showed greater declines. Mortality rates remained higher among men, and ischemic heart disease remained the leading cause of CVD mortality attributable to dietary risks in 2023.
- Ultra-processed food consumption represents an important target for cardiovascular prevention in Brazil, with an estimated 22% of premature CVD deaths attributable to these foods. Brazil's Tax Reform included sugar-sweetened beverages among products subject to the new Selective Tax, although its specific rate has not yet been defined; taxation of sugar-sweetened beverages of at least 20% has been proposed to induce substantial changes in consumption patterns.

Chapter 14 – Congenital Malformations of the Circulatory System and Pediatrics

- Congenital malformations of the circulatory system remain an important cause of early childhood mortality in Brazil. In 2023, they accounted for 50% of deaths due to congenital malformations among children aged < 1 year and were the

leading cause of death in the post-neonatal period (28–364 days), with a mortality rate of 119.4 per 100,000 live births.

- According to GBD 2023 estimates, mortality from congenital malformations of the circulatory system declined by 39.0% in Brazil between 1990 and 2023, from 4.9 to 3.0 deaths per 100,000 population. Reductions were greater in Federative Units with higher sociodemographic development, whereas mortality increased in Amazonas and showed no clear decline in Amapá and Roraima.
- Congenital malformations of the circulatory system impose a substantial burden on the Brazilian Unified Health System, accounting for 91,437 hospital admissions between 2019 and 2023, with total hospitalization costs of R$ 1.14 billion and a mean cost of R$ 12,290 per admission.

Chapter 15 – Chronic Kidney Disease

- Chronic kidney disease remains substantially underdiagnosed in Brazil. Although population studies estimate chronic kidney disease prevalence at approximately 9–14%, only 1.4% of adults reported a diagnosis in the 2019 National Health Survey. In the Brazilian REVEAL-CKD cohort, 97.0% of patients with laboratory evidence of stage 3 chronic kidney disease did not have the diagnosis adequately recorded, and only 4.9% had albuminuria assessed.
- According to GBD 2023 estimates, cardiovascular deaths attributable to kidney dysfunction increased from 26,803 in 1990 to 37,675 in 2023, while the age-standardized mortality rate declined by 59.8%, from 36.0 to 14.5 deaths per 100,000. Important geographic inequalities persisted, with 2023 rates ranging from 10.9 per 100,000 in the Distrito Federal to 20.3 in Amazonas.
- Advanced chronic kidney disease imposes a substantial burden on the Brazilian health system. In 2024, 172,585 patients were receiving dialysis, corresponding to 812 per million population; approximately 80% of dialysis therapy and 90% of kidney transplants are financed by the Brazilian Unified Health System.

CHAPTER 1 – TOTAL CARDIOVASCULAR DISEASES

ICD-9 390 to 459; ICD-10 I00 to I99.

See Tables 1.1 through 1.6 and Charts 1.1 through 1.8.

Abbreviations used in chapter 1

CI	Confidence Interval
CVD	Total Cardiovascular Diseases
DALYs	Disability-Adjusted Life Years
ELSA-Brasil	The Brazilian Longitudinal Study of Adult Health (in Portuguese, *Estudo Longitudinal de Saúde do Adulto*)
FU	Federative Unit
GBD	Global Burden of Disease
HDI	Human Development Index
HF	Heart Failure
ICD	International Statistical Classification of Diseases and Related Health Problems
IHD	Ischemic Heart Disease
NCD	Noncommunicable Disease
OR	Odds Ratio
PNS	Brazilian National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, *Sistema* Único *de Saúde*)
UI	Uncertainty Interval
YLD	Years Lived with Disability
YLL	Years of Life Lost

Overview

- Noncommunicable diseases (NCDs) are the leading cause of death worldwide, responsible for premature death, loss of quality of life, and adverse economic and social impacts. NCDs killed at least 43 million people in 2021, equivalent to 75% of non-pandemic-related deaths globally, significantly exceeding deaths from external causes and infectious diseases. Of all NCD-related deaths worldwide, nearly 44% (over 19 million) result from cardiovascular diseases (CVD).[7] Manderson and Jewett have found that the distribution of NCD mortality is grossly inequitable, with 86% of NCD-attributable premature deaths before age 70 located in low- and middle-income countries. They argued that those are "noncommunicable diseases of poverty".[8]
- In Brazil, NCDs accounted for 57% of deaths (n = 1,095,000) in 2021, with 35% due to CVD and 22% to neoplasms, reflecting the pandemic's impact. This situation changed in 2023, with NCDs accounting for 77% of all deaths in Brazil and CVD accounting for 34% of NCD deaths.[3,9-12]
- The definition of CVD may vary according to the study, from including all diseases listed in ICD-10 Chapter IX to just grouping the three leading causes [ischemic heart disease (IHD), stroke, and heart failure (HF)]. For the Global Burden of Disease (GBD) Study, the definition of total CVD comprises 10 causes: rheumatic heart disease, IHD, cerebrovascular disease, hypertensive heart disease, cardiomyopathy, myocarditis, atrial fibrillation and flutter, aortic aneurysm, peripheral vascular disease, and endocarditis.[3]
- Cardiovascular disease, which includes IHD and cerebrovascular disease, is the leading cause of premature death worldwide, responsible for approximately one-third of all deaths. This number is expected to increase in the future due to population aging.[13] Inequalities significantly influence premature death from DCV in Brazil, with low-income populations being more exposed to environmental and behavioral risks and facing barriers to health services.[14,15]
- Ischemic heart disease was the leading cause of death in the country, followed by stroke in both 1990 and 2023. In fact, in 2023, IHD was the leading cause of death in all Brazilian Federative Units (FUs), except for the state of Amazonas, in the Northern region. Three states in that region, Acre, Amapá, and Pará, showed no significant difference in mortality rates due to IHD and stroke.[3]
- COVID-19 was the leading cause of death among men and women in 2021. In men, the second leading cause of death was IHD, followed by cerebrovascular diseases. Among women, this order is reversed, with cerebrovascular diseases being the second leading cause and IHD, the third.[3]

Prevalence

- Gomes *et al*. have published a cross-sectional study from the Brazilian National Health Survey (PNS) conducted in 2019 on a sample of 88,531 adults over 18 years, stratified by sex and age groups, using a multivariate model. The self-reported diagnosis of heart disease in Brazil was 5.3% (95% CI, 5.0–5.6) and associated with aging, individuals 60 years and older (prevalence ratio = 2.8; 95% CI, 1.8 – 4.4), hypertension (prevalence ratio = 2.3; 95% CI, 2.0–2.5), and elevated cholesterol (OR = 1.7; 95% CI, 1,5–1,9). Being a woman and having physical activity during leisure time were protective factors.[16]
- In the ELSA-Brasil, a cohort study that included 15,105 civil servants from 6 academic institutions (54% women, 35-74 years, with baseline assessment between 2008 and 2010), the self-reported prevalence was as follows: coronary heart disease, 4.7% (men = 5.7%, women = 4.0%); HF, 1.5% (men = 1.9%, women = 1.5%); stroke, 1.3% for both sexes; rheumatic fever, 2.9% (men = 2.2%, women = 3.4%); and Chagas disease, 0.4%, for both sexes.[17]

- According to 2019 PNS data, only 0.5% of people in Brazil had ideal cardiovascular health, with higher rates among those with higher education (1.3%) and urban residents (0.6%).[18] Similar findings have been reported in international research; a literature review indicated a low prevalence of ideal cardiovascular health (3.3%), defined as meeting 6 or 7 ideal metrics. Females and young adults demonstrated better cardiovascular health status compared to males and older individuals. Individuals with higher education tended to have more ideal cardiovascular health metrics.[19] In a study of the Southern Cone of Latin America, only 0.1% (95% CI, 0.0–0.2) met the seven criteria that define ideal cardiovascular health.[20]
- In 2019, Brazil had around 12,946,932 people with prevalent CVD, and 51% were men. The prevalence among the elderly declined in males but increased in females aged 15-49 years.[18]
- According to recent statistics, the age-standardized prevalence rate of CVD in Brazil in 2023 was 6.4% (6.0-6.9) for both sexes, 6.7% (6.2-7.2) for males, and 6.1% (5.7- 6.7) for females. The GBD Study estimated 16,351,655 (15,261,238.5 – 17,736,201.4) prevalent cases in Brazil in 2023, a 50% increase since 1990.
- Chart 1.1 shows that the prevalence of CVD increases with age in Brazil, regardless of sex. However, the difference in prevalence between males and females is more pronounced among children under 5 years of age. From ages 5 years to 44 years, women have higher prevalence than men. After age 44 years, the prevalence among men increases and the difference between sexes is highest in the age group of 60-69 years.

Mortality

- Cardiovascular disease is the leading cause of death globally,[7,8] and, in 2021, approximately 80% of the world's deaths from CVD occurred in low- and middle-income countries.[8,9] The World Health Organization has established a global action plan for the year 2025, aiming to reduce by 25% the number of premature deaths from NCDs, including CVD.[21]
- Baptista *et al*. have examined the relationship between age composition and age-specific mortality rates with observed sex differences in CVD mortality across Brazilian microregions from 1996 to 2015. They found that CVD mortality decreased during this period. In regions with higher socioeconomic development, age structure was more closely linked to mortality, with older populations experiencing higher CVD death rates. Notably, the key factors influencing CVD mortality also varied across different Brazilian regions and FUs.[22]
- In Brazil, from 1990 to 2023, the age-standardized mortality rate from CVD per 100,000 people decreased from 325.2 (95% UI, 302.6 – 340.5) to 147.0 (95% UI, 132.2 – 155.1), representing a 54.8% reduction. The mortality rate was higher in men (182.5; 169.6–191.0) compared to women (118.0; 102.3–127.3), with declines of 50.9% and 58.3%, respectively (Chart 1.2).
- The age-standardized mortality rate from CVD varied in the different FUs. Maranhão and Alagoas had the highest mortality rates, exceeding the national average. Distrito Federal, Minas Gerais, Paraná, Rio de Janeiro, and Rio Grande do Sul experienced the largest percentage reduction in mortality during the same period, approximately 60% (Table 1.1).
- Malta *et al*. have compared the historical series of CVD mortality rates in Brazil using the Brazilian Mortality Information System database with and without correction and the GBD 2017 estimates between 2000 and 2017. The authors reported that the increase in mortality rates observed in 2017 in some Northern and Northeastern FUs was attributable to improvements in death registration and better classification of underlying causes of death in recent years.[23]
- The Family Health Program was associated with decreases in hospitalizations and deaths from CVD. Rasella *et al*. have found that mortality from cerebrovascular disease and heart disease declined by 0.69 (95% CI, 0.66-0.73) and 0.64 (95% CI, 0.59-0.68), respectively, when the Family Health Program coverage was sustained over an 8-year period.[24]
- Chart 1.3 shows the correlation between the percent change of age-standardized cardiovascular mortality rates from 1990 to 2023 and the Sociodemographic Index (SDI) in the Brazilian FUs, with the highest SDI levels linked to the greatest declines in CVD death rates.
- Studies have shown a strong link between low socioeconomic status and a higher burden of CVD.[19,22] Bichara *et al*. have observed that better socioeconomic conditions contribute to declining mortality rates from IHD and cerebrovascular diseases in Brazil. The FUs with the highest socioeconomic indicators experienced the largest decreases in mortality rates.[25]
- An inverse association of the municipal Human Development Index (HDI) and the supplementary health coverage with mortality from CVD has been observed, suggesting a relationship between socioeconomic factors and CVD. Supplementary health coverage increased in the country during the study period and was inversely associated with CVD mortality between 2004 and 2013.[26]
- Soares *et al*. have identified a decline in CVD mortality in the states of Rio de Janeiro, São Paulo, and Rio Grande do Sul that occurred before improvement in the socioeconomic index. Trends in gross domestic product per capita, reductions in child mortality, higher educational attainment (measured by years of schooling of individuals aged 25 years and older), and the HDI were strongly correlated with decreases in CVD mortality rates. In Rio de Janeiro, declines in mortality from CVDs, stroke, and HDI over recent decades were preceded by increases in the HDI.[27,28]

Burden of Disease (DALYs)

- Disability-adjusted life years (DALYs) are a synthetic measure of the burden of disease, widely used to quantify the total loss of health in a population. This indicator combines, in a single metric, the years of life lost due to

premature death (years of life lost – YLL) and the years lived with disability (YLD), expressed as the sum of these two components (DALY = YLL + YLD). One DALY corresponds to one year of healthy life lost, and the measure enables comparisons of the impact of different diseases, conditions, and risk factors across populations, age groups, sexes, and time periods. Developed in the context of the GBD Study, DALYs are particularly relevant for assessing CVDs, as they integrate the effects of premature mortality and the prolonged coexistence of disabilities resulting from those chronic conditions.[29-31]

- Cardiovascular diseases were the leading cause of total number of all-ages DALYs globally at level 2 in 2023, representing 15.6% (95% UI, 14.1-17.0) of all disease burden.[6]
- In Brazil, DALYs due to CVDs increase with age in both sexes, rising more sharply after age 50 years and peaking among the elderly. Men consistently show higher DALYs than women throughout most of adulthood. The male/female ratio remains above 1 at most ages, peaking in middle age, indicating a greater cardiovascular burden in men during that period. In older age groups, the ratio approaches 1, reflecting convergence between the sexes. This trend may reflect longer female survival and increased cardiovascular cases among elderly women, with important implications for prevention and care strategies across the lifespan (Chart 1.4).
- Chart 1.5 shows a consistent, sustained decline in age-standardized CVD DALY rates between 1990 and 2023 in both sexes and across the population as a whole. Throughout the period, men have the highest rates, followed by the combined total for both sexes, while women maintain the lowest rates, reflecting persistent sex-based differences in disease burden. Despite the continuous decline, the gradient between men and women remains relatively stable, indicating that advances in prevention and treatment have benefited both sexes but have not been sufficient to eliminate gender inequalities in cardiovascular burden.
- Chart 1.6 shows a consistent decline in age-standardized CVD DALY rates in Brazil and across all Brazilian geographic regions from 1990 to 2023, indicating progress in managing the cardiovascular burden nationwide. Nonetheless, regional differences persist: the Southeast and South regions start with the highest rates and gradually decline over the decades, whereas the North and Northeast regions maintain lower rates that also decline over time. By the end of the period, the regions show partial convergence, indicating reduced regional disparities, although absolute gaps persist.
- Table 1.2 illustrates a clear and steady decline in age-standardized CVD DALY rates in Brazil from 1990 to 2023. This trend is observed across all regions and FUs, showing widespread progress in reducing the cardiovascular burden over the years. However, the decline varied by region: the Southeast and South experienced larger declines, whereas, the North and Northeast, although also experiencing declines, had CVD DALY rates relatively higher in 2023. Although rates have improved, the total number of DALYs remains high, mainly due to population growth and aging. Cardiovascular diseases still represent a major health loss in Brazil, posing important challenges for health system planning and organization.
- Manderson and Jewett[8] state that poverty, and social and commercial factors are the primary drivers of NCDs. They suggest that addressing these broader determinants rather than individual lifestyle choices could be the most effective way to reduce the burden of NCDs, including CVD.

Healthcare Utilization and Cost

- In Brazil, administrative data from the Brazilian Unified Health System (SUS) have shown an increase in the total number of cardiovascular admissions and procedures in recent decades, with temporary interruption of this trend in the early years of the COVID-19 pandemic.[3]
- The total number of clinical and surgical admissions for cardiovascular procedures increased from 695,443 in 2008 to 844,882 in 2024, corresponding to a 21% rise in the period. This increase was driven by surgical and interventional procedures, whose volume almost doubled throughout the historical series, while clinical admissions had a more discrete increase and trend towards stabilization (Chart 1.7). In 2020, there was a sudden drop in the total number of admissions and procedures, an approximately 12% reduction as compared to the previous year, followed by gradual recovery of the clinical activity as of 2021, and more consistent recovery in 2022-2024. In 2008, surgical admissions represented 11% of the total volume and increased to 19% in recent years (Tables 1.3 and 1.4).
- Of the clinical conditions, HF and cerebrovascular diseases remained the major responsible for the number of cardiovascular hospitalizations, a pattern consistent with the Brazilian historical series, in which such conditions together with IHD and arrhythmias accounted for most CVD-related admissions. Regarding surgical and interventional procedures, there was an increasing predominance of coronary angioplasties, including primary angioplasty, and maintenance of the absolute number of myocardial revascularization surgeries and valvular procedures.
- The total amount paid by the SUS for clinical and surgical admissions for cardiovascular procedures increased substantially throughout the historical series. In nominal terms, the total expenditure with clinical admissions for cardiovascular procedures increased approximately from R$ 1.6 billion in 2008 to R$ 3.5 billion in 2024. However, after adjusting for inflation in the period, that expenditure increased approximately from R$ 3.1 billion to R$ 3.7 billion from 2008 to 2024. This increment was proportional to neither the growth in the number of procedures and more complex interventions, nor the incorporation of technology, suggesting a reduction in the funding in the area (Tables 1.5 and 1.6 and Chart 1.8).
- During the COVID-19 pandemic, there was a temporary reduction in the total expenditures associated with cardiovascular admissions and procedures, following the reduction in the number of hospitalizations in the period.

In 2020 and 2021, the total values paid by the SUS were lower than those in the immediately previous years, with recovery as of 2022.

- It is worth noting that the values reported represent payments by the SUS and/or the supplementary health system, and do not necessarily reflect the actual cost of CVD in the country. Indirect costs, out-of-hospital expenditures, and costs associated with medical devices, specialized materials, and long-term care are not captured in those records. In addition, global estimates based on CVD prevalence suggest that the total cost, including direct, indirect, and supplementary health costs, are substantially higher than those observed in the public health system, and can reach approximately **49 billion dollars** in the next 5 years.[32]

Future directions

- Despite advances in describing CVD mortality and burden in Brazil, important gaps remain in the literature. These include limited integration of mortality, morbidity, and disability data into more granular subnational analyses, such as at the municipal and microregional levels, as well as the scarcity of longitudinal studies that capture the dynamic interactions among social determinants, population aging, and access to health services. In addition, sex- and life-course-related differences in the transition from risk factors to clinical events and DALYs remain underexplored, particularly among socially vulnerable populations, thereby constraining the development of more equitable and evidence-informed public policies.[9,32]
- In this context, strengthening integrated health information systems that link administrative databases, population-based surveys, and national cohorts is a priority, enabling continuous, territorially sensitive monitoring of the cardiovascular burden. Investments in prospective analyses of the social and commercial determinants of health may support more cost-effective interventions in primary health care and prevention strategies across the life course. Furthermore, systematically incorporating disability and quality-of-life metrics into impact assessments is essential to improve health system planning in the face of population aging and persistent inequalities, in line with recent global agendas on CVDs and the burden of disease.[6,9]

Table 1.1 – Age-standardized cardiovascular mortality rates, in Brazil and its Federative Units, in 1990 and 2023, and percentage change of the rates in the period

Federative Units	1990 — Number of deaths (95% UI)	1990 — Rate (95% UI)	2023 — Number of deaths (95% UI)	2023 — Rate (95% UI)	Percent change (95% UI)
Brazil	254.332,8 (241.512,3; 264.497,8)	325,2 (302,6; 340,5)	379.656,9 (342.235,3; 400.401,1)	147,0 (132,2; 155,1)	-54,8 (-56,5; -53,3)
Brazil North	9.171,4 (8.654,4; 9.652,7)	278,8 (258,7; 297,2)	22.168,3 (20.065,0; 23.616,7)	150,6 (135,2; 161,5)	-46,0 (-49,0; -43,2)
Acre	369,8 (339,0; 402,2)	259,1 (235,2; 281,6)	924,0 (826,3; 1.010,2)	140,9 (125,2; 154,6)	-45,6 (-51,3; -39,0)
Amapá	212,9 (195,4; 231,2)	234,3 (211,2; 253,4)	789,3 (698,2; 860,5)	150,3 (131,9; 165,2)	-35,8 (-42,3; -28,4)
Amazonas	1.624,8 (1.502,8; 1.740,3)	261,0 (237,3; 282,6)	4.172,6 (3.740,7; 4.506,1)	145,3 (129,2; 157,8)	-44,3 (-49,3; -39,1)
Pará	5.062,7 (4.748,2; 5.409,8)	282,9 (260,6; 302,6)	10.816,7 (9.608,4; 11.643,7)	150,5 (133,0; 162,4)	-46,8 (-51,2; -42,8)
Rondônia	1.012,1 (944,3; 1.079,9)	355,5 (328,7; 378,4)	2.384,8 (2.142,2; 2.589,2)	157,5 (139,9; 172,6)	-55,7 (-59,9; -51,1)
Roraima	135,9 (123,9; 151,1)	294,7 (270,2; 324,2)	605,4 (544,8; 667,5)	161,3 (144,9; 179,2)	-45,3 (-51,5; -39,3)
Tocantins	753,2 (691,3; 811,2)	297,6 (267,6; 323,9)	2.475,4 (2.209,6; 2.738,8)	157,9 (140,1; 174,8)	-46,9 (-52,6; -40,1)
Brazil Northeast	59.360,2 (54.992,8; 63.014,1)	256,2 (235,6; 272,2)	101.168,0 (91.437,8; 108.722,9)	150,9 (136,5; 162,0)	-41,1 (-44,8; -36,7)
Alagoas	3.895,1 (3.588,4; 4.128,0)	313,3 (287,5; 334,1)	6.487,7 (5.901,6; 7.014,0)	192,9 (174,7; 208,9)	-38,4 (-43,0; -32,7)
Bahia	14.934,2 (13.569,4; 16.122,6)	237,8 (212,5; 256,9)	25.638,9 (22.581,4; 27.668,1)	138,9 (123,5; 149,2)	-41,6 (-44,9; -37,8)
Ceará	7.390,5 (6.763,2; 7.995,7)	206,2 (186,2; 223,7)	15.032,1 (13.340,5; 16.372,8)	134,4 (119,7; 145,9)	-34,8 (-40,5; -29,1)
Maranhão	5.790,6 (5.297,4; 6.307,7)	255,8 (232,9; 277,5)	12.786,0 (11.416,2; 13.981,1)	186,4 (166,4; 204,0)	-27,1 (-34,5; -19,1)
Paraíba	5.108,3 (4.643,3; 5.489,1)	241,8 (217,7; 260,4)	7.686,7 (6.854,9; 8.331,1)	146,7 (131,6; 158,7)	-39,3 (-44,5; -33,8)
Pernambuco	13.686,3 (12.685,8; 14.527,0)	333,8 (305,8; 356,3)	17.418,1 (15.772,4; 18.716,4)	158,9 (143,4; 171,0)	-52,4 (-55,5; -49,0)
Piaui	3.190,3 (2.894,4; 3.489,9)	247,9 (223,2; 271,6)	6.656,6 (5.976,4; 7.326,0)	160,1 (144,1; 176,1)	-35,4 (-41,3; -27,8)
Rio Grande do Norte	3.255,5 (2.918,2; 3.543,4)	216,8 (193,8; 236,1)	6.010,5 (5.280,8; 6.659,6)	139,2 (122,9; 153,7)	-35,8 (-42,0; -29,1)
Sergipe	2.109,4 (1.961,1; 2.252,8)	275,8 (253,5; 295,7)	3.451,3 (3.044,2; 3.747,0)	139,7 (122,9; 152,1)	-49,3 (-54,0; -44,5)
Brazil Southeast	131.750,2 (125.358,4; 136.692,1)	367,7 (343,6; 384,2)	175.106,8 (158.688,6; 186.055,9)	148,0 (133,8; 157,2)	-59,8 (-61,7; -57,8)
Espírito Santo	4.342,1 (4.035,8; 4.595,4)	336,6 (307,0; 356,7)	7.032,0 (6.258,8; 7.610,3)	140,9 (124,7; 152,9)	-58,1 (-61,2; -55,0)
Minas Gerais	28.509,7 (27.052,9; 29.684,1)	327,2 (305,0; 343,1)	37.311,8 (33.070,6; 40.098,4)	126,5 (112,2; 135,7)	-61,3 (-63,6; -59,0)
Rio de Janeiro	35.790,0 (34.149,9; 37.291,8)	418,3 (390,7; 438,3)	38.661,7 (35.413,6; 40.996,4)	163,3 (149,4; 173,0)	-61,0 (-63,1; -59,0)

São Paulo	63.108,4 (60.100,9; 65.409,7)	366,3 (341,6; 382,3)	92.101,2 (83.569,9; 97.689,5)	153,1 (138,5; 162,6)	-58,2 (-60,3; -56,2)
Brazil South	42.881,8 (40.636,1; 44.599,5)	357,5 (331,6; 374,3)	56.039,5 (50.491,7; 59.498,9)	138,5 (124,0; 147,4)	-61,3 (-63,3; -59,5)
Paraná	15.919,0 (15.009,7; 16.598,5)	382,5 (351,7; 401,1)	20.699,3 (18.519,2; 22.174,7)	140,7 (125,3; 151,1)	-63,2 (-65,5; -60,8)
Rio Grande do Sul	19.575,8 (18.618,4; 20.500,3)	345,2 (321,7; 364,1)	22.967,6 (20.526,8; 24.597,0)	136,6 (121,8; 146,6)	-60,4 (-63,0; -58,1)
Santa Catarina	7.387,0 (6.952,2; 7.795,4)	343,5 (317,4; 365,2)	12.372,6 (11.117,5; 13.301,0)	138,5 (122,6; 149,8)	-59,7 (-62,6; -57,1)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 1.2 – Age-standardized DALY (disability-adjusted life year) rates due to cardiovascular disease, in Brazil, its regions and Federative Units, in both sexes, in 1990 and 2023, and percent change of the rates in the period

Location	1990 Rate (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)
Brazil	7,302.9 (6,960.0 - 7,584.4)	3,503.3 (3,283.7 - 3,678.5)	-52.0 (-53.6; -50.6)
North region	5,921.9 (5,598.7 - 6,223.8)	3,475.4 (3,235.8 - 3,674.0)	-41.3 (-44.2; -38.8)
Acre	5,703.4 (5,282.3 - 6,112.0)	3,346.2 (3,063.5 - 3,647.5)	-41.3 (-47.5; -34.3)
Amapá	5,168.5 (4,773.9 - 5,577.7)	3,558.5 (3,221.5 - 3,869.2)	-31.1 (-38.7; -24.5)
Amazonas	5,417.0 (5,040.0 - 5,799.9)	3,307.2 (3,029.1 - 3,572.3)	-38.9 (-44.0; -34.0)
Pará	6,014.2 (5,640.1 - 6,373.1)	3,478.7 (3,198.1 - 3,706.9)	-42.2 (-46.5; -38.7)
Rondônia	7,452.7 (6,989.4 - 7,929.4)	3,558.0 (3,255.2 - 3,837.2)	-52.3 (-56.4; -47.9)
Roraima	6,334.5 (5,795.5 - 6,947.1)	3,728.5 (3,380.3 - 4,079.8)	-41.1 (-47.5; -34.2)
Tocantins	5,750.3 (5,290.4 - 6,170.1)	3,698.1 (3,367.8 - 4,035.7)	-35.7 (-42.1; -28.7)
Northeast region	5,814.8 (5,423.4 - 6,140.7)	3,631.2 (3,369.5 - 3,832.4)	-37.6 (-41.8; -33.0)
Alagoas	7,258.5 (6,747.5 - 7,670.8)	4,617.1 (4,272.2 - 4,927.6)	-36.4 (-41.6; -30.8)
Bahia	5,481.5 (5,072.9 - 5,818.4)	3,405.1 (3,125.7 - 3,627.5)	-37.9 (-41.5; -33.7)
Ceará	4,619.7 (4,278.8 - 4,972.3)	3,226.4 (2,967.6 - 3,456.0)	-30.2 (-36.6; -23.7)
Maranhão	6,052.6 (5,507.7 - 6,572.7)	4,306.1 (3,944.6 - 4,649.3)	-28.9 (-36.3; -20.7)
Paraíba	5,547.8 (5,094.5 - 5,961.1)	3,553.1 (3,281.2 - 3,801.0)	-36.0 (-41.6; -30.4)
Pernambuco	7,372.5 (6,857.4 - 7,766.0)	3,846.3 (3,568.5 - 4,072.0)	-47.8 (-51.3; -44.0)
Piaui	5,549.7 (5,083.6 - 6,009.0)	3,669.3 (3,342.1 - 3,945.5)	-33.9 (-40.1; -27.1)
Rio Grande do Norte	4,737.5 (4,312.5 - 5,115.7)	3,359.1 (3,045.7 - 3,622.0)	-29.1 (-35.8; -22.4)
Sergipe	5,934.3 (5,496.4 - 6,299.4)	3,352.5 (3,032.6 - 3,605.5)	-43.5 (-48.0; -37.9)
Southeast region	8,262.8 (7,865.5 - 8,573.0)	3,597.0 (3,358.2 - 3,783.4)	-56.5 (-58.5; -54.8)
Espírito Santo	7,473.6 (7,015.2 - 7,868.4)	3,366.7 (3,066.5 - 3,608.5)	-55.0 (-58.7; -51.9)
Minas Gerais	7,580.4 (7,173.0 - 7,914.3)	3,090.9 (2,856.2 - 3,291.5)	-59.2 (-61.6; -56.8)
Rio de Janeiro	9,589.8 (9,154.7 - 9,962.8)	3,989.5 (3,728.9 - 4,193.1)	-58.4 (-60.8; -56.5)
São Paulo	8,038.8 (7,647.7 - 8,343.9)	3,707.0 (3,467.0 - 3,902.8)	-53.9 (-56.0; -52.0)
South region	7,742.9 (7,342.0 - 8,058.4)	3,108.8 (2,859.2 - 3,307.6)	-59.8 (-61.8; -58.0)
Paraná	8,325.6 (7,864.4 - 8,684.2)	3,188.3 (2,925.8 - 3,386.6)	-61.7 (-63.9; -59.6)
Rio Grande do Sul	7,487.8 (7,141.7 - 7,829.0)	3,059.3 (2,822.9 - 3,267.0)	-59.1 (-61.4; -56.9)
Santa Catarina	7,310.3 (6,871.9 - 7,718.4)	3,070.9 (2,823.4 - 3,278.3)	-58.0 (-60.6; -55.6)
West-Central region	6,885.2 (6,551.5 - 7,205.8)	3,417.2 (3,183.5 - 3,608.0)	-50.4 (-52.7; -48.0)
Distrito Federal	6,692.5 (6,331.4 - 7,055.5)	2,526.7 (2,300.3 - 2,733.8)	-62.2 (-65.1; -59.3)
Goiás	6,973.0 (6,556.4 - 7,393.2)	3,489.8 (3,244.2 - 3,739.7)	-50.0 (-53.4; -46.7)
Mato Grosso	6,250.4 (5,763.3 - 6,668.6)	3,496.5 (3,231.4 - 3,724.1)	-44.1 (-48.7; -39.6)
Mato Grosso do Sul	7,434.2 (6,962.7 - 7,832.9)	4,043.7 (3,696.8 - 4,328.8)	-45.6 (-49.5; -41.8)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 1.3 – Total number of clinical admissions for cardiovascular diseases at the SUS, per competence year, Brazil, 2008–2024

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CHRONIC ISCHEMIC HEART DISEASE	12.393	9.743	9.300	8.497	8.000	7.197	7.581	6.403	6.317	6.171	6.292	6.703	5.099	4.691	5.756	6.511	6.805
CEREBRO VASCULAR DISEASE	159.545	176.047	181.035	184.751	182.065	183.043	187.110	191.678	195.787	198.068	203.066	211.149	199.126	208.296	235.136	247.688	247.206
VALVE DISEASE	3.237	4.156	3.526	3.637	3.285	2.996	2.753	2.400	2.244	2.231	2.330	2.289	1.536	1.628	1.882	1.943	2.099
ATRIAL FIBRILLATION	29.034	28.174	28.382	28.583	28.760	28.268	29.799	29.754	29.889	30.265	30.958	32.753	26.764	25.468	32.391	37.532	40.658
ACUTE MYOCARDIAL INFARCTION - CLINICAL	47.358	50.987	55.513	58.194	59.562	58.552	62.809	66.647	70.441	71.835	74.569	80.614	76.444	82.228	93.665	95.513	93.720
HEART FAILURE	298.474	297.763	289.110	284.844	264.469	254.285	243.913	240.832	236.358	230.297	222.394	222.620	187.770	183.497	227.938	233.410	230.559
CARDIOMYOPATHIES	2.092	2.363	2.459	2.302	2.357	2.293	2.370	2.230	2.250	1.997	2.251	2.390	1.899	1.892	2.098	2.091	1.978
ACUTE CORONARY SYNDROME	63.300	68.833	72.912	71.523	75.734	73.432	76.945	72.686	70.430	70.713	68.413	70.204	56.583	53.144	59.424	62.052	62.351
Total	615.433	638.066	642.237	642.331	624.232	610.066	613.280	612.630	613.716	611.577	610.273	628.722	555.221	560.844	658.290	686.740	685.376

Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).[34]

1Table 1.4 – Total number of surgical admissions at the SUS, per competence year, Brazil, 2008–2024

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
ATRIAL FIBRILLATION ABLATION	68	72	90	85	123	139	143	161	124	120	125	163	120	161	234	406	344
CORONARY ANGIOPLASTY	38.635	45.648	49.492	55.931	60.959	63.838	66.492	66.550	69.802	73.971	78.575	85.518	77.846	80.402	80.909	84.396	98.625
CORONARY ARTERY BYPASS GRAFT SURGERY	20.515	22.077	21.225	23.187	23.900	23.249	22.997	22.559	22.248	21.474	20.674	21.018	16.554	16.025	19.565	20.486	22.219
VALVE SURGERY	12.201	12.664	12.169	13.181	13.435	13.067	12.993	12.624	12.432	12.277	12.088	12.771	9.198	8.808	11.030	12.020	12.784
PRIMARY ANGIOPLASTY	7.648	6.362	6.262	6.033	5.865	6.055	7.135	8.524	10.195	10.774	10.811	11.099	11.253	11.795	19.183	22.815	24.695
CARDIOMYOPATHIES	15	43	13	21	28	23	20	18	32	29	26	24	18	14	21	27	26
OTHER VALVULOPLASTIES	451	477	445	486	456	527	515	513	399	427	391	450	399	471	532	544	635
MITRAL VALVULOPLASTY	477	551	478	473	403	431	408	341	206	236	200	195	129	159	167	181	178
Total	80.010	87.894	90.174	99.397	105.169	107.329	110.703	111.290	115.438	119.308	122.890	131.238	115.517	117.835	131.641	140.875	159.506

Source:Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).[34]

Table 1.5 – Total amount, after adjusting for inflation and converting into US dollars (US$), paid for clinical admissions at SUS, per competence year, Brazil, 2008 to 2024

	Values in Brazilian reais (R$)																
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024 (*)
CHRONIC ISCHEMIC HEART DISEASE	21.765.677,18	18.081.312,60	16.660.266,38	14.912.058,03	12.745.487,64	11.107.392,86	12.416.755,32	9.653.727,91	9.038.970,48	8.832.199,49	8.796.130,35	9.678.882,98	7.498.555,05	6.731.208,68	8.991.823,11	10.677.089,57	11.378.885,58
CEREBROVASCULAR DISEASE	396.491.245,56	496.658.515,73	502.317.840,52	490.116.997,07	489.727.266,04	482.837.867,27	484.915.971,22	474.065.708,24	447.584.948,44	434.459.842,61	443.957.677,32	454.135.371,25	433.836.464,67	439.615.835,53	529.227.050,52	553.708.011,53	519.118.019,24
VALVULAR HEART DISEASE	2.935.997,81	4.188.440,87	3.636.835,43	3.832.803,11	3.380.919,34	3.195.315,22	3.165.757,69	3.140.667,41	2.842.742,98	2.680.247,59	3.168.697,01	2.988.632,33	2.186.975,73	2.044.489,92	2.612.456,61	3.173.305,81	2.755.668,76
ATRIAL FIBRILLATION	38.490.366,19	45.847.289,80	46.835.489,15	44.988.742,79	45.631.159,73	42.262.172,67	45.235.057,74	43.811.669,89	40.604.767,42	41.604.523,54	41.824.784,48	42.961.657,14	36.392.066,74	34.254.360,48	50.734.350,96	60.167.568,56	62.404.497,60
MYOCARDIAL INFARCTION – CLINICAL	181.467.671,57	222.193.175,49	234.894.742,81	232.176.095,05	234.970.863,79	224.860.077,55	238.963.106,28	241.734.399,25	228.928.398,43	217.817.112,96	222.293.220,91	225.877.464,34	209.567.496,09	212.744.578,49	275.484.934,68	280.157.524,30	258.780.243,33
HEART FAILURE	759.929.970,08	850.865.498,55	828.503.774,02	788.423.277,65	711.392.909,84	680.872.370,40	651.728.631,04	634.008.076,26	586.380.723,14	553.716.316,68	540.937.526,68	537.033.696,95	460.431.815,23	450.268.298,12	598.861.628,44	615.510.720,60	583.781.760,01
CARDIOMYOPATHIES	3.593.795,70	5.011.575,02	5.415.834,88	4.531.714,57	4.727.519,96	4.871.308,02	5.388.034,20	5.036.258,83	5.201.104,57	4.081.286,92	4.837.774,72	4.743.904,82	3.864.082,98	3.981.272,44	4.043.844,54	4.189.994,65	4.027.194,52
ACUTE CORONARY SYNDROME	124.786.631,93	152.651.851,38	163.248.030,14	156.462.865,09	168.471.158,20	157.924.270,71	167.072.161,75	154.168.194,53	136.064.165,40	131.024.631,01	124.113.842,28	121.317.037,03	95.634.827,04	87.301.637,94	103.477.316,53	111.162.116,20	111.701.042,40

(*) The 2024 data have been updated. Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).[34]

Table 1.6 – Total amount, after adjusting for inflation and inconverting to US dollars (US$), paid for surgical procedures at SUS (in US dollars), per competence year, Brazil, 2008 to 2024

Procedure Groups – Surgical Cardiovascular Procedures	FINANCIAL AMOUNTS + IPCA (INFLATION-ADJUSTED VALUES IN US$)																
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024 (*)
ATRIAL FIBRILLATION ABLATION	$186.669,47	$184.271,47	$220.865,12	$202.249,62	$286.776,60	$309.611,42	$285.743,23	$315.795,57	$222.621,08	$204.589,39	$210.613,97	$266.770,49	$199.679,97	$241.747,42	$460.130,84	$1.156.290,43	$1.310.088,59
CORONARY ANGIOPLASTY	$109.021.394,60	$130.392.637,08	$138.593.625,78	$149.596.825,61	$154.635.040,31	$152.722.060,92	$152.479.985,46	$143.580.958,96	$136.512.479,84	$138.240.243,15	$142.677.353,57	$151.454.968,31	$135.574.929,93	$134.135.715,28	$113.900.505,91	$110.888.501,48	$151.785.321,53
CORONARY ARTERY BYPASS GRAFTING	$91.157.547,32	$101.997.210,75	$100.547.774,15	$127.411.965,47	$123.788.409,70	$114.090.447,81	$109.323.214,71	$100.920.195,83	$90.095.023,04	$83.583.159,13	$79.155.408,31	$77.246.693,51	$59.699.736,92	$54.728.139,07	$75.989.646,45	$102.273.812,44	$122.799.611,96
HEART VALVE SURGERY	$65.224.975,70	$68.793.735,25	$66.747.808,90	$79.280.002,13	$76.170.381,51	$70.118.876,08	$66.771.387,91	$61.608.212,81	$55.197.638,78	$52.173.252,74	$51.094.871,69	$51.965.329,83	$36.525.250,91	$33.533.495,21	$46.274.452,54	$62.971.532,17	$75.443.324,08
PRIMARY ANGIOPLASTY	$23.441.460,72	$18.526.964,95	$17.398.044,67	$15.747.434,72	$14.773.235,34	$14.642.332,60	$17.012.215,02	$19.547.500,71	$20.941.787,64	$21.215.819,29	$21.127.269,23	$20.773.636,65	$20.377.793,36	$20.757.722,90	$32.622.593,17	$36.667.315,91	$42.515.992,25
CARDIOMYOPATHIES	$87.512,18	$266.365,09	$90.172,87	$144.262,55	$181.250,24	$138.936,75	$113.289,62	$103.934,50	$165.894,24	$133.824,77	$122.591,38	$112.282,11	$83.145,41	$57.732,36	$89.718,36	$101.884,85	$106.244,59
OTHER VALVULOPLASTIES	$786.526,33	$812.486,60	$805.167,83	$849.265,82	$777.459,28	$805.604,92	$789.108,27	$726.825,18	$501.925,18	$559.465,73	$486.134,03	$543.434,00	$482.799,60	$554.392,52	$634.379,53	$797.892,77	$844.155,55
MITRAL VALVULOPLASTY	$1.613.220,86	$1.753.220,41	$1.475.427,52	$1.428.730,30	$1.129.805,68	$1.166.402,90	$1.041.329,40	$833.691,56	$433.717,16	$509.637,18	$420.554,33	$396.617,94	$245.599,06	$262.986,96	$326.590,82	$423.198,67	$400.196,57

(*) The 2024 data have been updated. Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).[34]

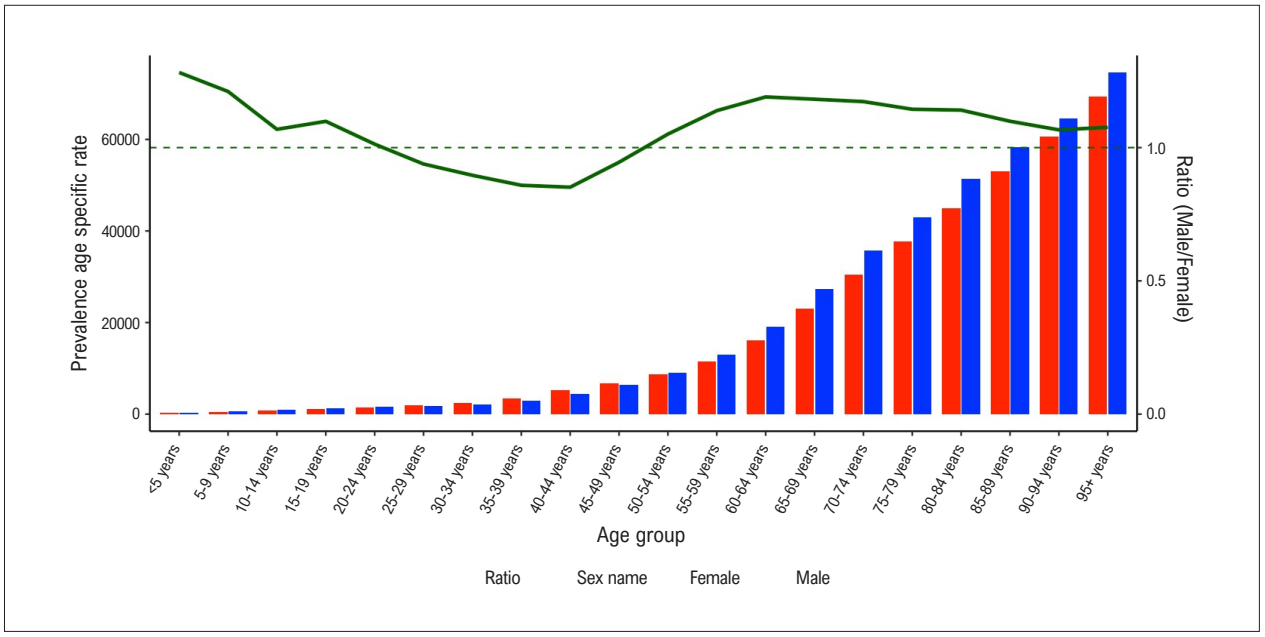

Chart 1.1 – *Prevalence of cardiovascular disease by sex and age group, and male/female ratio, in Brazil, 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

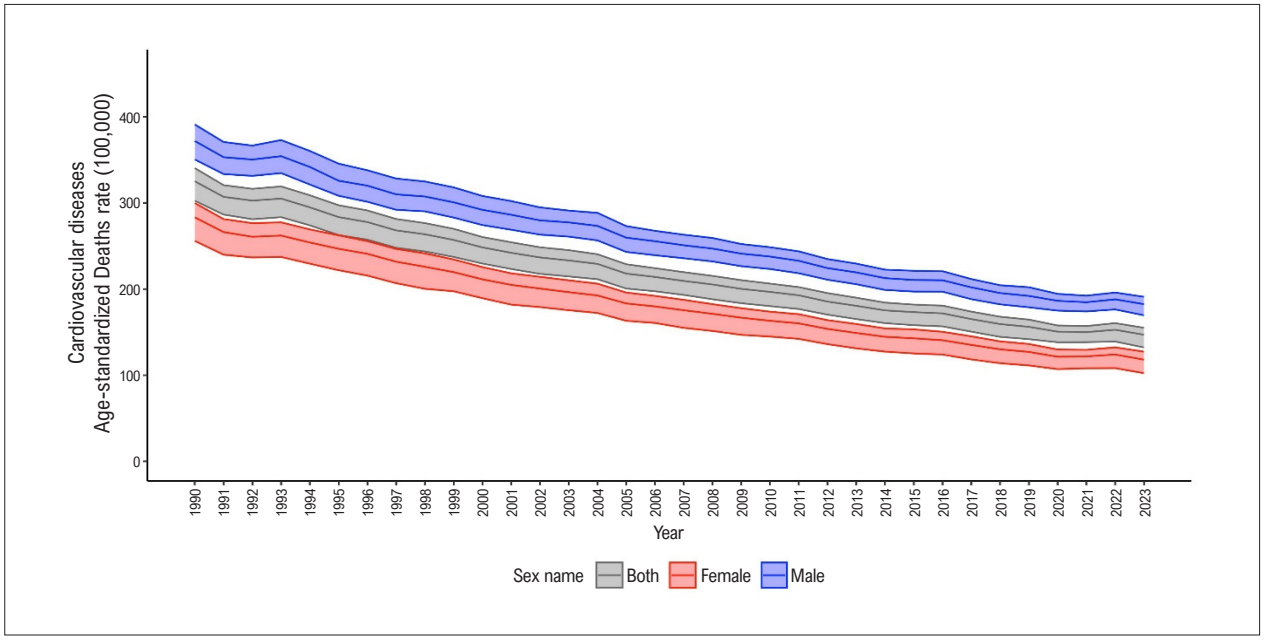

Chart 1.2 – *Trends in the age-standardized death rate from cardiovascular disease by sex, in Brazil, 1990-2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

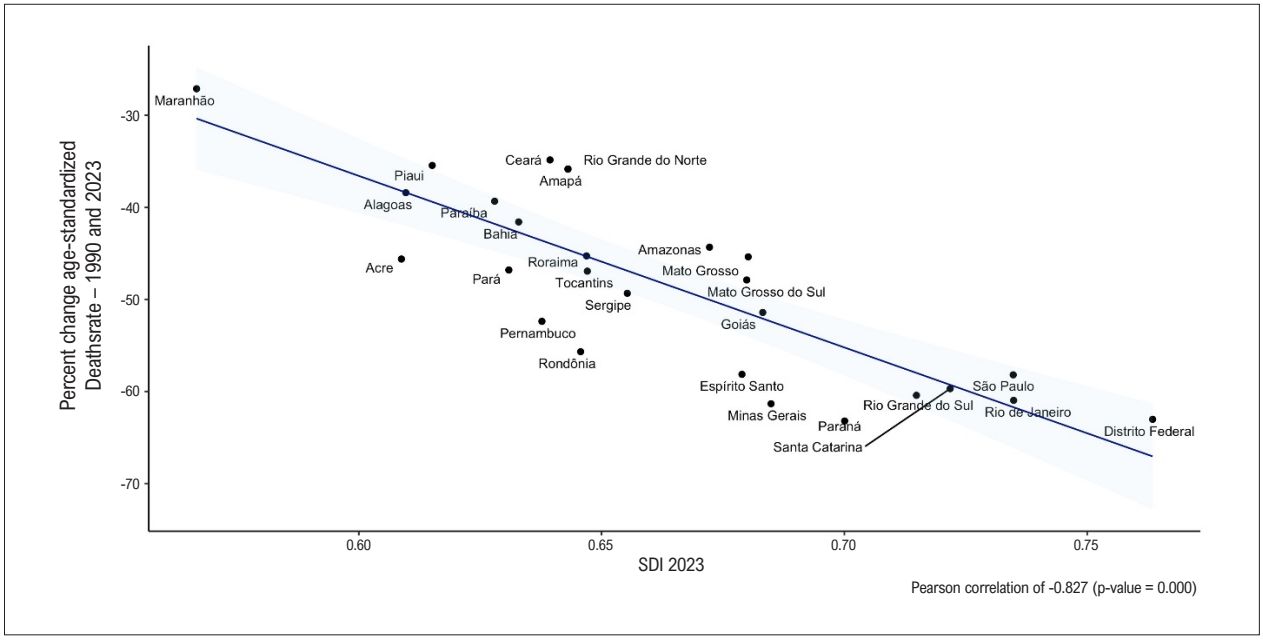

Chart 1.3 – *Correlation between the Sociodemographic Index (SDI) and the percent change of age-standardized cardiovascular mortality rates from 1990 to 2023 in the Brazilian Federative Units. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

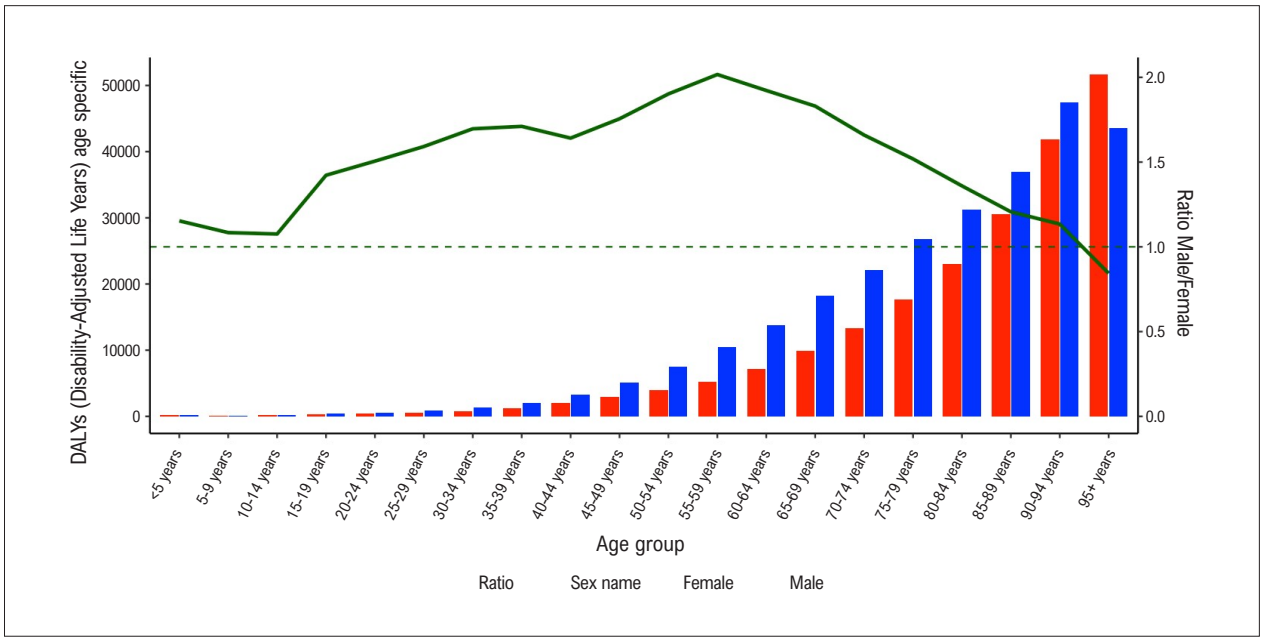

Chart 1.4 – Distribution of disability-adjusted life years (DALYs) due to cardiovascular diseases by age group and sex, including the male/female ratio, in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

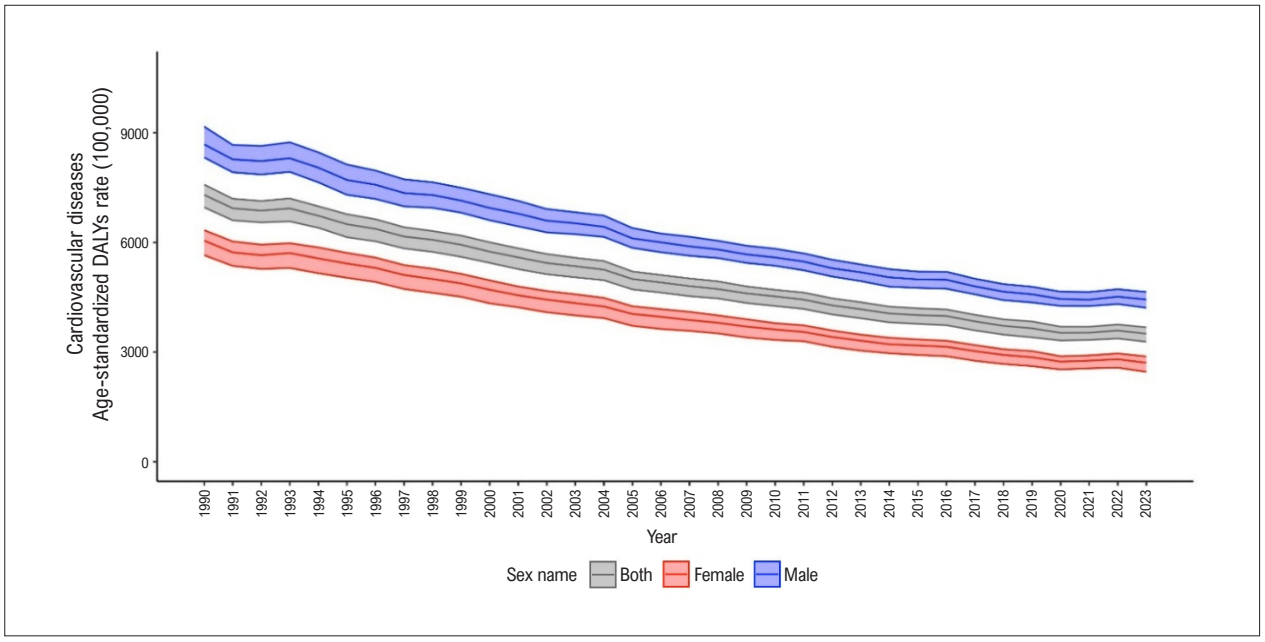

Chart 1.5 – *Temporal trend of age-standardized DALY rates due to cardiovascular diseases by sex, in Brazil, 1990–2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

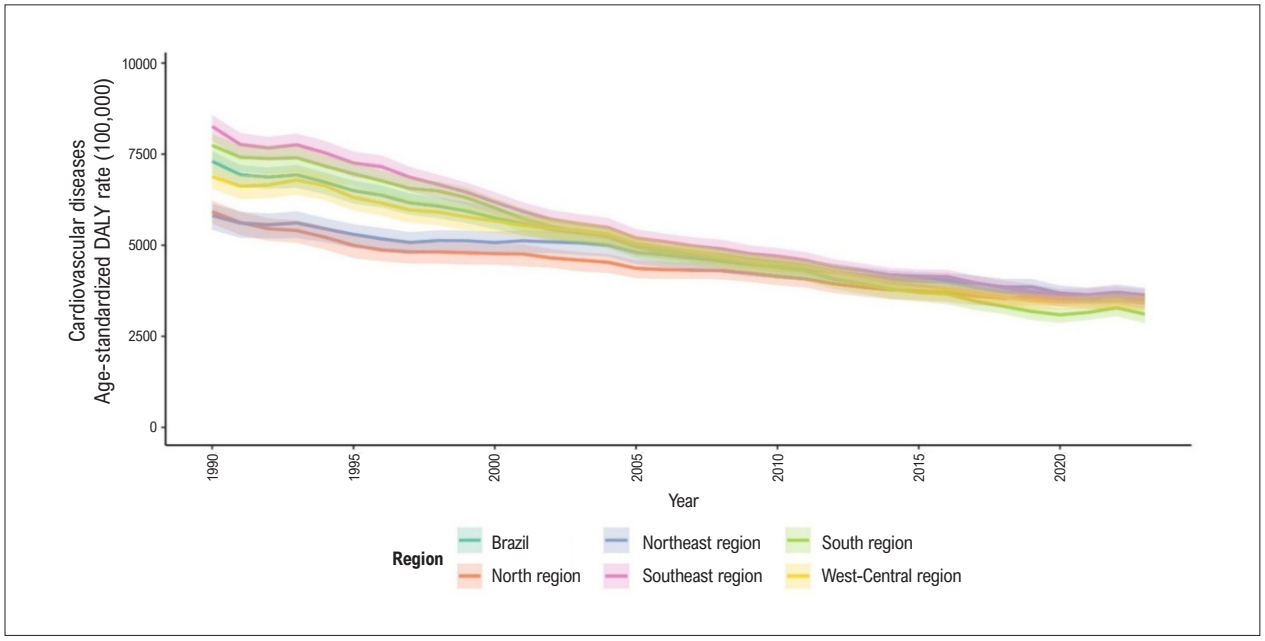

Chart 1.6 – *Temporal trend of age-standardized DALY rates due to cardiovascular diseases, in Brazil and its geographic regions, 1990–2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

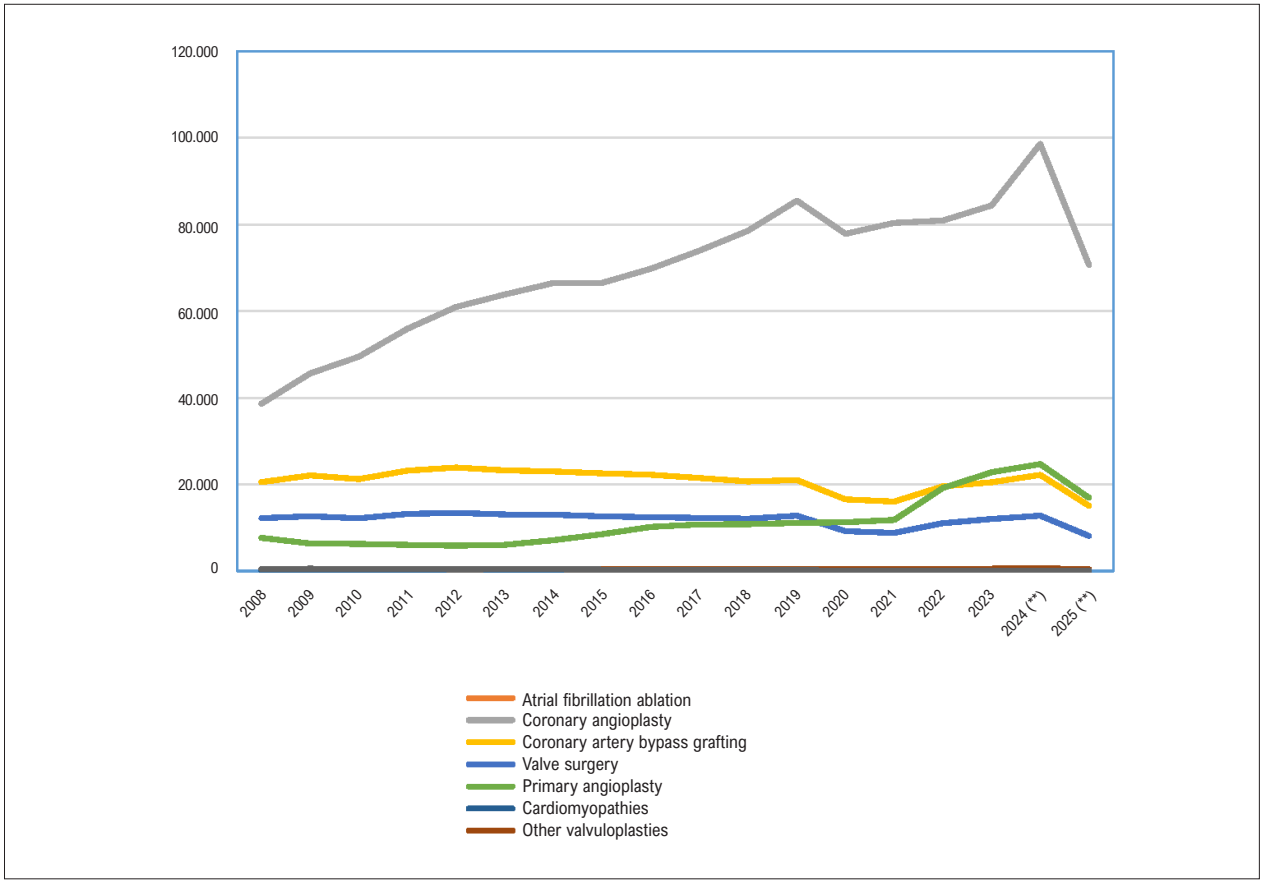

Chart 1.7 – *Total admissions for cardiovascular procedures per competence year according to the Grupo CCV. (*) Data from 2024 were updated. (**) Data from 2025 are from January to August. Source: Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).*[34]

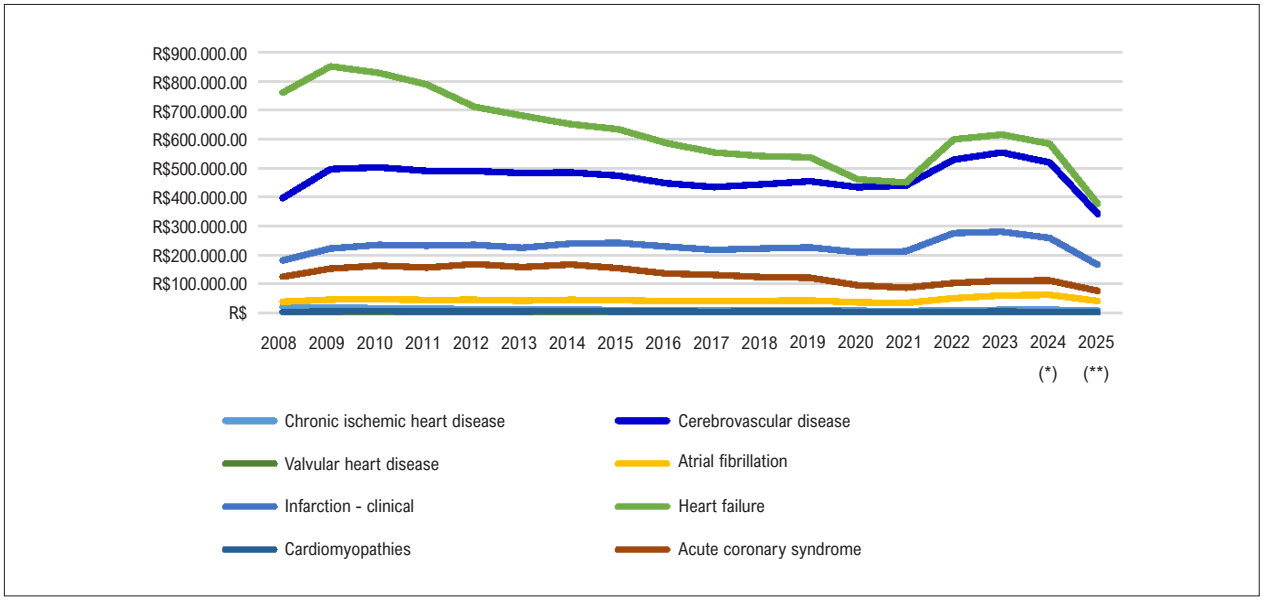

Chart 1.8 – *Clinical admissions for cardiovascular disease treatment reimbursed by the SUS in the 2008-2025 period. (*) Data from 2024 were updated. (**) Data from 2025 are from January to August. Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).*[34]

CHAPTER 2 – STROKE (CEREBROVASCULAR DISEASES)

ICD-9 430 to 438; ICD-10 I60 to I69.

See Tables 2.1 through 2.3 and Charts 2.1 through 2.3.

Abbreviations used in chapter 2

BEAT	Brain & hEart globAl iniTiative
BRIDGE-Stroke	Brazilian Intervention to Increase Evidence Usage – Stroke
CI	Confidence Interval
CVD	Cardiovascular Diseases
DALY	Disability-Adjusted Life Year
DATASUS	Department of Information and Data Processing of the Brazilian Unified Health System
GBD	Global Burden of Diseases
HRQoL	Health-Related Quality of Life
IBGE	Brazilian Institute of Geography and Statistics
ICD	International Classification of Diseases
IRR	Incidence Rate Ratio
JOINVASC	Joinville Stroke Registry in Brazil
MAPS	Matão Preventing Stroke
OR	Odds Ratio
PNS	Brazilian National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
RESILIENT	Randomized Controlled Trial of Endovascular Treatment for Acute Ischemic Stroke
RR	Relative Risk
RRi	Relative Risk Index (used for trend analyses)
SDI	Social Development Index
SIM	Brazilian Mortality Information System (in Portuguese, *Sistema de Informação sobre Mortalidade*)
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
UI	Uncertainty Interval
WSO	World Stroke Organization
YLD	Years Lived with Disability
YLL	Years of Life Lost
YPLL	Years of Potential Life Lost

Introduction

- Stroke represents one of the main morbidity and mortality causes in Brazil. In recent years a growing representation of Brazilian generated evidence has been contributing to a better understanding of the stroke burden. Moreover, tackling stroke statistics represents a key step towards the development of evidence-based care pathways.

Prevalence

- Data from the Global Burden of Diseases (GBD) Brazil Group have shown that the age-standardized prevalence rate of stroke in 2023 was 1,043.3 (964.1 to 1,147.0), representing a -25.6 (-29.4; -22.4) percent change from 1990 (Table 2.1 and Chart 2.1). Stroke is more prevalent in men, 1,139.1 (1,053.1; 1,252.9), and in the state of Maranhão, 1,303.2 (1,193.1; 1,429.1).
- Stroke prevalence estimates may differ slightly between studies because each study selects and recruits a sample of participants to represent the target study population (e.g., state, region, or country). In community-based studies, in the city of São Paulo, the age-adjusted prevalence rate for men was 4.6% (95% CI, 3.5-5.7) and for women, 6.5% (95% CI, 5.5-7.5)[35] in 2011. In another study in the same city, out of 3577 subjects, 244 cases (6.82%) of stroke survivors have identified.[36] In the town of Coari, authors have found a 6.3% crude prevalence of stroke in rural areas and 3.7% in urban areas.[37] In a nationally representative community-based epidemiological survey using data from the 2019 Brazilian National Health Survey (PNS), out of the 90,849 individuals assessed, 1.9% (95% CI, 1.7–2.0) of those aged 18 years or older had been diagnosed with a stroke. When observed by region, the highest prevalence was in the Northeast (2.0%; 95% CI, 1.8–2.2) and the lowest, in the South (1.7%; 95% CI, 1.5–2.1).[38] In a previous estimate of 2,231,000 self-reported stroke cases, prevalences of 1.6% and 1.4% were observed in men and women, respectively.[39]

Incidence

- In the Matão Preventing Stroke (MAPS) study between 2003–2004 and 2015–2016, the age-adjusted incidence decreased by 39% (incidence rate ratio [IRR] 0.61; 95% CI, 0.46–0.79) and mortality, by 50% (IRR 0.50; 95% CI, 0.31– 0.94), while 7% had a recurrent stroke.[40]

Mortality

- Data from the GBD Brazil Group have shown that the age-standardized mortality rates of stroke, per 100,000, in 2023 was 49.4 (44.2; 52.5), representing a -63.2 (-65.5; -60.9) percent change from 1990 (Table 2.2 and Chart 2.2). The highest mortality was observed in men, 59.0 (54.6; 62.8), and in the North region, 57.5 (51.8; 61.9).
- A descriptive and ecological study has analyzed trends in mortality from cerebrovascular diseases in Brazil between 2000 and 2021, using data from the Department of Information and Data Processing of the Brazilian Unified Health System (DATASUS) and joinpoint regression methods. The results showed an overall reduction in age-adjusted mortality rates from 95 to 52 deaths per 100,000 population, more pronounced among women (from 83 to 44 deaths per 100,000) than among men (from 108 to 63 deaths per 100,000). The South and Southeast regions

showed the largest decreases, with average annual percent changes of -4.05 and -3.86, respectively, while the North and Northeast regions initially recorded increases followed by decreases (average annual percent change ranging from 2.63 to -2.35 in the Northeast). Despite higher rates among individuals over 50 years of age, all age groups showed decline, with the most significant reduction in the 30-39 age group (average percent changes of -4.10 for men and of -4.85 for women). The drop was attributed to health policies, increased awareness of risk factors, and improvements in the health system, although regional and socioeconomic disparities persist.[41]

- In another ecological time-series study analyzing in-hospital mortality trends for ischemic stroke in Brazil from 1998 to 2018, the proportion of deaths decreased significantly, with an average annual reduction of 0.25% ($p<0.001$), resulting in a total decline of 43.76% over 20 years. At the beginning of the study, the proportion of in-hospital deaths was 14.8%, which dropped to 11.55% by 2018. The reduction was more pronounced in the South and Southeast regions, while some states in the North and Northeast showed stationary or increasing trends. Gender analysis revealed a slightly higher annual decline in men (0.24%) compared to women (0.22%).[42]
- In a time-series ecological study conducted in nine cities in the state of Rio Grande do Sul, analyzing data from 2009 to 2019, 9.35% of deaths occurred due to cerebrovascular diseases. There was a significant decrease in the mortality rates in five cities: Ijuí (-1.58 deaths/year), Passo Fundo (-0.98 deaths/year), Caxias do Sul (-1.85 deaths/year), Porto Alegre (-2.36 deaths/year), and Uruguaiana (-2.41 deaths/year). When evaluated by sex, there was a significant reduction in mortality in women in six cities, with decreases of 2 to 3 deaths/year per 100,000 inhabitants. For men, there was a significant reduction in two cities (Porto Alegre and Caxias do Sul), with decreases of approximately 1 to 2 deaths/year per 100,000 inhabitants.[43]
- In the city of São Paulo, from 1996 to 2011, age-adjusted mortality rates from cerebrovascular diseases decreased by 46.6% in men and 47.8% in women. For both sexes and age group of 35–74 years, the decline in age-adjusted rates was more pronounced among those residing in the wealthiest areas as compared to those living in the poorest ones.[44] A study using data from the Brazilian Mortality Information System (SIM) from 1990 to 2012 has shown a –48.05% variation in the mortality coefficient.[45] In the MAPS study, between 2003–2004 and 2015–2016, mortality decreased by 50% (IRR 0.50; 95% CI, 0.31–0.94). The 1-year case fatality was 26% and approximately 56% of the patients were functionally independent, while 7% had a recurrent stroke.[40,46]
- In a study conducted in the state of Paraná, Brazil, the age- and sex-specific mortality rates related to stroke between 2007 and 2016 increased from 138 to 163 per 100,000 inhabitants, with the highest increase observed among individuals over 79 years of age. However, the mortality rates decreased for the age groups of 34-44 years and 44-54 years.[47]

Global Burden of Cerebrovascular Diseases

YLL

- In a systematic review highlighting premature mortality from cardiovascular diseases (CVD) in Brazil using indicators of years of life lost (YLL), Brazil exhibited one of the highest rates of years of potential life lost (YPLL), 1163.1 per 100,000 population, significantly higher than the rates observed in high-income countries. The YPLL in Brazil was 11.0, indicating a substantial burden of premature mortality.[13]
- In a descriptive study analyzing stroke burden in the Southeast region of Brazil using secondary data from the DATASUS and the Brazilian Institute of Geography and Statistics (IBGE) for 2019, YLL accounted for 20% of the total disability-adjusted life years (DALYs), reflecting the impact of premature deaths due to stroke. The male population had a higher YLL burden, indicating significant loss of life years due to early mortality. The highest YLL values were observed in the economically active age group of 40–59 years, totalling 47,506 YLL, while the lowest values were seen in individuals aged 80 years or older.[48]
- A study conducted in the Southeast region of Brazil in 2019, Reis *et al*. using secondary data from the DATASUS and the IBGE showed a total of 713,132 estimated DALYs, with 80% attributed to years lived with disability (YLD) and 20% to YLLs. When adjusted for population size, the highest impact was observed in the male sex in the state of Minas Gerais, particularly in the age group of 70-79 years.[48]

DALY

- Data from the GBD Brazil Group have shown that the age-standardized DALY rate per 100,000 due to stroke in 2023 was 1116.8 (1040.8; 1168.2), representing a -62.0 (-64.1; -60.0) percent change from 1990. The highest DALY rate was observed in the North region, 1261.2 (1174.2; 1335.7) (Table 2.3 and Chart 2.3).
- In a descriptive study analyzing stroke burden in the Southeast region of Brazil using secondary data from DATASUS and IBGE for 2019, a total of 713,132 DALYs were estimated for 2019, with the state of São Paulo contributing the highest share (47.5%) due to its larger population. The age group of 40–59 years had the greatest DALY burden, totalling 264,925, indicating significant productivity loss in the economically active population. When adjusted for 100,000 inhabitants, the state of Minas Gerais had the highest DALY rate (1,398), with males showing a greater impact in older age groups.[48]
- In a study analyzing the burden of ischemic stroke across BRICS-plus nations from 1992 to 2021, Brazil reported the most substantial reduction in age-standardized DALY rate, a 59.37% decrease over the study period. The annual net drift in DALY rate for Brazil was -3.04%, the highest among those ten countries. In 1992, Brazil's age-standardized DALY rate was 1274.90 per 100,000 population, which dropped to 518.03 per 100,000 in 2021.[49]

- Trends of mortality and DALY rates for cerebrovascular disease (ICD-10: I-60-69), as per the GBD Brazil 2015, have shown that the annual reduction in mortality rates adjusted for age, for both sexes, have slowed between 2005 and 2015 as compared to the previous period, 1990 to 2005.

Complications and Associated Diseases

- Assessments from the 2013 PNS have shown a prevalence of post-stroke disabilities of 29.5% for men and of 21.5% for women, with only 0.27% of the individuals undergoing physical therapy for stroke.[50]
- A cross-sectional, population-based study has been conducted in Brazil using data from the Brazilian Longitudinal Study of Aging 2015-2016. It included 536 individuals aged 50 years and older who had experienced a stroke.[51] The prevalence of stroke was found to be 5.3% among individuals aged 50 years and older, increasing to 8.0% among those aged 75 years and older, with differences between sexes.

Quality of Care

- A cross-sectional study analyzing anonymized data from a large real-world database derived from data routinely collected by community health workers in Brazil between May 2016 and January 2021 has aimed to identify stroke survivors and assess their access to rehabilitation services. Out of the 2,397,764 individuals assisted, 21,785 (0.9%) reported a history of stroke, with a mean age of 66.5 years and 52.8% of female individuals. The Northeast region accounted for 50.3% of stroke survivors, and 77.7% lived in urban areas. Only 33.1% had received physical rehabilitation during hospitalization, and 52.7% after discharge. Geographic access to rehabilitation centers was suboptimal, with a mean distance of 79.13 km and mean travel time of 81.18 minutes. The study highlights significant gaps in rehabilitation service provision and emphasizes the need for improved healthcare pathways and resource allocation.[52]
- A retrospective cohort study has assessed 17,115 admissions to 165 intensive care units for stroke patients in Brazil from 2011 to 2020, focusing on the impact of the COVID-19 pandemic on stroke outcomes. Of the admissions, 79.7% were ischemic strokes and 20.3%, hemorrhagic strokes. In-hospital mortality was 9% for ischemic stroke and 24% for hemorrhagic stroke. The study found a 19% reduction in intensive care unit admissions for stroke in 2020 as compared to 2019, with ischemic stroke admissions decreasing by 18% and hemorrhagic stroke admissions by 26%. Mortality rates for ischemic stroke increased from 7.2% in 2019 to 9.1% in 2020, interrupting a decade-long trend of improving outcomes.[53]
- The World Stroke Organization (WSO) Brain & Heart Task Force developed the Brain & hEart globAl iniTiative (BEAT), a pilot feasibility program aimed at fostering collaboration between cardiologists and stroke physicians across 10 sites in 8 countries. The program focused on atrial fibrillation, patent *foramen ovale*, and stroke-heart syndrome, implementing site-specific clinical pathways, regular neurocardiology rounds, and integration of cardiologists into stroke teams. Conducted between August 2021 and June 2022, the program achieved its primary composite feasibility outcome in 90% of the sites, with 5 sites newly implementing clinical pathways, 8 establishing neurocardiology rounds, and 7 designating dedicated cardiologists. Challenges included limited access to prolonged cardiac monitoring and therapeutic technologies, while qualitative improvements included enhanced diagnostic consistency and interdisciplinary communication. The initiative has demonstrated feasibility but requires further testing in larger-scale programs to assess long-term sustainability and clinical outcomes.[54]
- A retrospective study analyzing data from 884 patients, the Joinville Stroke Registry in Brazil (JOINVASC), has been conducted to evaluate health-related quality of life (HRQoL) 3 months and 1 year after a first ischemic stroke or intraparenchymal hemorrhage. At 1 year, HRQoL was significantly higher in independent patients (0.81 ± 0.23) compared to dependent ones (0.40 ± 0.26, $p < .0001$). Predictors of poor HRQoL included increasing age, female sex, diabetes, hypertension, and higher modified Rankin scale scores. A significant improvement in HRQoL was observed between 3 months and 1 year (mean difference: 0.024, $p < 0.0001$).[55]
- In a study conducted at Hospital de Clínicas de Porto Alegre, evaluating strategies to improve door-to-needle time for acute ischemic stroke treatment during the COVID-19 pandemic between 2019 and 2021, 1739 suspected acute ischemic stroke cases were assessed, with 567 confirmed in 2019, 753 in 2020, and 789 in 2021. A total of 256 patients received thrombolytic therapy. The median door-to-needle time decreased from 78 minutes in 2019 to 66 minutes in 2020 and 57 minutes in 2021, with the proportion of patients treated within 60 minutes increasing from 21% in 2019 to 44.3% in 2020. Key actions included initiating intravenous thrombolysis on the computed tomography scan table, which reduced door-to-needle time by 22 minutes compared to treatment in the emergency department.[56]
- Dantas *et al*. have performed a study to assess stroke-related hospitalization in the Brazilian Unified Health System (SUS) from 2009 to 2016. In the period, the number of admissions increased from 131,122 to 146,950 and the absolute number of in-hospital deaths increased from 28,731 to 31,937. Younger age and male sex were significantly associated with patient survival. The annual age-adjusted hospitalization and in-hospital mortality rates decreased by 11.8% and 12.6%, respectively, but the case-fatality rate increased for patients older than 70 years.[57]
- A study assessing sociodemographic factors related to lack of hospital care for cerebrovascular disease deaths in the state of São Paulo during the periods of 1996-1998 and 2013-2015 has shown that, of the 127,319 individuals who died due to stroke during the mentioned periods, 19,362 (15.2%) had no hospital care. In the latter period, higher risk for death without assistance was identified for individuals of yellow races (RR = 1.48; 95% CI, 1.25-1.77), and lower risk for Black individuals (RR = 0.86; 95% CI,

0.76-0.95), married ones (RR = 0.70; 95% CI, 0.64-0.75), and for those living in the city of São Paulo (RR = 0.92; 95% CI, 0.86-0.98).[58]

- Experiences from the BRIDGE-Stroke trial have shown that a multifaceted quality improvement intervention on adherence to evidence-based therapies for the care of patients with acute ischemic stroke and transient ischemic attack improved the uptake of all eligible therapies from 25.2% to 49.2% (OR, 2.59; 95% CI, 1.22-5.53; p = 0.01).[59]
- The RESILIENT trial[60] has shown that thrombectomy, in conjunction with standard care, resulted in better functional outcomes at 90 days compared to standard care alone. The common odds ratio for a better distribution of scores on the modified Rankin scale was 2.28, favouring thrombectomy.

Impact of the COVID-19 Pandemic

- Regarding hospitalizations due to stroke, the study by Brant *et al*. has shown a decrease of 5.1% (RRi 0.949; 95% CI, 0.947-0.952) during the COVID-19 pandemic period (epidemiological week 10 to 21), the lowest relative decrease in the number of hospitalizations in the CVD group. Thus, although stroke is the second cause of hospitalization in absolute numbers, the reduction in the number of hospitalizations was lower than that for acute coronary syndrome. In parallel to this finding, hospitalizations for stroke showed absolute (RRi 1,154; 95% CI, 1,145-1,163) and proportional (RRi 1,216; 95% CI, 1,210-1,222) increases in intensive care unit admissions higher than those for CVD together; however, although an increase in proportional mortality was observed, especially in the third phase of the pandemic, this was lower than that for CVD alone (RRi 1,053; 95% CI, 1,048-1,058) and did not recover until the end of the period assessed. This increase progression in both numbers and proportion of hospital deaths throughout the pandemic period deserves to be highlighted, mainly because the proportion of intensive care unit use remained higher than expected throughout the period assessed.[61]
- Regarding stroke mortality, the same study has shown that stroke was the specific cause with the least reduction in mortality in the country, and in the North and West-Central regions there was no variation. These findings are in line with the relatively low reduction in the number of hospitalizations, suggesting a lower real impact of the pandemic on cerebrovascular diseases. In addition, the clinical symptoms being different from those of COVID-19 might have allowed for a more accurate diagnosis. Moreover, the smaller direct relationship between time to start treatment and mortality might have allowed patients longer time to recognize symptoms and seek a hospital - differently from acute coronary syndrome, in which most deaths occur in the first hours after the event.[61]

Cost

- The costs related to stroke hospital admissions and adjusted for inflation from 2008 to 2021 sum up to USD 1,195,975,877.98, varying from USD 28,661,321.88 in 2008 to USD 66,843,953.39 in 2021.
- A cost-effectiveness study assessing thrombolytic drugs in Brazil has reported that, for men and a one-year result, the cost of treatment with rt-PA is higher than the cost of conservative treatment. This result is mainly driven by the cost of the medication. Part of this additional cost is compensated by the lower cost of rehabilitation and smaller loss of productivity as early as in the first two years, because patients treated with rt-PA (alteplase) had fewer sequelae than those who received conservative treatment. After the second post-stroke year, for both sexes, treatment with rt-PA, considering direct and indirect costs, started to present a lower cost when compared to conservative treatment. From this time horizon onward, the additional cost of the medication starts to be more than compensated by the smaller loss of productivity and lower social security and patient rehabilitation costs.[62]
- The cost-utility analysis from the RESILIENT trial comparing mechanical thrombectomy plus standard medical care to standard medical care alone has shown that the incremental costs and quality-adjusted life years gained were estimated at Int$ 7440 and 1.04, respectively, resulting in an incremental cost-effectiveness ratio of Int$ 7153 per quality-adjusted life year. Despite the initially higher costs, the long-term benefits of mechanical thrombectomy justified its incorporation into the stroke centers of SUS, because it is likely to be cost-effective.[63]

Risk Factors and Prevention

- Using data from the GBD study, Silva *et al*. have assessed the impact of low levels of physical activity on stroke mortality in Brazil from 1990 to 2019.[64] There were reductions of 44.0% and 52.0% in age-standardized mortality rates due to stroke attributed to low physical activity for males and females, respectively. The study suggests that higher levels of physical activity might have prevented approximately 6.1% and 7.3% of male and female stroke deaths, respectively, in 2019.
- In a cross-sectional study analyzing anonymized data routinely collected by community health workers in Brazil, between May 2016 and September 2021, from a population of 2,133,900 individuals in the database, 35,103 (1.6%) had had a previous myocardial infarction (n = 11,628; 33.1%) or stroke (n = 25,925; 73.9%). Only 2346 (6.7%) and 212 (0.6%) reported statins and high-dose statins use, respectively. Age over 60 years, living in the Southern region, having a previous diagnosis of myocardial infarction, heart failure, diabetes, dyslipidemia or chronic kidney disease, as well as use of anti-hypertensives were associated with statin use.[65]

Awareness and treatment

- In recent years, there have been several initiatives to improve public stroke awareness in Brazil, mainly around the World Stroke Day (October 29th) annual campaigns led by the WSO.[66] Despite these efforts several studies have shown an alarming lack of knowledge about stroke risk factors and treatment, and recognition of stroke symptoms as a medical emergency. Pontes-Neto *et al*. have shown that 32% of the interviewed subjects recognized no warning

signs of stroke, only 34.6% of the subjects knew the correct nationwide emergency telephone number in Brazil (#192), and only 51.4% of the subjects reported they would call an ambulance for a relative with symptoms of stroke.[67]

- In a study conducted in the city of Caxias do Sul, Brazil, lower income and lower educational level were independent predictors of inability to recognize that stroke affects the brain.[68] In another study in the city of Santa Maria, Rio Grande do Sul, where 33% correctly reported the meaning of the acronym "AVC", meaning stroke in Portuguese, approximately 30% of the subjects incorrectly localized stroke in the heart.[69]
- In a study conducted in São Paulo, investigators have surveyed students from different education levels, including 1187 elementary-school students (mean age: 13 years; prior experience: 14%; 51% women), 806 high-school students (mean age: 17 years; prior experience: 13%; 47% women), and 1961 university students (mean age: 22 years old; prior experience: 9%; 66% women). Stroke awareness and knowledge about risk factors and warning signs ranged between 42% and 66% among the students. Less than 52% of them associated stroke with risk factors like hypercholesterolemia, smoking, diabetes, and hypertension. When prompted, 62% to 65% of the students recognized arm weakness, facial drooping, and speech difficulty as stroke warning signs, but only 43% identified acute headache as one. Notably, 67% of the students were aware of the emergency medical service number. Higher education, prior experience, and being female were associated with higher scores in identifying stroke risk factors (OR = 1.28, 95% CI, 1.10–1.48; OR = 2.12, 95% CI, 1.87–2.40; OR = 1.46, 95% CI, 1.16–1.83; respectively) and warning signs/symptoms (OR = 2.22, 95% CI, 1.89–2.60; OR = 3.30, 95% CI, 2.81–3.87; OR = 2.04, 95% CI, 1.58–2.63; respectively).[70]
- In a cross-sectional study conducted in high schools in Northeastern Brazil, Rodrigues *et al*. have aimed to assess stroke knowledge among high-school students.[71] Those authors have found that 80% of the students did not have the minimum knowledge on how to act in a stroke situation, while only 10% had the ideal knowledge on how to act. Males had lower levels of knowledge on risk factors and signs and symptoms of stroke. Students with more than 10 years of schooling and those aged 18 years demonstrated greater knowledge in certain aspects. That study highlights a knowledge deficit among high-school students regarding stroke recognition and activation of emergency medical services.

Future Research

- Over the last decade, Brazil has made substantial progress in cerebrovascular research with the consolidation of national stroke registries, successful large-scale randomized clinical trials, and increasing use of routinely collected health data. Despite these advances, important knowledge gaps remain and define priority areas for future research.
- First, there is a clear need for nationally representative, population-based studies on stroke incidence, prevalence, and recurrence, particularly in underrepresented regions, such as the North and Northeast. Community-based cohorts are geographically limited, and regional heterogeneity in socioeconomic conditions, access to care, and health system organization suggest that current estimates may underestimate inequalities in stroke burden.
- Second, future research should focus on implementation science and health systems research, aiming to understand how evidence-based interventions – such as stroke units, reperfusion therapies, secondary prevention strategies, and rehabilitation pathways – can be effectively scaled within the SUS. Studies evaluating barriers and facilitators to quality of care across different levels of complexity are particularly needed.
- Third, the growing availability of real-world data from primary care, hospital information systems, and digital health platforms represents a major opportunity to evaluate long-term outcomes, adherence to secondary prevention, multimorbidity trajectories, and equity in access to care. Leveraging these data sources can support continuous learning health systems and complement traditional clinical trials.
- In addition, Brazil offers a unique environment for the development and evaluation of digital, decentralized, and patient-centered research models, including pragmatic trials, hybrid effectiveness–implementation designs, and digital interventions aimed at prevention, early recognition, and post-stroke follow-up.[72,73]
- Finally, future studies should increasingly integrate patient-reported outcomes, quality of life measures, and social determinants of health, ensuring that stroke research addresses not only survival but also functional recovery, participation, and long-term well-being. Addressing these research priorities will be essential to further reduce the burden of stroke in Brazil, promote equity, and inform sustainable, evidence-based public health and clinical strategies.

Table 2.1 – Prevalence of stroke: numbers and age-standardized rates per 100,000 in Brazil and Federative Units, according to sex, in 1990 and 2023

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	672.687,6 (613.630,3; 752.051,0)	1.503,2 (1.364,3; 1.677,4)	1.323.900,6 (1.223.506,6; 1.464.228,9)	1.139,1 (1.053,1; 1.252,9)	-24,2 (-29,1; -20,3)
North region	33.632,4 (30.260,0; 37.885,7)	1.475,5 (1.308,6; 1.688,3)	93.584,8 (87.428,0; 102.661,3)	1.196,1 (1.111,5; 1.323,0)	-18,9 (-27,2; -12,1)
Acre	1.526,7 (1.377,2; 1.724,6)	1.525,9 (1.357,2; 1.753,8)	4.339,8 (3.908,9; 4.816,6)	1.244,2 (1.110,0; 1.395,9)	-18,5 (-26,6; -9,6)
Amapá	834,4 (739,8; 931,3)	1.571,2 (1.358,6; 1.763,9)	3.893,5 (3.508,9; 4.321,4)	1.373,0 (1.222,5; 1.523,3)	-12,6 (-22,1; -3,3)
Amazonas	6.120,4 (5.504,9; 6.940,5)	1.350,0 (1.173,5; 1.549,9)	18.704,5 (17.284,2; 20.336,6)	1.196,1 (1.100,7; 1.304,1)	-11,4 (-22,5; -0,4)
Pará	16.661,2 (14.555,2; 19.337,8)	1.449,1 (1.257,3; 1.704,3)	42.810,0 (39.124,2; 47.924,8)	1.139,7 (1.042,3; 1.288,5)	-21,4 (-33,0; -11,1)
Rondônia	3.910,9 (3.507,3; 4.394,5)	1.621,4 (1.412,4; 1.844,4)	9.558,5 (8.620,5; 10.974,2)	1.150,8 (1.038,0; 1.320,4)	-29,0 (-36,7; -19,8)
Roraima	672,3 (602,5; 755,8)	1.738,5 (1.503,5; 1.962,5)	3.005,2 (2.723,2; 3.325,2)	1.310,3 (1.181,7; 1.441,3)	-24,6 (-32,3; -15,6)
Tocantins	3.906,4 (3.493,3; 4.361,3)	1.695,2 (1.492,4; 1.933,5)	11.273,4 (10.230,0; 12.781,1)	1.395,1 (1.263,3; 1.580,9)	-17,7 (-25,7; -7,9)
Northeast region	185.671,9 (167.712,6; 205.916,8)	1.481,2 (1.321,1; 1.658,3)	366.135,9 (337.720,3; 400.385,0)	1.232,5 (1.135,3; 1.347,0)	-16,8 (-22,8; -11,1)
Alagoas	12.754,9 (11.180,3; 14.429,3)	1.872,4 (1.628,3; 2.136,0)	24.060,1 (21.688,7; 26.348,3)	1.561,5 (1.401,8; 1.704,8)	-16,6 (-25,6; -4,6)
Bahia	50.277,6 (45.286,1; 55.582,9)	1.487,5 (1.320,1; 1.663,5)	101.264,0 (91.303,3; 112.368,6)	1.243,4 (1.120,8; 1.377,2)	-16,4 (-24,5; -5,7)
Ceará	28.724,5 (25.467,4; 32.873,4)	1.472,7 (1.299,1; 1.691,1)	59.852,6 (54.028,7; 67.773,1)	1.228,0 (1.105,8; 1.389,2)	-16,6 (-27,1; -7,1)
Maranhão	19.471,7 (17.162,6; 21.903,2)	1.517,6 (1.323,4; 1.720,9)	45.832,4 (41.738,0; 50.771,7)	1.390,5 (1.262,7; 1.542,6)	-8,4 (-17,5; 3,1)
Paraíba	14.704,0 (12.880,7; 16.848,3)	1.329,9 (1.155,8; 1.526,7)	25.363,5 (23.065,1; 27.959,3)	1.135,7 (1.032,3; 1.252,4)	-14,6 (-23,2; -2,7)
Pernambuco	32.746,9 (28.848,7; 37.337,4)	1.496,1 (1.315,6; 1.727,9)	51.774,9 (47.136,6; 57.982,3)	1.088,4 (990,5; 1.220,6)	-27,3 (-35,6; -19,4)
Piaui	10.872,9 (9.610,1; 12.375,8)	1.491,9 (1.295,9; 1.723,5)	24.173,0 (21.742,8; 26.540,8)	1.288,1 (1.157,9; 1.413,3)	-13,7 (-22,9; -3,4)
Rio Grande do Norte	9.882,8 (8.804,5; 11.282,0)	1.244,1 (1.105,6; 1.423,4)	20.270,2 (18.128,3; 22.500,1)	1.088,7 (971,9; 1.212,5)	-12,5 (-21,2; -0,9)
Sergipe	6.236,6 (5.468,1; 7.221,7)	1.524,0 (1.318,0; 1.792,9)	13.545,2 (12.411,8; 15.107,9)	1.210,9 (1.108,1; 1.351,3)	-20,5 (-29,7; -11,1)
Southeast region	302.289,1 (277.511,7; 338.817,8)	1.471,5 (1.350,6; 1.644,1)	565.324,5 (519.332,7; 634.042,7)	1.095,8 (1.008,7; 1.218,0)	-25,5 (-32,0; -21,1)
Espírito Santo	12.593,9 (11.082,6; 14.091,0)	1.649,3 (1.425,3; 1.849,7)	25.178,8 (22.526,8; 28.404,3)	1.100,0 (978,9; 1.235,2)	-33,3 (-41,8; -23,8)
Minas Gerais	76.013,6 (67.598,2; 85.244,7)	1.531,6 (1.345,7; 1.720,4)	138.481,9 (125.309,5; 156.850,0)	1.055,6 (957,6; 1.191,5)	-31,1 (-38,0; -25,2)

Rio de Janeiro	73.366,5 (64.165,4; 84.179,0)	1.646,7 (1.424,5; 1.878,5)	113.303,0 (101.212,1; 126.847,4)	1.153,5 (1.035,4; 1.287,5)	-30,0 (-38,6; -21,9)
São Paulo	140.315,1 (126.932,3; 158.708,0)	1.347,0 (1.218,8; 1.533,2)	288.360,9 (259.376,2; 328.311,8)	1.094,1 (984,7; 1.241,6)	-18,8 (-26,6; -11,6)
South region	112.856,0 (99.801,9; 127.668,3)	1.604,1 (1.404,7; 1.815,9)	202.964,9 (187.180,9; 229.573,9)	1.097,0 (1.012,1; 1.236,6)	-31,6 (-37,6; -25,9)
Paraná	44.232,5 (38.215,2; 50.653,1)	1.703,5 (1.451,2; 1.969,5)	76.401,5 (69.096,0; 85.455,3)	1.113,9 (1.011,3; 1.247,1)	-34,6 (-41,6; -25,3)
Rio Grande do Sul	49.627,8 (43.634,2; 56.148,3)	1.586,8 (1.371,2; 1.820,7)	83.312,7 (74.400,6; 96.015,4)	1.145,1 (1.026,7; 1.308,6)	-27,8 (-36,3; -20,0)
Santa Catarina	18.995,7 (16.863,9; 21.586,3)	1.454,3 (1.269,8; 1.683,5)	43.250,7 (38.493,8; 49.702,9)	989,3 (882,3; 1.136,0)	-32,0 (-40,4; -24,9)
West-Central region	38.238,2 (34.042,4; 42.845,5)	1.545,1 (1.349,6; 1.754,1)	95.890,5 (88.275,0; 105.649,0)	1.121,4 (1.022,9; 1.235,4)	-27,4 (-33,6; -21,2)
Distrito Federal	5.359,4 (4.813,6; 5.997,7)	1.663,3 (1.456,5; 1.881,2)	15.437,6 (14.122,6; 16.933,1)	1.137,6 (1.035,3; 1.255,3)	-31,6 (-38,1; -25,2)
Goiás	16.049,9 (14.229,5; 18.090,1)	1.401,0 (1.217,9; 1.605,3)	41.016,2 (37.068,8; 45.795,4)	1.071,4 (965,4; 1.203,3)	-23,5 (-32,8; -13,5)
Mato Grosso	6.831,8 (5.955,1; 7.615,8)	1.369,0 (1.158,5; 1.562,4)	18.870,0 (17.069,3; 20.878,1)	1.010,4 (910,8; 1.117,4)	-26,2 (-33,7; -16,6)
Mato Grosso do Sul	9.997,1 (8.835,3; 11.308,1)	1.976,3 (1.708,3; 2.258,1)	20.566,7 (18.344,7; 22.785,4)	1.367,6 (1.221,7; 1.510,7)	-30,8 (-39,2; -21,0)
Female					
Brazil	696.218,9 (638.427,5; 770.520,1)	1.326,0 (1.203,6; 1.476,6)	1.370.536,0 (1.262.752,8; 1.507.006,4)	975,2 (900,9; 1.066,8)	-26,5 (-30,2; -23,1)
North region	34.628,5 (31.606,4; 38.446,7)	1.444,7 (1.294,0; 1.615,8)	96.051,3 (88.590,9; 105.183,9)	1.128,2 (1.035,7; 1.236,6)	-21,9 (-26,6; -16,2)
Acre	1.501,9 (1.358,7; 1.670,6)	1.547,4 (1.384,0; 1.713,8)	4.633,9 (4.288,2; 5.103,6)	1.212,2 (1.115,3; 1.337,2)	-21,7 (-28,1; -14,2)
Amapá	1.011,4 (913,9; 1.120,6)	1.544,9 (1.377,0; 1.727,8)	4.212,8 (3.916,9; 4.634,2)	1.310,0 (1.217,7; 1.445,0)	-15,2 (-21,9; -6,0)
Amazonas	6.926,6 (6.214,8; 7.613,5)	1.414,3 (1.249,3; 1.582,3)	20.517,0 (18.743,2; 22.619,5)	1.160,6 (1.055,6; 1.288,0)	-17,9 (-24,4; -11,3)
Pará	18.263,2 (16.515,3; 20.460,5)	1.459,7 (1.300,3; 1.647,4)	46.482,4 (42.144,4; 51.208,4)	1.132,6 (1.023,3; 1.252,8)	-22,4 (-28,8; -14,4)
Rondônia	3.449,7 (3.127,0; 3.786,0)	1.530,6 (1.377,0; 1.719,4)	8.771,8 (7.966,8; 9.809,8)	1.020,8 (924,2; 1.142,0)	-33,3 (-39,5; -28,1)
Roraima	459,4 (413,3; 512,5)	1.293,0 (1.139,5; 1.457,7)	2.425,1 (2.202,8; 2.666,9)	986,2 (885,6; 1.093,9)	-23,7 (-30,1; -17,3)
Tocantins	3.016,4 (2.727,4; 3.327,5)	1.318,0 (1.181,5; 1.458,3)	9.008,4 (8.220,8; 9.923,2)	1.092,5 (994,7; 1.202,0)	-17,1 (-24,0; -10,0)
Northeast region	195.813,0 (179.805,0; 215.865,8)	1.342,4 (1.233,4; 1.486,6)	384.901,9 (355.611,7; 419.383,3)	1.067,7 (985,1; 1.161,2)	-20,5 (-25,2; -16,1)
Alagoas	12.435,3 (11.344,7; 13.772,4)	1.581,0 (1.422,3; 1.762,9)	23.259,1 (21.177,5; 25.961,1)	1.205,4 (1.096,2; 1.347,1)	-23,8 (-30,1; -17,0)
Bahia	51.555,8 (47.192,2; 57.876,7)	1.304,9 (1.189,2; 1.476,0)	102.266,8 (94.009,8; 111.256,3)	1.059,7 (978,3; 1.151,6)	-18,8 (-24,8; -11,7)
Ceará	31.961,8 (28.791,1; 35.565,4)	1.396,3 (1.254,2; 1.566,9)	65.751,3 (59.648,1; 72.134,4)	1.112,5 (1.010,8; 1.217,5)	-20,3 (-27,1; -13,5)

Maranhão	19.473,9 (17.681,6; 21.726,0)	1.364,8 (1.225,3; 1.539,4)	46.320,8 (42.141,6; 51.601,8)	1.230,6 (1.119,4; 1.372,5)	-9,8 (-18,2; -2,4)
Paraíba	15.422,4 (14.034,2; 17.050,0)	1.220,3 (1.111,2; 1.348,4)	24.892,9 (22.672,9; 27.347,6)	902,4 (824,7; 987,3)	-26,0 (-31,2; -20,1)
Pernambuco	36.728,7 (32.986,0; 40.875,2)	1.382,9 (1.234,8; 1.546,6)	62.133,1 (56.721,3; 68.781,5)	1.007,8 (921,1; 1.116,0)	-27,1 (-33,3; -20,4)
Piaui	10.195,4 (9.147,1; 11.377,0)	1.237,4 (1.111,2; 1.402,9)	21.059,0 (19.009,3; 23.148,6)	972,8 (882,5; 1.068,1)	-21,4 (-27,6; -14,1)
Rio Grande do Norte	10.506,7 (9.491,7; 11.782,5)	1.171,2 (1.048,8; 1.315,6)	22.075,4 (20.150,7; 24.009,8)	967,6 (886,9; 1.051,8)	-17,4 (-23,2; -10,4)
Sergipe	7.532,9 (6.770,2; 8.470,6)	1.574,4 (1.417,4; 1.801,6)	17.143,6 (15.528,3; 18.960,3)	1.215,9 (1.102,4; 1.348,4)	-22,8 (-28,5; -14,1)
Southeast region	309.561,4 (281.008,8; 340.071,2)	1.254,5 (1.128,9; 1.390,2)	565.371,5 (517.497,3; 622.551,3)	887,0 (816,6; 972,4)	-29,3 (-33,2; -25,0)
Espírito Santo	12.340,4 (11.238,4; 13.884,5)	1.450,3 (1.295,6; 1.635,6)	27.457,4 (24.845,7; 30.199,2)	1.014,9 (920,7; 1.113,2)	-30,0 (-34,5; -23,7)
Minas Gerais	77.801,7 (69.118,5; 86.081,8)	1.346,8 (1.195,1; 1.505,9)	147.985,1 (134.423,3; 165.382,5)	967,0 (883,5; 1.075,3)	-28,2 (-34,5; -21,3)
Rio de Janeiro	81.848,2 (72.937,8; 91.719,4)	1.415,7 (1.257,6; 1.586,2)	120.900,6 (110.598,2; 131.991,9)	937,7 (859,0; 1.020,5)	-33,8 (-39,3; -27,6)
São Paulo	137.571,1 (123.308,6; 152.142,1)	1.115,9 (988,0; 1.243,5)	269.028,4 (242.189,4; 302.639,0)	819,8 (741,2; 914,4)	-26,5 (-31,9; -20,2)
South region	120.398,4 (108.511,3; 134.930,2)	1.467,2 (1.308,4; 1.656,9)	224.568,8 (206.083,2; 247.573,4)	1.014,7 (933,1; 1.119,0)	-30,8 (-34,9; -26,5)
Paraná	42.870,6 (38.335,7; 48.813,8)	1.522,0 (1.318,5; 1.744,7)	84.025,4 (77.475,7; 93.711,0)	1.036,3 (956,8; 1.149,5)	-31,9 (-38,6; -24,6)
Rio Grande do Sul	58.566,6 (52.191,6; 66.689,5)	1.512,3 (1.335,9; 1.721,7)	95.818,7 (86.750,8; 107.334,9)	1.082,6 (988,4; 1.196,0)	-28,4 (-35,3; -21,1)
Santa Catarina	18.961,2 (16.744,5; 21.225,4)	1.255,9 (1.107,4; 1.417,3)	44.724,7 (40.545,5; 50.652,0)	869,2 (788,2; 978,0)	-30,8 (-36,5; -23,6)
West-Central region	35.817,6 (32.745,9; 39.606,0)	1.361,7 (1.230,6; 1.524,7)	99.642,5 (91.958,5; 109.315,1)	1.012,4 (936,8; 1.109,9)	-25,7 (-29,3; -21,3)
Distrito Federal	5.980,1 (5.344,0; 6.621,4)	1.356,1 (1.200,4; 1.539,7)	17.839,1 (16.033,6; 19.403,5)	996,0 (897,6; 1.083,7)	-26,6 (-32,9; -19,4)
Goiás	16.973,2 (15.392,9; 18.773,6)	1.409,4 (1.255,1; 1.568,8)	45.988,5 (41.950,4; 51.309,8)	1.050,8 (961,7; 1.175,5)	-25,4 (-30,2; -19,7)
Mato Grosso	5.931,7 (5.344,8; 6.593,4)	1.276,1 (1.133,7; 1.432,4)	19.064,6 (17.504,6; 20.592,4)	974,3 (892,7; 1.055,3)	-23,6 (-29,7; -17,0)
Mato Grosso do Sul	6.932,5 (6.165,2; 7.681,5)	1.332,6 (1.165,7; 1.482,9)	16.750,2 (15.134,8; 18.408,0)	978,1 (884,5; 1.072,5)	-26,6 (-31,8; -20,2)
Both					
Brazil	1.368.906,5 (1.256.753,8; 1.517.251,5)	1.402,8 (1.269,6; 1.561,2)	2.694.436,7 (2.486.518,1; 2.970.694,4)	1.043,3 (964,1; 1.147,0)	-25,6 (-29,4; -22,4)
North region	68.260,9 (62.251,8; 75.977,2)	1.454,7 (1.307,8; 1.633,6)	189.636,1 (177.429,5; 206.798,3)	1.159,1 (1.076,8; 1.266,9)	-20,3 (-26,3; -15,1)
Acre	3.028,5 (2.765,8; 3.353,6)	1.540,6 (1.388,9; 1.732,6)	8.973,7 (8.282,9; 9.773,4)	1.224,5 (1.119,6; 1.343,5)	-20,5 (-27,2; -14,1)

Amapá	1.845,8 (1.668,6; 2.023,6)	1.543,0 (1.372,2; 1.712,4)	8.106,3 (7.563,9; 8.892,8)	1.337,9 (1.235,2; 1.471,8)	-13,3 (-19,1; -6,3)
Amazonas	13.047,0 (11.828,6; 14.607,1)	1.379,9 (1.218,3; 1.558,3)	39.221,5 (36.546,3; 42.794,8)	1.174,4 (1.086,8; 1.281,2)	-14,9 (-22,0; -7,3)
Pará	34.924,4 (31.371,7; 39.512,7)	1.447,8 (1.284,4; 1.651,8)	89.292,4 (82.019,5; 98.061,1)	1.133,8 (1.038,8; 1.247,3)	-21,7 (-30,5; -14,7)
Rondônia	7.360,6 (6.755,2; 8.111,4)	1.584,9 (1.416,4; 1.772,8)	18.330,3 (16.821,6; 20.612,9)	1.085,4 (991,4; 1.219,4)	-31,5 (-37,2; -25,8)
Roraima	1.131,7 (1.019,2; 1.263,3)	1.519,7 (1.334,2; 1.696,9)	5.430,3 (4.960,4; 5.919,0)	1.146,8 (1.041,5; 1.256,3)	-24,5 (-30,1; -18,9)
Tocantins	6.922,8 (6.281,5; 7.674,4)	1.506,1 (1.350,9; 1.684,9)	20.281,7 (18.559,9; 22.398,9)	1.243,5 (1.133,8; 1.375,6)	-17,4 (-23,6; -10,7)
Northeast region	381.485,0 (349.842,3; 421.381,4)	1.405,2 (1.280,9; 1.558,3)	751.037,9 (695.311,1; 815.722,8)	1.136,7 (1.052,3; 1.234,5)	-19,1 (-23,3; -15,3)
Alagoas	25.190,2 (22.924,2; 28.102,6)	1.717,0 (1.551,2; 1.930,2)	47.319,3 (43.196,7; 51.759,1)	1.356,7 (1.237,3; 1.481,4)	-21,0 (-26,8; -14,9)
Bahia	101.833,5 (93.525,5; 111.699,3)	1.384,8 (1.261,7; 1.518,0)	203.530,8 (186.213,5; 222.027,5)	1.138,9 (1.043,9; 1.240,5)	-17,8 (-23,2; -10,9)
Ceará	60.686,3 (54.932,7; 67.423,7)	1.431,5 (1.290,0; 1.600,7)	125.603,9 (114.731,8; 137.663,5)	1.160,8 (1.061,2; 1.270,4)	-18,9 (-26,4; -12,2)
Maranhão	38.945,7 (35.153,0; 43.698,4)	1.434,0 (1.283,3; 1.624,4)	92.153,2 (84.473,9; 101.022,1)	1.303,2 (1.193,1; 1.429,1)	-9,1 (-16,8; -1,1)
Paraíba	30.126,4 (27.174,4; 33.489,0)	1.274,2 (1.144,7; 1.424,2)	50.256,4 (45.774,3; 54.790,3)	997,0 (911,0; 1.084,1)	-21,8 (-26,7; -15,6)
Pernambuco	69.475,6 (62.509,7; 77.882,5)	1.432,1 (1.284,5; 1.614,9)	113.907,9 (104.430,1; 125.417,3)	1.035,6 (950,1; 1.140,4)	-27,7 (-33,8; -21,2)
Piaui	21.068,3 (18.977,8; 23.656,7)	1.359,2 (1.213,4; 1.539,4)	45.232,0 (41.251,1; 49.751,6)	1.114,4 (1.017,9; 1.223,5)	-18,0 (-25,3; -10,8)
Rio Grande do Norte	20.389,5 (18.508,5; 22.848,5)	1.206,1 (1.089,8; 1.360,2)	42.345,6 (39.170,2; 45.910,9)	1.016,3 (941,5; 1.101,8)	-15,7 (-21,9; -8,1)
Sergipe	13.769,5 (12.361,5; 15.635,5)	1.548,8 (1.386,3; 1.786,6)	30.688,8 (28.317,2; 33.854,5)	1.206,8 (1.109,6; 1.330,7)	-22,1 (-27,9; -15,8)
Southeast region	611.850,5 (561.321,6; 675.265,3)	1.346,4 (1.222,3; 1.490,7)	1.130.696,0 (1.042.550,3; 1.256.136,3)	973,4 (899,9; 1.077,7)	-27,7 (-32,4; -24,4)
Espírito Santo	24.934,3 (22.541,7; 27.882,5)	1.543,4 (1.388,5; 1.719,4)	52.636,2 (47.518,6; 57.521,7)	1.049,1 (951,0; 1.143,4)	-32,0 (-37,5; -26,7)
Minas Gerais	153.815,4 (137.146,1; 170.523,1)	1.427,1 (1.265,0; 1.590,6)	286.467,0 (262.072,5; 320.158,8)	1.004,3 (922,2; 1.118,2)	-29,6 (-34,1; -24,5)
Rio de Janeiro	155.214,7 (138.915,8; 175.332,4)	1.505,4 (1.334,2; 1.696,9)	234.203,6 (213.552,2; 258.150,0)	1.022,3 (935,2; 1.118,9)	-32,1 (-38,3; -26,8)
São Paulo	277.886,2 (255.115,9; 306.637,6)	1.215,7 (1.112,3; 1.345,7)	557.389,2 (508.328,2; 621.776,4)	933,4 (853,9; 1.035,5)	-23,2 (-28,5; -18,2)
South region	233.254,4 (209.850,6; 260.933,5)	1.524,3 (1.360,6; 1.714,4)	427.533,7 (395.958,6; 473.224,3)	1.046,4 (970,9; 1.154,8)	-31,3 (-36,0; -26,8)
Paraná	87.103,0 (76.694,1; 98.485,0)	1.609,1 (1.386,1; 1.844,4)	160.426,9 (148.143,2; 175.940,9)	1.066,9 (986,7; 1.164,6)	-33,7 (-39,1; -25,9)
Rio Grande do Sul	108.194,4 (96.519,9; 120.978,4)	1.535,2 (1.361,3; 1.718,0)	179.131,4 (163.313,0; 203.180,4)	1.103,3 (1.008,7; 1.236,2)	-28,1 (-34,4; -21,9)

Santa Catarina	37.956,9 (34.416,1; 42.768,8)	1.342,4 (1.197,4; 1.519,9)	87.975,4 (80.092,1; 98.991,6)	920,3 (839,2; 1.031,5)	-31,4 (-36,7; -26,8)
West-Central region	74.055,8 (67.437,6; 82.449,0)	1.453,5 (1.288,6; 1.630,4)	195.533,0 (181.257,7; 213.257,0)	1.060,0 (984,9; 1.155,0)	-27,1 (-31,6; -22,7)
Distrito Federal	11.339,5 (10.327,9; 12.709,1)	1.475,5 (1.325,1; 1.661,3)	33.276,7 (30.446,5; 36.286,4)	1.052,3 (962,9; 1.144,5)	-28,7 (-33,8; -23,8)
Goiás	33.023,1 (29.858,8; 36.980,3)	1.404,9 (1.234,5; 1.577,1)	87.004,7 (80.300,2; 96.210,5)	1.057,4 (977,6; 1.174,5)	-24,7 (-30,2; -18,6)
Mato Grosso	12.763,5 (11.478,9; 14.153,4)	1.327,9 (1.155,7; 1.495,0)	37.934,6 (34.757,7; 41.171,3)	990,6 (909,7; 1.078,9)	-25,4 (-31,1; -17,8)
Mato Grosso do Sul	16.929,7 (15.190,0; 18.816,5)	1.663,8 (1.466,6; 1.852,3)	37.316,9 (33.750,5; 40.804,2)	1.156,6 (1.047,2; 1.263,0)	-30,5 (-36,6; -24,6)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 2.2 – Death from stroke: numbers and age-standardized rates per 100,000 in Brazil and Federative Units, according to sex, in 1990 and 2023

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	54.703,1 (50.566,1; 59.737,8)	150,1 (138,6; 163,8)	65.436,5 (60.873,6; 69.534,2)	59,0 (54,6; 62,8)	-60,7 (-64,0; -57,2)
North region	2.222,3 (2.039,0; 2.441,0)	137,5 (125,5; 150,6)	4.630,5 (4.267,4; 4.993,5)	67,1 (61,2; 72,6)	-51,2 (-56,1; -46,5)
Acre	90,8 (80,4; 103,3)	118,9 (106,9; 134,9)	174,1 (148,7; 198,6)	56,4 (48,3; 64,6)	-52,6 (-61,2; -43,2)
Amapá	50,5 (44,5; 56,7)	137,3 (121,4; 152,9)	175,3 (154,1; 201,9)	72,3 (62,8; 81,8)	-47,4 (-56,3; -37,0)
Amazonas	391,6 (349,7; 439,6)	125,1 (111,6; 139,6)	939,2 (841,6; 1.042,1)	71,5 (64,0; 79,7)	-42,9 (-50,9; -35,0)
Pará	1.217,1 (1.104,8; 1.350,6)	143,4 (128,2; 159,7)	2.225,4 (1.998,0; 2.458,6)	66,9 (59,3; 74,3)	-53,3 (-58,9; -46,7)
Rondônia	265,1 (235,4; 293,9)	163,3 (144,3; 181,6)	495,4 (430,7; 572,2)	66,4 (56,9; 76,7)	-59,3 (-65,5; -52,4)
Roraima	33,3 (28,0; 39,6)	132,3 (111,9; 154,3)	123,5 (102,8; 146,9)	67,4 (56,5; 80,4)	-49,1 (-58,4; -34,9)
Tocantins	173,8 (150,3; 203,0)	139,1 (119,8; 162,5)	497,7 (435,9; 579,3)	64,4 (55,9; 75,3)	-53,7 (-62,0; -43,1)
Northeast region	13.379,3 (11.882,0; 15.214,6)	123,8 (110,5; 140,6)	18.467,2 (16.431,8; 20.449,8)	63,9 (56,7; 70,7)	-48,4 (-55,2; -39,8)
Alagoas	997,5 (885,0; 1.119,0)	171,8 (153,7; 192,3)	1.228,7 (1.084,3; 1.381,7)	85,1 (74,7; 96,0)	-50,5 (-57,4; -41,9)
Bahia	3.249,6 (2.904,0; 3.638,3)	113,3 (100,8; 126,3)	5.023,7 (4.475,7; 5.512,5)	62,7 (55,7; 68,6)	-44,7 (-51,2; -36,4)
Ceará	1.642,9 (1.442,2; 1.864,9)	98,1 (86,2; 111,5)	2.619,9 (2.310,9; 2.953,6)	54,5 (47,9; 61,3)	-44,4 (-52,4; -34,4)
Maranhão	1.475,6 (1.159,2; 1.799,1)	136,9 (108,8; 166,7)	2.654,3 (2.298,8; 3.052,3)	85,7 (73,6; 98,6)	-37,4 (-51,5; -17,1)
Paraíba	991,5 (849,1; 1.163,1)	98,6 (85,1; 114,9)	1.198,7 (1.048,0; 1.371,0)	54,4 (47,5; 62,2)	-44,8 (-53,9; -32,8)
Pernambuco	3.007,2 (2.702,8; 3.372,8)	160,8 (144,0; 180,4)	2.890,4 (2.579,5; 3.245,9)	63,6 (56,7; 71,4)	-60,5 (-65,6; -53,9)
Piaui	790,8 (663,6; 950,6)	127,7 (106,4; 154,4)	1.310,8 (1.122,9; 1.547,6)	70,8 (60,3; 83,7)	-44,5 (-55,7; -29,7)
Rio Grande do Norte	697,6 (585,7; 806,9)	99,1 (82,6; 114,5)	832,5 (708,7; 1.013,0)	45,5 (38,8; 55,1)	-54,1 (-62,9; -41,8)
Sergipe	526,6 (468,7; 594,1)	145,6 (129,4; 164,6)	708,3 (607,8; 815,0)	67,7 (58,1; 77,7)	-53,5 (-60,4; -44,1)
Southeast region	27.082,3 (25.136,0; 29.301,1)	164,2 (151,2; 179,3)	27.816,7 (25.321,9; 30.399,0)	55,6 (50,4; 60,8)	-66,1 (-69,5; -61,9)
Espírito Santo	1.123,5 (1.021,0; 1.234,6)	178,9 (161,7; 196,8)	1.127,7 (991,8; 1.264,3)	52,1 (45,5; 58,5)	-70,9 (-74,4; -66,1)
Minas Gerais	6.592,8 (6.094,2; 7.161,1)	158,9 (146,6; 173,3)	7.031,8 (6.336,5; 7.697,1)	54,3 (48,8; 59,6)	-65,8 (-69,5; -61,6)

Rio de Janeiro	7.286,0 (6.714,9; 7.875,0)	196,6 (180,0; 214,2)	6.617,2 (6.029,4; 7.269,4)	68,4 (62,3; 75,1)	-65,2 (-69,1; -60,8)
São Paulo	12.080,0 (11.105,3; 13.192,7)	151,3 (139,5; 166,4)	13.040,1 (11.886,0; 14.168,4)	51,9 (47,0; 56,6)	-65,7 (-69,2; -61,1)
South region	9.414,1 (8.618,1; 10.205,8)	169,4 (154,6; 185,0)	10.238,9 (9.308,5; 11.171,4)	59,4 (53,3; 65,1)	-65,0 (-68,6; -60,4)
Paraná	3.933,7 (3.608,3; 4.286,3)	191,2 (173,9; 208,9)	4.190,2 (3.803,5; 4.634,8)	65,5 (59,0; 72,6)	-65,8 (-69,8; -61,2)
Rio Grande do Sul	3.837,4 (3.507,3; 4.149,4)	154,7 (141,8; 167,6)	4.021,8 (3.619,5; 4.444,1)	57,4 (51,4; 63,6)	-62,9 (-67,0; -58,2)
Santa Catarina	1.643,1 (1.496,4; 1.795,2)	162,8 (147,3; 178,1)	2.026,9 (1.816,3; 2.256,6)	53,0 (46,5; 59,3)	-67,5 (-71,3; -62,8)
West-Central region	2.605,2 (2.393,2; 2.867,7)	138,6 (127,4; 152,0)	4.283,1 (3.918,6; 4.615,7)	54,9 (49,6; 59,4)	-60,4 (-64,4; -56,0)
Distrito Federal	297,7 (268,6; 328,1)	136,9 (123,2; 153,0)	557,0 (491,0; 629,6)	45,9 (40,3; 52,1)	-66,5 (-71,0; -61,4)
Goiás	1.278,4 (1.154,4; 1.418,6)	142,5 (127,7; 157,7)	1.913,9 (1.729,6; 2.105,1)	54,3 (48,8; 60,1)	-61,9 (-66,8; -56,1)
Mato Grosso	440,1 (386,5; 491,2)	123,6 (109,7; 139,0)	917,0 (802,3; 1.029,8)	56,3 (48,8; 63,1)	-54,4 (-61,5; -46,7)
Mato Grosso do Sul	589,0 (535,7; 654,6)	146,2 (133,0; 163,1)	895,2 (791,7; 1.004,4)	62,9 (55,4; 70,6)	-57,0 (-63,4; -50,0)
Female					
Brazil	49.933,5 (46.018,8; 53.866,5)	119,8 (108,5; 129,9)	61.726,4 (53.598,7; 68.169,4)	41,7 (36,4; 46,0)	-65,2 (-67,6; -62,6)
North region	1.985,7 (1.812,1; 2.142,5)	121,4 (107,5; 132,4)	3.752,6 (3.256,3; 4.166,6)	48,8 (41,9; 54,5)	-59,8 (-63,7; -56,4)
Acre	71,2 (62,6; 80,8)	109,7 (94,5; 124,9)	155,1 (132,7; 179,6)	45,4 (38,7; 52,7)	-58,6 (-65,6; -51,4)
Amapá	43,5 (37,9; 49,3)	83,6 (71,8; 94,9)	142,5 (116,4; 162,1)	51,6 (42,6; 58,8)	-38,4 (-48,3; -27,9)
Amazonas	359,5 (323,5; 398,5)	114,3 (100,7; 127,7)	780,1 (662,2; 904,6)	51,1 (43,2; 59,3)	-55,3 (-61,2; -48,7)
Pará	1.179,0 (1.065,7; 1.287,4)	127,4 (113,8; 140,2)	1.849,9 (1.550,5; 2.097,4)	48,6 (40,5; 55,3)	-61,9 (-66,4; -57,4)
Rondônia	173,8 (154,0; 192,9)	145,0 (125,7; 160,1)	352,6 (303,7; 412,0)	47,0 (40,7; 55,3)	-67,6 (-72,2; -62,4)
Roraima	22,1 (18,8; 26,0)	112,5 (94,9; 129,7)	87,7 (74,1; 107,2)	48,1 (40,0; 57,0)	-57,3 (-64,4; -47,3)
Tocantins	136,6 (117,4; 160,5)	107,8 (91,0; 125,8)	384,7 (322,1; 442,7)	48,5 (40,6; 55,9)	-55,1 (-64,7; -46,2)
Northeast region	12.801,5 (11.177,6; 14.257,6)	104,3 (90,1; 116,1)	17.623,4 (14.947,6; 20.281,9)	46,1 (39,4; 52,9)	-55,8 (-62,7; -48,3)
Alagoas	975,0 (854,0; 1.084,4)	151,5 (130,8; 168,6)	1.134,0 (957,5; 1.332,3)	59,5 (50,3; 69,8)	-60,7 (-67,1; -54,2)
Bahia	3.368,2 (2.906,5; 3.748,9)	99,6 (85,5; 111,0)	4.891,0 (4.082,1; 5.659,2)	46,7 (39,6; 54,1)	-53,1 (-59,4; -46,0)
Ceará	1.564,3 (1.329,8; 1.787,6)	81,6 (69,0; 93,6)	2.543,8 (2.148,2; 2.969,9)	39,5 (33,6; 45,8)	-51,6 (-59,9; -42,4)
Maranhão	900,5 (712,3; 1.092,4)	82,1 (64,7; 99,5)	2.307,0 (1.894,2; 2.745,4)	61,9 (50,9; 73,9)	-24,6 (-42,2; -1,9)

Paraíba	1.093,2 (919,5; 1.244,2)	99,7 (83,4; 112,9)	1.230,0 (1.037,0; 1.452,5)	40,2 (34,0; 47,4)	-59,6 (-67,0; -51,0)
Pernambuco	3.140,1 (2.777,4; 3.468,9)	141,5 (124,2; 156,1)	2.862,8 (2.479,0; 3.271,7)	44,7 (38,8; 51,1)	-68,4 (-72,8; -63,6)
Piaui	631,6 (527,1; 758,8)	96,0 (79,1; 115,9)	1.191,2 (946,7; 1.437,0)	51,2 (41,4; 61,7)	-46,6 (-58,5; -33,6)
Rio Grande do Norte	590,9 (490,1; 701,8)	74,0 (60,8; 88,2)	804,2 (642,0; 963,8)	32,2 (26,2; 38,3)	-56,5 (-66,1; -46,6)
Sergipe	537,6 (470,2; 602,9)	134,1 (116,1; 150,7)	659,3 (555,6; 779,2)	46,5 (39,4; 54,7)	-65,4 (-70,9; -59,3)
Southeast region	24.410,6 (22.513,6; 26.507,7)	125,2 (113,3; 136,6)	27.125,1 (23.170,8; 30.294,0)	39,3 (33,7; 43,7)	-68,6 (-71,8; -65,2)
Espírito Santo	919,9 (828,4; 1.000,7)	139,5 (123,8; 152,9)	1.006,4 (848,5; 1.142,7)	35,7 (30,3; 40,4)	-74,4 (-77,7; -70,7)
Minas Gerais	5.563,8 (5.149,8; 6.027,2)	119,5 (108,7; 130,2)	6.577,2 (5.551,7; 7.420,7)	39,3 (33,3; 44,0)	-67,1 (-70,9; -63,5)
Rio de Janeiro	7.468,3 (6.876,5; 8.124,7)	153,5 (139,7; 168,5)	6.876,0 (6.020,6; 7.623,6)	48,4 (42,8; 53,5)	-68,5 (-71,7; -64,9)
São Paulo	10.458,6 (9.641,5; 11.368,2)	112,7 (101,7; 123,2)	12.665,4 (10.892,5; 14.173,5)	36,0 (31,0; 40,2)	-68,1 (-71,4; -64,5)
South region	8.652,0 (7.949,3; 9.374,3)	135,7 (122,9; 148,1)	9.512,0 (8.151,0; 10.544,6)	40,7 (34,9; 45,1)	-70,0 (-73,0; -66,8)
Paraná	3.072,1 (2.824,5; 3.352,2)	146,3 (133,1; 160,6)	3.531,2 (2.987,3; 3.917,4)	42,6 (36,0; 47,2)	-70,9 (-74,1; -67,3)
Rio Grande do Sul	4.065,9 (3.692,2; 4.452,1)	129,3 (115,9; 142,2)	4.052,9 (3.425,7; 4.552,5)	40,6 (34,9; 45,6)	-68,6 (-72,0; -65,4)
Santa Catarina	1.513,9 (1.370,6; 1.658,7)	133,7 (119,7; 146,7)	1.927,9 (1.629,5; 2.192,6)	38,1 (32,2; 43,4)	-71,5 (-75,1; -67,6)
West-Central region	2.083,7 (1.917,6; 2.255,2)	115,8 (105,0; 126,0)	3.713,4 (3.258,4; 4.137,1)	39,9 (34,8; 44,6)	-65,5 (-68,7; -62,0)
Distrito Federal	295,1 (269,6; 324,8)	102,8 (92,2; 114,7)	553,5 (454,3; 639,6)	32,9 (26,8; 38,0)	-68,0 (-73,1; -63,4)
Goiás	1.017,5 (928,1; 1.118,3)	121,2 (108,8; 134,1)	1.702,0 (1.458,3; 1.944,6)	40,9 (34,9; 46,8)	-66,2 (-70,2; -62,0)
Mato Grosso	316,2 (278,5; 356,4)	106,5 (91,2; 119,3)	723,0 (610,1; 833,7)	41,7 (34,9; 48,5)	-60,8 (-67,0; -55,1)
Mato Grosso do Sul	454,9 (411,3; 503,0)	121,9 (110,0; 135,3)	734,9 (627,4; 837,8)	43,6 (37,2; 49,8)	-64,2 (-69,0; -58,3)
Both					
Brazil	104.636,6 (98.680,0; 111.865,4)	134,0 (124,5; 143,5)	127.163,0 (114.151,0; 135.073,2)	49,4 (44,2; 52,5)	-63,2 (-65,5; -60,9)
North region	4.208,0 (3.945,3; 4.517,1)	129,7 (119,9; 139,0)	8.383,2 (7.642,1; 8.953,7)	57,5 (51,8; 61,9)	-55,7 (-58,7; -52,9)
Acre	162,1 (147,4; 178,6)	114,7 (103,0; 126,8)	329,2 (292,3; 363,4)	50,7 (44,8; 56,3)	-55,9 (-61,6; -50,2)
Amapá	94,1 (86,2; 102,2)	104,5 (94,5; 113,5)	317,8 (277,9; 351,0)	61,4 (53,4; 68,2)	-41,2 (-48,2; -33,6)
Amazonas	751,1 (696,2; 817,6)	120,1 (109,0; 131,1)	1.719,2 (1.540,5; 1.875,1)	60,6 (54,0; 66,7)	-49,5 (-54,9; -44,1)

Pará	2.396,1 (2.221,3; 2.594,1)	135,6 (125,0; 146,9)	4.075,3 (3.626,4; 4.421,4)	57,2 (50,5; 62,3)	-57,8 (-61,7; -54,3)
Rondônia	439,0 (404,4; 475,4)	156,2 (143,1; 170,9)	848,0 (761,3; 940,8)	56,6 (50,4; 62,9)	-63,8 (-67,5; -59,1)
Roraima	55,3 (48,5; 63,4)	122,7 (107,2; 139,3)	211,2 (185,1; 244,8)	57,3 (50,8; 65,6)	-53,3 (-59,9; -45,3)
Tocantins	310,3 (278,0; 346,9)	121,6 (106,9; 134,5)	882,3 (768,8; 981,4)	56,4 (48,9; 62,8)	-53,6 (-59,7; -46,3)
Northeast region	26.180,7 (23.550,1; 28.716,4)	113,5 (101,4; 124,6)	36.090,6 (31.905,3; 39.756,4)	54,0 (48,0; 59,4)	-52,4 (-57,7; -46,4)
Alagoas	1.972,5 (1.794,1; 2.137,4)	161,4 (145,9; 176,0)	2.362,7 (2.106,4; 2.584,2)	70,7 (63,0; 77,6)	-56,2 (-60,8; -50,8)
Bahia	6.617,8 (5.974,6; 7.257,4)	106,0 (94,3; 116,1)	9.914,7 (8.733,4; 10.910,2)	53,9 (47,8; 59,3)	-49,1 (-53,4; -44,2)
Ceará	3.207,2 (2.823,5; 3.553,8)	89,3 (78,2; 98,5)	5.163,7 (4.536,5; 5.775,9)	46,2 (40,8; 51,4)	-48,3 (-54,0; -40,5)
Maranhão	2.376,1 (1.978,9; 2.793,8)	108,7 (90,4; 126,3)	4.961,3 (4.368,9; 5.566,8)	72,6 (63,9; 81,4)	-33,2 (-44,6; -19,1)
Paraíba	2.084,7 (1.860,5; 2.312,8)	99,1 (87,8; 109,9)	2.428,7 (2.125,7; 2.697,5)	46,4 (40,7; 51,5)	-53,2 (-58,8; -46,8)
Pernambuco	6.147,3 (5.617,8; 6.682,3)	150,4 (136,9; 164,2)	5.753,2 (5.187,0; 6.306,2)	52,7 (47,4; 57,7)	-65,0 (-68,5; -60,6)
Piaui	1.422,5 (1.220,6; 1.628,5)	111,2 (95,8; 127,7)	2.502,0 (2.167,7; 2.865,5)	60,2 (52,2; 68,9)	-45,9 (-54,3; -34,1)
Rio Grande do Norte	1.288,5 (1.121,6; 1.452,9)	85,7 (73,8; 97,0)	1.636,7 (1.396,6; 1.861,1)	38,0 (32,6; 43,2)	-55,6 (-62,6; -47,6)
Sergipe	1.064,2 (964,3; 1.165,6)	139,3 (126,1; 152,7)	1.367,6 (1.191,4; 1.510,2)	55,6 (48,3; 61,3)	-60,1 (-64,8; -55,3)
Southeast region	51.492,9 (48.592,4; 54.727,0)	142,9 (133,8; 153,1)	54.941,8 (48.938,0; 59.128,1)	46,4 (41,2; 50,0)	-67,5 (-70,0; -65,2)
Espírito Santo	2.043,3 (1.894,7; 2.191,1)	158,5 (145,3; 170,7)	2.134,1 (1.861,3; 2.339,8)	43,0 (37,3; 47,2)	-72,9 (-75,3; -70,1)
Minas Gerais	12.156,6 (11.479,3; 12.973,3)	137,9 (129,4; 147,4)	13.609,0 (12.034,7; 14.795,1)	46,2 (40,8; 50,1)	-66,5 (-69,2; -63,6)
Rio de Janeiro	14.754,3 (13.887,9; 15.649,9)	172,3 (161,5; 183,8)	13.493,2 (12.155,2; 14.469,4)	56,9 (51,2; 61,0)	-67,0 (-69,6; -64,7)
São Paulo	22.538,6 (21.233,3; 24.021,5)	130,1 (121,6; 139,4)	25.705,6 (22.918,4; 27.635,0)	42,8 (38,0; 46,1)	-67,1 (-69,8; -64,3)
South region	18.066,1 (17.034,5; 19.210,6)	151,4 (141,5; 161,9)	19.750,9 (17.644,0; 21.221,1)	48,9 (43,3; 52,5)	-67,7 (-70,3; -65,1)
Paraná	7.005,8 (6.578,6; 7.491,4)	168,2 (155,5; 180,6)	7.721,4 (6.941,1; 8.331,1)	52,7 (47,1; 56,9)	-68,7 (-71,1; -65,6)
Rio Grande do Sul	7.903,2 (7.440,5; 8.462,9)	140,9 (131,1; 151,7)	8.074,7 (7.225,7; 8.707,9)	47,9 (42,8; 51,8)	-66,0 (-68,7; -63,1)
Santa Catarina	3.157,0 (2.964,5; 3.370,3)	147,4 (135,9; 158,5)	3.954,8 (3.513,5; 4.312,4)	44,7 (39,3; 49,0)	-69,7 (-72,6; -66,6)
West-Central region	4.688,9 (4.409,7; 5.003,3)	127,5 (118,2; 136,9)	7.996,5 (7.238,4; 8.571,0)	46,8 (41,9; 50,3)	-63,3 (-66,1; -60,4)

Distrito Federal	592,8 (554,8; 636,3)	116,5 (108,2; 125,9)	1.110,4 (977,9; 1.222,6)	38,3 (33,3; 42,5)	-67,1 (-71,0; -63,2)
Goiás	2.296,0 (2.145,6; 2.473,4)	132,2 (121,9; 143,0)	3.615,9 (3.244,6; 3.922,3)	47,1 (41,9; 51,4)	-64,3 (-67,6; -60,3)
Mato Grosso	756,2 (687,6; 828,0)	115,9 (104,5; 126,7)	1.640,0 (1.462,1; 1.814,4)	48,8 (43,0; 54,0)	-57,9 (-63,1; -53,0)
Mato Grosso do Sul	1.043,9 (964,7; 1.127,4)	134,4 (123,0; 146,2)	1.630,1 (1.443,0; 1.772,5)	52,5 (46,0; 57,1)	-61,0 (-65,1; -57,0)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 2.3 – DALYs due to stroke: numbers and rates per 100,000 in Brazil and Federative Units, according to sex, in 1990 and 2023

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	1.461.940,8 (1.357.881,5; 1.577.823,3)	3.353,6 (3.117,1; 3.628,1)	1.555.538,1 (1.466.602,4; 1.636.822,1)	1.330,1 (1.257,9; 1.401,1)	-60,3 (-63,4; -57,1)
North region	59.946,7 (54.978,2; 66.401,1)	2.836,5 (2.609,4; 3.106,2)	112.841,2 (105.389,1; 120.610,6)	1.458,4 (1.357,9; 1.556,5)	-48,6 (-53,0; -44,1)
Acre	2.466,5 (2.146,0; 2.877,8)	2.519,5 (2.237,3; 2.881,5)	4.374,3 (3.784,1; 5.001,4)	1.258,3 (1.087,4; 1.432,4)	-50,1 (-58,4; -39,9)
Amapá	1.332,4 (1.165,8; 1.503,5)	2.748,8 (2.438,3; 3.049,6)	4.584,8 (4.067,9; 5.199,1)	1.615,8 (1.433,7; 1.817,7)	-41,2 (-50,5; -30,4)
Amazonas	10.617,3 (9.525,9; 11.857,0)	2.601,1 (2.338,2; 2.914,7)	23.435,7 (20.931,0; 26.102,0)	1.532,3 (1.372,7; 1.688,9)	-41,1 (-48,8; -33,4)
Pará	31.814,5 (28.823,5; 35.441,2)	2.963,5 (2.701,5; 3.258,8)	53.468,1 (48.734,2; 58.544,1)	1.447,1 (1.309,8; 1.584,0)	-51,2 (-56,9; -45,0)
Rondônia	7.769,4 (6.888,0; 8.734,4)	3.372,7 (3.014,6; 3.723,5)	11.709,9 (10.388,8; 13.431,1)	1.421,6 (1.258,8; 1.623,5)	-57,8 (-63,4; -51,5)
Roraima	1.084,6 (901,5; 1.306,2)	2.776,0 (2.357,9; 3.258,7)	3.349,7 (2.799,0; 3.951,2)	1.462,6 (1.238,4; 1.716,5)	-47,3 (-56,8; -33,2)
Tocantins	4.862,0 (4.132,0; 5.723,1)	2.526,5 (2.161,9; 2.938,9)	11.918,8 (10.567,1; 13.839,6)	1.462,8 (1.296,7; 1.694,4)	-42,1 (-52,3; -28,9)
Northeast region	330.301,0 (292.909,7; 379.043,7)	2.703,0 (2.409,3; 3.084,7)	435.041,6 (391.354,6; 483.908,0)	1.455,4 (1.310,3; 1.618,7)	-46,2 (-53,5; -37,4)
Alagoas	25.094,6 (22.137,9; 28.758,4)	3.760,4 (3.335,5; 4.214,1)	30.341,2 (27.068,0; 34.188,6)	1.953,4 (1.741,8; 2.200,7)	-48,1 (-55,2; -38,5)
Bahia	83.384,0 (73.840,2; 94.137,0)	2.524,4 (2.252,2; 2.828,0)	118.027,1 (107.829,9; 129.838,6)	1.440,6 (1.314,7; 1.582,9)	-42,9 (-50,0; -35,0)
Ceará	38.989,5 (33.895,6; 44.414,9)	2.067,7 (1.818,4; 2.358,5)	59.671,0 (52.691,5; 66.640,5)	1.221,5 (1.078,6; 1.362,6)	-40,9 (-49,5; -31,4)
Maranhão	38.845,1 (29.982,2; 48.587,2)	3.032,9 (2.380,0; 3.747,9)	62.148,4 (54.447,9; 71.839,4)	1.883,4 (1.649,8; 2.170,4)	-37,9 (-52,1; -18,1)
Paraíba	22.882,1 (19.688,6; 26.816,0)	2.128,6 (1.840,5; 2.482,0)	28.812,6 (25.609,0; 32.711,1)	1.275,7 (1.132,3; 1.450,7)	-40,1 (-48,9; -28,1)
Pernambuco	74.056,0 (66.102,5; 82.985,5)	3.480,8 (3.129,6; 3.881,7)	69.895,6 (62.056,4; 77.864,6)	1.453,4 (1.297,7; 1.621,7)	-58,2 (-63,8; -52,1)
Piaui	19.238,0 (15.991,2; 23.458,1)	2.738,9 (2.302,5; 3.293,6)	29.724,5 (25.746,1; 34.744,9)	1.579,2 (1.368,2; 1.847,2)	-42,3 (-53,5; -28,5)
Rio Grande do Norte	15.605,7 (13.152,6; 18.163,4)	2.045,3 (1.716,0; 2.363,0)	19.574,0 (16.681,2; 23.277,8)	1.045,1 (893,9; 1.241,0)	-48,9 (-58,0; -36,2)
Sergipe	12.206,0 (10.799,8; 13.887,2)	3.076,7 (2.737,1; 3.455,6)	16.847,1 (14.820,6; 19.450,3)	1.499,7 (1.308,4; 1.726,7)	-51,3 (-58,0; -41,2)
Southeast region	751.688,9 (696.128,9; 805.667,5)	3.748,5 (3.482,4; 4.037,1)	671.305,4 (618.481,6; 727.628,6)	1.285,7 (1.183,3; 1.394,0)	-65,7 (-69,0; -61,9)
Espírito Santo	29.260,8 (26.659,9; 32.170,4)	3.942,6 (3.601,1; 4.327,0)	26.436,4 (23.487,7; 29.333,0)	1.153,5 (1.026,1; 1.277,6)	-70,7 (-74,4; -66,8)
Minas Gerais	184.723,5 (171.955,9; 199.071,7)	3.740,1 (3.483,9; 4.052,6)	166.052,0 (150.735,4; 181.608,7)	1.254,3 (1.136,9; 1.372,9)	-66,5 (-70,0; -62,2)

Rio de Janeiro	202.758,3 (187.691,2; 217.431,1)	4.552,6 (4.218,4; 4.893,8)	162.053,9 (147.466,9; 176.875,4)	1.610,0 (1.464,6; 1.754,7)	-64,6 (-68,3; -60,5)
São Paulo	334.946,2 (306.873,7; 360.821,0)	3.382,9 (3.120,5; 3.664,3)	316.763,2 (290.841,5; 344.357,4)	1.192,7 (1.093,5; 1.294,9)	-64,7 (-68,3; -60,4)
South region	245.578,8 (225.676,3; 263.930,4)	3.638,2 (3.376,4; 3.917,3)	232.588,0 (211.455,0; 251.747,3)	1.259,1 (1.145,8; 1.365,9)	-65,4 (-69,1; -61,0)
Paraná	102.537,5 (94.470,8; 112.106,1)	4.127,8 (3.799,6; 4.484,9)	94.978,4 (86.477,3; 104.158,6)	1.388,4 (1.263,8; 1.520,5)	-66,4 (-70,1; -61,8)
Rio Grande do Sul	100.967,7 (93.123,9; 108.833,0)	3.338,8 (3.088,2; 3.590,4)	90.405,9 (82.089,6; 99.624,3)	1.235,1 (1.124,1; 1.361,0)	-63,0 (-67,1; -58,6)
Santa Catarina	42.073,6 (38.239,5; 46.161,7)	3.417,2 (3.122,4; 3.721,7)	47.203,6 (42.832,1; 52.024,7)	1.099,3 (995,3; 1.210,3)	-67,8 (-71,2; -63,6)
West-Central region	74.425,5 (68.288,5; 82.140,0)	3.096,8 (2.863,3; 3.389,5)	103.761,9 (96.163,9; 111.135,6)	1.213,8 (1.122,7; 1.298,5)	-60,8 (-64,6; -56,9)
Distrito Federal	9.230,9 (8.339,7; 10.236,5)	2.936,1 (2.679,3; 3.233,6)	13.666,4 (12.194,6; 15.284,7)	999,6 (898,5; 1.118,0)	-66,0 (-70,1; -60,6)
Goiás	36.188,6 (32.678,6; 40.237,5)	3.237,6 (2.944,6; 3.590,1)	46.083,5 (41.695,0; 50.733,2)	1.205,5 (1.092,6; 1.327,1)	-62,8 (-67,7; -57,1)
Mato Grosso	12.569,0 (10.921,0; 14.202,3)	2.683,2 (2.359,2; 3.003,1)	22.402,6 (19.480,1; 25.132,3)	1.220,2 (1.075,6; 1.367,1)	-54,5 (-60,3; -47,4)
Mato Grosso do Sul	16.437,0 (14.905,3; 18.207,1)	3.313,8 (3.018,6; 3.681,3)	21.609,5 (19.282,2; 23.920,5)	1.426,4 (1.271,9; 1.573,3)	-57,0 (-63,2; -50,4)
Female					
Brazil	1.249.504,7 (1.164.664,9; 1.340.844,0)	2.566,4 (2.372,2; 2.760,1)	1.346.820,2 (1.230.444,0; 1.439.596,1)	941,6 (864,6; 1.005,4)	-63,3 (-65,5; -60,8)
North region	51.274,7 (47.031,3; 55.144,8)	2.456,7 (2.259,8; 2.637,9)	89.236,6 (81.434,3; 96.150,6)	1.075,4 (975,7; 1.162,6)	-56,2 (-59,8; -52,8)
Acre	2.052,4 (1.790,9; 2.323,7)	2.372,2 (2.109,1; 2.684,2)	3.970,1 (3.463,3; 4.531,9)	1.063,5 (930,3; 1.210,2)	-55,2 (-62,1; -47,8)
Amapá	1.133,2 (998,8; 1.278,0)	1.821,8 (1.624,3; 2.022,4)	3.509,3 (3.016,4; 3.963,2)	1.143,0 (973,4; 1.291,6)	-37,3 (-47,1; -26,3)
Amazonas	9.319,6 (8.421,9; 10.260,0)	2.289,3 (2.055,5; 2.511,4)	18.419,4 (16.465,6; 20.785,3)	1.091,7 (972,7; 1.241,1)	-52,3 (-57,8; -45,3)
Pará	28.704,9 (26.295,7; 31.433,8)	2.564,7 (2.326,6; 2.792,5)	43.300,3 (38.336,0; 48.017,2)	1.076,5 (949,1; 1.195,8)	-58,0 (-62,8; -53,4)
Rondônia	5.339,9 (4.793,1; 5.933,5)	2.945,2 (2.621,5; 3.238,9)	8.465,2 (7.353,1; 9.624,1)	1.014,7 (881,2; 1.156,7)	-65,5 (-70,5; -61,0)
Roraima	708,3 (608,8; 817,0)	2.329,4 (1.997,2; 2.714,1)	2.521,8 (2.104,8; 3.050,6)	1.071,1 (901,3; 1.294,0)	-54,0 (-63,0; -43,7)
Tocantins	4.016,5 (3.449,9; 4.730,2)	2.099,8 (1.804,0; 2.436,1)	9.050,6 (7.811,5; 10.322,7)	1.097,7 (946,6; 1.250,9)	-47,7 (-58,7; -37,3)
Northeast region	307.698,3 (272.896,7; 345.382,9)	2.238,7 (2.000,0; 2.508,7)	385.890,8 (337.843,5; 442.021,2)	1.053,7 (924,4; 1.204,8)	-52,9 (-60,1; -45,3)
Alagoas	24.114,6 (21.072,9; 27.416,9)	3.270,7 (2.875,5; 3.674,0)	26.174,2 (22.833,6; 30.071,3)	1.356,7 (1.185,3; 1.562,7)	-58,5 (-64,7; -51,5)
Bahia	82.252,4 (73.137,8; 91.325,5)	2.198,4 (1.966,9; 2.441,1)	106.380,6 (92.536,9; 119.962,2)	1.081,3 (947,2; 1.218,4)	-50,8 (-57,3; -43,5)
Ceará	38.475,5 (33.557,6; 44.121,3)	1.780,8 (1.555,5; 2.029,9)	54.026,1 (47.044,1; 62.100,5)	893,8 (779,1; 1.028,6)	-49,8 (-58,3; -40,0)

Maranhão	22.799,2 (18.583,4; 27.942,3)	1.695,8 (1.385,6; 2.047,8)	51.468,5 (44.117,8; 59.880,3)	1.372,0 (1.175,4; 1.596,8)	-19,1 (-37,8; 4,0)
Paraíba	25.690,9 (22.017,1; 30.157,3)	2.129,8 (1.833,0; 2.470,4)	26.443,8 (22.831,9; 30.596,0)	931,2 (809,3; 1.072,8)	-56,3 (-64,2; -46,8)
Pernambuco	72.982,1 (64.908,0; 81.604,8)	2.942,2 (2.612,7; 3.277,5)	64.161,9 (56.618,2; 72.449,7)	1.026,8 (905,0; 1.158,8)	-65,1 (-69,7; -60,2)
Piaui	15.571,4 (13.103,0; 18.672,7)	2.044,0 (1.734,7; 2.443,9)	24.583,1 (20.894,7; 29.042,4)	1.111,1 (948,9; 1.311,0)	-45,6 (-56,7; -33,3)
Rio Grande do Norte	13.793,9 (11.615,6; 16.030,5)	1.604,7 (1.353,2; 1.870,0)	17.408,9 (14.708,2; 20.255,6)	745,1 (630,9; 870,0)	-53,6 (-62,6; -44,1)
Sergipe	12.018,4 (10.692,1; 13.353,8)	2.693,1 (2.401,7; 3.002,4)	15.243,8 (13.442,8; 17.411,9)	1.075,5 (950,7; 1.231,2)	-60,1 (-65,9; -53,4)
Southeast region	619.921,6 (575.498,6; 667.175,8)	2.703,8 (2.516,8; 2.920,0)	587.234,9 (535.474,3; 641.741,6)	896,5 (821,7; 982,9)	-66,8 (-69,4; -63,6)
Espírito Santo	23.105,7 (21.226,1; 25.075,0)	2.937,0 (2.679,1; 3.175,0)	22.332,2 (19.803,3; 24.797,8)	817,4 (727,4; 903,4)	-72,2 (-75,1; -68,8)
Minas Gerais	146.014,6 (135.265,6; 158.154,8)	2.670,4 (2.468,8; 2.888,0)	140.637,7 (126.435,6; 155.580,3)	893,1 (806,1; 983,8)	-66,6 (-69,6; -63,1)
Rio de Janeiro	187.946,0 (174.207,2; 202.944,6)	3.398,4 (3.147,5; 3.680,9)	149.713,4 (136.766,0; 164.762,6)	1.129,1 (1.036,1; 1.240,4)	-66,8 (-69,6; -63,0)
São Paulo	262.855,4 (244.572,1; 283.335,1)	2.365,5 (2.186,6; 2.563,8)	274.551,7 (247.759,8; 301.960,9)	815,1 (738,0; 894,4)	-65,5 (-68,6; -62,2)
South region	210.774,1 (196.220,9; 227.866,9)	2.796,6 (2.580,6; 3.018,4)	197.864,0 (178.109,2; 216.560,2)	871,1 (785,5; 955,1)	-68,9 (-71,5; -66,0)
Paraná	78.833,9 (72.859,6; 85.463,3)	3.084,1 (2.839,1; 3.348,7)	74.946,7 (66.093,8; 82.264,4)	909,7 (805,0; 995,5)	-70,5 (-73,6; -67,4)
Rio Grande do Sul	95.234,1 (87.774,9; 103.525,7)	2.638,2 (2.420,7; 2.858,6)	82.245,4 (74.279,5; 90.158,5)	886,5 (808,3; 974,7)	-66,4 (-69,2; -63,2)
Santa Catarina	36.706,1 (33.623,9; 40.106,3)	2.691,2 (2.454,0; 2.923,4)	40.672,0 (36.050,3; 44.983,0)	788,7 (702,0; 870,7)	-70,7 (-73,5; -67,1)
West-Central region	59.835,9 (55.318,7; 64.883,4)	2.546,0 (2.338,2; 2.750,7)	86.593,8 (79.161,8; 94.368,8)	886,4 (807,1; 967,7)	-65,2 (-68,1; -62,0)
Distrito Federal	9.019,9 (8.228,1; 9.931,3)	2.292,3 (2.081,0; 2.523,8)	12.743,0 (11.263,6; 14.528,2)	712,1 (625,4; 810,3)	-68,9 (-73,0; -64,7)
Goiás	28.684,8 (26.160,2; 31.198,3)	2.653,8 (2.404,5; 2.905,8)	39.192,0 (35.240,4; 43.407,9)	902,5 (809,2; 1.000,3)	-66,0 (-69,6; -61,6)
Mato Grosso	9.374,7 (8.252,4; 10.773,2)	2.325,6 (2.047,6; 2.613,0)	17.580,6 (15.345,3; 20.028,7)	924,1 (800,9; 1.057,9)	-60,3 (-66,6; -54,0)
Mato Grosso do Sul	12.756,5 (11.572,1; 14.098,0)	2.702,7 (2.453,9; 2.976,4)	17.078,2 (15.238,1; 19.243,8)	993,5 (887,3; 1.118,8)	-63,2 (-68,1; -57,5)
Both					
Brazil	2.711.445,5 (2.569.358,8; 2.875.991,6)	2.937,5 (2.782,7; 3.124,9)	2.902.358,3 (2.706.929,9; 3.034.899,3)	1.116,8 (1.040,8; 1.168,2)	-62,0 (-64,1; -60,0)
North region	111.221,4 (104.326,2; 119.651,9)	2.652,6 (2.495,9; 2.827,6)	202.077,8 (189.389,8; 212.870,1)	1.261,2 (1.174,2; 1.335,7)	-52,5 (-55,4; -49,8)
Acre	4.518,9 (4.061,1; 5.008,8)	2.453,2 (2.221,8; 2.698,2)	8.344,3 (7.521,2; 9.159,3)	1.157,5 (1.045,7; 1.265,2)	-52,8 (-58,9; -47,2)
Amapá	2.465,6 (2.249,1; 2.702,6)	2.208,2 (2.027,6; 2.387,8)	8.094,0 (7.348,7; 8.925,2)	1.371,6 (1.241,5; 1.507,4)	-37,9 (-45,6; -30,0)

Amazonas	19.936,9 (18.455,0; 21.733,8)	2.451,4 (2.278,1; 2.666,9)	41.855,1 (38.471,6; 45.165,5)	1.302,1 (1.187,4; 1.404,0)	-46,9 (-51,9; -42,1)
Pará	60.519,4 (56.437,9; 65.154,1)	2.766,3 (2.569,5; 2.967,6)	96.768,4 (89.567,0; 103.494,5)	1.254,8 (1.157,2; 1.340,5)	-54,6 (-58,6; -50,8)
Rondônia	13.109,3 (12.065,3; 14.355,9)	3.197,9 (2.951,1; 3.462,1)	20.175,0 (18.296,8; 22.188,0)	1.216,4 (1.101,5; 1.337,0)	-62,0 (-65,6; -57,5)
Roraima	1.792,9 (1.585,2; 2.064,0)	2.566,5 (2.260,7; 2.921,0)	5.871,5 (5.190,8; 6.765,9)	1.264,4 (1.123,6; 1.460,4)	-50,7 (-57,6; -40,6)
Tocantins	8.878,5 (7.896,1; 9.967,5)	2.300,2 (2.065,4; 2.553,2)	20.969,4 (18.952,1; 22.964,4)	1.280,1 (1.147,3; 1.405,1)	-44,3 (-51,3; -36,2)
Northeast region	637.999,3 (583.112,1; 698.720,2)	2.458,0 (2.255,6; 2.684,1)	820.932,4 (751.083,6; 885.367,8)	1.235,0 (1.129,7; 1.331,6)	-49,8 (-55,4; -43,5)
Alagoas	49.209,1 (44.683,9; 54.161,0)	3.504,6 (3.214,5; 3.821,4)	56.515,3 (51.999,6; 61.228,0)	1.622,1 (1.491,5; 1.758,1)	-53,7 (-58,4; -48,1)
Bahia	165.636,3 (151.643,7; 180.337,8)	2.351,2 (2.146,5; 2.553,8)	224.407,7 (205.860,1; 242.183,6)	1.245,9 (1.142,5; 1.344,3)	-47,0 (-51,5; -41,3)
Ceará	77.465,0 (69.657,5; 86.543,0)	1.915,4 (1.714,9; 2.127,8)	113.697,1 (103.511,9; 124.634,5)	1.040,9 (948,0; 1.140,6)	-45,7 (-52,0; -37,3)
Maranhão	61.644,4 (50.902,0; 72.932,7)	2.350,2 (1.965,9; 2.763,9)	113.617,0 (100.669,3; 126.987,2)	1.609,7 (1.427,1; 1.797,7)	-31,5 (-43,1; -17,1)
Paraíba	48.573,0 (43.216,6; 53.850,2)	2.128,7 (1.908,4; 2.355,8)	55.256,4 (49.545,6; 60.662,1)	1.084,8 (974,4; 1.191,2)	-49,0 (-55,2; -42,0)
Pernambuco	147.038,1 (135.488,8; 159.572,3)	3.191,3 (2.942,6; 3.460,9)	134.057,5 (122.955,4; 145.192,3)	1.211,7 (1.110,5; 1.311,8)	-62,0 (-66,1; -57,5)
Piaui	34.809,4 (29.744,7; 39.949,3)	2.379,5 (2.035,1; 2.729,8)	54.307,6 (48.357,2; 60.892,4)	1.327,9 (1.181,3; 1.486,7)	-44,2 (-52,5; -33,0)
Rio Grande do Norte	29.399,6 (25.810,7; 33.111,8)	1.812,1 (1.586,8; 2.034,4)	36.982,9 (32.377,5; 41.425,3)	879,6 (772,0; 985,9)	-51,5 (-58,7; -43,3)
Sergipe	24.224,4 (22.111,1; 26.506,0)	2.869,5 (2.630,2; 3.140,0)	32.091,0 (28.927,9; 34.944,7)	1.261,8 (1.139,0; 1.377,7)	-56,0 (-60,4; -50,3)
Southeast region	1.371.610,5 (1.297.979,3; 1.449.166,6)	3.186,1 (3.020,8; 3.368,3)	1.258.540,3 (1.168.247,0; 1.330.383,1)	1.070,2 (994,3; 1.131,2)	-66,4 (-68,6; -63,9)
Espírito Santo	52.366,5 (49.272,6; 55.733,8)	3.425,1 (3.218,9; 3.648,4)	48.768,6 (44.058,3; 52.489,8)	969,9 (874,9; 1.042,9)	-71,7 (-74,2; -69,2)
Minas Gerais	330.738,1 (312.721,4; 348.810,2)	3.175,2 (2.999,4; 3.355,8)	306.689,7 (281.645,4; 326.853,7)	1.060,9 (976,2; 1.129,6)	-66,6 (-69,1; -63,7)
Rio de Janeiro	390.704,3 (367.759,7; 413.085,8)	3.910,4 (3.687,3; 4.134,0)	311.767,2 (289.329,0; 330.708,5)	1.337,4 (1.242,1; 1.416,5)	-65,8 (-68,4; -63,3)
São Paulo	597.801,6 (564.975,0; 634.230,6)	2.836,0 (2.677,7; 3.008,8)	591.314,9 (545.885,5; 629.212,4)	981,9 (904,5; 1.043,7)	-65,4 (-67,8; -62,5)
South region	456.352,9 (431.396,4; 482.239,0)	3.192,7 (3.021,5; 3.378,5)	430.452,0 (397.516,3; 458.389,3)	1.045,3 (966,4; 1.113,5)	-67,3 (-69,5; -64,8)
Paraná	181.371,3 (170.635,0; 193.518,5)	3.597,4 (3.373,4; 3.828,1)	169.925,1 (154.900,4; 181.189,9)	1.126,2 (1.027,9; 1.196,9)	-68,7 (-71,3; -66,1)
Rio Grande do Sul	196.201,8 (185.139,9; 208.055,0)	2.959,3 (2.793,2; 3.153,2)	172.651,3 (159.683,0; 186.061,5)	1.041,3 (961,4; 1.123,5)	-64,8 (-67,2; -62,1)
Santa Catarina	78.779,8 (74.326,0; 83.687,2)	3.035,1 (2.860,1; 3.227,8)	87.875,6 (80.252,1; 94.122,3)	929,5 (848,2; 996,5)	-69,4 (-71,7; -66,6)
West-Central region	134.261,4 (126.031,5; 142.138,9)	2.828,6 (2.650,4; 3.016,8)	190.355,7 (177.247,8; 201.974,4)	1.038,6 (964,2; 1.103,4)	-63,3 (-65,8; -60,6)

Distrito Federal	18.250,8 (17.085,9; 19.634,8)	2.564,2 (2.395,8; 2.735,3)	26.409,4 (24.055,2; 28.757,5)	835,3 (757,6; 909,7)	-67,4 (-70,5; -63,9)
Goiás	64.873,4 (60.314,8; 70.219,7)	2.952,4 (2.761,3; 3.183,8)	85.275,4 (78.594,3; 91.824,5)	1.044,4 (962,6; 1.126,5)	-64,6 (-67,6; -61,2)
Mato Grosso	21.943,7 (19.816,3; 24.137,5)	2.523,2 (2.287,2; 2.739,5)	39.983,2 (36.395,4; 44.025,2)	1.069,4 (968,2; 1.179,0)	-57,6 (-62,4; -52,8)
Mato Grosso do Sul	29.193,5 (27.313,8; 31.572,1)	3.020,7 (2.818,6; 3.267,5)	38.687,7 (35.342,4; 41.641,1)	1.195,4 (1.089,6; 1.289,1)	-60,4 (-64,1; -56,5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

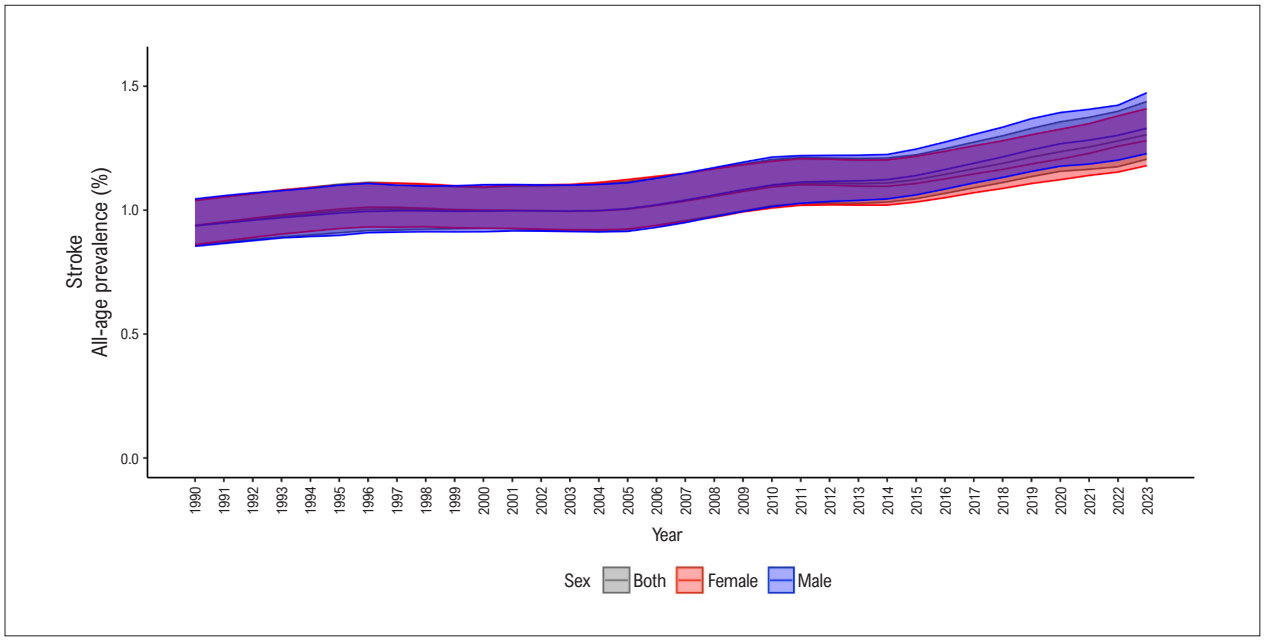

Figure 2.1 – *Sex-standardized prevalence rates of stroke per 100,000 inhabitants in Brazil, from 1990 to 2023. Source: Data derived from the Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

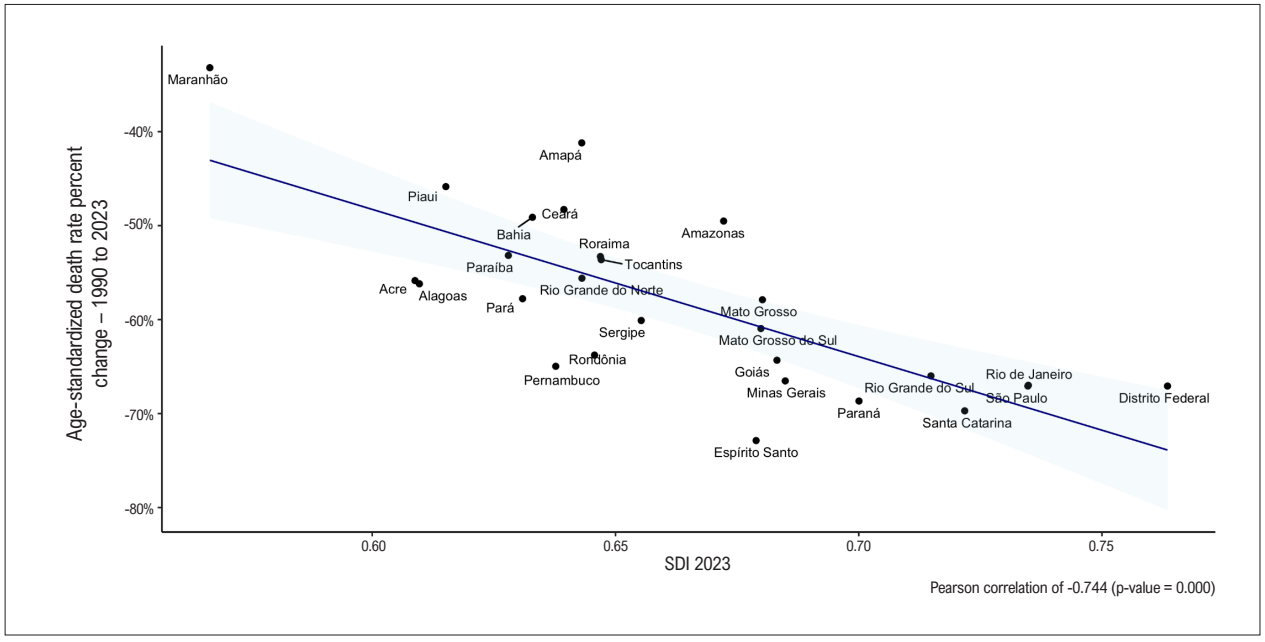

Figure 2.2 – *Correlation between the 2023 sociodemographic index (SDI) and the percentage change in age-standardized stroke mortality rates per 100,000 inhabitants across Brazilian federative units, from 1990 to 2023. Source: Data derived from the Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

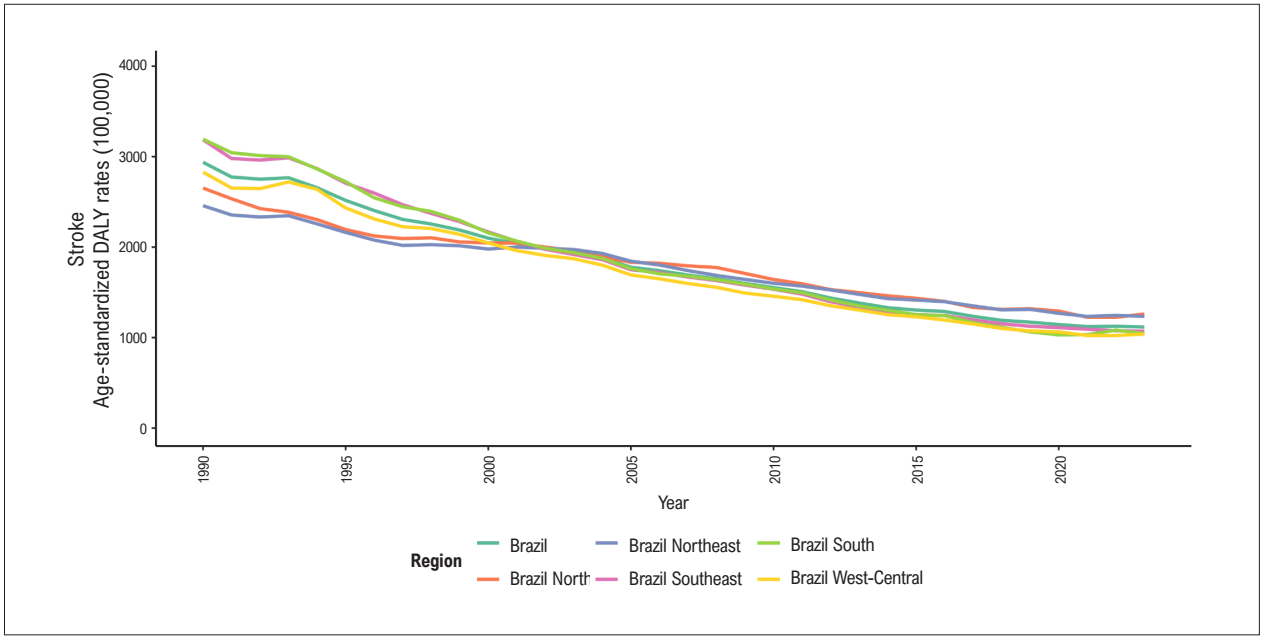

Figure 2.3 – *Age-standardized DALY rates due to stroke per 100,000 inhabitants in Brazil and its geographic regions, from 1990 to 2023. Source: Data derived from the Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 3 – ACUTE AND CHRONIC CORONARY HEART DISEASE

ICD-9-CM 410 to 414; ICD-10 I10 to I25.

See Tables 3.1 through 3.3 and Charts 3.1 through 3.4.

Abbreviations used in chapter 3

ACCEPT registry	Brazilian Registry of Clinical Practice in Acute Coronary Syndromes
ACS	Acute Coronary Syndrome
AMI	Acute Myocardial Infarction
B-CaRe:QCO registry	Brasilia Cardiovascular Registry for Quality of Care and Outcomes
BRACE	Brazilian Registry in Acute Coronary Syndromes
BYPASS registry	Brazilian Registry of Adult Patients Undergoing Cardiovascular Surgery
CABG	Coronary Artery Bypass Grafting
CAC	Coronary Artery Calcification
CHD	Coronary Heart Disease
CI	Confidence Interval
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Years
ECG	Electrocardiogram
ELSA-Brasil	Brazilian Longitudinal Study of Adult Health (in Portuguese, *Estudo Longitudinal de Saúde do Adulto*)
ERICO	Strategy of Registry of Acute Coronary Syndrome
GBD	Global Burden of Disease
ICP-BR registry	Brazilian Integrated Percutaneous Coronary Intervention Data System (in Portuguese, *Sistema Integrado de Dados de Intervenção Coronária Percutânea*)
IHD	Ischemic Heart Disease
INSTEMI Registry	Brazilian multicenter registry of STEMI patients undergoing primary PCI
IQR	Interquartile Range
LATAM CTO PCI registry	Chronic Total Occlusion-Percutaneous Coronary Intervention registry from Latin America
MACE	Major Adverse Cardiovascular Events
MASS	Medicine, Angioplasty or Surgery Study
NEAT registry	Network to Control Atherothrombosis
NSTEMI	Non-ST-Elevation Myocardial Infarction
PCI	Percutaneous Coronary Intervention
PNS	National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
RBCI-COVID19	Brazilian Registry of Interventional Cardiology during the COVID-19 Pandemic (in Portuguese, *Registro Brasileiro de Cardiologia Intervencionista durante a Pandemia de COVID-19*)
REPLICCAR-I registry	São Paulo's Cardiovascular Surgery Registry I (in Portuguese, *Registro Paulista de Cirurgia Cardiovascular I*)
REPLICCAR-II registry	São Paulo's Cardiovascular Surgery Registry II (in Portuguese: *Registro Paulista de Cirurgia Cardiovascular II*)
RiR	Risk Ratios
SD	Standard Deviation
SIH	Brazilian Hospital Information System (in Portuguese, *Sistema de Informações Hospitalares*)
STEMI	ST-Elevation Myocardial Infarction
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
UI	Uncertainty Interval

Overview

- Coronary heart disease (CHD), also known as ischemic heart disease (IHD), comprises a spectrum of symptomatic and asymptomatic clinical conditions typically related to a reduction in blood flow to the heart muscle. The most common cause is atherosclerotic disease in the coronary arteries, a chronic condition with variable presentations, progressing from a long asymptomatic phase to stable angina, unstable angina, and acute myocardial infarction (AMI). Ischemic heart disease is a common cause of heart failure, with reduced or preserved left ventricular ejection fraction, ventricular arrhythmias, and sudden cardiac arrest.
- Coronary heart disease was the leading cause of death in Brazil in the last decades for men and women. Because of the wide range of CHD clinical presentations, its reported prevalence, incidence, and mortality vary widely, depending on the population and healthcare setting studied.

Prevalence

- According to estimates from the GBD study 2023, the number of individuals living with IHD, defined as those with previous AMI, at least moderate (> 50%) stenosis of an epicardial coronary artery, or ischemic cardiomyopathy, increased from 3,116,452 (95% UI, 2,715,763-3,603,367) in 1990 to 3,781,434 (95% UI, 3,289,832-4,406,085) in 2023 in Brazil (Table 3.1). The IHD prevalence decreased from 2.1% (95% UI, 1.9%-2.5%) to 1.8% (95% UI, 1.6%-2.1%) in the period (percent change: -14.3% [95% UI, -22.0% to -4.9%], Chart 3.1). These rates increased sharply with age: 0.6% (95% UI, 0.5%-0.7%), 4.3% (95%

UI, 3.5%-5.2%), and 8.6% (95% UI, 6.9%-10.2%) among individuals aged 15-49 years, 50-69 years, and 70 years or older, respectively, in 2023. In all age strata, IHD was more frequent in males than in females.[33]

- According to the GBD study 2023 estimates, the age-standardized IHD prevalence was 1428 (95% UI, 1246-1659) per 100 000 inhabitants in the total population, 1170 (95% UI, 1021-1351) per 100 000 females, and 1737 (95% UI, 1508-2023) per 100 000 males in 2023 (Table 3.1). The GBD STUDY 2023 estimated that the age-standardized IHD prevalence rate declined 53% (95% UI, 49%-56%) from 1990 to 2023 in the country (Table 3.1).[33]
- According to the GBD study 2023 estimates, the highest age-standardized IHD prevalence rates in 2023 were observed in the Southern region, while the lowest rates were observed in the Northern region (Table 3.1).[33]
- The self-reported prevalence of CHD was 2.7% in the baseline assessment of the ELSA-Brasil cohort (2008-2010).[74]
- According to the 2019 National Health Survey (PNS), an epidemiological nationwide home-based survey, overall prevalence rates of mild and moderate/severe angina among adults (using the short version of the WHO-Rose Angina Questionnaire) were 8.1% (95% CI, 7.8%-8.4%) and 4.5% (95% CI, 4.2%-4.7%), respectively.[75]
- Self-reported angina pectoris is more prevalent in females than in males.[1] Moreover, it is essential to note that self-reported assessments of angina are very sensitive, but not specific to CHD, because they require neither confirmatory exams nor health reports. Consequently, higher prevalence rates of self-reported angina are observed in surveys as compared to CHD prevalence rates of national statistics.
- Coronary artery calcification (CAC) has been evaluated in 3616 individuals with neither cardiovascular disease (CVD) nor diabetes mellitus from the ELSA-Brasil. Some CAC was observed in 17% of the women, 36% of the men, and in 7% of individuals aged 35-44 years, 18% of those aged 45-54 years, 45% of those aged 55-64 years, and 66% of those aged 65-74 years.[76]
- In registries and a cluster-randomized study involving patients with acute coronary syndrome (ACS) recruited from 2007 to 2014, the percentages of individuals with unstable angina, non-ST elevation myocardial infarction (NSTEMI), and ST elevation myocardial infarction (STEMI) were 15-30%, 31-36%, and 36-54%, respectively.[2,3]

Incidence

- The GBD study 2023 estimated, for 2023, an incidence of 327,085 (95% UI, 282,414-383,483) IHD events in Brazil and an age-standardized incidence rate of 124 (95% UI, 108-145) per 100 000 inhabitants in the whole population, 103 (95% UI, 91-118) per 100 000 females, and 150 (95% UI, 127-178) per 100 000 males. The GBD study 2023 estimated that the age-standardized IHD incidence rate declined 49% (95% UI, 46%-51%) from 1990 to 2023 in the country. The incidence rate was strongly associated with aging: 35 (95% UI, 25-46), 328 (95% UI, 268-417), and 957 (95% UI, 793-1169) per 100 000 individuals aged 15-49 years, 50-69 years, and 70 years or older, respectively. In all age groups, IHD was more incident in males than in females.[33]

Mortality

- According to the GBD study 2023 estimates, there were 158,100 (95% UI, 144,478-166,890) deaths due to IHD in Brazil in 2023 (Table 3-2), corresponding to 10.8% (95% UI, 9.8%-11.4%) of total deaths and 41.6% of all CVD deaths in the country. IHD ranked as the number one cause of death in males and females. In addition, IHD was the main cause of death in all but four Federative Units (Amapá, Amazonas, Bahia, and Sergipe).[33]
- According to the GBD study 2023 estimates, the IHD mortality rate in 2023 increased with aging: 12 (95% UI, 11-13), 131 (95% UI, 125-137), and 579 (95% UI, 504-628) per 100 000 individuals aged 15-49 years, 50-69 years, and 70 years or older, respectively. In all age groups, mortality rates were higher in males than in females.[33]
- The GBD study 2023 estimated that the age-standardized IHD mortality rate was 61 (95% UI, 55-64) per 100 000 inhabitants in the total population, 44 (95% UI, 38-48) per 100 000 females, and 81 (95% UI, 76-86) per 100 000 males in Brazil in 2023 (Table 3-2). The GBD study 2023 estimated that the age-standardized IHD mortality rate declined 54% (95% UI, 52%-57%) from 1990 to 2023 (Table 3.2, Chart 3.2).[33]
- According to the GBD study 2023 estimates, the age-standardized IHD mortality rate in 2023 was numerically smaller in the South than in other regions. The lowest age-standardized IHD mortality rates were observed in the Distrito Federal and Minas Gerais, while the highest rates were in the states of Maranhão, Mato Grosso do Sul, and Alagoas (Table 3.2). From 1990 to 2023, there was a progressive reduction in regional differences of age-standardized IHD mortality (Chart 3.3).[33]
- Bichara *et al*. have conducted a time-series ecological study analyzing the association between CHD mortality and economic development indicators in Brazil from 2000 to 2019. Standardized CHD mortality (direct method based on the Brazilian population in 2000) decreased from 46.1 to 36.4 per 100 000 inhabitants. In 2000, the Federative Units with the highest CHD mortality rates were in the South, Southeast, and West-Central regions. The greatest reductions in CHD mortality rates in the period were observed in regions with better socioeconomic conditions.[25]
- Dutra *et al*. have examined 59,093 CHD deaths in individuals aged 30–70 years across 1191 municipalities in Southern Brazil from 2018 to 2022. Mortality rates ranged from 17.1 to 119.9 (mean 51.8±16.8) per 100 000. The highest mortality rates were detected in the Northwest and North regions of Paraná, as well as in the East-Central, Southwest, and Southeast areas of Rio Grande do Sul. Using machine learning techniques with geospatial analysis to predict CHD mortality, the authors have reported higher mortality rates in sociodemographically disadvantaged

areas with reduced availability of cardiologists, diagnostic tests, and access to hemodynamic services.[77]

- Puzzi *et al*. have assessed 14,603 CHD deaths in women aged 50–79 years in Paraná from 2010 to 2019. Mortality rates declined from 132.6 to 87.4 per 100 000. Improved access to exercise stress testing and cardiology centers, along with socioeconomic factors, contributed to reductions in mortality. Central-West, Central-South, Central-East, and Southern areas of the Central-North parts of the state had higher-than-expected rates.[78]
- Sandri *et al*. have analyzed temporal trends in CVD mortality in nine cities of Rio Grande do Sul from 2009 to 2019. Of 74,910 CVD deaths, 31.1% were due to CHD. In most instances, stable mortality rates for IHD were observed.[43]
- Victor *et al*. have analyzed the association between CHD mortality and ultra-processed food consumption among individuals aged 30-69 years across 5,558 Brazilian municipalities in 2016. In adjusted analyses, the authors found a significant association between a higher availability of ultra-processed foods and increased CHD mortality.[79]
- Bastos *et al*., using the method of multiple causes applied to national data from 2006 to 2020, have identified AMI, hypertension, chronic CHD, heart failure, and diabetes as the most frequent associated causes when CHD was the underlying cause of death.[80]

Burden of Disease

- The GBD study 2023 estimated an age-standardized rate of 1410 (95% UI, 1324-1468) DALYs (disability-adjusted life years) per 100 000 individuals due to IHD in Brazil in 2023 (Table 3-3). This DALY rate was equivalent to 5.4% (95% UI, 4.8%-6.0%) of all DALYs, making IHD the leading cause of DALYs in both sexes (second most common among males and fourth among females).[33]
- According to the GBD study 2023 estimates, the age-standardized DALY rate due to IHD declined by 52% (95% UI, 49%-54%) from 1990 to 2023 in the country (Table 3.3, Chart 3.4).[33]
- According to the GBD study 2023 estimates, the age-standardized DALY rate due to IHD in 2023 was lowest in the Distrito Federal and Minas Gerais, and highest in the states of Maranhão, Mato Grosso do Sul, and Alagoas (Table 3.3).[33]

Outcomes in Acute Coronary Syndrome

- Several studies, including registries, have reported short- and long-term outcomes of individuals admitted with ACS in Brazil. These studies are heterogeneous regarding study populations, clinical presentations, settings, locations, and recruitment years, which may explain differences in reported outcomes. In general, mortality rates in registries are lower than those reported in the Hospital Information System of the Brazilian Unified Health System (SIH/SUS). Several studies have highlighted regional differences in treatment practices and mortality, as well as poorer outcomes in low-income patients and those treated in public services as compared to individuals admitted to private hospitals.[1-3]
- Studies involving patients with ACS from 2003 to 2020 reported in-hospital mortality from 2.9% to 10.9%. These studies are described in detail in the previous versions of the Cardiovascular Statistics – Brazil.[1-3]
- Regarding longer-term outcomes after ACS, major adverse cardiovascular events (MACE) occurred in 13.6% of participants in the ACCEPT Registry (a multicenter study involving public and private centers across the five Brazilian regions) at 1-year follow-up.[81] Mortality was 13.2% after a median follow-up time of 1.7 year in the Brasilia Heart Study,[82] and 17.5% after a median follow-up time of 4 years in the ERICO study.[83] Death rates were 15.06 and 5.97 per 1000 patients-years among those aged > 55 years and ≤ 55 years, respectively, after a median follow-up of 6.67 years in the B-CaRe:QCO Registry.[84] These studies are described in more detail in the 2023 version of the Cardiovascular Statistics – Brazil.[3]
- Ritt *et al*. have reported a follow-up of 1553 STEMI patients admitted within 12 hours of symptom onset in the ACCEPT Registry from 2010 to 2014. The 1-year occurrence of MACE (death, reinfarction, or stroke) was 12.5%. The lowest percentage was observed in the Northeast region (5.2%), while the highest numbers were observed in the North (17.5%) and West-Central (25%) regions.[85]
- Moraes *et al*. have assessed 2710 STEMI patients treated with a pharmacoinvasive strategy in the city of São Paulo from 2010 to 2020. Of these, 74.7% underwent percutaneous coronary intervention (PCI), 21.9% received medical therapy, and 3.4% underwent coronary artery bypass grafting (CABG). The following rates were found: 5.6% for in-hospital mortality, 42.9% for acute heart failure, and 8.9% for cardiogenic shock.[86]
- Gioppatto *et al*. have evaluated mortality rates associated with delaying reperfusion therapy among 2622 STEMI patients admitted to public hospitals in Brasília, Distrito Federal, from 2011 to 2019. Most of the participants received the pharmacoinvasive strategy. In-hospital mortality increased from 4.4% (thrombolysis within 3 hours) to 10.5% (thrombolysis after 9 hours), with a 6.2% increased mortality risk per hour of reperfusion delay.[87]
- Stephanus *et al*. have reported that, of 1043 patients admitted with STEMI in Brasília, Distrito Federal, from 2009 to 2019, a 4-hour delay in lysis-to-PCI time was associated with a 27.9% reduction in in-hospital mortality and a 7.1% reduction in MACE in a propensity score matching analysis.[88]
- Nascimento *et al*. have reported outcomes of 5.580 ACS patients treated in a public cardiology hospital in the city of São Paulo from 2018 to 2022. The authors have found rates of 1.9% for in-hospital mortality (0.6% for unstable angina, 2.9% for NSTEMI, and 5.7% for STEMI), 5.6% for stroke, and 2.5% for 30-day post-discharge mortality (1.1% for unstable angina, 4.0% for NSTEMI, and 5.5% for STEMI).[89]
- In the INSTEMI Registry, of 1417 STEMI patients undergoing primary PCI with second- and third-generation drug-eluting stents in two tertiary hospitals in the city of Porto Alegre

from 2017 to 2021, in-hospital mortality was 7.5% and stent thrombosis occurred in 0.7%. After a 17-month follow-up period, mortality occurred in 9.4% of the cases and combined major cardiovascular outcomes (new myocardial infarction, stent thrombosis, target vessel revascularization, stroke, or death) in 17.1%.[90]

- The occurrence of cardiogenic shock and cardiac arrest has been reported in 15.9% and 12.2% of patients with STEMI, respectively, in a cohort of 1603 STEMI patients, followed for a median of 3.6 years. Both events were significantly associated with early and late mortality.[91]
- Milan *et al*. have investigated sex differences among 468 female and 894 male STEMI patients undergoing primary PCI in a tertiary university hospital in Southern Brazil from 2011 to 2021. The authors did not observe significant differences in in-hospital mortality (12.8% in females, 10.5% in males) or composite long-term outcomes (31.7% in females, 26.7% in males at 41 months).[92]
- An observational study conducted with 1146 women with ACS submitted to PCI at a tertiary public cardiovascular center, from January 2019 to December 2020, has revealed that all-cause death occurred in 5.3%, cardiac death in 3.5%, recurrent ACS in 8%, and additional revascularization procedures in 5.5% after a 1.5-year follow-up.[93]

Outcomes in Chronic Coronary Syndrome

- Outcomes in chronic coronary syndrome in Brazil can be retrieved from the MASS database. Among patients with stable multivessel CHD and preserved left ventricular function who underwent CABG, PCI, or medical treatment between 2002 and 2015, the 5-year all-cause mortality was 7.5%, 7.5%, and 12.3% among those with low, intermediate, and high SYNTAX score, respectively.[94] Among participants with multivessel CHD admitted between 1995 and 2018, the overall mortality was 23% and 22% for those with or without myocardial ischemia, respectively, after a median follow-up of 8.7 years.[95]

Outcomes in Percutaneous Coronary Intervention

- Several registries and studies involving patients undergoing PCI from 2005 to 2016, mostly from public institutions, have reported in-hospital mortality rates ranging from 2.3% to 2.6%. In the ICP-BR Registry, the in-hospital mortality was 0.2% for patients with stable angina and 6.1% for those with STEMI.[96] These studies are described in detail in the previous versions of the Cardiovascular Statistics – Brazil.[1-3]
- In the LATAM CTO PCI Registry, of the 1196 chronic total occlusion PCIs across 26 Brazilian hospitals, in-hospital MACE and death occurred in 2.3% and 0.75% of the cases, respectively.[97]

Outcomes in Coronary Artery Bypass Graft Surgery

- Using the BYPASS Registry database, Paez *et al*. have found an in-hospital mortality rate of 2.8% among 2292 patients from all Brazilian regions who had undergone first-time isolated CABG up to November 2018.[98]
- In a subsequent publication, Ramos *et al*. have reported in-hospital, 30-day, 6-month, and 1-year mortality rates of 2.2%, 1.1%, 1.2%, and 0.7%, respectively, among 2589 participants of the BYPASS Registry who had undergone isolated CABG and who had neither chronic obstructive pulmonary disease, nor previous cardiac surgery, nor end-stage renal disease.[99]
- Gonzales-Tamayo *et al*. have reported that, among 2961 patients from the REPLICCAR-I Registry who underwent isolated CABG in 10 hospitals between 2013 and 2016, the all-cause mortality rates were 3.4% at 30 days and 5.3% at 4 years of follow-up.[100]
- In the prospective REPLICCAR-II Registry, among 3122 patients undergoing isolated CABG in 5 hospitals in the state of São Paulo between July 2017 and June 2019, a propensity score matching technique was used to match 1062 patients who received single or multiple arterial grafts, adjusting for mortality risk. Operative mortality was 1.88% in both groups.[101]
- Among 3991 patients from the REPLICCAR-II Registry who underwent elective or urgent CABG in the city of São Paulo from 2017 to 2019, Lacava *et al*. have found higher postoperative mortality in females than in males (4.4% vs. 2.7%) in a propensity score matching analysis.[102]
- In the REPLICCAR-II Registry, prolonged post-CABG hospitalization (>14 days) occurred in 6.2% of 3703 patients, with predictors including age >60 years, renal failure, and intraoperative transfusions.[103]
- Among 3964 patients from the REPLICCAR-II Registry who had undergone CABG, Borgomoni *et al*. have reported a 21.4% failure-to-rescue rate (including death and the development of postoperative complications: prolonged ventilation time, stroke, reoperation, or acute kidney injury).[104]
- Couto *et al*. have reported a 6.5% in-hospital mortality among 9584 patients who underwent CABG in 133 centers from all Brazilian regions from 2017 to 2021. Using machine-learning techniques, the authors identified age, NSTEMI, non-elective surgery, heart failure, and admission to a public hospital as predictors of prolonged stay.[105]
- Several other single-center experiences, with both retrospective and prospective analyses, have described short-term mortality rates ranging from 1.5% to 11.7% for patients who had undergone CABG.[1-3]
- Machado *et al*. have found a 26.6% decline in CABG procedures in Brazil from the pre-pandemic period (2018–2019) to the post-pandemic period (2020–2021), with on-pump and off-pump CABGs declining by 28.1% and 10.3%, respectively.[106]

Healthcare Utilization and Cost

- Administrative data from the public health system have shown that the number of hospitalizations for acute and chronic CHD remained stable from 2015 to 2019, with more patients being admitted for ACS and myocardial infarction than for chronic coronary syndrome. During the COVID-19 pandemic, there was a decrease in

clinical admissions. After 2022, the annual number of admissions for clinical cases of CHD increased from 139,095 (2020-2021) to 161,932 (2022-2024), a 16% increase. Percutaneous coronary intervention has continuously increased over the last two decades, rising from 38,635 procedures in 2008 to 85,518 in 2019. After a slight decline during the COVID-19 pandemic, volumes regained the previously observed upward trend, reaching 84,396 procedures in 2024. Notably, the number of primary angioplasties nearly doubled in recent years, increasing from 11,099 in 2019 to 24,695 in 2024, suggesting expanded capacity and changes in regional care pathways. The annual number of hospitalizations for CABG remained stable between 2008 (20,515) and 2019 (21,018). In 2020-2021, volumes declined to an average of 16,243 procedures per year, representing a 26% reduction. In 2022, hospitalizations increased to 19,565 and subsequently stabilized in 2023-2024 at approximately 21,000 surgeries per year within the Brazilian Unified Health System (SUS).[34]

- In the last decades, significant changes have occurred in the reimbursement values per procedure for the management of CHD in the SUS, as described in detail in previous versions of the Cardiovascular Statistics – Brazil.[1-3] From 2009 to 2022, the mean value reimbursed per PCI procedure dropped by half. However, the amount paid for elective and primary PCIs rose from ~R$ 920 million to R$ 1,805 million between 2020 and 2024, accounting for 40-50% of overall cardiovascular spending. The number of CABGs in the SUS was similar in 2009 (22,077) and 2024 (22,219), and the adjusted amount reimbursed per CABG (mean ticket) decreased even after adjustment for inflation.[34]
- Between 2020 and 2024, the inflation-adjusted mean cost per PCI, primary PCI, and CABG in the SUS remained essentially flat. Total spending growth in interventional cardiology was therefore driven by volume expansion rather than increases in real reimbursement. CABG consistently exhibited the highest unit cost, approximately double that of elective PCI, yet without any real-term increase over time, suggesting persistent underfunding of surgical revascularization relative to procedural growth.[34]
- Barros e Silva *et al*., analyzing 17,434 patients from the Amil private insurance database (2015–2017), reported annual per-patient costs of USD 3,591 (primary prevention) and USD 8,210 (secondary prevention). Outpatient care accounted for 59.8% of total primary prevention costs, while hospital care accounted for 54.1% of total secondary prevention costs.[107]
- Gioppatto *et al*. have reported that costs were 45% higher when pharmacological thrombolysis was given ≥ 9 hours from symptom onset in STEMI patients, with each 3-hour delay increasing in-hospital costs by Int$ 497±286.[87]
- Stephanus *et al*. have found that each 4-hour delay in lysis-to-PCI time in STEMI patients was associated with a reduction in hospital costs of Int$ 847.5±99.8 in a propensity-score-matched analysis.[88]
- Orlandi *et al*., in a micro-costing study of 1120 CABG surgeries from 2017 to 2019, have reported cost increases by 152% with deep sternal wound infections and 188% with mediastinitis.[108]

Quality of Care

- Several publications addressing the quality of care in ACS in Brazil are described in detail in the previous versions of Cardiovascular Statistics – Brazil.[2,3] These studies highlight regional differences in quality care performance indices,[109] lower quality care in public services compared to private hospitals[110] and in low-income individuals compared to high-income patients,[82] a longer delay in receiving fibrinolysis in females in relation to males,[111] and opportunities for healthcare improvement. Importantly, low-quality care in ACS was associated with a higher risk of hard outcomes and in-hospital mortality in the ACCEPT and BRACE studies.[81,109]
- In the ACCEPT Registry, overall reperfusion rates among STEMI patients admitted within 12 hours were 76.8% (80.5% in the Southeast, 79.3% in the South, 67.1% in the Northeast, 50% in the West-Central, and 47.5% in the North). One-year adherence rates to evidence-based therapies were 89.4% (acetylsalicylic acid), 52% (P2Y12 inhibitor), and 87.4% (statins).[85]
- Milan *et al*. have observed no sex difference in discharge prescriptions of acetylsalicylic acid, clopidogrel, statins, or beta-blockers in 468 female and 894 male STEMI patients undergoing PCI at a tertiary university hospital in Southern Brazil from 2011 to 2021.[92]
- Some studies have reported on pivot times in the setting of a pharmacoinvasive strategy in STEMI. Among 2290 patients hospitalized in a university hospital in the city of São Paulo, Bianco *et al*. have reported the following median times:
  - pain-health unit: 120 (IQR 60-220) minutes;
  - door-needle: 71 (IQR 42-135) minutes;
  - pain-needle: 222 (IQR 140-345) minutes.[111]
- Among 2710 STEMI patients undergoing the pharmacoinvasive strategy and transferred to a tertiary center in the city of São Paulo between 2010 and 2020, de Marqui Moraes *et al*. have reported the following median times:
  - symptom-to-medical-contact: 120 minutes;
  - door-to-needle: 70 minutes;
  - fibrinolysis-to-angiography for successful reperfusion: 15.7 hours;
  - fibrinolysis-to-rescue-PCI: 7.2 hours.[86]
- Among 6341 patients with STEMI who underwent a pharmacoinvasive strategy in Brasília-DF between 2011 and 2020 as part of the B-CaRe:QCO Registry, Carvalho *et al*. have reported the following times for patients aged > 55 years: pain-primary hospital: mean 165 (SD 142) minutes; door-needle: median 70 (IQR 43-120) minutes; pain-needle: median 225 (IQR 150-335) minutes. Respective times for patients aged ≤ 55 years were: mean 154 minutes (SD 131), median 68 minutes (IQR 43-111), and median 210 minutes (IQR 140-315).[84]

- Among 1043 STEMI patients undergoing the pharmacoinvasive strategy in Brasília-DF from 2009 to 2019, Stephanus *et al*. have reported the following mean times: pain-to-hospital, 120 minutes; door-to-lysis, 70 minutes; and lysis-to-PCI, 870 minutes.[88]
- Some publications, described in detail in the previous versions of the Cardiovascular Statistics – Brazil, have reported the success of some strategies (e.g., incorporation of telemedicine) in improving the quality of care in ACS (e.g., increasing the rate of reperfusion therapy and the use of antiplatelet agents and statins, and reducing in-hospital mortality).[2,3]
- Roriz *et al*. have conducted a quality improvement intervention study in STEMI patients under the public health system in in the city of Salvador, Bahia state, comparing 287 records from the pre-intervention phase (2009-2010) with 598 records from the post-intervention period (2019-2020). The authors reported significant improvements in the time from ECG to STEMI team trigger (from a median of 31 to 16 minutes), door-to-ECG time (from 159 to 29 minutes), and the rate of any reperfusion therapy (from 31% to 72%).[112]
- Some studies have evaluated the Good Practices in Cardiology program, supported by the Brazilian Society of Cardiology. Passaglia *et al*. have found adherence rates above 85% for six of seven indicators in 763 ACS patients treated at the Hospital das Clínicas of the Federal University of Minas Gerais between 2016 and 2019, with discharge acetylsalicylic acid and statin prescription rates of 95.5% and 96.5%, respectively.[113]
- Additionally, within the context of the Good Practices in Cardiology program, Taniguchi *et al*. have assessed 6090 ACS patients across 19 hospitals from 2016 to 2022. Significant improvements were noted, with acetylsalicylic acid use within 24 hours increasing from 90.2% to 94.7%, statin use at discharge increasing from 87.3% to 95.2%, and beta-blocker use at discharge increasing from 82.1% to 88.6%.[114]
- In the context of chronic coronary syndrome, a cross-sectional study has assessed 35103 individuals with prior myocardial infarction or stroke between 2016 and 2021 within the Brazilian primary care program, Family Health Strategy. Only 6.7% and 0.6% reported use of statin and high-dose statin therapy, respectively.[65]
- In the NEAT Registry, involving 2003 patients with CHD or peripheral arterial disease across 25 centers (56% public) from all Brazilian regions between 2020 and 2022, 4% were not on antithrombotic therapy, 5.1% were not on statins, and 55.4% of those on statins were not on high-intensity regimens.[115]

Impact of the COVID-19 Pandemic

- As detailed in the 2023 version of the Cardiovascular Statistics – Brazil, several studies have described a decrease in the number of hospital admissions due to ACS and chronic ischemic conditions during the COVID-19 pandemic.[3]
- In an ecological time-series study spanning epidemiological weeks 10/2020 to 39/2021, Brant *et al*. have evaluated CVD mortality rates in Brazil during the COVID-19 pandemic. The authors compared observed and expected rates to determine risk ratios (RiR). As the underlying cause of death, the observed age-standardized CVD mortality rate (165.8 per 100 000 inhabitants) was similar to the expected rate (RiR=1.00). As multiple causes of death, CVD mortality rate increased by 10% compared to the expected, while the RiR for mortality from ACS was 1.03 (95% CI: 1.02-1.03). The authors also reported an increase in out-of-hospital mortality (RiR 1.18, 95% CI: 1.17-1.19), especially in the North region.[116]
- Brant *et al*. have compared observed and expected CVD deaths during the initial phase of the COVID-19 pandemic (March 17 to May 22, 2020) in the six Brazilian cities with the greatest numbers of COVID-19 deaths at that time (São Paulo, Rio de Janeiro, Fortaleza, Recife, Belém, and Manaus). Specified deaths due to ACS increased in Belém and Manaus but decreased in the other cities. Unspecified cardiovascular deaths increased in all cities and were correlated with home deaths. The net effect was an increase in the excess percentage of total cardiovascular deaths in all cities (especially Belém and Manaus), except Rio de Janeiro and Recife.[117]
- Machado *et al*. have compared 534 prepandemic and 635 pandemic-era STEMI patients undergoing primary PCI from 2019 to 2021 in two tertiary hospitals in the city of Porto Alegre. Despite increased pain-to-door and door-to-balloon times during the COVID-19 pandemic, the authors reported similar in-hospital mortality (9.3% in 2019 vs. 9.1% in 2020-2021) and 30-day MACE incidence (12.3% vs. 12.8%, respectively).[118]
- The RBCI-COVID19 Registry analyzed 1282 interventional cardiology procedures across 24 cardiac catheterization laboratories during the pandemic (2020), reporting a 2.4% overall mortality and a 15.6% mortality among COVID-19 patients.[119]
- Data from the national SUS database have shown that, after the pandemic, there was a strong rebound in clinical admissions due to CHD and surgical procedures, reaching the highest numbers in 2024, above the pre-pandemic baseline.[34]

Future Research

- Additional data are needed for further understanding of the epidemiological distribution of CHD in Brazil, in particular:

  1. Development of nationwide databases aiming at gathering accurate and real-time information on the epidemiology of the distinct clinical presentations of CHD, including delivery of care, performance, and outcome measurements;

  2. Analyses of disaggregated data to deeply understand diverse aspects of the CHD epidemiology and treatment according to sex, age, race, education, income, health system access, region, and other characteristics of the microenvironment;

3. Systematic reviews of prevalence and mortality rates of ACS, stable angina, PCI, and CABG, including representative samples of all geographical regions of the country, stratified by system delivery aspects;

4. Assessment of the effectiveness of structured nationwide programs for quality and performance measurement of different providers (public, not-for-profit, and for-profit) to understand the current situation, as well as to design strategies aimed at reducing CVD morbidity and mortality;

5. Additional economic and cost-effectiveness analyses of the impact of CHD and its diagnostic and therapeutic interventions, from a macro level and using micro-costing methods, for both public and private healthcare systems;

6. Development of structured programs to assess the prevalence, incidence, and clinical and economic impact of chronic CHD on the outpatient setting;

7. Analyses to evaluate the long-term impact of the COVID-19 pandemic on the CHD prevalence, incidence, mortality, burden, and treatment effectiveness.

Table 3.1 – Number of cases, age-standardized prevalence rates (per 100 000) of ischemic heart disease in 1990 and 2023, and percent change of rates in the period, by sex, in Brazil and its Federative Units

Sex	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
	Brazil	1.552.946,9 (1.355.443,0; 1.803.576,8)	3.130,3 (2.742,7; 3.643,5)	2.082.260,7 (1.807.174,1; 2.433.037,5)	1.736,5 (1.507,9; 2.023,2)	-44,5 (-48,6; -39,6)
	North region	53.516,8 (46.614,2; 63.292,2)	1.934,5 (1.691,4; 2.252,2)	113.777,2 (98.679,8; 132.973,5)	1.408,7 (1.215,5; 1.643,7)	-27,2 (-33,4; -19,8)
	Acre	1.789,3 (1.527,2; 2.156,7)	1.554,9 (1.320,0; 1.846,8)	4.871,6 (4.196,5; 5.673,7)	1.365,2 (1.177,0; 1.600,7)	-12,2 (-22,4; -2,0)
	Amapá	1.304,1 (1.120,8; 1.543,3)	2.027,5 (1.756,4; 2.341,6)	4.783,8 (4.107,3; 5.575,0)	1.668,9 (1.440,2; 1.944,1)	-17,7 (-26,1; -8,0)
	Amazonas	8.731,9 (7.451,2; 10.233,7)	1.531,6 (1.338,2; 1.781,9)	24.874,3 (21.337,4; 29.502,6)	1.533,1 (1.311,3; 1.827,4)	0,1 (-11,8; 14,4)
	Pará	26.889,4 (23.348,8; 31.781,2)	1.977,2 (1.728,1; 2.315,5)	47.720,7 (40.735,6; 56.428,0)	1.234,8 (1.048,1; 1.446,5)	-37,5 (-43,5; -30,1)
	Rondônia	6.982,0 (5.976,8; 8.188,1)	2.220,8 (1.912,7; 2.560,1)	14.104,2 (12.153,9; 16.605,8)	1.634,4 (1.405,4; 1.909,9)	-26,4 (-33,9; -17,3)
	Roraima	933,5 (791,0; 1.133,6)	1.780,8 (1.510,9; 2.095,6)	3.390,9 (2.886,1; 3.978,5)	1.378,0 (1.174,0; 1.605,7)	-22,6 (-31,1; -13,2)
	Tocantins	6.886,5 (5.934,3; 8.148,1)	2.468,6 (2.160,6; 2.878,4)	14.031,7 (12.005,8; 16.442,2)	1.693,2 (1.447,8; 1.972,1)	-31,4 (-38,1; -23,2)
	Northeast region	357.126,1 (311.534,0; 416.174,0)	2.655,2 (2.331,1; 3.082,6)	464.278,9 (399.986,9; 541.699,2)	1.524,3 (1.311,5; 1.783,9)	-42,6 (-47,8; -36,9)
	Alagoas	24.722,5 (21.253,9; 28.968,5)	3.241,4 (2.811,6; 3.741,5)	27.627,1 (23.541,0; 32.912,5)	1.743,7 (1.468,9; 2.082,3)	-46,2 (-52,7; -38,4)
	Bahia	75.913,3 (65.993,8; 89.135,1)	2.065,9 (1.784,4; 2.409,0)	117.971,1 (103.191,0; 136.569,6)	1.404,2 (1.223,0; 1.629,6)	-32,0 (-38,7; -24,6)
	Ceará	64.469,0 (55.827,1; 74.448,7)	3.091,5 (2.728,0; 3.531,8)	78.837,9 (65.856,9; 93.690,9)	1.584,9 (1.318,8; 1.880,5)	-48,7 (-55,3; -40,9)
	Maranhão	37.902,9 (32.976,3; 45.210,1)	2.628,6 (2.317,1; 3.090,6)	48.409,3 (39.399,7; 57.405,1)	1.447,3 (1.177,4; 1.713,4)	-44,9 (-51,9; -37,8)
	Paraíba	29.550,0 (25.595,5; 34.507,7)	2.676,2 (2.313,1; 3.124,0)	33.430,9 (27.989,8; 39.339,6)	1.465,7 (1.225,3; 1.726,3)	-45,2 (-51,0; -38,6)
	Pernambuco	73.380,7 (63.686,5; 84.790,2)	3.135,9 (2.726,7; 3.624,5)	78.404,5 (67.797,4; 91.645,3)	1.609,3 (1.383,5; 1.880,8)	-48,7 (-54,0; -42,9)

Piaui	18.367,9 (15.851,0; 21.395,1)	2.344,6 (2.029,8; 2.736,8)	26.186,5 (22.681,8; 30.379,6)	1.374,1 (1.191,0; 1.595,6)	-41,4 (-46,3; -34,9)
Rio Grande do Norte	21.456,0 (18.571,1; 24.824,5)	2.620,6 (2.279,9; 3.001,9)	34.621,5 (30.300,9; 40.256,4)	1.800,7 (1.574,5; 2.085,3)	-31,3 (-36,7; -25,0)
Sergipe	11.363,8 (9.935,9; 13.266,1)	2.487,7 (2.187,2; 2.862,2)	18.790,1 (16.164,6; 22.057,5)	1.627,4 (1.400,1; 1.913,9)	-34,6 (-41,6; -26,2)
Southeast region	764.251,0 (667.904,0; 890.328,0)	3.388,7 (2.968,5; 3.939,3)	966.455,6 (836.824,3; 1.132.775,6)	1.808,0 (1.569,4; 2.103,2)	-46,6 (-50,6; -41,7)
Espírito Santo	28.446,1 (24.661,5; 32.911,6)	3.275,8 (2.844,0; 3.783,3)	47.564,9 (41.106,1; 55.294,6)	1.998,8 (1.734,0; 2.306,0)	-39,0 (-43,5; -33,9)
Minas Gerais	193.666,6 (169.129,1; 226.359,1)	3.576,2 (3.142,3; 4.128,7)	238.858,8 (205.037,6; 275.876,8)	1.766,5 (1.530,5; 2.023,3)	-50,6 (-54,7; -45,6)
Rio de Janeiro	159.558,2 (137.527,5; 188.037,4)	3.189,9 (2.770,5; 3.695,7)	171.465,4 (147.905,6; 203.039,6)	1.684,1 (1.473,6; 1.974,7)	-47,2 (-51,8; -42,1)
São Paulo	382.580,1 (330.932,2; 447.771,2)	3.397,1 (2.978,9; 3.953,8)	508.566,5 (435.770,0; 592.249,0)	1.856,6 (1.592,2; 2.148,0)	-45,3 (-50,2; -39,4)
South region	291.847,7 (253.931,5; 342.296,9)	3.671,4 (3.205,4; 4.225,7)	384.376,7 (330.480,6; 450.776,2)	2.010,9 (1.744,0; 2.344,9)	-45,2 (-49,3; -40,5)
Paraná	102.694,2 (89.990,9; 120.188,7)	3.474,6 (3.066,7; 3.995,2)	144.509,2 (123.602,4; 169.368,8)	2.041,4 (1.747,5; 2.379,2)	-41,2 (-46,5; -34,9)
Rio Grande do Sul	131.220,7 (114.883,1; 154.838,5)	3.769,9 (3.312,2; 4.373,7)	145.840,4 (126.248,1; 172.389,0)	1.951,5 (1.703,0; 2.273,9)	-48,2 (-52,3; -43,5)
Santa Catarina	57.932,8 (50.208,9; 68.955,2)	3.820,9 (3.343,2; 4.501,7)	94.027,1 (80.882,8; 110.977,1)	2.061,2 (1.775,3; 2.429,4)	-46,1 (-50,8; -41,1)
West-Central region	86.205,3 (75.620,4; 101.720,5)	2.943,7 (2.580,2; 3.401,5)	153.372,3 (133.807,2; 177.517,5)	1.738,2 (1.515,2; 2.018,1)	-41,0 (-45,5; -35,9)
Distrito Federal	10.287,0 (8.953,8; 12.002,5)	2.538,3 (2.237,8; 2.944,2)	22.223,9 (19.382,8; 25.779,4)	1.595,0 (1.379,8; 1.840,9)	-37,2 (-43,1; -30,8)
Goiás	42.537,7 (37.043,8; 50.770,7)	3.210,9 (2.814,6; 3.747,8)	68.917,9 (59.405,3; 81.541,2)	1.750,9 (1.513,2; 2.057,9)	-45,5 (-50,8; -39,5)
Mato Grosso	16.822,1 (14.706,3; 19.528,5)	2.779,3 (2.450,1; 3.208,0)	33.793,3 (29.276,6; 39.567,4)	1.761,0 (1.526,3; 2.047,0)	-36,6 (-42,1; -30,6)
Mato Grosso do Sul	16.558,5 (14.460,1; 19.226,7)	2.821,8 (2.463,9; 3.236,6)	28.437,1 (24.485,3; 33.264,2)	1.820,6 (1.569,4; 2.117,7)	-35,5 (-41,4; -28,6)

Female						
	Brazil	1.563.505,2 (1.363.643,4; 1.805.850,5)	2.912,5 (2.561,7; 3.338,6)	1.699.173,4 (1.480.825,8; 1.961.992,5)	1.169,7 (1.020,7; 1.351,2)	-59,8 (-62,8; -56,4)
	North region	47.169,0 (40.663,9; 56.359,5)	1.820,1 (1.594,5; 2.129,2)	79.461,2 (67.482,4; 92.582,0)	940,7 (795,1; 1.104,6)	-48,3 (-52,7; -42,6)
	Acre	1.515,7 (1.261,5; 1.886,0)	1.463,4 (1.207,8; 1.798,4)	3.561,5 (3.080,6; 4.106,2)	958,9 (826,9; 1.106,1)	-34,5 (-44,7; -23,9)
	Amapá	1.061,8 (919,8; 1.242,4)	1.596,1 (1.387,4; 1.838,0)	3.101,3 (2.642,9; 3.645,7)	1.002,6 (849,8; 1.178,7)	-37,2 (-44,5; -29,3)
	Amazonas	6.512,3 (5.271,7; 8.006,9)	1.252,7 (1.007,3; 1.531,9)	15.625,3 (13.677,8; 17.974,4)	895,6 (776,5; 1.035,2)	-28,5 (-39,3; -15,3)
	Pará	24.429,2 (21.197,4; 29.097,3)	1.824,1 (1.593,5; 2.134,6)	35.332,2 (29.119,7; 42.404,3)	863,5 (708,0; 1.051,0)	-52,7 (-58,4; -44,2)
	Rondônia	6.301,2 (5.404,3; 7.622,4)	2.557,3 (2.221,3; 2.957,2)	9.751,9 (8.268,5; 11.368,7)	1.130,9 (954,4; 1.310,5)	-55,8 (-60,2; -50,5)
	Roraima	663,8 (534,0; 814,5)	1.769,7 (1.454,3; 2.141,2)	2.130,5 (1.824,1; 2.471,4)	893,7 (754,6; 1.033,2)	-49,5 (-54,7; -43,9)
	Tocantins	6.685,0 (5.804,1; 7.883,1)	2.654,4 (2.318,0; 3.074,5)	9.958,5 (8.466,3; 11.704,8)	1.207,4 (1.022,8; 1.425,4)	-54,5 (-60,7; -47,2)
	Northeast region	396.212,9 (347.801,8; 462.054,5)	2.655,9 (2.336,9; 3.058,3)	411.204,0 (355.181,8; 478.395,0)	1.115,8 (965,9; 1.300,7)	-58,0 (-62,1; -53,4)
	Alagoas	27.100,0 (23.410,0; 32.385,5)	3.239,9 (2.811,4; 3.807,8)	26.980,2 (22.848,0; 31.889,6)	1.374,8 (1.159,3; 1.631,0)	-57,6 (-63,0; -50,1)
	Bahia	84.773,0 (73.261,3; 98.767,4)	2.093,8 (1.822,0; 2.414,9)	99.436,8 (86.427,0; 116.569,9)	1.004,4 (873,8; 1.180,3)	-52,0 (-57,1; -46,4)
	Ceará	71.421,9 (61.936,8; 83.152,4)	3.066,6 (2.664,6; 3.545,7)	66.023,0 (56.180,9; 77.824,7)	1.092,6 (926,4; 1.291,6)	-64,4 (-68,8; -59,4)
	Maranhão	39.167,3 (34.181,3; 46.196,6)	2.599,0 (2.287,8; 3.033,5)	45.092,6 (37.023,4; 54.551,5)	1.195,2 (974,8; 1.447,3)	-54,0 (-60,5; -47,4)
	Paraíba	36.390,2 (31.785,8; 42.758,0)	2.893,1 (2.520,4; 3.388,2)	31.668,3 (27.351,3; 36.551,6)	1.103,3 (951,7; 1.276,4)	-61,9 (-66,4; -56,8)
	Pernambuco	83.036,7 (72.453,6; 97.948,3)	3.052,9 (2.668,2; 3.560,0)	74.685,4 (64.743,3; 87.589,3)	1.180,2 (1.023,8; 1.384,2)	-61,3 (-65,5; -57,0)
	Piaui	18.942,4 (16.510,2; 22.232,6)	2.239,6 (1.956,6; 2.588,2)	22.450,6 (19.133,8; 26.158,1)	1.012,9 (865,4; 1.176,6)	-54,8 (-59,6; -48,7)
	Rio Grande do Norte	22.821,3 (19.870,0; 26.634,3)	2.517,0 (2.199,4; 2.913,3)	28.817,9 (24.362,7; 33.950,9)	1.227,9 (1.042,1; 1.448,5)	-51,2 (-56,1; -44,7)

	Sergipe	12.560,1 (10.814,5; 14.683,8)	2.521,9 (2.188,3; 2.918,7)	16.049,2 (13.881,1; 18.482,2)	1.120,2 (966,6; 1.294,4)	-55,6 (-60,0; -50,0)
	Southeast region	738.103,7 (642.407,2; 856.164,3)	2.955,1 (2.583,9; 3.401,9)	750.502,3 (652.867,1; 865.259,4)	1.122,5 (984,1; 1.295,5)	-62,0 (-64,7; -58,6)
	Espírito Santo	27.208,7 (23.554,0; 31.644,3)	3.063,8 (2.676,9; 3.552,1)	35.712,6 (30.792,6; 41.368,4)	1.279,3 (1.100,9; 1.480,4)	-58,2 (-61,9; -54,3)
	Minas Gerais	200.173,5 (171.594,8; 231.886,2)	3.417,8 (2.967,9; 3.955,9)	184.911,1 (160.399,8; 212.828,5)	1.157,8 (1.009,5; 1.333,4)	-66,1 (-69,1; -63,1)
	Rio de Janeiro	157.533,4 (137.304,9; 183.758,0)	2.641,5 (2.312,1; 3.060,4)	136.986,8 (118.449,8; 160.427,8)	1.018,2 (884,8; 1.189,0)	-61,5 (-64,8; -57,6)
	São Paulo	353.188,1 (304.641,7; 410.917,5)	2.888,2 (2.502,7; 3.339,3)	392.891,8 (339.383,0; 455.516,3)	1.135,8 (982,9; 1.316,5)	-60,7 (-63,8; -56,8)
	South region	297.467,8 (259.074,7; 341.360,2)	3.513,8 (3.073,5; 3.993,1)	328.617,7 (285.970,7; 380.467,7)	1.424,3 (1.245,2; 1.642,6)	-59,5 (-62,3; -56,0)
	Paraná	97.140,5 (84.667,8; 110.867,7)	3.296,1 (2.894,8; 3.742,6)	122.114,4 (104.627,2; 143.594,0)	1.450,4 (1.247,7; 1.698,9)	-56,0 (-59,6; -51,7)
	Rio Grande do Sul	143.307,8 (124.157,2; 165.520,7)	3.623,8 (3.140,3; 4.159,8)	131.407,9 (113.941,0; 151.897,8)	1.407,6 (1.212,6; 1.621,0)	-61,2 (-64,1; -57,6)
	Santa Catarina	57.019,6 (49.527,1; 66.865,2)	3.623,0 (3.183,5; 4.209,2)	75.095,4 (66.076,5; 87.700,1)	1.414,2 (1.247,4; 1.641,9)	-61,0 (-64,6; -56,7)
	West-Central region	84.551,7 (73.180,7; 98.274,6)	3.028,8 (2.654,9; 3.505,6)	129.388,2 (112.276,2; 149.198,0)	1.290,4 (1.118,8; 1.489,1)	-57,4 (-61,1; -53,4)
	Distrito Federal	8.172,6 (6.967,9; 9.664,2)	1.856,8 (1.629,1; 2.135,0)	16.272,8 (14.083,4; 18.829,7)	889,2 (769,1; 1.024,2)	-52,1 (-56,2; -47,2)
	Goiás	46.301,3 (39.962,0; 53.946,4)	3.615,1 (3.155,6; 4.207,1)	67.524,5 (58.883,1; 78.179,7)	1.510,8 (1.316,0; 1.752,4)	-58,2 (-62,3; -53,3)
	Mato Grosso	15.395,6 (13.224,5; 18.358,8)	3.004,4 (2.610,7; 3.509,5)	22.670,4 (19.191,2; 26.238,1)	1.156,1 (979,0; 1.341,0)	-61,5 (-65,4; -56,6)
	Mato Grosso do Sul	14.682,2 (12.755,0; 17.122,1)	2.686,5 (2.360,8; 3.126,7)	22.920,4 (19.826,6; 26.656,1)	1.305,6 (1.128,1; 1.514,5)	-51,4 (-56,1; -46,8)
Both						
	Brazil	3.116.452,1 (2.715.763,3; 3.603.366,8)	3.018,2 (2.667,0; 3.478,3)	3.781.434,0 (3.289.831,9; 4.406.085,1)	1.427,6 (1.245,7; 1.658,8)	-52,7 (-56,1; -48,7)
	North region	100.685,8 (87.428,0; 119.932,6)	1.878,3 (1.655,3; 2.192,4)	193.238,4 (166.313,5; 226.378,2)	1.168,5 (1.003,1; 1.360,2)	-37,8 (-42,8; -31,8)

	Acre	3.305,0 (2.800,5; 4.050,2)	1.512,4 (1.272,5; 1.822,9)	8.433,1 (7.399,7; 9.712,0)	1.155,5 (1.005,0; 1.336,4)	-23,6 (-34,0; -14,1)
	Amapá	2.365,9 (2.053,1; 2.776,7)	1.809,0 (1.584,3; 2.085,1)	7.885,1 (6.784,7; 9.199,3)	1.319,2 (1.140,2; 1.539,6)	-27,1 (-33,7; -18,7)
	Amazonas	15.244,2 (12.890,6; 18.123,2)	1.395,7 (1.191,2; 1.656,3)	40.499,6 (35.231,9; 47.187,6)	1.200,8 (1.040,6; 1.406,8)	-14,0 (-24,5; -3,2)
	Pará	51.318,6 (44.761,0; 60.422,2)	1.899,5 (1.672,9; 2.206,7)	83.052,9 (70.167,7; 98.008,8)	1.043,0 (873,0; 1.237,2)	-45,1 (-50,5; -38,6)
	Rondônia	13.283,2 (11.427,8; 15.741,0)	2.370,3 (2.063,7; 2.701,7)	23.856,1 (20.634,9; 27.748,0)	1.381,2 (1.194,5; 1.602,2)	-41,7 (-46,6; -35,8)
	Roraima	1.597,3 (1.341,1; 1.941,7)	1.778,2 (1.504,6; 2.098,9)	5.521,4 (4.704,5; 6.401,7)	1.139,7 (980,0; 1.321,4)	-35,9 (-42,3; -29,3)
	Tocantins	13.571,5 (11.817,2; 16.074,5)	2.556,8 (2.241,5; 2.972,6)	23.990,2 (20.787,6; 27.921,1)	1.449,6 (1.250,9; 1.689,9)	-43,3 (-49,0; -36,1)
	Northeast region	753.339,0 (658.929,6; 873.460,1)	2.655,4 (2.341,8; 3.057,0)	875.482,9 (754.728,3; 1.019.521,6)	1.302,5 (1.122,9; 1.519,1)	-50,9 (-55,6; -45,9)
	Alagoas	51.822,5 (44.906,6; 60.929,4)	3.239,9 (2.825,3; 3.781,6)	54.607,4 (46.538,3; 64.827,9)	1.538,4 (1.305,8; 1.815,2)	-52,5 (-58,0; -45,5)
	Bahia	160.686,3 (139.611,5; 187.744,4)	2.080,2 (1.827,0; 2.411,0)	217.407,9 (189.772,2; 252.615,7)	1.190,6 (1.039,7; 1.385,5)	-42,8 (-48,2; -37,3)
	Ceará	135.890,9 (119.245,7; 156.156,9)	3.078,4 (2.701,5; 3.536,5)	144.860,8 (122.176,2; 171.886,2)	1.317,8 (1.111,1; 1.566,5)	-57,2 (-62,2; -51,4)
	Maranhão	77.070,2 (67.630,7; 90.508,4)	2.607,5 (2.290,9; 3.018,1)	93.501,9 (76.574,2; 111.626,1)	1.314,6 (1.070,7; 1.567,5)	-49,6 (-56,3; -43,0)
	Paraíba	65.940,2 (57.730,3; 77.357,0)	2.792,2 (2.440,6; 3.247,9)	65.099,3 (55.512,4; 75.895,8)	1.267,3 (1.082,0; 1.479,9)	-54,6 (-59,6; -48,9)
	Pernambuco	156.417,4 (137.357,0; 182.057,8)	3.091,9 (2.731,9; 3.565,3)	153.089,9 (132.264,7; 178.572,6)	1.365,9 (1.184,0; 1.592,1)	-55,8 (-60,1; -51,3)
	Piaui	37.310,3 (32.329,3; 43.204,8)	2.290,0 (2.009,1; 2.645,1)	48.637,1 (41.998,6; 56.579,0)	1.181,7 (1.020,7; 1.372,7)	-48,4 (-53,4; -43,1)
	Rio Grande do Norte	44.277,3 (38.658,8; 51.213,1)	2.565,8 (2.259,9; 2.949,3)	63.439,4 (55.117,7; 73.472,6)	1.490,8 (1.295,3; 1.734,2)	-41,9 (-46,9; -36,0)
	Sergipe	23.923,9 (20.905,1; 27.954,0)	2.507,3 (2.214,5; 2.877,7)	34.839,3 (30.335,7; 40.395,5)	1.346,2 (1.165,2; 1.554,1)	-46,3 (-51,1; -40,5)
	Southeast region	1.502.354,8 (1.310.100,2; 1.734.281,1)	3.161,0 (2.784,9; 3.668,7)	1.716.957,9 (1.490.668,2; 2.002.941,6)	1.430,0 (1.244,9; 1.661,1)	-54,8 (-57,9; -51,2)

	Espírito Santo	55.654,8 (48.175,9; 64.581,4)	3.169,1 (2.768,4; 3.641,1)	83.277,4 (72.464,2; 97.434,9)	1.609,8 (1.406,0; 1.869,5)	-49,2 (-52,9; -45,0)
	Minas Gerais	393.840,2 (344.101,0; 455.007,9)	3.495,5 (3.065,3; 4.034,9)	423.769,9 (367.150,9; 490.659,0)	1.439,3 (1.253,6; 1.662,4)	-58,8 (-62,0; -55,2)
	Rio de Janeiro	317.091,6 (277.330,0; 370.592,5)	2.890,0 (2.539,8; 3.331,2)	308.452,2 (267.339,9; 362.517,3)	1.304,9 (1.142,9; 1.522,1)	-54,8 (-58,4; -50,7)
	São Paulo	735.768,2 (641.727,7; 853.819,0)	3.132,4 (2.746,2; 3.617,5)	901.458,3 (775.264,6; 1.046.122,5)	1.458,6 (1.261,2; 1.685,6)	-53,4 (-56,9; -48,9)
	South region	589.315,5 (514.049,2; 681.741,5)	3.595,6 (3.156,2; 4.095,8)	712.994,4 (616.459,2; 834.028,8)	1.690,3 (1.467,3; 1.962,3)	-53,0 (-56,2; -49,3)
	Paraná	199.834,7 (174.030,2; 230.144,2)	3.387,4 (2.989,9; 3.886,7)	266.623,6 (227.971,3; 309.837,8)	1.719,4 (1.477,4; 1.988,6)	-49,2 (-53,2; -44,2)
	Rio Grande do Sul	274.528,5 (239.674,2; 318.700,8)	3.698,9 (3.244,2; 4.214,7)	277.248,3 (240.174,8; 325.076,4)	1.649,8 (1.439,5; 1.919,3)	-55,4 (-58,5; -51,7)
	Santa Catarina	114.952,4 (99.681,1; 134.541,0)	3.723,9 (3.262,1; 4.303,4)	169.122,5 (146.815,1; 197.159,8)	1.714,4 (1.492,7; 1.991,7)	-54,0 (-57,7; -50,0)
	West-Central region	170.757,0 (149.188,4; 199.066,9)	2.985,8 (2.634,2; 3.418,6)	282.760,4 (246.833,4; 326.097,6)	1.499,5 (1.304,6; 1.730,4)	-49,8 (-53,8; -45,6)
	Distrito Federal	18.459,6 (15.963,7; 21.458,3)	2.173,6 (1.909,2; 2.501,9)	38.496,8 (33.445,9; 44.274,7)	1.191,5 (1.030,3; 1.361,3)	-45,2 (-49,3; -40,1)
	Goiás	88.839,0 (77.183,0; 103.536,2)	3.410,5 (2.976,5; 3.897,7)	136.442,4 (119.213,4; 158.707,8)	1.623,2 (1.412,4; 1.877,7)	-52,4 (-56,6; -47,2)
	Mato Grosso	32.217,7 (28.136,6; 37.920,8)	2.881,6 (2.512,2; 3.335,9)	56.463,7 (49.146,7; 65.331,1)	1.454,3 (1.265,0; 1.683,7)	-49,5 (-53,8; -44,8)
	Mato Grosso do Sul	31.240,7 (27.416,4; 36.324,5)	2.755,1 (2.438,8; 3.168,3)	51.357,6 (44.790,8; 59.594,5)	1.548,3 (1.346,4; 1.791,4)	-43,8 (-48,0; -38,5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington [33]

Table 3.2 – Number of deaths, age-standardized mortality rates (per 100 000) of ischemic heart disease in 1990 and 2023, and percent change of rates in the period, by sex, in Brazil and its Federative Units

Sex	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
	Brazil	59.851,5 (55.818,2; 64.371,6)	160,2 (148,5; 172,8)	92.724,5 (87.177,2; 97.607,1)	81,1 (75,9; 85,6)	-49,4 (-52,7; -46,1)
	North region	2.093,6 (1.921,8; 2.281,4)	123,1 (112,2; 133,7)	5.740,9 (5.298,5; 6.184,9)	79,3 (72,5; 85,6)	-35,6 (-41,7; -29,5)
	Acre	88,2 (77,2; 102,8)	110,6 (96,6; 129,5)	239,5 (208,6; 272,3)	74,0 (63,8; 84,0)	-33,2 (-43,9; -19,4)
	Amapá	50,9 (44,2; 57,6)	129,5 (112,4; 146,7)	200,2 (172,6; 228,5)	78,0 (67,9; 88,9)	-39,8 (-49,0; -27,8)
	Amazonas	359,5 (323,9; 396,5)	113,3 (100,7; 125,1)	987,5 (864,7; 1.105,5)	70,7 (61,9; 79,5)	-37,6 (-46,1; -27,0)
	Pará	1.119,3 (1.008,3; 1.228,0)	126,0 (112,9; 139,5)	2.913,3 (2.619,7; 3.194,9)	83,8 (74,7; 91,7)	-33,5 (-42,1; -24,5)
	Rondônia	260,5 (232,8; 293,4)	148,8 (132,5; 166,4)	619,9 (547,7; 692,2)	78,9 (69,2; 89,1)	-47,0 (-54,6; -38,8)
	Roraima	35,5 (29,9; 42,4)	131,9 (111,4; 156,8)	171,6 (142,0; 202,5)	83,8 (69,2; 97,8)	-36,4 (-48,8; -21,3)
	Tocantins	179,6 (157,7; 208,6)	126,6 (109,7; 149,0)	608,9 (534,6; 696,1)	77,0 (67,4; 88,1)	-39,1 (-48,9; -26,4)
	Northeast region	12.648,8 (11.158,9; 14.480,7)	114,9 (99,3; 131,7)	24.153,4 (21.878,6; 26.313,1)	82,1 (74,1; 89,4)	-28,6 (-37,1; -16,9)
	Alagoas	646,0 (550,1; 740,3)	106,9 (91,7; 122,4)	1.540,7 (1.369,3; 1.716,5)	103,4 (91,7; 116,3)	-3,2 (-18,7; 14,8)
	Bahia	2.866,7 (2.542,3; 3.221,8)	98,6 (87,2; 111,2)	5.420,1 (4.873,3; 5.961,6)	66,5 (59,7; 73,2)	-32,6 (-40,5; -22,7)
	Ceará	1.512,6 (1.313,0; 1.744,9)	89,0 (76,6; 102,2)	3.647,2 (3.287,1; 4.028,4)	75,0 (67,7; 82,8)	-15,7 (-27,6; -0,2)
	Maranhão	1.852,4 (1.483,4; 2.274,8)	158,3 (126,9; 194,8)	3.190,9 (2.795,6; 3.587,8)	101,0 (88,3; 113,6)	-36,2 (-47,6; -18,3)
	Paraíba	1.023,0 (874,6; 1.180,2)	100,3 (85,4; 115,6)	1.940,6 (1.756,3; 2.154,5)	87,1 (78,8; 96,8)	-13,1 (-26,2; 4,7)
	Pernambuco	2.817,6 (2.491,4; 3.145,5)	148,9 (132,7; 166,2)	4.378,6 (3.936,8; 4.805,5)	93,6 (83,9; 102,9)	-37,2 (-45,3; -28,4)
	Piaui	720,0 (586,6; 883,9)	112,1 (91,4; 139,9)	1.570,5 (1.348,4; 1.784,2)	84,1 (72,0; 95,6)	-25,0 (-39,5; -4,1)
	Rio Grande do Norte	833,4 (714,6; 963,6)	118,7 (101,2; 137,1)	1.718,9 (1.507,0; 1.984,6)	92,3 (80,8; 106,3)	-22,2 (-35,7; -6,4)
	Sergipe	377,1 (323,6; 429,4)	104,7 (89,8; 119,9)	745,8 (647,6; 847,5)	69,1 (59,5; 78,5)	-33,9 (-44,2; -20,7)
	Southeast region	32.078,8 (30.212,3; 34.191,7)	192,4 (179,2; 206,5)	43.216,7 (40.128,5; 46.158,1)	84,1 (77,8; 90,2)	-56,3 (-60,3; -53,1)

	Espírito Santo	916,0 (835,3; 1.002,2)	144,5 (129,2; 158,8)	1.718,6 (1.548,0; 1.909,4)	76,6 (68,9; 85,3)	-47,0 (-52,9; -40,0)
	Minas Gerais	6.041,1 (5.560,3; 6.505,8)	148,2 (135,1; 160,9)	8.206,8 (7.417,9; 8.896,6)	62,3 (56,3; 67,5)	-58,0 (-62,6; -53,9)
	Rio de Janeiro	8.766,8 (8.129,6; 9.425,7)	230,0 (211,1; 248,4)	9.398,8 (8.516,1; 10.142,1)	95,6 (86,8; 103,5)	-58,4 (-62,6; -54,8)
	São Paulo	16.355,0 (15.410,2; 17.351,0)	201,9 (188,0; 216,6)	23.892,5 (22.138,4; 25.674,0)	91,6 (84,6; 98,4)	-54,6 (-58,4; -51,0)
	South region	10.438,4 (9.728,6; 11.203,0)	180,5 (166,8; 195,1)	12.905,4 (11.843,0; 13.849,7)	71,9 (65,2; 77,5)	-60,2 (-64,1; -56,6)
	Paraná	3.648,6 (3.366,6; 3.922,3)	173,6 (159,2; 188,4)	4.661,6 (4.250,7; 5.056,5)	69,7 (63,3; 75,8)	-59,9 (-63,9; -55,8)
	Rio Grande do Sul	5.065,0 (4.699,9; 5.428,4)	192,6 (178,2; 208,6)	5.195,5 (4.660,9; 5.608,5)	72,6 (65,0; 78,4)	-62,3 (-66,4; -58,7)
	Santa Catarina	1.724,8 (1.582,7; 1.879,4)	165,8 (150,9; 181,8)	3.048,2 (2.772,5; 3.313,7)	74,3 (66,3; 80,9)	-55,2 (-60,2; -50,3)
	West-Central region	2.591,8 (2.391,4; 2.807,5)	134,5 (123,6; 146,3)	6.708,1 (6.166,0; 7.171,9)	81,8 (74,8; 87,8)	-39,2 (-44,7; -33,7)
	Distrito Federal	333,3 (305,1; 360,2)	144,8 (132,2; 157,8)	728,3 (652,1; 809,8)	57,4 (51,0; 64,2)	-60,3 (-65,4; -54,3)
	Goiás	1.140,7 (1.034,9; 1.259,3)	125,4 (113,2; 138,9)	3.095,3 (2.807,0; 3.363,7)	83,5 (75,9; 91,1)	-33,4 (-41,1; -25,2)
	Mato Grosso	483,3 (431,7; 543,9)	130,0 (116,2; 145,5)	1.393,3 (1.249,2; 1.533,1)	80,3 (71,3; 88,7)	-38,2 (-45,4; -29,3)
	Mato Grosso do Sul	634,5 (575,3; 695,9)	154,8 (139,2; 170,8)	1.491,2 (1.312,7; 1.645,7)	101,3 (89,0; 111,9)	-34,5 (-43,0; -26,0)
Female						
	Brazil	43.764,6 (40.082,5; 47.442,3)	108,8 (97,2; 118,9)	65.375,7 (56.729,3; 70.904,3)	44,0 (38,3; 47,5)	-59,6 (-62,5; -56,6)
	North region	1.335,6 (1.198,6; 1.480,9)	85,3 (75,5; 94,9)	3.278,6 (2.852,3; 3.621,3)	42,5 (36,7; 47,1)	-50,2 (-54,9; -44,8)
	Acre	49,8 (41,5; 56,7)	82,9 (69,2; 94,4)	139,4 (117,6; 163,8)	41,1 (34,5; 48,6)	-50,5 (-59,2; -39,8)
	Amapá	32,6 (27,2; 37,3)	66,5 (55,2; 76,5)	107,0 (89,0; 125,9)	39,1 (32,3; 45,9)	-41,3 (-50,4; -29,8)
	Amazonas	247,8 (215,4; 277,4)	84,6 (72,5; 95,4)	558,3 (466,8; 644,3)	36,3 (30,2; 42,0)	-57,1 (-63,7; -49,9)
	Pará	760,5 (673,4; 858,4)	85,2 (74,2; 96,0)	1.696,9 (1.428,8; 1.930,3)	44,4 (37,3; 50,6)	-47,9 (-55,6; -40,6)
	Rondônia	127,9 (109,5; 143,5)	116,5 (100,2; 129,5)	354,6 (300,3; 407,2)	46,7 (39,3; 53,9)	-59,9 (-66,3; -52,9)
	Roraima	15,1 (12,2; 18,4)	84,7 (69,8; 102,0)	74,2 (60,2; 87,0)	41,6 (34,7; 48,6)	-50,9 (-60,9; -38,3)
	Tocantins	101,9 (82,6; 117,6)	85,7 (68,4; 100,7)	348,3 (294,7; 401,2)	44,0 (37,2; 50,9)	-48,6 (-58,9; -36,5)

	Northeast region	9.318,8 (7.840,1; 10.553,6)	77,3 (64,4; 87,9)	17.884,5 (15.287,8; 20.103,7)	46,7 (40,3; 52,3)	-39,6 (-48,1; -28,5)
	Alagoas	522,8 (437,0; 594,0)	80,8 (66,6; 91,9)	1.191,0 (1.009,0; 1.351,4)	62,0 (52,4; 70,2)	-23,2 (-36,1; -4,1)
	Bahia	2.214,3 (1.843,5; 2.519,4)	67,0 (55,6; 76,6)	4.316,0 (3.618,4; 4.863,1)	41,2 (35,0; 46,1)	-38,6 (-47,2; -28,7)
	Ceará	1.278,6 (1.069,9; 1.497,8)	68,2 (56,6; 80,2)	2.663,1 (2.247,4; 3.067,1)	41,5 (35,4; 47,6)	-39,1 (-48,8; -26,4)
	Maranhão	809,4 (590,4; 994,2)	73,1 (53,3; 89,3)	2.067,6 (1.733,6; 2.425,3)	55,4 (46,5; 65,0)	-24,2 (-41,4; 6,6)
	Paraíba	878,2 (724,1; 1.028,0)	80,5 (65,8; 94,4)	1.447,2 (1.218,2; 1.664,7)	47,3 (40,2; 54,3)	-41,3 (-51,0; -29,5)
	Pernambuco	2.346,8 (2.024,9; 2.644,9)	107,3 (92,2; 121,0)	3.319,8 (2.886,1; 3.698,9)	51,6 (44,9; 57,5)	-51,9 (-57,5; -44,6)
	Piaui	391,3 (300,2; 476,5)	60,0 (45,2; 73,2)	1.087,9 (902,6; 1.295,8)	46,6 (39,0; 55,4)	-22,2 (-38,8; 4,4)
	Rio Grande do Norte	573,7 (476,7; 673,9)	73,3 (60,5; 86,1)	1.249,1 (1.039,9; 1.459,6)	49,8 (41,9; 58,0)	-32,0 (-44,0; -14,5)
	Sergipe	303,7 (256,4; 342,3)	77,3 (64,6; 87,3)	542,9 (448,4; 629,1)	38,1 (31,5; 44,2)	-50,7 (-58,2; -40,9)
	Southeast region	23.842,6 (21.686,4; 25.755,1)	128,5 (115,8; 139,3)	31.009,3 (26.754,6; 34.193,5)	44,6 (38,6; 49,0)	-65,3 (-68,2; -62,0)
	Espírito Santo	638,3 (564,8; 715,0)	99,8 (86,9; 113,1)	1.093,4 (931,3; 1.244,2)	38,5 (32,8; 43,8)	-61,4 (-66,8; -56,2)
	Minas Gerais	4.523,5 (4.065,4; 4.955,7)	103,6 (91,9; 114,0)	5.742,2 (4.856,2; 6.432,2)	34,2 (29,2; 38,1)	-67,0 (-70,7; -63,0)
	Rio de Janeiro	6.697,3 (6.084,6; 7.264,9)	141,6 (126,8; 155,0)	7.165,0 (6.276,2; 7.989,5)	50,0 (43,8; 55,6)	-64,7 (-68,0; -61,5)
	São Paulo	11.983,5 (11.014,8; 12.912,4)	136,6 (122,6; 148,2)	17.008,7 (14.691,4; 18.769,6)	47,9 (41,5; 52,7)	-64,9 (-67,6; -61,5)
	South region	7.703,8 (6.974,9; 8.364,8)	123,8 (110,6; 135,7)	9.092,6 (7.752,3; 10.077,5)	38,6 (32,9; 42,8)	-68,8 (-71,7; -65,4)
	Paraná	2.601,6 (2.343,6; 2.842,4)	129,7 (115,2; 142,4)	3.121,8 (2.642,9; 3.475,9)	37,2 (31,6; 41,6)	-71,3 (-74,3; -68,1)
	Rio Grande do Sul	3.852,2 (3.490,2; 4.221,8)	123,8 (111,2; 136,1)	3.941,0 (3.352,2; 4.365,6)	39,2 (33,4; 43,3)	-68,3 (-71,5; -64,4)
	Santa Catarina	1.250,0 (1.127,3; 1.385,3)	113,1 (100,5; 126,8)	2.029,8 (1.700,2; 2.275,3)	39,7 (33,2; 44,6)	-64,9 (-69,1; -60,6)
	West-Central region	1.563,9 (1.429,9; 1.716,1)	94,2 (84,6; 104,9)	4.110,7 (3.609,7; 4.515,6)	43,7 (38,1; 48,2)	-53,6 (-58,3; -48,7)
	Distrito Federal	242,7 (216,1; 273,6)	97,7 (85,1; 109,2)	518,6 (432,5; 596,8)	30,6 (25,3; 35,4)	-68,7 (-73,4; -63,7)
	Goiás	686,1 (620,8; 764,9)	86,8 (76,8; 98,9)	1.858,3 (1.584,8; 2.098,4)	44,0 (37,3; 49,8)	-49,3 (-55,2; -43,1)
	Mato Grosso	253,6 (219,1; 286,0)	92,0 (78,7; 104,1)	776,9 (681,0; 890,0)	44,6 (38,7; 51,4)	-51,5 (-58,7; -41,9)

	Mato Grosso do Sul	381,5 (340,8; 423,1)	110,7 (97,2; 123,7)	956,9 (812,9; 1.091,4)	56,3 (47,8; 64,1)	-49,2 (-55,8; -41,7)
Both						
	Brazil	103.616,1 (97.536,7; 109.810,2)	133,1 (123,2; 141,6)	158.100,2 (144.477,8; 166.890,5)	60,6 (55,2; 64,1)	-54,4 (-56,5; -52,2)
	North region	3.429,2 (3.170,6; 3.665,9)	104,5 (95,6; 112,2)	9.019,5 (8.263,8; 9.599,4)	60,2 (54,6; 64,2)	-42,4 (-46,1; -38,0)
	Acre	138,0 (123,2; 154,1)	98,5 (87,9; 109,8)	378,8 (334,0; 417,6)	56,9 (49,7; 62,9)	-42,2 (-49,5; -34,0)
	Amapá	83,5 (74,4; 92,3)	92,6 (82,3; 101,9)	307,2 (271,5; 345,6)	57,6 (50,7; 64,8)	-37,7 (-45,1; -29,2)
	Amazonas	607,3 (557,3; 655,7)	99,2 (89,2; 107,5)	1.545,8 (1.371,4; 1.715,1)	52,5 (46,5; 58,3)	-47,1 (-52,4; -40,6)
	Pará	1.879,8 (1.730,5; 2.046,0)	105,4 (95,6; 114,4)	4.610,2 (4.134,0; 4.976,7)	63,2 (56,5; 68,5)	-40,0 (-45,4; -34,4)
	Rondônia	388,5 (351,9; 424,9)	135,3 (124,2; 148,1)	974,5 (871,2; 1.072,1)	62,6 (55,5; 69,4)	-53,7 (-58,6; -48,7)
	Roraima	50,6 (44,9; 57,7)	110,7 (97,9; 125,1)	245,8 (210,0; 278,7)	62,5 (54,1; 70,4)	-43,6 (-52,8; -33,7)
	Tocantins	281,5 (249,0; 315,7)	105,6 (92,3; 118,4)	957,2 (861,6; 1.061,6)	60,5 (54,1; 67,2)	-42,8 (-50,3; -33,5)
	Northeast region	21.967,6 (19.685,7; 24.355,1)	95,0 (85,1; 105,2)	42.037,9 (37.608,5; 45.595,0)	62,6 (56,1; 67,8)	-34,1 (-40,2; -26,6)
	Alagoas	1.168,8 (1.040,5; 1.311,4)	93,2 (82,5; 103,9)	2.731,6 (2.436,4; 2.986,6)	80,3 (71,3; 87,9)	-13,9 (-24,4; -1,2)
	Bahia	5.081,0 (4.579,5; 5.601,9)	81,8 (73,3; 90,5)	9.736,1 (8.570,9; 10.528,8)	52,8 (46,7; 56,9)	-35,5 (-41,5; -29,3)
	Ceará	2.791,3 (2.481,5; 3.122,9)	78,0 (68,8; 87,7)	6.310,4 (5.595,3; 6.888,0)	56,6 (50,3; 61,6)	-27,5 (-35,1; -17,6)
	Maranhão	2.661,8 (2.212,1; 3.101,8)	114,8 (95,2; 133,6)	5.258,5 (4.704,0; 5.904,3)	76,3 (68,1; 85,6)	-33,6 (-44,1; -19,0)
	Paraíba	1.901,2 (1.672,9; 2.121,3)	89,7 (78,7; 100,0)	3.387,9 (2.997,6; 3.683,7)	64,7 (57,6; 70,4)	-27,8 (-36,1; -17,7)
	Pernambuco	5.164,3 (4.749,5; 5.590,8)	126,4 (114,9; 137,5)	7.698,4 (6.946,0; 8.285,0)	69,8 (62,8; 75,1)	-44,8 (-49,8; -40,1)
	Piaui	1.111,3 (934,0; 1.280,3)	85,1 (71,8; 98,5)	2.658,3 (2.317,3; 2.950,0)	63,9 (55,8; 71,0)	-24,9 (-35,1; -8,3)
	Rio Grande do Norte	1.407,1 (1.224,6; 1.585,2)	94,4 (81,8; 107,1)	2.968,0 (2.659,8; 3.337,2)	68,9 (61,8; 77,3)	-27,1 (-36,1; -15,1)
	Sergipe	680,8 (610,4; 751,8)	89,9 (80,0; 99,2)	1.288,6 (1.128,9; 1.418,5)	51,8 (45,1; 57,1)	-42,4 (-48,8; -34,9)
	Southeast region	55.921,4 (52.561,3; 59.138,0)	158,0 (145,4; 167,7)	74.226,0 (67.498,7; 79.171,2)	62,2 (56,5; 66,4)	-60,6 (-62,9; -58,4)
	Espírito Santo	1.554,3 (1.430,4; 1.683,7)	121,4 (109,7; 132,6)	2.812,0 (2.519,7; 3.063,2)	55,7 (49,8; 60,6)	-54,1 (-58,7; -50,0)

	Minas Gerais	10.564,6 (9.816,3; 11.289,4)	124,7 (113,6; 134,4)	13.949,1 (12.484,3; 15.106,7)	47,1 (42,2; 51,0)	-62,3 (-65,0; -59,4)
	Rio de Janeiro	15.464,0 (14.537,8; 16.416,4)	180,5 (166,3; 192,3)	16.563,8 (14.999,6; 17.607,3)	69,5 (63,0; 73,8)	-61,5 (-64,0; -59,3)
	São Paulo	28.338,5 (26.679,8; 29.891,8)	166,8 (153,5; 176,9)	40.901,2 (37.188,8; 43.783,4)	67,3 (61,0; 72,1)	-59,7 (-62,1; -57,4)
	South region	18.142,2 (17.055,9; 19.234,8)	150,5 (138,5; 160,8)	21.998,0 (20.029,1; 23.566,0)	53,5 (48,5; 57,5)	-64,4 (-66,8; -62,2)
	Paraná	6.250,2 (5.835,6; 6.627,9)	151,4 (137,1; 162,0)	7.783,5 (7.029,5; 8.431,4)	51,9 (46,5; 56,3)	-65,7 (-68,1; -63,3)
	Rio Grande do Sul	8.917,2 (8.312,0; 9.485,3)	154,9 (143,5; 165,4)	9.136,5 (8.183,5; 9.870,9)	53,9 (48,3; 58,3)	-65,2 (-67,9; -62,5)
	Santa Catarina	2.974,8 (2.779,0; 3.197,4)	137,9 (125,3; 149,0)	5.078,1 (4.553,5; 5.453,9)	55,4 (49,5; 59,7)	-59,8 (-63,2; -56,7)
	West-Central region	4.155,7 (3.893,2; 4.408,4)	114,7 (105,0; 123,2)	10.818,7 (9.888,6; 11.496,2)	61,3 (55,5; 65,5)	-46,5 (-50,1; -43,2)
	Distrito Federal	576,0 (534,4; 615,6)	117,7 (107,4; 128,0)	1.246,9 (1.096,4; 1.362,9)	42,0 (36,6; 46,3)	-64,4 (-67,8; -60,2)
	Goiás	1.826,8 (1.690,8; 1.965,0)	106,3 (96,1; 115,3)	4.953,6 (4.485,1; 5.331,3)	62,3 (56,0; 67,2)	-41,3 (-47,0; -35,9)
	Mato Grosso	736,9 (668,6; 807,8)	112,8 (102,2; 123,7)	2.170,2 (1.969,6; 2.356,8)	62,1 (56,3; 67,5)	-44,9 (-50,6; -39,4)
	Mato Grosso do Sul	1.016,0 (934,0; 1.092,2)	133,5 (121,3; 143,9)	2.448,1 (2.180,1; 2.658,8)	77,3 (68,4; 83,8)	-42,1 (-47,2; -36,7)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 3.3 – Number of DALYs, age-standardized DALY rates (per 100 000) of ischemic heart disease in 1990 and 2023, and percent change of rates in the period, by sex, in Brazil and its Federative Units

Sex	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
	Brazil	1.644.913,3 (1.547.026,6; 1.754.411,4)	3.722,1 (3.487,1; 3.971,3)	2.352.659,1 (2.243.402,5; 2.457.494,5)	1.959,9 (1.862,8; 2.046,1)	-47,3 (-50,8; -43,8)
	North region	57.772,5 (52.992,0; 62.899,6)	2.667,2 (2.452,9; 2.880,5)	146.933,6 (137.803,8; 156.738,5)	1.824,8 (1.706,0; 1.951,9)	-31,6 (-37,8; -25,3)
	Acre	2.406,9 (2.105,8; 2.773,8)	2.460,7 (2.169,9; 2.844,4)	6.295,5 (5.416,1; 7.145,8)	1.736,0 (1.513,6; 1.962,2)	-29,4 (-41,5; -14,5)
	Amapá	1.388,8 (1.216,1; 1.571,5)	2.783,0 (2.422,6; 3.134,2)	5.441,3 (4.592,7; 6.220,0)	1.836,9 (1.577,7; 2.083,2)	-34,0 (-44,0; -22,5)
	Amazonas	9.620,0 (8.690,2; 10.633,4)	2.372,8 (2.154,2; 2.620,4)	26.052,6 (22.974,2; 29.217,7)	1.616,6 (1.425,6; 1.800,9)	-31,9 (-40,7; -21,9)
	Pará	30.185,6 (27.413,8; 33.354,2)	2.750,0 (2.501,8; 3.017,8)	73.268,6 (66.659,7; 80.288,9)	1.912,0 (1.738,6; 2.093,9)	-30,5 (-39,2; -22,6)
	Rondônia	7.826,0 (6.995,3; 8.812,7)	3.218,1 (2.893,1; 3.598,0)	15.645,9 (13.842,9; 17.553,7)	1.816,3 (1.611,8; 2.024,8)	-43,6 (-51,2; -35,7)
	Roraima	1.144,0 (964,2; 1.355,5)	2.830,5 (2.390,2; 3.352,3)	4.849,7 (4.050,5; 5.646,3)	1.958,6 (1.624,4; 2.278,3)	-30,8 (-44,1; -15,3)
	Tocantins	5.201,3 (4.583,8; 6.084,0)	2.494,4 (2.203,8; 2.893,4)	15.380,1 (13.623,1; 17.582,2)	1.848,5 (1.643,8; 2.117,9)	-25,9 (-38,2; -11,1)
	Northeast region	329.913,6 (293.389,3; 376.182,5)	2.689,6 (2.392,1; 3.054,5)	600.250,2 (546.573,5; 653.128,0)	1.971,6 (1.790,1; 2.143,4)	-26,7 (-34,7; -14,6)
	Alagoas	18.006,3 (15.380,5; 20.700,4)	2.629,8 (2.260,7; 2.996,9)	39.674,7 (35.279,2; 44.156,7)	2.482,3 (2.215,4; 2.760,8)	-5,6 (-20,0; 12,1)
	Bahia	75.384,2 (67.769,5; 84.169,5)	2.282,3 (2.053,0; 2.550,7)	134.243,9 (121.414,3; 146.689,2)	1.611,7 (1.456,9; 1.758,3)	-29,4 (-37,6; -18,9)
	Ceará	37.723,1 (33.078,6; 43.498,2)	1.991,4 (1.746,1; 2.291,7)	88.124,2 (79.539,4; 97.573,8)	1.778,5 (1.605,2; 1.967,7)	-10,7 (-22,3; 4,1)
	Maranhão	54.601,0 (44.504,8; 66.982,0)	4.079,6 (3.317,8; 4.965,9)	79.424,2 (69.809,9; 88.656,9)	2.365,3 (2.075,8; 2.641,5)	-42,0 (-52,6; -27,2)
	Paraíba	25.182,6 (21.802,2; 29.039,9)	2.375,5 (2.053,8; 2.732,0)	47.538,5 (43.211,2; 52.330,2)	2.077,6 (1.888,9; 2.287,5)	-12,5 (-25,7; 4,9)
	Pernambuco	72.159,3 (64.085,9; 80.791,8)	3.394,4 (3.017,8; 3.779,7)	112.580,5 (103.327,1; 123.100,9)	2.279,7 (2.085,0; 2.490,0)	-32,8 (-40,9; -23,4)

	Piaui	18.918,9 (15.415,6; 22.763,4)	2.640,5 (2.157,8; 3.160,3)	37.297,4 (32.554,2; 42.157,0)	1.962,9 (1.712,5; 2.223,6)	-25,7 (-39,2; -6,0)
	Rio Grande do Norte	18.826,7 (16.262,0; 21.430,2)	2.509,2 (2.169,5; 2.854,8)	42.633,3 (37.411,8; 48.798,0)	2.228,7 (1.957,8; 2.554,6)	-11,2 (-26,6; 7,0)
	Sergipe	9.111,7 (7.850,1; 10.355,4)	2.296,5 (1.990,6; 2.616,4)	18.733,4 (16.565,1; 21.312,0)	1.622,8 (1.436,9; 1.839,5)	-29,3 (-39,8; -15,6)
	Southeast region	895.790,5 (845.137,2; 954.007,0)	4.452,4 (4.210,4; 4.742,7)	1.114.441,1 (1.037.558,1; 1.184.789,5)	2.089,0 (1.944,7; 2.223,8)	-53,1 (-57,2; -49,7)
	Espírito Santo	24.487,8 (22.278,7; 26.751,7)	3.276,2 (2.993,6; 3.576,3)	43.135,3 (39.301,1; 46.962,8)	1.819,3 (1.656,1; 1.983,6)	-44,5 (-50,8; -37,1)
	Minas Gerais	166.817,1 (155.238,8; 180.136,2)	3.442,4 (3.198,3; 3.720,6)	204.743,1 (186.653,4; 220.214,3)	1.521,1 (1.386,5; 1.634,3)	-55,8 (-60,8; -51,7)
	Rio de Janeiro	248.167,8 (233.266,2; 267.410,2)	5.468,9 (5.094,5; 5.871,9)	239.919,4 (221.073,6; 256.218,7)	2.356,3 (2.164,3; 2.525,1)	-56,9 (-61,1; -53,1)
	São Paulo	456.317,8 (429.706,1; 485.302,4)	4.587,4 (4.305,1; 4.874,1)	626.643,4 (583.104,7; 668.473,4)	2.288,6 (2.129,9; 2.439,9)	-50,1 (-54,5; -46,2)
	South region	285.286,2 (265.486,9; 305.021,8)	4.090,9 (3.816,1; 4.389,2)	318.591,9 (293.365,9; 341.503,3)	1.669,9 (1.537,3; 1.791,2)	-59,2 (-62,7; -55,7)
	Paraná	99.638,1 (92.609,8; 106.818,7)	3.904,6 (3.628,0; 4.179,9)	116.908,7 (105.779,3; 126.053,9)	1.650,0 (1.500,4; 1.778,1)	-57,7 (-61,7; -53,6)
	Rio Grande do Sul	138.800,1 (129.148,7; 148.164,5)	4.422,6 (4.115,7; 4.740,5)	123.899,4 (113.551,9; 133.255,0)	1.662,0 (1.522,2; 1.787,3)	-62,4 (-66,2; -58,9)
	Santa Catarina	46.848,0 (43.318,0; 51.063,3)	3.670,9 (3.380,0; 4.002,1)	77.783,9 (71.405,2; 84.384,6)	1.714,1 (1.557,6; 1.853,4)	-53,3 (-58,1; -48,3)
	West-Central region	76.150,5 (70.426,3; 82.580,9)	3.094,5 (2.872,7; 3.358,8)	172.442,2 (161.168,3; 183.268,4)	1.933,9 (1.800,0; 2.050,5)	-37,5 (-42,7; -31,8)
	Distrito Federal	10.349,3 (9.473,1; 11.262,3)	3.203,7 (2.947,8; 3.451,0)	18.535,6 (16.739,7; 20.536,9)	1.305,1 (1.183,4; 1.448,1)	-59,3 (-63,9; -54,0)
	Goiás	33.673,6 (30.465,5; 37.232,5)	2.951,4 (2.691,6; 3.240,9)	80.063,9 (72.699,0; 86.552,8)	2.006,7 (1.826,0; 2.162,5)	-32,0 (-40,1; -23,9)
	Mato Grosso	14.303,4 (12.875,3; 16.171,8)	2.947,2 (2.651,5; 3.307,5)	36.304,8 (32.753,5; 40.056,0)	1.879,3 (1.689,5; 2.057,7)	-36,2 (-44,1; -27,4)
	Mato Grosso do Sul	17.824,1 (16.134,6; 19.558,6)	3.537,6 (3.221,5; 3.888,9)	37.537,9 (33.779,8; 41.376,9)	2.405,6 (2.151,7; 2.649,1)	-32,0 (-39,8; -24,0)

Female						
	Brazil	1.006.316,0 (927.275,3; 1.088.923,0)	2.169,5 (1.992,3; 2.351,3)	1.366.260,9 (1.235.250,1; 1.457.717,2)	938,9 (852,4; 1.000,7)	-56,7 (-59,6; -53,8)
	North region	31.237,4 (28.265,7; 34.683,5)	1.620,8 (1.460,8; 1.796,3)	71.865,0 (65.139,6; 78.330,6)	872,9 (783,6; 953,6)	-46,1 (-51,3; -41,1)
	Acre	1.215,7 (1.027,2; 1.393,1)	1.595,0 (1.337,5; 1.805,4)	3.171,5 (2.730,3; 3.712,2)	867,7 (748,3; 1.016,6)	-45,6 (-55,2; -33,0)
	Amapá	741,8 (642,4; 843,4)	1.345,7 (1.166,0; 1.524,7)	2.378,1 (2.027,3; 2.760,9)	797,5 (681,2; 925,8)	-40,7 (-50,0; -28,5)
	Amazonas	5.531,5 (4.869,3; 6.251,5)	1.520,4 (1.331,4; 1.702,3)	12.279,2 (10.502,2; 14.064,4)	735,3 (624,0; 843,0)	-51,6 (-59,2; -43,1)
	Pará	16.909,5 (15.143,6; 19.011,5)	1.616,5 (1.441,1; 1.810,6)	36.585,7 (31.786,9; 40.614,3)	914,6 (792,7; 1.016,7)	-43,4 (-51,6; -36,2)
	Rondônia	3.600,0 (3.100,9; 4.081,9)	2.226,2 (1.918,0; 2.481,6)	8.031,3 (6.870,7; 9.107,0)	953,7 (824,1; 1.080,1)	-57,2 (-62,9; -49,9)
	Roraima	435,2 (353,3; 525,4)	1.648,8 (1.367,1; 1.998,7)	1.900,9 (1.548,1; 2.239,2)	843,8 (691,0; 980,4)	-48,8 (-60,3; -34,6)
	Tocantins	2.803,8 (2.303,3; 3.240,3)	1.585,5 (1.314,0; 1.819,7)	7.518,2 (6.578,1; 8.554,5)	917,0 (800,8; 1.042,3)	-42,2 (-52,9; -29,7)
	Northeast region	213.411,4 (182.812,6; 240.456,9)	1.602,8 (1.377,5; 1.808,7)	372.646,4 (330.463,4; 414.429,1)	1.007,1 (896,1; 1.120,9)	-37,2 (-45,9; -25,0)
	Alagoas	13.237,4 (10.940,0; 15.001,3)	1.829,4 (1.525,2; 2.075,3)	26.876,1 (23.631,7; 30.406,2)	1.376,3 (1.211,4; 1.553,8)	-24,8 (-37,5; -4,2)
	Bahia	49.572,9 (42.137,2; 55.919,2)	1.379,0 (1.180,4; 1.552,4)	91.367,3 (81.024,6; 102.680,7)	919,7 (819,0; 1.032,3)	-33,3 (-42,3; -22,4)
	Ceará	29.349,8 (24.791,9; 33.909,8)	1.407,0 (1.185,6; 1.617,6)	52.115,1 (45.911,2; 59.348,9)	853,4 (755,6; 969,5)	-39,3 (-49,2; -26,6)
	Maranhão	19.943,1 (14.888,0; 24.308,8)	1.534,9 (1.151,0; 1.862,3)	43.361,7 (36.583,2; 49.846,7)	1.156,4 (974,7; 1.330,6)	-24,7 (-41,0; 4,4)
	Paraíba	19.940,3 (16.436,3; 23.283,4)	1.690,1 (1.400,9; 1.976,9)	29.547,3 (25.942,9; 33.539,7)	1.025,3 (904,0; 1.163,4)	-39,3 (-49,9; -25,7)
	Pernambuco	53.170,3 (46.707,4; 59.066,2)	2.185,3 (1.918,8; 2.430,0)	71.395,0 (63.846,5; 79.253,6)	1.125,3 (1.007,3; 1.248,8)	-48,5 (-55,1; -40,3)
	Piaui	9.481,0 (7.290,5; 11.395,1)	1.276,6 (986,1; 1.523,7)	21.255,8 (18.344,0; 24.803,4)	948,2 (820,2; 1.106,0)	-25,7 (-40,9; -3,3)
	Rio Grande do Norte	12.172,4 (10.279,7; 14.119,6)	1.465,8 (1.239,3; 1.709,0)	24.964,2 (21.643,4; 28.560,5)	1.052,9 (925,0; 1.201,5)	-28,2 (-40,6; -10,6)

	Sergipe	6.544,2 (5.643,8; 7.403,4)	1.511,0 (1.285,7; 1.711,1)	11.763,8 (10.089,4; 13.523,2)	822,9 (707,0; 946,6)	-45,5 (-53,9; -34,8)
	Southeast region	542.537,6 (494.379,7; 580.610,9)	2.509,6 (2.279,7; 2.695,6)	645.655,4 (572.239,6; 701.951,5)	964,4 (857,7; 1.049,7)	-61,6 (-64,4; -58,3)
	Espírito Santo	15.104,1 (13.439,9; 16.783,0)	2.012,1 (1.783,5; 2.237,4)	23.286,8 (20.369,4; 25.887,0)	834,0 (727,7; 927,5)	-58,6 (-63,6; -53,1)
	Minas Gerais	104.376,9 (94.723,0; 114.190,8)	2.054,6 (1.861,1; 2.253,0)	118.521,9 (103.483,1; 131.291,4)	738,0 (647,7; 814,8)	-64,1 (-67,6; -60,2)
	Rio de Janeiro	155.974,1 (141.731,2; 169.306,3)	2.904,4 (2.623,9; 3.151,7)	150.944,1 (133.468,3; 164.676,7)	1.114,6 (988,7; 1.214,7)	-61,6 (-65,5; -57,9)
	São Paulo	267.082,5 (245.569,3; 284.801,5)	2.577,7 (2.368,0; 2.762,3)	352.902,6 (315.306,1; 383.729,5)	1.022,0 (914,4; 1.110,2)	-60,4 (-63,0; -57,0)
	South region	177.902,5 (162.173,0; 192.639,5)	2.444,7 (2.211,3; 2.653,3)	184.931,6 (162.098,7; 201.235,7)	798,6 (700,5; 870,6)	-67,3 (-70,1; -64,1)
	Paraná	62.362,1 (56.356,5; 67.500,3)	2.569,5 (2.311,6; 2.770,8)	66.632,0 (56.475,2; 73.327,4)	792,3 (673,1; 870,0)	-69,2 (-72,2; -65,8)
	Rio Grande do Sul	86.308,3 (78.695,1; 93.969,2)	2.439,7 (2.214,8; 2.642,6)	76.270,2 (67.424,0; 83.159,9)	804,1 (714,6; 877,4)	-67,0 (-70,1; -64,0)
	Santa Catarina	29.232,0 (26.524,6; 32.044,8)	2.230,2 (2.010,1; 2.429,6)	42.029,3 (36.633,9; 46.530,6)	800,3 (694,9; 887,0)	-64,1 (-68,2; -60,2)
	West-Central region	41.227,1 (37.994,4; 45.284,5)	1.928,4 (1.756,3; 2.117,8)	91.162,6 (83.323,2; 98.665,1)	921,9 (837,1; 998,6)	-52,2 (-56,7; -47,7)
	Distrito Federal	6.262,7 (5.684,6; 7.043,9)	1.892,7 (1.683,0; 2.116,3)	10.796,2 (9.220,2; 12.182,0)	600,4 (511,0; 679,8)	-68,3 (-73,3; -63,6)
	Goiás	18.332,8 (16.707,7; 20.239,1)	1.822,6 (1.649,8; 2.012,9)	41.912,2 (36.872,1; 46.621,4)	949,0 (834,9; 1.055,5)	-47,9 (-53,6; -42,1)
	Mato Grosso	7.000,3 (6.020,6; 7.906,0)	1.904,8 (1.658,6; 2.129,2)	17.396,0 (15.593,0; 19.737,3)	914,8 (812,8; 1.031,5)	-52,0 (-59,0; -42,2)
	Mato Grosso do Sul	9.631,3 (8.696,2; 10.678,6)	2.231,7 (1.987,4; 2.471,9)	21.058,2 (18.013,6; 23.738,4)	1.206,2 (1.032,1; 1.363,0)	-45,9 (-53,1; -38,3)
Both						
	Brazil	2.651.229,2 (2.509.455,2; 2.793.230,4)	2.911,0 (2.748,3; 3.083,9)	3.718.920,0 (3.493.454,9; 3.871.092,2)	1.410,3 (1.324,3; 1.468,3)	-51,6 (-53,8; -49,4)
	North region	89.009,9 (82.569,0; 95.847,5)	2.159,5 (2.001,1; 2.312,6)	218.798,7 (205.689,3; 230.871,1)	1.338,1 (1.249,1; 1.414,4)	-38,0 (-42,0; -33,3)

	Acre	3.622,6 (3.272,1; 4.026,2)	2.063,7 (1.855,2; 2.290,9)	9.466,9 (8.494,1; 10.474,0)	1.292,5 (1.157,1; 1.429,6)	-37,4 (-45,1; -27,1)
	Amapá	2.130,6 (1.917,2; 2.358,8)	1.995,9 (1.797,2; 2.203,6)	7.819,4 (6.845,9; 8.734,9)	1.300,8 (1.152,0; 1.455,7)	-34,8 (-42,2; -26,2)
	Amazonas	15.151,4 (13.918,4; 16.489,7)	1.953,8 (1.799,1; 2.123,2)	38.331,8 (34.695,3; 42.256,8)	1.159,7 (1.040,9; 1.278,5)	-40,6 (-46,7; -33,9)
	Pará	47.095,1 (43.452,1; 50.997,8)	2.186,4 (2.010,2; 2.376,4)	109.854,3 (100.182,8; 117.939,6)	1.399,7 (1.270,9; 1.499,6)	-36,0 (-41,5; -30,1)
	Rondônia	11.426,0 (10.368,1; 12.441,1)	2.794,8 (2.551,1; 3.042,8)	23.677,3 (21.448,8; 25.898,5)	1.381,4 (1.247,9; 1.507,4)	-50,6 (-55,8; -45,2)
	Roraima	1.579,1 (1.390,8; 1.796,0)	2.314,7 (2.055,4; 2.615,9)	6.750,5 (5.859,5; 7.579,1)	1.401,1 (1.207,6; 1.568,7)	-39,5 (-49,5; -29,2)
	Tocantins	8.005,1 (7.054,7; 8.999,2)	2.052,7 (1.824,1; 2.283,3)	22.898,4 (20.868,2; 25.352,4)	1.381,7 (1.258,2; 1.530,2)	-32,7 (-41,4; -21,2)
	Northeast region	543.325,0 (492.038,3; 597.543,0)	2.116,5 (1.918,1; 2.324,4)	972.896,6 (892.033,1; 1.043.619,7)	1.451,0 (1.330,4; 1.555,4)	-31,4 (-37,7; -23,3)
	Alagoas	31.243,7 (28.140,3; 34.967,1)	2.211,0 (1.991,8; 2.469,3)	66.550,8 (60.239,6; 72.462,0)	1.875,9 (1.698,2; 2.043,5)	-15,2 (-26,0; -3,0)
	Bahia	124.957,0 (113.765,5; 136.516,4)	1.808,0 (1.643,1; 1.974,2)	225.611,3 (207.251,3; 240.268,2)	1.242,2 (1.139,6; 1.323,5)	-31,3 (-37,9; -24,3)
	Ceará	67.072,9 (60.102,4; 74.346,2)	1.682,0 (1.509,7; 1.855,1)	140.239,3 (126.792,8; 150.514,0)	1.278,7 (1.157,8; 1.373,2)	-24,0 (-31,8; -13,6)
	Maranhão	74.544,1 (62.450,4; 86.576,9)	2.788,8 (2.348,7; 3.227,6)	122.785,9 (110.927,7; 135.458,5)	1.726,8 (1.557,0; 1.908,4)	-38,1 (-47,6; -24,7)
	Paraíba	45.122,9 (39.939,2; 50.166,9)	2.006,0 (1.777,0; 2.230,6)	77.085,7 (70.799,2; 83.331,3)	1.503,5 (1.381,7; 1.624,4)	-25,1 (-33,4; -14,3)
	Pernambuco	125.329,6 (115.611,1; 135.868,7)	2.741,1 (2.522,0; 2.974,2)	183.975,5 (169.535,7; 197.305,8)	1.639,8 (1.508,5; 1.759,2)	-40,2 (-45,4; -34,5)
	Piaui	28.400,0 (24.143,6; 32.697,5)	1.934,8 (1.651,6; 2.198,7)	58.553,3 (52.456,5; 64.255,7)	1.424,3 (1.274,7; 1.562,4)	-26,4 (-36,1; -9,7)
	Rio Grande do Norte	30.999,0 (27.763,5; 34.775,3)	1.956,4 (1.753,2; 2.196,7)	67.597,6 (60.987,9; 74.645,0)	1.592,8 (1.439,6; 1.762,1)	-18,6 (-28,6; -5,6)
	Sergipe	15.655,8 (13.965,7; 17.253,2)	1.877,7 (1.679,8; 2.068,5)	30.497,2 (27.638,9; 33.198,2)	1.183,3 (1.073,2; 1.290,5)	-37,0 (-44,1; -28,9)
	Southeast region	1.438.328,1 (1.361.833,9; 1.507.723,0)	3.422,5 (3.213,3; 3.593,3)	1.760.096,5 (1.644.287,5; 1.856.136,8)	1.479,4 (1.383,2; 1.559,6)	-56,8 (-59,5; -54,3)

Espírito Santo	39.591,9 (36.713,6; 42.688,7)	2.628,5 (2.433,5; 2.828,2)	66.422,1 (60.193,3; 71.746,9)	1.291,5 (1.169,1; 1.393,3)	-50,9 (-55,3; -46,8)
Minas Gerais	271.194,0 (253.331,6; 288.165,5)	2.718,1 (2.519,4; 2.889,9)	323.264,9 (296.738,3; 346.525,2)	1.105,4 (1.016,0; 1.183,9)	-59,3 (-62,5; -56,0)
Rio de Janeiro	404.141,9 (380.596,0; 425.749,4)	4.059,9 (3.819,7; 4.286,6)	390.863,5 (361.062,9; 411.954,6)	1.664,9 (1.534,0; 1.756,1)	-59,0 (-61,9; -56,3)
São Paulo	723.400,3 (687.623,3; 760.430,4)	3.528,1 (3.329,3; 3.706,5)	979.545,9 (918.533,3; 1.036.710,4)	1.601,1 (1.498,3; 1.694,1)	-54,6 (-57,3; -51,8)
South region	463.188,7 (434.611,0; 489.973,1)	3.232,1 (3.019,8; 3.421,4)	503.523,5 (464.630,5; 535.207,9)	1.200,6 (1.103,8; 1.276,0)	-62,9 (-65,2; -60,6)
Paraná	162.000,2 (151.995,6; 171.231,8)	3.232,0 (3.011,0; 3.427,6)	183.540,8 (168.663,1; 195.461,8)	1.188,8 (1.091,5; 1.266,5)	-63,2 (-65,9; -60,7)
Rio Grande do Sul	225.108,4 (211.995,5; 237.706,6)	3.358,0 (3.132,2; 3.559,3)	200.169,6 (184.231,8; 213.015,4)	1.195,9 (1.097,5; 1.273,9)	-64,4 (-66,9; -61,6)
Santa Catarina	76.080,0 (70.950,7; 81.097,0)	2.922,1 (2.719,7; 3.121,4)	119.813,2 (109.564,9; 127.935,8)	1.227,4 (1.116,4; 1.310,9)	-58,0 (-61,3; -54,9)
West-Central region	117.377,6 (110.264,6; 124.713,3)	2.525,0 (2.360,6; 2.677,6)	263.604,8 (246.944,9; 278.073,4)	1.398,9 (1.303,3; 1.477,3)	-44,6 (-47,8; -41,1)
Distrito Federal	16.612,0 (15.506,4; 17.725,0)	2.486,9 (2.312,3; 2.659,0)	29.331,8 (26.468,9; 32.032,8)	908,7 (819,4; 989,6)	-63,5 (-66,8; -60,0)
Goiás	52.006,5 (48.098,8; 55.932,5)	2.395,5 (2.225,5; 2.575,2)	121.976,1 (112.602,5; 130.670,7)	1.448,2 (1.333,8; 1.548,9)	-39,5 (-44,7; -34,3)
Mato Grosso	21.303,8 (19.339,4; 23.569,2)	2.477,5 (2.255,7; 2.719,9)	53.700,7 (49.006,0; 58.053,5)	1.393,1 (1.274,6; 1.501,5)	-43,8 (-49,3; -37,5)
Mato Grosso do Sul	27.455,3 (25.324,9; 29.555,5)	2.909,9 (2.677,9; 3.120,7)	58.596,1 (53.199,7; 63.384,1)	1.774,3 (1.605,8; 1.915,8)	-39,0 (-44,7; -33,6)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

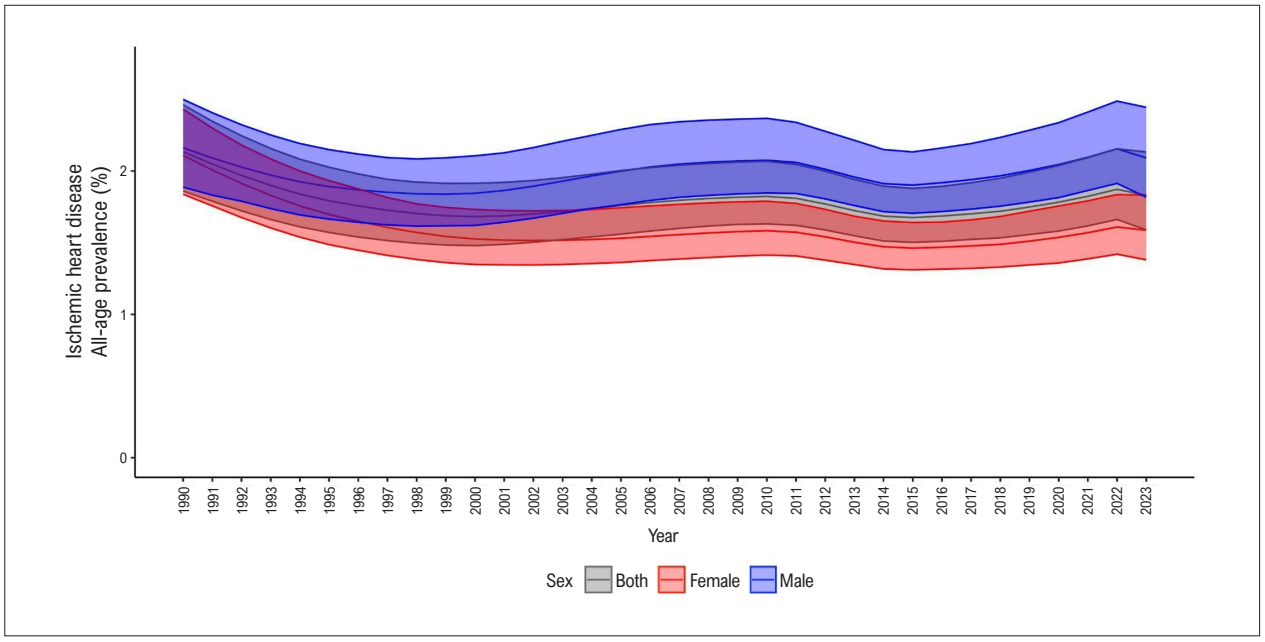

Chart 3.1 – *Prevalence (percentage) of ischemic heart disease in Brazil, by sex (1990-2023). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

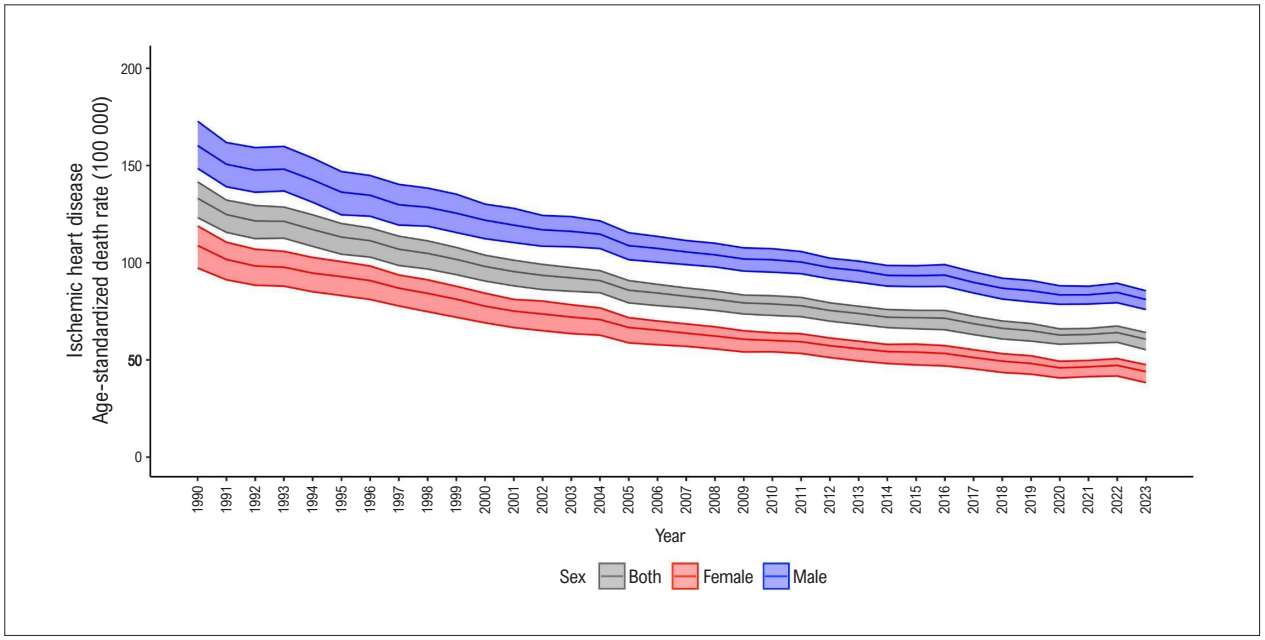

Chart 3.2 – *Age-standardized mortality rates due to ischemic heart disease in Brazil, by sex (1990-2023). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

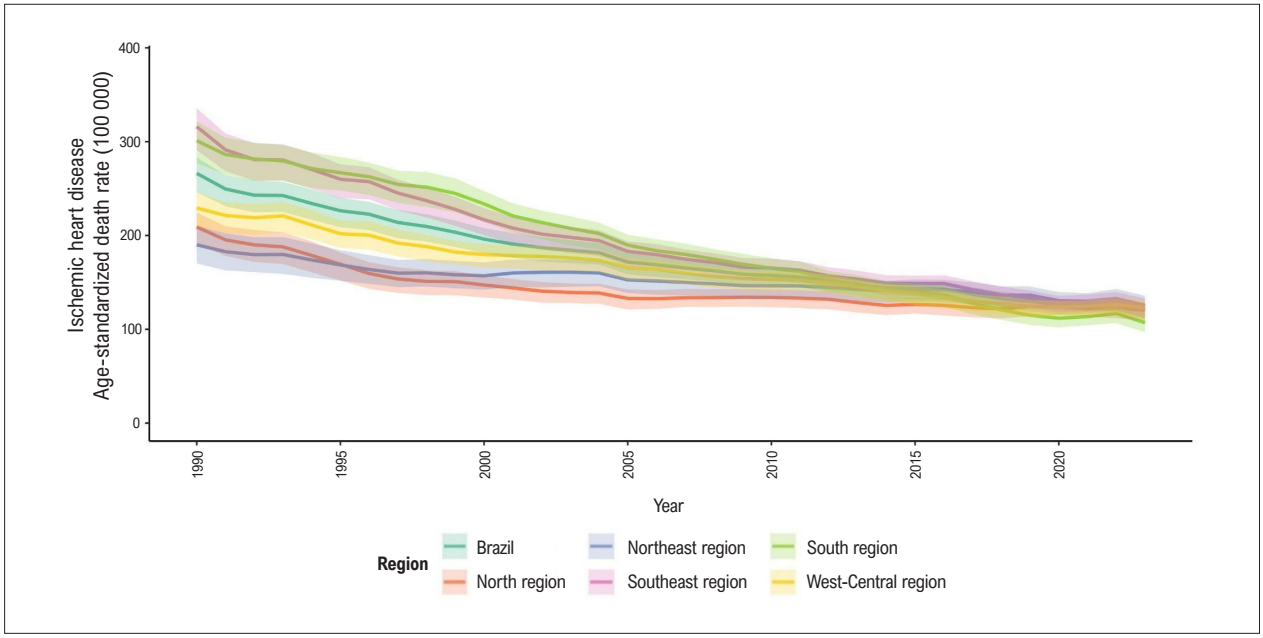

Chart 3.3 – *Age-standardized mortality rates due to ischemic heart disease in Brazil, by region (1990-2023). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

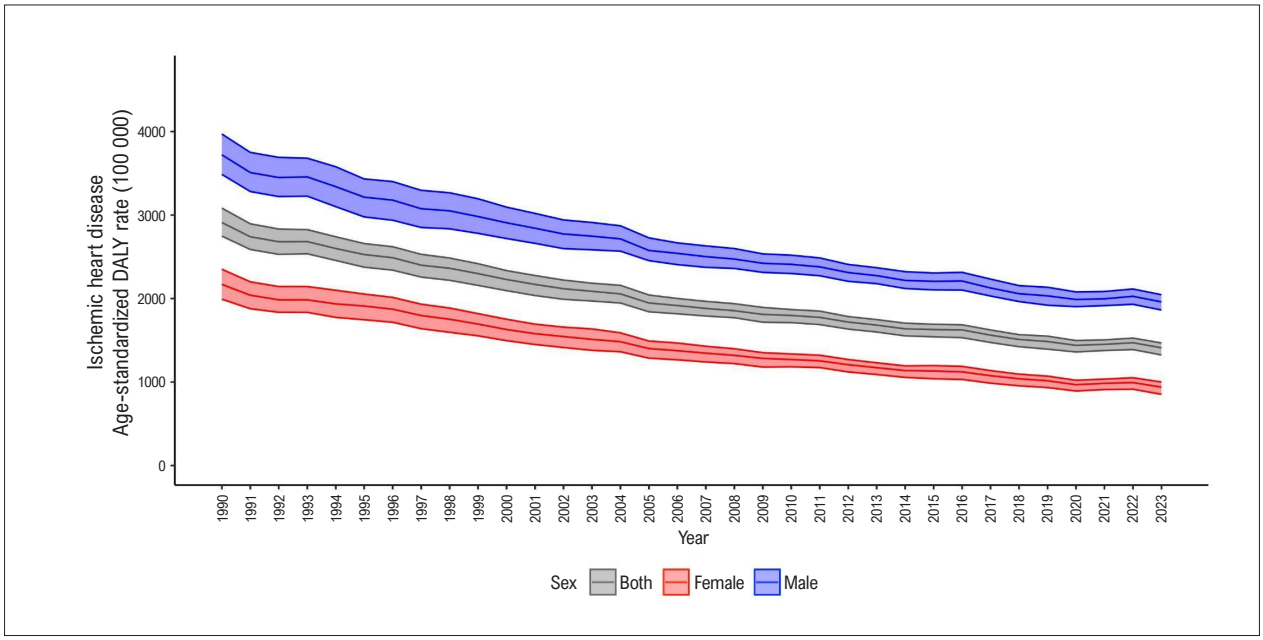

Chart 3.4 – *Age-standardized DALY rates due to ischemic heart disease in Brazil, by sex (1990-2023). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.* [33]

CHAPTER 4 – CARDIOMYOPATHY AND HEART FAILURE

ICD-10 I42; I50; B57.2.

See Tables 4.1 through 4.13 and Charts 4.1 through 4.11.

Abbreviations used in chapter 4

BNP	B-type natriuretic peptide
BREATHE	I Brazilian Registry of Heart Failure
ChCM	Chagas Cardiomyopathy
ChD	Chagas Disease
CI	Confidence Interval
DALY	Disability-Adjusted Life Years
ELSA-Brasil	Brazilian Longitudinal Study of Adult Health
FU	Federative Unit
GBD	Global Burden of Disease
HF	Heart Failure
HR	Hazard Ratio
ICD-10	International Classification of Diseases, 10th Revision
LVEF	Left Ventricular Ejection Fraction
NYHA	New York Heart Association
OR	Odds Ratio
PAHO/WHO	Pan American Health Organization/ World Health Organization
RAISE project	*The burden of Chagas disease in the contemporary world* project
SDI	Sociodemographic Index
SEADE	Data Analysis Foundation of the State System (in Portuguese, *Fundação Sistema Estadual de Análise de Dados*)
SIM	Brazilian Mortality Information System (in Portuguese, *Sistema de Informação sobre Mortalidade*)
SUS	Brazilian Unified Health System (in Portuguese, *Sistema* Único *de Saúde*)
UI	Uncertainty Interval
US	United States
YLD	Years Lived with Disability

Cardiomyopathy and Myocarditis

Prevalence and Incidence

- According to GBD Study 2023 estimates, in Brazil, cardiomyopathy and myocarditis all-age prevalence increased from 1990 to 2023, similarly to age-standardized prevalence rates, which passed from 126.3 (95% UI, 105.4 - 147.9) in 1990 to 130.0 (95% UI, 107.3 - 151.5) in 2023, an increase of 2.9% (95 UI, -3.9 to 9.4) in the period. (Chart 4.1 and Table 4.1). In absolute numbers, estimates for cardiomyopathy and myocarditis prevalence in Brazil rose from 148,474.9 (95% UI, 124,791.4 – 172,285.1) in 1990 to 293,415.9 (95% UI, 241,523.7 – 347,302.3) in 2023, mainly due to population growth and aging. Cardiomyopathy and myocarditis prevalence was greater in men (151.9; 95% UI, 126.1-177.7) than in women (110.7; 95% UI, 90.0-130.3) in 2023, and the observed prevalence increase was higher for men, 4.5 (95% UI, -3.2 – 10.8), than for women, 1.3 (95% UI, -5.9 – 9.1), in the period.
- According to GBD Study 2023 estimates, the prevalence of cardiomyopathy and myocarditis is highly variable amongst Brazilian Federative Units (FU) and the percent change varied unevenly between 1990 and 2023 (Table 4.1). In 2023, the highest rates were observed in São Paulo, Goiás, Distrito Federal, Roraima, Paraíba, and Rio de Janeiro. From 1990 to 2023, the largest increases in age-standardized prevalence rates were observed in Rio de Janeiro, Maranhão, São Paulo, and Pernambuco.
- More details about cardiomyopathy and myocarditis data from previous GBD studies can be found in Cardiovascular Statistics – Brazil 2023.[3]

Mortality

- According to GBD Study 2023 estimates, cardiomyopathy and myocarditis mortality rates seemed to increase during the 1990s, but decreased in the two following decades (Chart 4.2). As shown in Table 4.2, mortality rates were 15.5 (95% UI, 14.0 - 16.9) in 1990 and 5.9 (95% UI, 5.3 - 6.6) in 2023, per 100,000 inhabitants, a decrease of 61.8% (95% UI; -65.5 to -58.9). Despite this decrease in mortality rates, the number of deaths due to cardiomyopathy and myocarditis increased in the period, due to population growth and aging. Cardiomyopathy and myocarditis were responsible for 13,114 (95% UI, 11,989 - 14,239) deaths in 1990, rising to 15,116 (95% UI, 13,378 - 16,727) deaths in 2023. The GBD Study 2023 estimates of cardiomyopathy mortality rates refer to cases of cardiomyopathy listed as an underlying cause of death. Deaths due to heart failure (HF) related to other specific causes are attributed to the underlying disease, i.e., deaths related to ischemic cardiomyopathy are coded as due to ischemic heart disease. Moreover, for the GBD project, HF is not considered a primary cause of death, thus, all deaths coded as related to HF should be recoded to the baseline condition.
- Table 4.2 depicts the total number of deaths due to cardiomyopathy and myocarditis, age-standardized mortality rates (per 100,000 inhabitants), and percent change of the rates, in Brazil and its FUs, in 1990 and 2023. All FUs had a decrease in their mortality rates, with the highest percentages of reduction observed between 1990 and 2023 in Paraná and Minas Gerais. In 2023, the FUs with the lowest mortality rates were Rio Grande do Sul, Rio Grande do Norte, Amazonas, and Bahia.

- Table 4.3 shows cardiomyopathy and myocarditis mortality rates by age groups, from the GBD Study 2023 estimates. Women had lower age-standardized mortality rates, as well as a more pronounced reduction from 1990 to 2023. The rates in women were 13.3 (95% UI, 11.5 - 15.0), in 1990, and 4.2 (95% UI, 3.5 – 4.8), in 2023, a reduction of 68.8% (95% UI, -73.0 to -64.8). The rates in men were 17.9 (95% UI, 15.7 - 20.0), in 1990, and 8.0 (95% UI, 6.9 - 9.0), in 2023, a variation of -55.2% (95% UI, -59.7 to -50.6). As expected, the highest mortality rate was observed in the 70+ year group, with rates of 131.7 (95% UI, 115.2 - 145.5) per 100,000 , in 1990, and of 48.8 (95% UI, 40.2 - 55.7), in 2023. For the 50-69-year group, the rates were 28.8 (95% UI, 26.0 – 31.1) per 100,000 , in 1990, and 11.4 (95% UI, 10.1 – 12.5), in 2023. Overall, mortality rates decreased from 1990 to 2023 in all age groups (Table 4.3).
- In a study reporting data from the SEADE, from São Paulo state, cardiomyopathies were responsible for 3571 deaths, representing 23.3% of the HF-related deaths during 2006 as follows: dilated cardiomyopathy accounted for 17.2% of deaths; alcoholic cardiomyopathy, for 0.45%; and restrictive cardiomyopathies, for 0.37%. Chagas cardiomyopathy (ChCM) and alcoholic cardiomyopathy were responsible for 7.8% and 0.45% of HF-related deaths, respectively.[120]
- For specific cardiomyopathies, data are scarce. A recent study including 1244 patients with hypertrophic cardiomyopathy has reported an overall mortality in 232 patients over 7.7 years of follow-up (1.3%/year). Mean age was 54.6±16.5 years and mean left ventricular ejection fraction (LVEF) was 65.8%±7.6. Atrial fibrillation/flutter occurred in 9.6% of patients. Patients with B-type natriuretic peptide (BNP) > 200 pg/ml, left atrium ≥ 45 mm, and LVEF ≤ 50% had higher mortality ($p < 0.001$).[121] These data are similar to those of a previous cohort, which has reported an annual mortality rate of 1%.[122]

Burden of Disease

- According to GBD 2023 estimates, the cardiomyopathy and myocarditis age-standardized DALY rate in Brazil presented similar trends to those observed for mortality, with an increase in the 1990s and a decrease during the following decades. As shown in Table 4.4, age-standardized DALY rates were 394.9 (95% UI, 362.3 - 428.8) in 1990 and 172.4 (95% UI, 157.8 - 187.8) in 2023, per 100,000 inhabitants, a decrease of 56.3% (95% UI, -60.0 to -52.9). These changes are similar to those observed in mortality rates. Despite this decrease in DALY rates, cardiomyopathy and myocarditis resulted in 414,749 (95% UI, 379,595 - 450,092) DALYs in Brazil in 1990 and in 424,338 (95% UI, 387,563 - 462,725) in 2023 (Chart 4.3).
- Table 4.5 shows cardiomyopathy and myocarditis DALY rates according to age groups, from GBD study 2023 estimates. The age-standardized DALY rates were lower for women, whose reduction from 1990 to 2023 was more pronounced than for men. Rates for women were 320.0 (95% UI, 282.8 – 355.2) in 1990 and 111.0 (95% UI, 96.9 – 124.7) in 2023, a reduction of 65.3% (95% UI, -68.7 to -61.7). Rates for men were 476.1 (95% UI, 417.1 – 529.5) in 1990 and 241.3 (95% UI, 214.9 – 269.7) in 2023, a reduction of 49.3% (95% UI, -54.4 to -43.9). As expected, the highest DALY rate was observed in the group of 70+ years, followed by the 50-69-year group. Overall, DALY rates decreased from 1990 to 2023 in all age groups (Table 4.5).

Chronic Chagas Disease and Chagas Cardiomyopathy

Prevalence and Incidence

- Based on the latest estimates provided by the 2018 Pan American Health Organization/World Health Organization (PAHO/WHO) report on Chagas disease (ChD) in the Americas, Brazil bears the highest absolute burden of the disease in the region.[123] In Brazil, an estimated 3,913,142 individuals live with *T. cruzi* infection. Chagas cardiomyopathy represents the most severe clinical manifestation of the disease. In Brazil, it is estimated that 782,628 people suffer from this cardiac condition, a figure that accounts for approximately 51% of all cardiomyopathy cases across the 21 endemic countries in the Americas. Furthermore, the estimated prevalence of *T. cruzi* infection among blood donors in Brazil is 0.16%. This represents one of the lowest rates among endemic nations, highlighting the success and effectiveness of the country's blood safety and screening policies.
- Chagas disease has been recently reassessed within the RAISE project (Burden of Chagas Disease in the Contemporary World),[124] a collaboration led by the World Heart Federation and the GBD Study, with the objective of comprehensively re-estimating the global burden of ChD and ChCM. The results were incorporated into the GBD 2023 estimates. According to the GBD Study 2023, there were a total of 4,010,982.9 prevalent cases (95% UI, 3,461,447.1–4,625,517.1) in Brazil in 2023. Age-standardized prevalence of ChD in Brazil declined by 61.6% (95% UI, -62.6 to -60.1) from 1990 to 2023, from 4171.8 per 100,000 (95% UI, 3637.2–4792.0) in 1990 to 1600.3 per 100,000 (95% UI, 1380.8–1842.4) in 2023 (Table 4.6). In 2023, prevalence was higher in women [1614.6 (95% UI, 1405.6–1855.8)] than in men [1583.4 (95% UI, 1360.8–1815.0)]. Within Brazil, the West-Central region had the highest prevalence [3601.7 (95% UI, 3118.1–4117.3)], whereas the North region, the lowest [912.4 (95% UI, 764.4–1054.4)]. The state with the highest prevalence was Goiás [6278.0 (95% UI, 5446.1–7172.4)].
- A study conducted by Laporta *et al*. has estimated the prevalence of ChD in Brazil for the period 2015–2016, using statistical modeling of data extracted from a meta-analysis and health information systems.[125] A total of 3,706,043 individuals with ChD were estimated in Brazil, with an average prevalence of 3.25% across the 3778 municipalities where the condition was identified. Notably, the study found that 2,064,967 of those affected are women, including 591,512 women of childbearing age, highlighting a critical risk for vertical transmission. In addition, the study has shown that there are areas in the

Amazon region where ChD prevalence was estimated at 4-5%, including the Belém area and the state of Maranhão.

- Most individuals infected with *T. cruzi* are unaware of their condition. In addition, low awareness among healthcare professionals and patients, together with the lack of systematic screening, limits case detection and hinders accurate estimation of the true disease's prevalence.[124] These recent estimates of ChD prevalence from PAHO, GBD/RAISE study, and the Brazilian Health Ministry are notably higher than previous estimates, reflecting additional data and methodological improvements.
- The World Health Organization Global Report on Neglected Tropical Diseases 2025 recognizes Brazil for successfully interrupting the vector-borne transmission of ChD.[126] This achievement explains the significant reduction in the disease's prevalence across the country.

Mortality

- According to the GBD Study 2023, the mortality rates due to ChD in Brazil have decreased over the past decades (Chart 4.4). In 1990, ChD was responsible for 9,387.0 (95% UI, 8,785.7-10,052.3) deaths, which decreased to 5,731.0 (95% UI, 5,127.2-6,286.0) in 2023 (Table 4.7). Age-standardized mortality rate showed a striking decrease (-78.3% change), from 10.1 (95% UI, 9.3-10.9) deaths per 100,000 inhabitants in 1990 to 2.2 (95% UI, 2.0-2.4) per 100,000 inhabitants in 2023 (Table 4.8). Men had higher age-standardized mortality rate in 2023 than women, 2.6 (95% UI, 2.4-2.9) and 1.8 (95% UI, 1.6-2.1), respectively.
- The estimated mortality due to ChD in children under 5 years is practically zero. Of the other age groups, the reduction in mortality rates was more pronounced (86.8% change; 95% UI, -88.5 to -84.8) in the age group of 15-49 years, from 3.1 (95% UI, 2.9-3.3) to 0.4 (95% UI, 0.4-0.5) per 100,000 . Regarding the other age groups, most deaths occurred in those aged 70 years or older, who presented the lowest percent reduction, -66.1% (95% UI, -70.9 to -60.8) during the period 1990-2023: 62.8 (95% UI, 55.1 – 71.1) to 21.3 (95% UI, 18.3 – 24.0) per 100,000 (Table 4.8). The decrease in age-standardized mortality rate due to ChD, per 100,000 inhabitants, correlates with the sociodemographic index (SDI) of the Brazilian FUs in the period of 1990-2023 ($R = -0.56$, $p = 0.003$) (Chart 4.5).
- Among patients with HF and LVEF ≤ 50% in a Brazilian university hospital, ChCM was present in 15% (2002–2004) and 18% (2012–2014). Two-year mortality decreased over time, but ChCM remained associated with a higher risk of death, with HR increasing from 1.92 (95% CI, 1.00–3.71) to 3.51 (95% CI, 1.94–6.36). The population attributable risk of ChCM rose from 11.0% (95% CI, 2.8–18.5) to 21.9% (95% CI, 16.5–26.9) ($p = 0.023$), indicating a greater relative contribution of ChCM to mortality in HF over time.[3,127]
- In a nationwide study that analyzed all death certificates issued between 2000 and 2019 in Brazil, ChD was mentioned in 122,291 (0.54%), 94,788 (77.5%) as an underlying cause and 27,503 (22.5%) as an associated cause of death. The mean standardized mortality rate was 3.22 per 100,000 inhabitants/year, with a declining trend in the period. The highest mortality rates were observed in the following groups: male sex; age ≥ 80 years; black race/skin color; schooling of 1-3 years; and West-Central region residents (Chart 4.6).[128]
- Another cohort has shown decreases in the absolute death rates over time in both ChCM and non-ChCM patients, but increases in the HR associated with ChCM were observed over time.[129]
- In a cohort study including 1551 patients with ChCM from Minas Gerais state, a score to predict 2-year mortality was developed. The score included simple variables such as age, New York Heart Association (NYHA) functional class, heart rate, QRS duration, and abnormal NT-proBNP adjusted for age. The observed mortality rates in the low-, intermediate-, and high-risk groups were 0%, 3.6%, and 32.7%, respectively, in the derivation cohort and 3.2%, 8.7%, and 19.1%, respectively, in the validation cohort, with C statistics of 0.82 and 0.71, respectively. It seems to be a helpful and simple score that could be used in remote areas with limited technological resources.[130] In this cohort, a higher frequency of cardiovascular events has been reported in municipalities with fewer physicians per 1000 inhabitants or lower primary healthcare coverage.[131]
- A study conducted in the RAISE project has suggested that the actual mortality rate from ChD is significantly higher than what is currently recorded in official statistics. The study's methodology was based on a detailed analysis of data from the Brazilian Mortality Information System (SIM) between 2015 and 2019. The researchers have demonstrated that after the reclassification of those deaths, the estimated mortality for ChD could be 26.4% higher than previously reported. This correction had a much more profound impact on historically endemic states, such as Minas Gerais, Goiás, and Bahia.[132]
- Another study that analyzed mortality patterns across two distinct cohorts - one comprising asymptomatic individuals with positive serology (REDS cohort) and another with patients already diagnosed with ChCM (SaMi-Trop cohort) – has estimated a potential under-registration rate of 53.8% for ChD-related deaths.[133]
- Additionally, an analysis of the I Brazilian Registry of Heart Failure (BREATHE) has shown that patients hospitalized in Brazil with decompensated ChCM have a higher mortality rate than those with decompensated HF of other etiologies (39.4% vs. 26.6%, $p < 0.001$), despite being younger and having fewer comorbidities. Even after adjusting for other variables, Chagas etiology remained an independent predictor of in-hospital death (OR 2.02; 95% CI, 1.47-2.77).[134,135]

Burden of Disease

- In the GBD Study 2023, 166,204 DALYs (95% UI, 149,223 - 187,681) due to ChD were estimated in Brazil, with a relative reduction of 53.2% compared to 1990, 355,291 DALYs (95% UI, 311,666 - 361,606) (Table 4.9). Age-standardized DALY rates declined at the national level (-80.4%) and in all Brazilian FUs between 1990 and

2023, but with different regional patterns (Chart 4.7). The highest fatal and non-fatal burden due to ChD was observed among males, the elderly (Table 4.10), and in those FUs encompassing important endemic areas for vector transmission in the past, such as Goiás, Tocantins, Minas Gerais, Bahia, and Distrito Federal.

- A nationwide cost-of-illness study has revealed the substantial economic burden of ChD in Brazil.[136] The annual economic impact of chronic ChD was estimated at $11.44 billion, representing 0.23% of the country's gross domestic product. The study determined a lifetime cost per patient of $45,034, with direct medical costs accounting for approximately 72% of the total lifetime economic burden, while indirect costs–primarily due to loss of productivity–accounted for the remaining 28%. Furthermore, annual direct medical expenditures related to the disease represent roughly 11% of the Ministry of Health's total budget, underscoring the significant strain ChD places on the Brazilian public health system.

Heart Failure

- Because HF is not considered an underlying cause of death (ie. garbage code), in the GBD study all deaths attributed to HF in death certificates are reclassified and/or redistributed to other causes, according to the GBD methodology. As such, there is no data from GBD on mortality due to HF. Because HF is classified as an "impairment" according to GBD methodology, the only indicators we have for HF from the GBD study are prevalence and YLDs, which is the morbidity component of DALYs.

Prevalence and Incidence

- According to GBD Study 2023 estimates, the absolute numbers of HF prevalence in Brazil rose from 0.79 million in 1990 to almost 1.69 million in 2023, mainly due to population growth and aging. There was a decrease of 14.5% (-21.4; -7.9) in the age-standardized HF prevalence in Brazil, from 813.5 (697.1; 934.6) in 1990 to 695.2 (623.2; 765.3) in 2023. The lowest rates were observed in the South and North regions. The HF prevalence was higher in men, 796.4 (718.3; 876.0), than in women, 615.0 (546.9; 679.2), in 2023, and the decrease in prevalence from 1990 to 2023 was more pronounced in men (Table 4.11). Regarding age groups, there is a 5-fold increase in the incidence rates from the <50-year group to the 50-69-year group, and a further 6-fold increase from this group to the 70+ year group. From 1990 to 2023, prevalence decreased across most age groups (Table 4.12).
- A systematic review has evaluated the burden of HF in Latin America, and included 143 articles published between January 1994 and June 2014, with at least 50 participants aged ≥ 18 years; most included studies (64%) were from Brazil.[137] The patients' mean age was 60±9 years, and the mean ejection fraction was 36±9%. The prevalence of HF was 1% (95% CI, 0.1-2.7). Of the studies included, only one assessed incidence, with 1091 individuals identified through multistage probability sampling in the city of Porto Alegre, Brazil. The incidence of HF in the single population study providing this information was 199 cases per 100,000 person-years.[138]
- A study from the Brazil National Health Survey held in 2013, with data of 59,655 adults (≥ 18 years) found a prevalence of self-rated HF of 1.1%, which would represent about 1.7 million people. In those over 60 years of age, the prevalence was 3.3%.[139]
- In 14,854 participants from 2008 to 2023 in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), the incidence of HF was 1.35 per 1000 person-years (1.39% cumulative). Incidence was higher among older adults (65-74 years), self-reported Black individuals, and those with excess weight. The study highlights the progression of HF incidence and identifies important modifiable risk factors in the Brazilian population.[140] In the same cohort, including only the 2356 participants aged 60 years and over who had an echocardiogram performed at baseline visit, the prevalence of symptomatic HF (stage C) was 269 (11%), with a 4.29 (95% CI, 2.8-6.6) increase in mortality over a median follow-up of 12 years. This study highlights the high prevalence of symptomatic HF in older adults and the increased mortality that may be responsible for an elevated public health burden.[141]
- Previous population-based studies have reported HF prevalence of 9.3% in 633 individuals aged ≥45 years from a medium-sized city in Brazil,[142] and of 7.9% in 7113 frail elderly residents in Zona da Mata, Minas Gerais state.[143]

Mortality

- An ecological study developed with secondary data on HF mortality in Brazil from 1996 to 2017 has reported 1,242,014 deaths from HF (Chart 4.8).[144] The temporal trend analysis results showed a significant decrease of 2.3% (95% CI, -2.3 to -2.7) in the mortality rate across all Brazilian FUs. Northern municipalities maintained low mortality rates during the period analyzed, suggesting underreporting.
- Another ecological study that analyzed mortality from HF in Brazil for individuals aged 50 years or older, between 1998 and 2019, has found similar results.[145] The average rate was 75.5 deaths per 100,000 inhabitants, and women accounted for the highest proportion (n = 299,093; 52.67%). The trend of mortality from HF in Brazilian individuals over 50 years of age was downward over 21 years, and this trend was observed in both sexes and in 23 FUs (Chart 4.9). That study showed that the mortality rates from HF increased with advancing age for all Brazilian regions, with a higher occurrence in individuals aged 80 years or older (n = 257,277; 45.31%).
- As reported in the Cardiovascular Statistics – Brazil 2023,[3] HF is frequently listed as the underlying cause of death rather than in the chain of events leading to death, and percentages of death due to HF vary from 3% to 9%, depending on the region, age, and analysis performed. In addition, mortality on the follow-up of patients with HF varies in Brazilian cohort studies, ranging from one-year mortality of 6.8% to 20%, depending on clinical factors and with survival improving over time.

- In a recent publication from the ELSA-Brasil study, 251 participants with HF were followed-up for 12.3 years: 48 (19%) died. The overall survivals of participants with HF at 2, 6, 10, and 12.3 years of follow-up were 96%, 89%, 82%, and 80%, respectively. The mortality risk was 4.5 times higher (HR 4.46; 95% CI, 3.3-5.9) compared to that of the unaffected group ($p < 0.01$), and even after applying an adjusted model, the mortality risk remained twice as high (HR 1.77; 95% CI, 1.3-2.4).[146]
- In a cohort of 1,978 patients admitted due to acute HF across Brazilian public hospitals under the 'Best Practice in Cardiology' program between 2016 and 2019, hemodynamic profiles at admission were evaluated as key predictors of clinical outcomes.[147] The study reported a high six-month mortality rate of 22%, with cold hemodynamic profiles showing a significant association with both in-hospital mortality (HR 1.72; 95% CI, 1.27–2.31; $p < 0.001$) and six-month mortality (HR 1.61; 95% CI, 1.29–2.02). Additionally, the six-month rehospitalization rate was 22%, occurring more frequently among patients with wet profiles (OR 2.30; 95% CI, 1.45–3.65; $p < 0.001$), highlighting the importance of hemodynamic assessment in risk stratification for acute HF.

Hospitalizations

- Hospital admissions are the main consequences of decompensated HF, resulting in worse prognosis and increasing costs. The BREATHE study has evaluated a sample of patients admitted due to acute decompensated HF. A total of 1,263 patients were included from 51 centers from different Brazilian regions in 2011 and 2012. In-hospital mortality was 12.6%, and care quality indicators based on hospital discharge recommendations were reached in less than 65% of the patients.[148] As reported in the Cardiovascular Statistics – Brazil 2023,[3] similar rates of in-hospital mortality have been reported, ranging from 9% to 17%.
- Several temporal analyses have shown a decrease in both number of hospitalizations and in-hospital mortality over time, mostly in the last decade, as discussed in detail in the Cardiovascular Statistics – Brazil 2021.[3,149]
- However, a more recent study has analyzed hospitalizations, 2,851,437 men and 2,749,424 women, between 2000 and 2021 in Brazil, using data from the Department of Information and Data Processing of the Brazilian Unified Health System (SUS). Regarding hospitalization rates, there was in fact an annual percent decrease of 6.7% to 8.1% in men and of 7.5% to 8.3% in women. However, with respect to mortality rates, there was an annual percent increase of 1.8% to 3.6% in men and of 3.1% to 3.5% in women.[150]

Burden of Disease

- The age-standardized YLD rates due to HF were 66.5 (45.7; 91.2) in 1990 and 61.2 (42.2; 85.5) in 2023, per 100,000 inhabitants, a decrease of 7.9 (-14.3; -2.5). Despite this decrease in YLD rates, HF resulted in 65,389 (45,034; 90,186) DALYs in Brazil in 1990 and 147,942 (101,812; 206,411) in 2023, due to population growth and aging. As expected, the highest YLD rate was observed in the 70+ year group, followed by the 50-69-year group (Tables 4.12 and 4.13).

Impact of the COVID-19 Pandemic

- The impacts of the COVID-19 pandemic have been discussed in the Cardiovascular Statistics - Brazil 2023.[1] Briefly, hospitalization and mortality data for Brazil in 2020 have shown reductions in HF hospitalizations and mortality. However, there was an increase in in-hospital deaths, suggesting that less severe patients were probably not hospitalized and, on the other hand, the more severe ones probably sought the hospital later, worsening the outcomes.[151] Other studies have confirmed those findings, with 16-20% reductions in HF hospitalizations as well as increases in HF lethality and in the hospital admission of patients with grater clinical severity (measured through the ADHERE risk score) during the COVID-19 outbreak.[152,153] (Charts 4.10 and 4.11).
- Another aspect of interest is the impact of COVID-19 infection on the progression of other diseases. A longitudinal study involving a cohort of patients with ChD (SaMi-Trop project) has revealed that positive SARS-CoV-2 serology was the only factor independently associated with the development of new major electrocardiographic abnormalities over a one-year follow-up period. Infected individuals showed a significantly higher risk of cardiac progression (OR 2.65; 95% UI, 1.27–5.53), suggesting that COVID-19 may accelerate the natural history of ChD.[135]

Health Care Utilization and Cost

- According to data from the SUS, in 2024 there were 232,537 hospitalizations for HF and cardiomyopathies. In the last two decades, these absolute numbers remained relatively stable and those still represent the leading cause of clinical hospitalization in public institutions. They account for more than one-third of total clinical admissions related to cardiovascular conditions in the last two decades.
- During the observed period, there was a reduction in the number of clinical admissions for HF from 298,474 (157 per 100,000) in 2008 to 230,559 (103 per 100,000) in 2024. Recent data suggest stabilization of HF–related hospital activity following the pandemic-related decline in 2020–2021.
- Administrative data show a substantial change in healthcare utilization related to heart failure and cardiomyopathies. In 2009, 300,126 hospitalizations were recorded, with inflation-adjusted payments totaling R$ 855.9 million. In 2024, 232,537 hospitalizations were recorded, with inflation-adjusted payments totaling R$ 587.8 million. This represents a reduction of approximately 23% in both the number of hospitalizations and total inflation-adjusted payments. The mean inflation-adjusted reimbursement per admission was similar: R$ 2,852 in 2009 and R$ 2,528 in 2024.

- Importantly, these estimates are derived from administrative coding data and primarily reflect admissions classified under HF diagnostic groups. Consequently, hospitalizations related to cardiac surgical procedures or device implantation – such as coronary artery bypass grafting, valve surgery, implantable cardioverter-defibrillators, or cardiac resynchronization therapy – are recorded under separate procedural or surgical categories. Therefore, they may not be fully captured within HF-specific admission counts or cost estimates. As a result, the reported figures likely represent the core burden of clinical HF admissions but may underestimate the total economic impact associated with advanced HF management, particularly in critical patients, those requiring procedural or device-based therapies.
- An ecological study using data from 2018 to 2021 has found projections that indicate a total expenditure of more than BRL 1 billion with hospitalizations, with an average hospital cost of BRL 1,725.27 per person. The average cost of hospitalization exceeded BRL 2 billion. Approximately 3% of federal expenditures are earmarked for HF benefit payments. Of the total number of absences, 65% corresponded to men and 35% to women, with costs that could reach R$ 6 billion lost per year.[154]
- A study of 198 outpatients with HF in three Brazilian hospitals from October 2018 to January 2021 has shown poor quality of life scores and high treatment costs (mean costs of outpatient follow-up were: US$ 215±238 for NYHA I patients, US$ 296±399 for NYHA II, and US$ 667±1012 for NYHA III/IV).[155]
- A micro-costing study has evaluated the direct medical cost of care for advanced HF patients who were candidates for left-ventricular assist device (and ineligible for transplantation). The average cost per patient was Int$120,457 (standard deviation of Int$78,029). Hospitalizations represented the largest share of total costs, accounting for 72%.[156]
- As discussed in the Cardiovascular Statistics - Brazil 2023,[3,149] the economic burden of HF in Brazil imposes a financial cost of R$ 22.1 billion (US$ 6.8 billion), as assessed in 2015, the second out of four main heart conditions in Brazil (myocardial infarction, HF, hypertension, and atrial fibrillation). In addition, increases in the mean per-patient cost of HF-related hospitalizations have been reported.[157]

Future Research

- Because HF is considered a garbage code when assigned as the underlying cause of death, studies investigating a better method for reclassification and redistribution of this cause are needed to reduce bias and promote better data comparability to enhance health policies.
- Brazilian cohort studies for cardiomyopathies are scarce, and some clinical studies in Brazil have reported HF data, but there are few multicenter studies with Brazilian population data. It is important to have data for both HF and cardiomyopathy, for both outpatients and hospitalizations, and to fully understand the increasing burden of HF in cardiovascular diseases. More multicenter large-scale studies are needed to better describe the burden, outcomes, and costs of HF in the Brazilian population.
- In addition, studies exploring quality of care and costs in HF would help develop health policies to improve awareness, access to life-saving interventions, organ donation, and the better use of resources in this complex and demanding disease.

Table 4.1 – Number of prevalence cases, age-standardized prevalence rate (per 100,000) of cardiomyopathy and myocarditis, in Brazil, in 1990 and 2023, and percent change (%) of rates in the period

	1990		2023		Percent Change (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	148,474.9 (124,791.4; 172,285.1)	126.3 (105.4; 147.9)	293,415.9 (241,523.7; 347,902.3)	130.0 (107.3; 151.5)	2.9 (-3.9; 9.4)
Acre	283.5 (236.3; 341.3)	92.9 (77.3; 109.6)	713.8 (577.3; 857.0)	89.5 (71.8; 108.9)	-3.6 (-13.6; 6.0)
Alagoas	2,830.2 (2,357.7; 3,341.5)	139.6 (115.6; 162.1)	4,225.8 (3,468.6; 5,022.8)	129.0 (106.2; 153.6)	-7.6 (-15.6; 1.2)
Amapá	231.2 (194.5; 275.6)	113.6 (95.3; 131.2)	748.5 (612.6; 881.5)	110.9 (89.2; 132.7)	-2.4 (-12.9; 6.9)
Amazonas	1,703.6 (1,402.3; 2,044.6)	114.8 (94.8; 134.1)	3,883.2 (3,187.1; 4,655.8)	106.6 (86.2; 128.1)	-7.1 (-16.2; 2.9)
Bahia	10,995.4 (9,153.4; 13,058.1)	115.6 (96.2; 137.5)	17,342.7 (13,995.5; 21,014.6)	109.2 (87.6; 130.0)	-5.6 (-16.1; 3.5)
Ceará	7,324.3 (6,152.9; 8,545.0)	139.2 (118.2; 162.2)	13,963.8 (11,496.9; 16,514.7)	140.6 (115.9; 167.1)	1.0 (-8.6; 11.1)
Distrito Federal	1,580.4 (1,308.8; 1,852.6)	144.1 (119.2; 169.6)	4,250.8 (3,460.6; 5,061.9)	145.6 (118.7; 172.2)	1.1 (-7.5; 11.8)
Espírito Santo	2,355.4 (1,979.1; 2,753.6)	115.6 (95.5; 136.4)	4,698.6 (3,833.1; 5,679.8)	110.1 (90.1; 132.2)	-4.8 (-14.5; 4.7)
Goiás	4,686.2 (3,956.5; 5,540.9)	169.2 (139.1; 200.8)	10,951.0 (9,048.0; 12,899.1)	146.5 (119.2; 172.7)	-13.4 (-21.5; -4.6)
Maranhão	3,636.7 (2,965.8; 4,415.0)	81.1 (67.3; 95.7)	6,519.1 (5,243.7; 8,006.2)	91.9 (73.8; 112.5)	13.3 (1.6; 23.8)
Mato Grosso	1,753.2 (1,466.5; 2,098.7)	126.2 (104.2; 146.8)	4,038.8 (3,343.2; 4,841.7)	112.7 (92.3; 134.5)	-10.7 (-19.4; -1.6)
Mato Grosso do Sul	1,918.1 (1,611.0; 2,213.1)	146.4 (122.1; 170.1)	3,787.4 (3,094.1; 4,534.6)	130.5 (106.8; 157.1)	-10.9 (-19.3; -1.5)
Minas Gerais	17,624.0 (14,750.9; 20,590.6)	140.1 (116.5; 165.5)	33,213.8 (27,002.3; 40,446.8)	137.6 (112.0; 163.9)	-1.8 (-11.4; 10.0)
Pará	3,736.7 (3,056.0; 4,524.3)	101.8 (86.0; 119.1)	8,161.3 (6,753.3; 9,579.9)	102.6 (83.5; 122.3)	0.8 (-8.3; 10.9)
Paraíba	4,194.0 (3,484.3; 4,849.9)	148.9 (124.3; 173.8)	6,494.2 (5,404.1; 7,805.9)	143.1 (118.9; 171.3)	-3.9 (-12.2; 5.4)
Paraná	7,743.7 (6,486.5; 9,048.7)	118.4 (98.7; 141.6)	14,160.1 (11,602.0; 16,906.5)	111.5 (90.8; 132.0)	-5.8 (-14.6; 5.7)
Pernambuco	6,232.0 (5,151.7; 7,323.6)	101.0 (83.8; 119.7)	10,369.0 (8,474.6; 12,622.0)	105.9 (86.7; 127.7)	4.9 (-6.5; 17.1)
Piauí	2,415.8 (1,978.5; 2,935.9)	106.9 (89.0; 126.0)	3,742.5 (3,006.2; 4,587.0)	103.9 (83.4; 125.2)	-2.8 (-11.0; 6.5)
Rio de Janeiro	12,704.3 (10,565.1; 14,956.6)	115.4 (96.6; 135.1)	26,606.3 (21,485.4; 32,577.0)	141.6 (116.9; 167.1)	22.7 (11.6; 33.4)
Rio Grande do Norte	2,123.5 (1,774.8; 2,502.6)	99.5 (83.2; 115.7)	3,523.6 (2,897.0; 4,245.5)	95.9 (78.5; 113.9)	-3.6 (-12.4; 5.0)
Rio Grande do Sul	7,180.7 (5,913.3; 8,441.5)	91.0 (74.1; 106.6)	12,023.8 (9,578.1; 14,792.8)	94.0 (75.0; 113.3)	3.3 (-8.1; 14.2)
Rondônia	832.6 (682.4; 999.3)	106.1 (88.0; 124.1)	1,593.7 (1,289.7; 1,954.8)	101.1 (81.1; 123.9)	-4.7 (-13.2; 5.4)
Roraima	201.0 (167.8; 239.2)	154.6 (128.4; 182.4)	793.3 (664.3; 942.7)	144.6 (119.3; 173.5)	-6.4 (-13.9; 4.0)

Santa Catarina	4,163.3 (3,490.9; 4,855.5)	119.9 (100.1; 140.9)	9,838.7 (8,059.2; 11,811.1)	119.8 (98.1; 142.9)	0.0 (-9.2; 10.3)
São Paulo	37,725.9 (31,501.1; 44,020.8)	152.5 (126.9; 177.1)	83,281.1 (67,580.1; 98,781.5)	164.3 (135.5; 197.0)	7.8 (-3.8; 17.1)
Sergipe	1,531.8 (1,281.4; 1,784.3)	130.7 (106.4; 153.1)	2,780.4 (2,282.0; 3,345.6)	118.6 (96.9; 142.0)	-9.3 (-19.3; 0.5)
Tocantins	767.1 (633.5; 905.0)	114.8 (95.7; 133.7)	1,710.8 (1,418.1; 2,040.2)	108.7 (89.0; 129.0)	-5.4 (-14.7; 5.0)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.2 – Number of deaths, age-standardized mortality rates (per 100,000) of cardiomyopathy and myocarditis, in Brazil and its Federative Units, in 1990 and 2023, and percent change (%) of rates in the period

Location	1990		2023		Percent Change (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	13,113.7 (11,989.1; 14,238.6)	15.5 (14.0; 16.9)	15,115.9 (13,377.6; 16,726.9)	5.9 (5.3; 6.6)	-61.8 (-65.5; -58.9)
Acre	16.9 (14.2; 20.2)	9.5 (8.1; 11.2)	26.7 (21.9; 31.8)	3.9 (3.2; 4.7)	-58.9 (-67.3; -49.2)
Alagoas	256.8 (211.8; 303.3)	18.5 (15.3; 21.8)	203.2 (173.4; 237.4)	5.9 (5.0; 6.9)	-67.8 (-74.8; -60.4)
Amapá	9.4 (7.9; 11.1)	9.0 (7.6; 10.7)	26.0 (21.5; 30.3)	4.6 (3.8; 5.3)	-49.3 (-59.2; -38.6)
Amazonas	73.1 (63.1; 83.3)	10.1 (8.7; 11.6)	113.5 (94.5; 133.2)	3.6 (3.0; 4.3)	-64.0 (-69.7; -55.4)
Bahia	828.0 (714.0; 953.7)	12.0 (10.4; 13.9)	667.6 (551.5; 772.7)	3.7 (3.1; 4.3)	-69.1 (-75.0; -63.2)
Ceará	428.3 (360.0; 511.5)	11.1 (9.2; 13.3)	607.9 (509.8; 702.1)	5.5 (4.7; 6.4)	-50.2 (-60.7; -39.1)
Distrito Federal	111.7 (98.2; 126.4)	18.0 (15.6; 20.4)	161.6 (134.3; 184.9)	5.4 (4.5; 6.2)	-70.0 (-75.1; -65.0)
Espírito Santo	194.5 (171.5; 216.1)	13.9 (12.3; 15.6)	296.0 (254.5; 335.8)	6.0 (5.1; 6.8)	-57.3 (-64.3; -51.4)
Goiás	468.9 (423.5; 518.2)	25.5 (22.7; 28.2)	523.9 (455.0; 604.0)	6.8 (5.8; 7.8)	-73.6 (-77.2; -70.0)
Maranhão	162.4 (113.6; 223.8)	5.6 (3.9; 7.7)	304.0 (244.6; 371.5)	4.3 (3.5; 5.3)	-23.1 (-47.2; 12.1)
Mato Grosso	97.9 (83.2; 115.6)	13.1 (11.2; 15.4)	175.9 (147.0; 206.5)	5.0 (4.1; 5.9)	-61.8 (-68.9; -53.4)
Mato Grosso do Sul	162.5 (144.6; 182.1)	19.7 (17.5; 22.1)	190.6 (161.9; 218.6)	6.1 (5.2; 7.0)	-69.0 (-73.5; -63.7)
Minas Gerais	1,718.6 (1,546.0; 1,876.5)	18.3 (16.3; 20.0)	1,263.4 (1,066.3; 1,443.7)	4.4 (3.7; 5.1)	-75.8 (-78.8; -73.0)
Pará	205.3 (177.9; 233.9)	9.9 (8.4; 11.3)	295.1 (247.2; 338.2)	4.0 (3.4; 4.6)	-59.8 (-67.1; -52.2)
Paraíba	383.6 (317.6; 454.4)	16.8 (13.8; 19.9)	286.1 (240.7; 341.6)	5.6 (4.7; 6.7)	-66.7 (-73.4; -58.4)
Paraná	784.8 (693.3; 861.9)	17.3 (15.2; 19.2)	577.4 (493.8; 660.9)	4.0 (3.4; 4.6)	-76.9 (-79.7; -73.9)
Pernambuco	507.5 (436.1; 592.9)	11.2 (9.6; 13.1)	447.0 (378.5; 519.6)	4.1 (3.5; 4.8)	-63.3 (-70.3; -55.9)
Piauí	141.7 (112.6; 174.0)	10.0 (7.9; 12.4)	157.9 (126.2; 193.1)	3.9 (3.1; 4.8)	-61.3 (-70.9; -49.9)
Rio de Janeiro	1,208.7 (1,083.2; 1,329.8)	13.4 (12.0; 14.7)	1,321.7 (1,149.9; 1,491.8)	5.9 (5.1; 6.6)	-56.0 (-61.7; -50.4)
Rio Grande do Norte	112.0 (92.9; 135.4)	6.9 (5.7; 8.3)	135.3 (111.3; 163.7)	3.2 (2.6; 3.8)	-53.5 (-64.9; -42.1)
Rio Grande do Sul	547.8 (487.1; 602.0)	9.2 (8.1; 10.1)	491.5 (417.1; 559.2)	3.1 (2.6; 3.5)	-66.8 (-71.5; -62.5)
Rondônia	46.1 (40.0; 52.8)	13.1 (11.2; 15.1)	68.8 (58.0; 81.0)	4.4 (3.7; 5.2)	-66.3 (-71.9; -58.7)
Roraima	11.9 (9.8; 14.2)	20.7 (17.1; 24.4)	35.0 (29.5; 42.5)	8.3 (7.0; 9.9)	-59.7 (-66.6; -47.9)
Santa Catarina	372.0 (336.3; 410.3)	16.4 (14.6; 18.2)	462.8 (394.9; 530.5)	5.1 (4.3; 5.8)	-68.7 (-73.1; -64.5)
São Paulo	4,115.6 (3,693.5; 4,503.0)	22.5 (20.1; 24.6)	6,094.7 (5,255.5; 6,939.3)	10.4 (8.9; 11.8)	-53.9 (-59.1; -48.1)
Sergipe	102.1 (87.3; 119.3)	12.5 (10.7; 14.6)	106.2 (86.7; 125.2)	4.3 (3.5; 5.0)	-66.0 (-72.4; -58.3)
Tocantins	45.7 (38.6; 55.3)	15.5 (12.9; 18.5)	76.2 (63.1; 89.8)	4.8 (3.9; 5.6)	-69.1 (-75.2; -61.0)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.3 – Mortality rate (per 100,000 inhabitants) due to cardiomyopathy and myocarditis, by age group, in Brazil, in 1990 and 2023, and percent change of rates in the period

	1990	2023	Percent Change (95% UI)
Age-standardized	15.5 (14.0; 16.9)	5.9 (5.3; 6.6)	-61.8 (-65.5; -58.9)
Under 5	3.6 (3.1; 4.2)	1.0 (0.9; 1.1)	-72.9 (-76.8; -68.2)
5-14 years	0.4 (0.3; 0.4)	0.3 (0.2; 0.3)	-29.9 (-41.7; -14.8)
15-49 years	2.9 (2.6; 3.3)	2.3 (2.1; 2.5)	-22.3 (-30.3; -15.0)
50-69 years	28.5 (26.0; 31.1)	11.4 (10.1; 12.5)	-60.0 (-63.7; -55.9)
70+ years	131.7 (115.2; 145.5)	48.8 (40.2; 55.7)	-62.9 (-67.6; -58.7)
All Ages	8.8 (8.0; 9.5)	7.1 (6.3; 7.9)	-18.8 (-26.6; -12.4)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.4 – Cardiomyopathy and myocarditis: number of DALYs, age-standardized DALY rates (per 100,000), in Brazil and its Federative Units, in 1990 and 2023, and percent change (%) of rates in the period

Location	1990		2023		Percent Change (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	414,749.2 (379,595.3; 450,091.9)	394.9 (362.3; 428.8)	424,337.9 (387,562.7; 462,725.1)	172.4 (157.8; 187.8)	-56.3 (-60.0; -52.9)
Acre	699.1 (589.4; 845.0)	256.2 (218.8; 304.1)	826.6 (692.0; 964.9)	106.8 (88.7; 125.3)	-58.3 (-67.5; -48.9)
Alagoas	9,197.3 (7,667.8; 11,016.9)	497.8 (416.4; 582.4)	6,163.2 (5,320.7; 7,066.9)	175.9 (152.3; 202.1)	-64.7 (-72.2; -55.7)
Amapá	339.2 (282.5; 403.1)	221.8 (187.7; 258.5)	868.3 (724.8; 1,024.8)	130.8 (109.0; 151.9)	-41.0 (-52.0; -28.6)
Amazonas	2,670.8 (2,291.2; 3,024.6)	237.9 (206.0; 268.9)	3,836.7 (3,311.3; 4,418.5)	107.4 (92.8; 125.4)	-54.9 (-61.6; -45.4)
Bahia	27,990.6 (24,166.4; 32,297.9)	330.5 (287.2; 377.0)	19,672.6 (17,111.4; 22,807.5)	116.7 (101.7; 134.8)	-64.7 (-71.4; -58.0)
Ceará	13,584.5 (11,653.9; 16,105.0)	284.8 (244.3; 339.7)	17,627.8 (15,170.8; 20,076.5)	166.1 (143.1; 189.5)	-41.7 (-54.8; -28.9)
Distrito Federal	4,172.4 (3,679.7; 4,706.4)	458.1 (405.4; 515.7)	4,614.4 (3,989.6; 5,302.7)	144.5 (125.0; 165.9)	-68.5 (-73.4; -63.4)
Espírito Santo	6,161.6 (5,494.8; 6,859.1)	346.5 (309.2; 383.7)	8,428.7 (7,284.7; 9,630.9)	174.4 (150.6; 199.1)	-49.7 (-57.8; -42.5)
Goiás	14,993.2 (13,501.8; 16,462.4)	606.2 (547.9; 665.1)	14,565.0 (12,793.9; 16,591.4)	181.7 (159.6; 206.8)	-70.0 (-73.9; -66.0)
Maranhão	7,411.3 (5,315.7; 9,987.2)	182.0 (130.2; 252.1)	9,281.7 (7,667.9; 11,097.0)	127.5 (105.1; 152.6)	-29.9 (-51.3; -1.0)
Mato Grosso	3,598.1 (3,062.0; 4,267.5)	324.0 (280.3; 380.9)	5,211.4 (4,468.6; 6,036.6)	137.6 (117.6; 159.8)	-57.5 (-65.4; -48.3)
Mato Grosso do Sul	5,151.6 (4,576.8; 5,768.2)	471.2 (420.3; 529.1)	5,346.7 (4,667.3; 6,126.2)	170.1 (148.4; 194.8)	-63.9 (-69.4; -57.8)
Minas Gerais	53,809.9 (48,818.8; 59,090.3)	470.6 (426.5; 514.1)	33,000.0 (28,762.6; 37,526.2)	125.8 (109.2; 143.1)	-73.3 (-76.4; -70.1)
Pará	7,319.0 (6,378.4; 8,344.9)	247.7 (216.4; 282.9)	8,877.6 (7,716.4; 10,013.8)	111.1 (96.8; 125.3)	-55.1 (-63.0; -46.7)
Paraíba	14,307.4 (11,979.5; 17,017.3)	516.8 (438.5; 609.8)	8,167.5 (7,021.2; 9,542.8)	169.2 (145.2; 197.0)	-67.3 (-74.0; -58.8)
Paraná	23,671.9 (21,241.3; 25,897.7)	417.7 (371.9; 456.9)	15,598.6 (13,551.8; 17,688.8)	111.0 (96.5; 126.6)	-73.4 (-76.4; -69.9)
Pernambuco	17,798.6 (15,316.8; 20,731.3)	312.6 (269.8; 363.2)	13,317.1 (11,464.6; 15,336.7)	124.8 (107.5; 143.9)	-60.1 (-68.0; -52.5)
Piauí	4,859.9 (3,944.4; 6,031.3)	262.6 (213.0; 324.5)	4,459.4 (3,676.6; 5,327.6)	115.1 (95.0; 137.2)	-56.2 (-66.9; -44.9)
Rio de Janeiro	37,991.2 (34,180.0; 41,926.5)	354.1 (321.0; 389.4)	38,156.2 (33,344.1; 43,422.5)	186.7 (163.4; 212.9)	-47.3 (-53.9; -39.7)
Rio Grande do Norte	3,720.5 (3,131.0; 4,445.0)	187.1 (158.5; 223.6)	3,823.7 (3,217.4; 4,531.9)	95.3 (80.6; 112.2)	-49.0 (-60.6; -36.4)
Rio Grande do Sul	16,272.3 (14,601.7; 17,891.3)	225.2 (202.1; 247.0)	12,289.6 (10,745.3; 13,859.8)	84.4 (74.4; 95.6)	-62.5 (-67.3; -57.6)

Rondônia	1,810.8 (1,559.2; 2,069.7)	314.2 (273.2; 357.8)	1,993.6 (1,689.2; 2,327.2)	117.7 (100.6; 137.4)	-62.5 (-68.6; -54.9)
Roraima	490.9 (399.5; 583.2)	489.4 (407.4; 576.2)	1,238.7 (1,058.7; 1,483.7)	226.8 (194.3; 270.9)	-53.7 (-61.8; -39.9)
Santa Catarina	10,914.6 (9,866.7; 12,037.6)	375.1 (338.6; 412.7)	12,416.9 (10,676.9; 14,069.5)	134.3 (115.8; 151.8)	-64.2 (-69.1; -59.6)
São Paulo	120,923.2 (109,357.9; 132,329.8)	535.4 (483.0; 585.3)	169,286.6 (149,542.2; 192,132.0)	301.8 (266.4; 341.9)	-43.6 (-50.5; -35.7)
Sergipe	3,155.7 (2,736.9; 3,728.8)	309.1 (267.4; 362.3)	3,053.4 (2,603.0; 3,604.8)	121.5 (103.3; 142.7)	-60.7 (-68.0; -52.5)
Tocantins	1,733.4 (1,439.0; 2,100.1)	333.3 (282.6; 398.7)	2,216.0 (1,872.4; 2,585.7)	133.7 (113.3; 156.4)	-59.9 (-68.3; -50.4)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.5 – DALY rates due to cardiomyopathy and myocarditis (per 100,000), according to age groups, in Brazil, 1990 and 2023, and percent change (%) of rates in the period

Age group	1990	2023	Percent Change (95% UI)
Age-standardized	394.9 (362.3; 428.8)	172.4 (157.8; 187.8)	-56.3 (-60.0; -52.9)
Under 5	330.7 (287.5; 385.0)	95.1 (84.2; 109.0)	-71.2 (-75.3; -66.2)
5-14 years	35.9 (30.8; 42.3)	28.9 (24.5; 34.7)	-19.4 (-31.4; -6.4)
15-49 years	160.5 (144.7; 176.9)	125.1 (114.5; 137.1)	-22.0 (-29.6; -15.1)
50-69 years	871.9 (796.2; 952.7)	358.2 (318.8; 394.5)	-58.9 (-62.7; -54.9)
70+ years	2,001.7 (1,778.0; 2,198.5)	712.4 (606.1; 804.0)	-64.4 (-68.5; -60.6)
All Ages	277.7 (254.2; 301.4)	200.1 (182.7; 218.2)	-28.0 (-34.2; -22.4)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.6 – Chagas disease: number of prevalence cases, age-standardized prevalence rates (per 100,000), and percent change (%) of rates, in Brazil and its Federative Units, 1990 and 2023

	1990		2023		Percent Change (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	4,794,479.1 (4,195,252.5; 5,554,404.5)	4,171.8 (3,637.2; 4,792.0)	4,010,982.9 (3,461,447.1; 4,625,517.1)	1,600.3 (1,380.8; 1,842.4)	-61.6 (-62.6; -60.1)
Acre	7,213.6 (6,051.2; 8,435.3)	2,856.3 (2,380.1; 3,326.5)	7,997.1 (6,833.2; 9,358.4)	989.4 (840.0; 1,157.5)	-65.4 (-67.8; -62.6)
Alagoas	66,148.2 (56,013.2; 80,497.6)	3,845.0 (3,252.3; 4,642.2)	51,454.1 (43,960.5; 60,162.0)	1,453.4 (1,243.0; 1,693.8)	-62.2 (-65.1; -59.4)
Amapá	4,097.7 (3,395.2; 5,013.4)	2,529.6 (2,077.7; 3,061.5)	5,944.8 (5,065.1; 6,898.2)	861.0 (729.6; 997.1)	-66.0 (-68.8; -62.4)
Amazonas	16,277.0 (14,084.6; 19,117.4)	1,256.5 (1,080.0; 1,446.0)	20,755.2 (17,564.8; 24,093.0)	548.9 (466.0; 631.6)	-56.3 (-59.2; -52.8)
Bahia	980,998.5 (869,749.9; 1,125,780.0)	11,068.8 (9,804.5; 12,552.8)	787,035.0 (668,165.1; 913,997.3)	4,586.8 (3,899.4; 5,319.0)	-58.6 (-61.9; -55.8)
Ceará	77,804.9 (65,077.0; 90,300.8)	1,621.3 (1,348.6; 1,900.9)	54,391.0 (46,362.1; 63,882.7)	515.3 (441.0; 604.5)	-68.2 (-71.0; -65.9)
Distrito Federal	64,542.6 (54,409.1; 77,230.4)	6,042.9 (5,073.9; 7,144.0)	77,559.6 (65,683.3; 90,961.8)	2,327.5 (1,979.7; 2,722.8)	-61.5 (-64.1; -59.0)
Espírito Santo	48,736.7 (39,840.9; 58,172.9)	2,513.7 (2,004.6; 3,006.3)	39,491.1 (33,449.5; 46,693.3)	818.4 (699.5; 963.5)	-67.4 (-69.5; -64.9)
Goiás	466,473.7 (412,540.7; 530,546.8)	15,136.9 (13,500.2; 16,902.1)	530,218.1 (460,665.2; 607,713.7)	6,278.0 (5,446.1; 7,172.4)	-58.5 (-61.2; -55.9)
Maranhão	87,933.5 (73,838.0; 103,640.4)	2,700.3 (2,280.8; 3,171.9)	73,026.3 (61,709.8; 85,871.4)	1,004.1 (850.0; 1,175.4)	-62.8 (-65.5; -59.2)
Mato Grosso	45,153.9 (38,798.6; 53,962.4)	3,515.5 (2,972.2; 4,151.2)	51,133.6 (44,002.4; 59,843.6)	1,263.8 (1,087.8; 1,474.0)	-64.0 (-66.5; -61.5)
Mato Grosso do Sul	30,505.4 (25,642.0; 35,152.2)	2,367.7 (1,993.2; 2,747.9)	30,344.4 (26,242.3; 35,081.8)	938.3 (812.9; 1,079.3)	-60.4 (-62.3; -58.1)
Minas Gerais	533,784.2 (476,023.1; 600,111.5)	4,355.8 (3,879.2; 4,899.4)	500,933.5 (433,959.0; 585,971.1)	1,872.1 (1,620.3; 2,165.5)	-57.0 (-60.2; -53.7)
Pará	85,951.7 (72,131.9; 103,361.6)	2,761.5 (2,296.3; 3,294.3)	81,315.0 (67,941.8; 94,916.9)	966.0 (804.7; 1,115.5)	-65.0 (-67.6; -62.3)
Paraíba	73,927.9 (62,380.9; 88,891.1)	2,943.7 (2,454.6; 3,553.0)	52,663.0 (44,541.5; 60,822.0)	1,082.1 (919.1; 1,254.9)	-63.2 (-66.2; -60.3)
Paraná	237,931.5 (200,510.2; 280,474.0)	3,676.4 (3,084.9; 4,393.3)	181,434.4 (153,317.1; 208,966.7)	1,246.7 (1,058.9; 1,438.3)	-66.1 (-68.3; -63.6)
Pernambuco	189,128.2 (165,041.9; 219,029.9)	3,487.6 (3,042.8; 4,023.6)	147,967.5 (125,449.4; 175,351.1)	1,368.0 (1,162.6; 1,611.9)	-60.8 (-63.2; -58.3)
Piauí	69,240.9 (59,702.1; 78,856.6)	3,891.3 (3,329.1; 4,457.7)	53,330.4 (46,071.0; 61,090.5)	1,349.1 (1,168.1; 1,542.4)	-65.3 (-67.5; -61.6)
Rio de Janeiro	332,719.1 (283,795.0; 388,814.2)	2,898.0 (2,465.7; 3,369.8)	238,164.7 (200,733.2; 279,921.6)	1,120.9 (955.1; 1,305.6)	-61.3 (-64.2; -58.1)
Rio Grande do Norte	38,615.5 (33,446.3; 44,119.0)	2,098.8 (1,804.7; 2,420.9)	26,895.1 (22,746.6; 30,598.9)	663.0 (563.6; 753.7)	-68.4 (-70.2; -66.2)
Rio Grande do Sul	216,204.0 (178,081.1; 264,090.8)	2,724.9 (2,236.0; 3,313.6)	141,167.0 (120,269.8; 166,483.8)	954.5 (821.7; 1,115.2)	-65.0 (-67.3; -62.0)

Rondônia	15,129.4 (12,375.6; 17,880.9)	2,301.5 (1,879.1; 2,689.0)	11,812.4 (9,839.8; 13,765.4)	670.1 (561.0; 779.2)	-70.9 (-72.9; -68.8)
Roraima	2,631.4 (2,141.3; 3,181.8)	2,203.9 (1,845.2; 2,671.0)	4,045.0 (3,357.3; 4,844.7)	710.0 (591.7; 844.9)	-67.8 (-70.4; -64.7)
Santa Catarina	90,576.9 (74,958.9; 111,021.0)	2,604.3 (2,176.7; 3,175.3)	86,965.6 (74,293.4; 102,994.7)	920.8 (791.2; 1,086.8)	-64.6 (-67.9; -61.1)
São Paulo	957,997.0 (817,826.1; 1,123,950.0)	3,686.5 (3,134.0; 4,371.1)	709,355.6 (616,144.3; 819,393.1)	1,229.0 (1,071.6; 1,416.2)	-66.7 (-68.9; -63.9)
Sergipe	29,860.9 (25,012.7; 35,968.8)	2,859.5 (2,381.6; 3,419.5)	16,291.4 (13,842.5; 19,189.4)	638.4 (542.4; 751.1)	-77.7 (-79.4; -75.4)
Tocantins	24,894.8 (21,396.1; 29,597.7)	4,302.8 (3,677.4; 5,091.7)	29,292.1 (24,683.2; 33,928.3)	1,742.4 (1,469.1; 2,017.9)	-59.5 (-62.1; -56.5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.7 – Number of deaths, age-standardized mortality rates (per 100,000 inhabitants) due to Chagas disease, and percent change (%) of rates, in Brazil and its Federative Units, 1990 and 2023

	1990		2023		Percent change (95% UI)
	Number of deaths (95% UI)	Mortality Rate (95% UI)	Number of deaths (95% UI)	Mortality Rate (95% UI)	
Brazil	9,387.0 (8,785.7; 10,052.3)	10.1 (9.3; 10.9)	5,731.0 (5,127.2; 6,286.0)	2.2 (2.0; 2.4)	-78.3 (-80.4; -75.5)
Acre	6.3 (4.9; 8.0)	3.6 (2.8; 4.7)	6.5 (5.2; 7.9)	0.9 (0.8; 1.1)	-74.1 (-80.6; -64.6)
Alagoas	126.5 (94.6; 162.7)	9.3 (7.0; 12.0)	91.4 (73.2; 110.8)	2.6 (2.1; 3.2)	-71.5 (-79.4; -58.8)
Amapá	2.5 (1.9; 3.2)	2.4 (1.8; 3.1)	3.8 (2.9; 4.8)	0.7 (0.5; 0.8)	-72.0 (-79.1; -62.0)
Amazonas	17.5 (14.2; 21.1)	2.2 (1.8; 2.6)	18.4 (15.2; 22.3)	0.6 (0.5; 0.7)	-73.1 (-80.0; -64.0)
Bahia	862.5 (733.3; 1,015.0)	12.3 (10.5; 14.5)	706.7 (607.8; 823.4)	3.9 (3.3; 4.5)	-68.5 (-74.3; -61.1)
Ceará	112.4 (81.4; 148.5)	2.9 (2.1; 3.8)	103.0 (80.0; 129.0)	0.9 (0.7; 1.2)	-67.5 (-75.2; -55.9)
Distrito Federal	248.3 (225.2; 270.9)	37.0 (32.7; 41.6)	197.1 (161.8; 244.5)	6.5 (5.3; 8.1)	-82.5 (-86.1; -77.6)
Espírito Santo	43.0 (35.5; 53.0)	2.9 (2.4; 3.5)	27.8 (22.2; 34.1)	0.5 (0.4; 0.7)	-81.0 (-85.4; -75.9)
Goiás	1,187.7 (1,093.6; 1,280.2)	56.2 (51.4; 60.9)	764.9 (685.2; 849.8)	9.8 (8.8; 10.9)	-82.5 (-84.5; -80.3)
Maranhão	62.9 (46.3; 82.6)	2.6 (1.9; 3.4)	60.2 (45.8; 73.9)	0.9 (0.7; 1.1)	-66.3 (-75.3; -52.5)
Mato Grosso	63.9 (52.1; 77.6)	7.6 (6.2; 9.2)	70.7 (56.2; 85.0)	2.0 (1.5; 2.3)	-74.4 (-80.3; -66.7)
Mato Grosso do Sul	74.4 (63.2; 86.3)	7.9 (6.8; 9.3)	53.9 (45.4; 64.2)	1.7 (1.4; 2.0)	-78.9 (-82.9; -73.1)
Minas Gerais	2,519.7 (2,363.2; 2,668.6)	24.4 (22.8; 26.2)	1,224.2 (1,082.5; 1,358.9)	4.1 (3.7; 4.6)	-83.0 (-84.9; -80.7)
Pará	80.1 (68.8; 93.1)	3.7 (3.2; 4.3)	64.5 (54.0; 75.2)	0.9 (0.7; 1.0)	-76.9 (-81.5; -72.0)
Paraíba	79.1 (60.7; 103.4)	3.6 (2.8; 4.7)	62.1 (47.7; 77.9)	1.2 (0.9; 1.5)	-66.7 (-75.5; -55.4)
Paraná	518.0 (471.1; 569.8)	10.2 (9.2; 11.3)	255.1 (224.8; 289.2)	1.7 (1.5; 1.9)	-83.3 (-85.7; -81.0)
Pernambuco	287.3 (229.5; 358.9)	6.3 (5.0; 7.9)	156.7 (130.0; 185.8)	1.4 (1.2; 1.7)	-77.6 (-83.3; -69.7)
Piauí	86.2 (63.7; 112.1)	6.2 (4.6; 8.1)	80.9 (61.6; 100.1)	2.0 (1.5; 2.4)	-68.4 (-76.6; -54.8)
Rio de Janeiro	384.6 (343.0; 427.7)	3.9 (3.5; 4.4)	194.4 (170.2; 219.5)	0.8 (0.7; 0.9)	-79.3 (-82.6; -75.6)
Rio Grande do Norte	38.9 (30.8; 48.2)	2.5 (2.0; 3.1)	29.8 (23.0; 36.5)	0.7 (0.5; 0.9)	-71.5 (-79.5; -62.1)
Rio Grande do Sul	228.0 (207.3; 247.7)	3.5 (3.2; 3.8)	109.8 (95.2; 125.4)	0.6 (0.6; 0.7)	-81.5 (-84.4; -78.7)

Rondônia	38.6 (31.6; 46.5)	9.4 (7.8; 11.4)	25.8 (18.2; 35.4)	1.6 (1.1; 2.2)	-83.1 (-89.1; -74.2)
Roraima	1.9 (1.5; 2.4)	2.8 (2.3; 3.5)	2.5 (1.7; 3.4)	0.6 (0.4; 0.8)	-79.8 (-87.5; -70.0)
Santa Catarina	73.7 (64.1; 83.8)	2.9 (2.6; 3.4)	52.6 (44.6; 62.4)	0.6 (0.5; 0.7)	-80.9 (-84.2; -76.7)
São Paulo	2,175.5 (2,011.4; 2,367.2)	10.2 (9.3; 11.2)	1,288.9 (1,158.3; 1,409.7)	2.1 (1.9; 2.3)	-79.2 (-81.8; -76.0)
Sergipe	26.7 (21.5; 33.5)	3.2 (2.6; 4.1)	23.1 (17.8; 28.3)	0.9 (0.7; 1.1)	-71.7 (-79.7; -61.3)
Tocantins	40.7 (28.1; 57.5)	11.3 (8.0; 15.7)	56.2 (42.2; 71.9)	3.5 (2.6; 4.5)	-69.1 (-76.4; -56.9)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.8 – Mortality rate (per 100,000 inhabitants) due to Chagas disease, per age group and sex, in Brazil, in 1990 and 2023, and percent change of rates in the period

	1990	2023	Percent Change (95% UI)
All			
Age-standardized	10.1 (9.3; 10.9)	2.2 (2.0; 2.4)	-78.3 (-80.4; -75.5)
Under 5	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	-92.7 (-94.3; -90.6)
5-14 years	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	-85.5 (-89.7; -80.3)
15-49 years	3.1 (2.9; 3.3)	0.4 (0.4; 0.5)	-86.8 (-88.5; -84.8)
50-69 years	27.3 (25.3; 29.2)	4.7 (4.2; 5.3)	-82.8 (-84.6; -80.0)
70+ years	62.8 (55.1; 71.1)	21.3 (18.3; 24.0)	-66.1 (-70.9; -60.8)
All Ages	6.3 (5.9; 6.7)	2.7 (2.4; 3.0)	-57.0 (-61.5; -51.5)
Male			
Age-standardized	12.7 (11.4; 14.2)	2.6 (2.4; 2.9)	-79.3 (-81.8; -76.5)
Under 5	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	-93.3 (-95.1; -90.9)
5-14 years	0.0 (0.0; 0.1)	0.0 (0.0; 0.0)	-87.6 (-91.9; -81.7)
15-49 years	4.3 (3.9; 4.7)	0.5 (0.5; 0.6)	-87.3 (-89.3; -85.0)
50-69 years	34.9 (31.7; 38.2)	6.0 (5.3; 7.0)	-82.8 (-85.4; -79.6)
70+ years	73.4 (60.2; 87.3)	23.2 (20.4; 26.2)	-68.3 (-74.4; -61.0)
All Ages	7.7 (7.0; 8.4)	2.9 (2.7; 3.2)	-61.8 (-65.9; -56.7)
Female			
Age-standardized	7.8 (7.1; 8.4)	1.8 (1.6; 2.1)	-76.4 (-79.7; -72.6)
Under 5	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	-91.8 (-94.0; -88.9)
5-14 years	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	-81.8 (-88.5; -71.8)
15-49 years	2.0 (1.8; 2.2)	0.3 (0.2; 0.3)	-85.6 (-88.3; -82.5)
50-69 years	20.4 (18.5; 22.0)	3.5 (3.2; 4.0)	-82.6 (-84.8; -79.9)
70+ years	54.2 (47.6; 60.1)	19.8 (16.4; 23.0)	-63.4 (-69.1; -56.9)
All Ages	4.9 (4.5; 5.3)	2.5 (2.1; 2.8)	-49.6 (-56.9; -41.3)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.9 – Number of DALYs, age-standardized DALY rates (per 100,000) due to Chagas disease, and percent change (%) of rates, in Brazil and its Federative Units, 1990 and 2023

Location	1990		2023		Percent Change (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	335,290.6 (311,665.6; 361,605.9)	322.8 (299.6; 349.1)	166,204.3 (149,223.2; 187,681.5)	63.4 (56.8; 71.6)	-80.4 (-82.0; -78.1)
Acre	251.3 (202.0; 306.6)	122.0 (97.8; 147.9)	242.8 (197.7; 287.7)	32.1 (26.1; 38.3)	-73.7 (-78.9; -66.7)
Alagoas	4,384.4 (3,479.2; 5,594.0)	288.9 (230.1; 366.6)	2,829.5 (2,300.4; 3,370.6)	79.1 (64.3; 94.4)	-72.6 (-79.7; -62.4)
Amapá	107.8 (87.8; 132.0)	84.6 (68.9; 103.7)	155.5 (126.0; 188.6)	24.5 (19.9; 29.7)	-71.0 (-76.3; -64.1)
Amazonas	668.4 (551.5; 795.7)	67.6 (55.8; 79.9)	676.1 (565.6; 793.0)	19.4 (16.2; 22.8)	-71.4 (-77.4; -63.8)
Bahia	34,668.8 (30,250.2; 40,134.4)	451.9 (394.3; 527.0)	23,764.8 (20,159.4; 28,328.5)	131.9 (112.1; 157.4)	-70.8 (-75.2; -65.4)
Ceará	3,743.0 (2,886.9; 4,873.2)	88.0 (68.2; 114.3)	2,988.9 (2,410.3; 3,608.1)	27.4 (22.1; 33.1)	-68.8 (-75.2; -59.9)
Distrito Federal	9,019.0 (8,226.0; 9,894.4)	1,037.1 (936.7; 1,142.6)	5,253.7 (4,407.3; 6,346.1)	161.4 (135.6; 194.8)	-84.4 (-87.3; -80.6)
Espírito Santo	1,695.8 (1,430.0; 1,988.4)	99.6 (83.7; 116.7)	1,056.3 (873.2; 1,257.0)	20.8 (17.1; 24.7)	-79.1 (-82.9; -75.2)
Goiás	41,286.8 (37,947.8; 44,361.8)	1,640.1 (1,503.7; 1,761.6)	21,490.7 (19,249.1; 24,184.2)	259.6 (232.4; 291.9)	-84.2 (-85.8; -82.3)
Maranhão	2,542.5 (1,960.6; 3,233.8)	91.7 (71.1; 116.7)	2,191.7 (1,755.2; 2,619.5)	30.5 (24.4; 36.4)	-66.7 (-73.4; -56.8)
Mato Grosso	2,482.1 (2,063.9; 2,994.1)	235.2 (195.4; 280.6)	2,275.6 (1,878.2; 2,672.9)	57.7 (47.3; 67.6)	-75.5 (-80.5; -69.3)
Mato Grosso do Sul	2,628.6 (2,237.8; 2,994.2)	236.5 (200.7; 268.6)	1,630.7 (1,388.7; 1,884.2)	49.2 (41.8; 56.8)	-79.2 (-82.8; -74.1)
Minas Gerais	85,583.2 (80,212.2; 90,816.4)	744.6 (699.4; 792.0)	30,773.9 (28,100.6; 33,943.3)	105.7 (96.3; 116.8)	-85.8 (-87.1; -84.1)
Pará	3,139.1 (2,715.7; 3,654.0)	122.7 (107.1; 143.2)	2,407.7 (2,060.5; 2,781.3)	29.7 (25.5; 34.3)	-75.8 (-79.0; -72.3)
Paraíba	2,731.6 (2,146.6; 3,458.9)	118.2 (93.1; 149.6)	2,007.0 (1,590.9; 2,405.5)	39.5 (31.2; 47.3)	-66.5 (-72.9; -57.2)
Paraná	18,128.4 (16,603.0; 19,689.7)	310.4 (282.8; 339.0)	7,383.6 (6,534.3; 8,498.8)	48.4 (42.8; 55.6)	-84.4 (-86.2; -82.3)
Pernambuco	9,877.4 (8,203.0; 11,998.5)	200.2 (167.0; 242.7)	5,142.3 (4,303.2; 6,142.0)	46.1 (38.6; 55.1)	-77.0 (-82.1; -70.3)
Piauí	2,996.5 (2,316.8; 3,843.9)	192.5 (150.2; 248.1)	2,458.4 (1,969.1; 2,968.4)	60.2 (48.3; 72.6)	-68.7 (-75.7; -58.0)
Rio de Janeiro	14,474.5 (12,929.4; 16,226.8)	133.7 (119.0; 151.0)	6,896.6 (5,924.1; 8,195.4)	29.7 (25.5; 35.5)	-77.8 (-80.4; -75.0)
Rio Grande do Norte	1,386.8 (1,144.5; 1,712.1)	83.0 (68.4; 102.7)	989.3 (800.5; 1,162.7)	23.5 (19.1; 27.7)	-71.7 (-77.7; -64.9)
Rio Grande do Sul	8,318.3 (7,513.3; 9,352.2)	114.1 (102.6; 128.5)	3,812.2 (3,234.1; 4,446.2)	23.4 (19.8; 27.4)	-79.5 (-81.7; -77.5)
Rondônia	1,455.3 (1,223.7; 1,729.2)	268.2 (226.4; 318.8)	774.7 (564.3; 1,026.5)	44.1 (32.0; 58.1)	-83.6 (-88.8; -76.1)
Roraima	87.8 (70.7; 108.0)	94.8 (76.1; 115.4)	103.9 (78.9; 133.9)	20.4 (15.6; 26.3)	-78.5 (-84.9; -70.7)

Santa Catarina	2,836.8 (2,421.5; 3,292.6)	96.2 (83.0; 110.4)	2,051.2 (1,704.7; 2,481.3)	21.1 (17.5; 25.6)	-78.1 (-81.0; -75.0)
São Paulo	78,350.5 (72,112.0; 84,679.3)	322.9 (295.2; 348.8)	34,436.0 (31,137.2; 38,077.2)	56.1 (50.7; 62.1)	-82.6 (-84.4; -80.5)
Sergipe	990.9 (815.2; 1,201.9)	109.5 (90.7; 131.5)	740.9 (598.7; 876.9)	28.5 (23.0; 33.7)	-74.0 (-79.6; -66.8)
Tocantins	1,454.9 (1,067.0; 1,973.1)	308.0 (224.3; 418.4)	1,670.2 (1,285.0; 2,079.1)	100.0 (77.3; 124.8)	-67.5 (-74.4; -57.1)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.10 – DALY rates due to Chagas disease (per 100,000), by age and sex, in Brazil, 1990 and 2023, and percent change of the rates in the period

Age group	1990	2023	Percent Change (95% UI)
All			
Age-standardized	322.8 (299.6, 349.1)	63.4 (56.8, 71.6)	-80.4 (-82.0, -78.1)
Under 5	2.7 (2.3, 3.4)	0.2 (0.2, 0.3)	-92.4 (-94.0, -90.3)
5-14 years	4.0 (3.2, 5.1)	0.9 (0.7, 1.2)	-77.7 (-82.2, -72.2)
15-49 years	176.0 (163.2, 190.9)	28.8 (24.4, 34.3)	-83.6 (-85.9, -81.4)
50-69 years	933.1 (865.4, 1,003.7)	172.3 (152.0, 193.4)	-81.5 (-83.4, -79.1)
70+ years	1,199.2 (1,071.4, 1,358.6)	389.2 (339.2, 443.8)	-67.5 (-71.5, -63.2)
All Ages	224.5 (208.7, 242.2)	78.4 (70.4, 88.5)	-65.1 (-68.1, -61.1)
Male			
Age-standardized	412.4 (376.9, 450.4)	77.6 (69.7, 87.4)	-81.2 (-83.1, -78.7)
Under 5	3.1 (2.4, 4.0)	0.2 (0.2, 0.3)	-93.1 (-94.8, -90.6)
5-14 years	4.8 (3.6, 6.3)	0.9 (0.7, 1.3)	-80.3 (-85.3, -74.0)
15-49 years	236.4 (216.4, 258.0)	35.8 (30.1, 42.2)	-84.9 (-87.2, -82.5)
50-69 years	1,188.1 (1,079.8, 1,302.3)	217.8 (190.7, 249.3)	-81.7 (-84.1, -78.6)
70+ years	1,427.7 (1,213.3, 1,673.6)	446.5 (391.5, 508.4)	-68.7 (-73.8, -63.2)
All Ages	281.0 (258.1, 306.5)	89.9 (80.6, 101.3)	-68.0 (-71.2, -63.8)
Female			
Age-standardized	240.5 (219.4, 262.2)	51.2 (44.5, 59.0)	-78.7 (-81.2, -76.0)
Under 5	2.4 (1.8, 3.2)	0.2 (0.2, 0.3)	-91.5 (-93.6, -88.6)
5-14 years	3.3 (2.5, 4.4)	0.9 (0.6, 1.2)	-73.9 (-80.4, -66.8)
15-49 years	117.6 (105.0, 131.8)	22.1 (17.8, 27.0)	-81.2 (-84.0, -78.2)
50-69 years	698.0 (630.5, 756.8)	132.3 (116.7, 149.3)	-81.0 (-83.4, -78.4)
70+ years	1,015.3 (903.9, 1,139.1)	347.0 (296.6, 401.4)	-65.8 (-70.3, -60.7)
All Ages	169.4 (155.0, 183.9)	67.4 (58.7, 77.4)	-60.2 (-64.8, -55.0)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.11 – Number of heart failure cases, age-standardized prevalence rates (per 100,000), and percent change (%) of rates, in Brazil and its geographic regions, according to sex, in 1990 and 2023

	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	433.011,8 (370.110,3; 493.682,0)	956,8 (822,1; 1.086,4)	859.633,5 (772.152,8; 951.471,9)	796,4 (718,3; 876,0)	-16,8 (-23,0; -10,6)
North	21.153,3 (18.622,9; 23.508,7)	829,2 (735,5; 928,0)	54.983,8 (49.264,9; 60.425,7)	741,2 (661,9; 817,7)	-10,6 (-16,6; -4,7)
Northeast	137.459,6 (117.524,6; 157.582,4)	1.035,1 (881,9; 1.193,8)	238.963,9 (214.776,2; 269.175,9)	836,5 (753,4; 934,0)	-19,2 (-24,7; -12,9)
Southeast	180.844,3 (154.519,1; 205.760,9)	913,9 (790,8; 1.033,1)	365.396,8 (326.360,8; 402.630,2)	776,3 (695,4; 852,1)	-15,1 (-21,7; -8,1)
South	60.297,6 (52.356,7; 67.583,9)	859,7 (756,2; 953,4)	123.663,2 (109.419,9; 136.703,4)	744,2 (660,9; 823,1)	-13,4 (-20,4; -6,1)
West-Central	33.257,0 (27.595,6; 40.352,2)	1.307,3 (1.096,0; 1.563,6)	76.625,9 (67.150,9; 86.948,3)	952,9 (845,1; 1.073,9)	-27,1 (-33,7; -20,1)
Female					
Brazil	354.302,6 (305.618,3; 412.793,3)	691,4 (591,9; 809,3)	828.910,5 (736.548,0; 922.607,8)	615,0 (546,9; 679,2)	-11,0 (-18,6; -3,8)
North	16.243,6 (14.395,6; 18.072,7)	623,9 (549,5; 701,4)	46.595,0 (41.562,2; 51.524,5)	583,2 (520,6; 650,0)	-6,5 (-14,2; -0,2)
Northeast	107.368,1 (91.880,0; 126.480,7)	716,6 (612,8; 852,0)	219.393,0 (196.591,3; 245.011,0)	621,7 (558,2; 693,2)	-13,3 (-21,5; -5,8)
Southeast	157.125,4 (134.956,7; 182.096,9)	678,3 (583,7; 786,1)	375.173,5 (330.800,3; 416.643,2)	612,4 (542,1; 675,9)	-9,7 (-16,8; -2,2)
South	51.259,2 (44.296,5; 58.610,9)	648,2 (560,9; 734,0)	123.491,3 (108.555,0; 136.747,6)	591,5 (524,1; 651,0)	-8,7 (-16,5; -1,1)
West-Central	22.306,2 (17.975,7; 28.470,2)	888,1 (707,0; 1.143,5)	64.257,8 (55.582,5; 74.966,9)	702,5 (613,1; 812,4)	-20,9 (-29,9; -11,9)
Both					
Brazil	787.314,4 (676.994,7; 906.127,5)	813,5 (697,1; 934,6)	1.688.544,1 (1.512.387,3; 1.868.174,4)	695,2 (623,2; 765,3)	-14,5 (-21,4; -7,9)
North	37.397,0 (32.956,4; 41.184,7)	724,5 (640,9; 813,2)	101.578,7 (91.383,7; 111.770,6)	658,7 (590,4; 729,2)	-9,1 (-15,3; -3,0)
Northeast	244.827,8 (207.931,0; 282.783,8)	865,7 (738,5; 1.011,2)	458.356,9 (411.698,6; 514.974,9)	717,5 (647,0; 804,6)	-17,1 (-23,7; -10,6)
Southeast	337.969,7 (289.355,0; 388.138,3)	783,4 (674,8; 893,2)	740.570,3 (658.935,9; 815.731,5)	683,4 (609,1; 751,3)	-12,8 (-19,4; -5,7)
South	111.556,8 (96.796,8; 126.073,4)	744,8 (650,3; 833,5)	247.154,5 (219.072,5; 273.330,5)	658,8 (584,3; 724,5)	-11,5 (-18,5; -5,4)
West-Central	55.563,2 (45.626,5; 69.016,4)	1.099,7 (902,9; 1.351,1)	140.883,7 (122.894,4; 161.335,4)	818,3 (721,4; 927,3)	-25,6 (-32,2; -18,3)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.12 – Prevalence of heart failure and YLD numbers and rates (per 100,000) due to heart failure, by age group, in Brazil, 1990 and 2023, and percent change of rates in the period

Age group	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Prevalence					
<5 years	64.337,5 (54.362,5; 76.393,0)	380,9 (321,9; 452,3)	59.720,2 (50.282,9; 70.210,5)	401,9 (338,4; 472,5)	NA
5-14 years	76.947,3 (64.314,5; 92.970,5)	216,3 (180,8; 261,3)	67.924,5 (55.525,7; 82.253,7)	238,4 (194,9; 288,8)	NA
15-49 years	174.837,8 (144.097,6; 212.895,4)	227,5 (187,5; 277,0)	239.212,4 (204.253,5; 274.764,1)	217,7 (185,9; 250,0)	NA
50-69 years	210.701,7 (169.172,3; 262.173,7)	1.338,6 (1.074,8; 1.665,6)	455.379,6 (377.038,4; 539.932,8)	1.042,6 (863,2; 1.236,2)	NA
70+ years	260.490,1 (223.289,5; 303.371,1)	6.093,3 (5.223,1; 7.096,4)	866.307,3 (737.414,8; 998.088,1)	5.713,4 (4.863,4; 6.582,5)	NA
All ages	787.314,4 (676.994,7; 906.127,5)	527,2 (453,4; 606,8)	1.688.544,1 (1.512.387,3; 1.868.174,4)	796,2 (713,1; 880,9)	51,0 (39,5; 62,5)
Age-standardized	NA	813,5 (697,1; 934,6)	NA	695,2 (623,2; 765,3)	-14,5 (-21,4; -7,9)
YLDs					
<5 years	5.965,8 (4.258,2; 8.522,3)	35,3 (25,2; 50,5)	5.531,1 (3.896,2; 7.921,1)	37,2 (26,2; 53,3)	NA
5-14 years	7.292,9 (4.883,8; 10.543,9)	20,5 (13,7; 29,6)	6.379,1 (4.331,5; 9.368,5)	22,4 (15,2; 32,9)	NA
15-49 years	14.583,4 (10.071,5; 20.757,1)	19,0 (13,1; 27,0)	21.056,8 (14.706,1; 29.705,8)	19,2 (13,4; 27,0)	NA
50-69 years	16.171,7 (11.169,6; 22.377,7)	102,7 (71,0; 142,2)	38.880,2 (27.137,0; 53.924,7)	89,0 (62,1; 123,5)	NA
70+ years	21.375,5 (14.424,0; 30.025,9)	500,0 (337,4; 702,4)	76.094,9 (52.095,2; 110.811,5)	501,9 (343,6; 730,8)	NA
All ages	65.389,3 (45.034,0; 90.186,2)	43,8 (30,2; 60,4)	147.942,1 (101.812,7; 206.411,9)	69,8 (48,0; 97,3)	59,3 (48,3; 69,7)
Age-standardized	NA	66,5 (45,7; 91,2)	NA	61,2 (42,2; 85,5)	-7,9 (-14,3; -2,5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 4.13 – DALYs due to heart failure: numbers, age-standardized rates (per 100,000, according to sex, in Brazil and its geographic regions, 1990 and 2023), and percent change (%) of rates in the period

	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	35.290,8 (24.565,1; 48.580,2)	76,6 (53,5; 104,6)	74.481,8 (52.039,9; 103.788,3)	69,3 (48,1; 97,6)	-9,5 (-15,8; -3,7)
North	1.838,9 (1.255,2; 2.577,6)	69,9 (48,6; 96,8)	4.943,8 (3.426,6; 6.888,1)	66,6 (45,7; 93,2)	-4,8 (-10,5; 1,3)
Northeast	11.046,0 (7.668,2; 15.144,5)	81,2 (56,8; 109,4)	20.454,1 (14.224,3; 28.060,4)	71,9 (50,1; 98,8)	-11,5 (-18,2; -5,2)
Southeast	14.863,3 (10.388,8; 20.698,4)	74,1 (52,1; 102,3)	31.920,8 (22.585,9; 44.493,9)	68,1 (47,9; 96,1)	-8,1 (-14,8; -1,1)
South	5.043,9 (3.534,8; 6.829,5)	70,9 (49,9; 96,8)	10.949,1 (7.537,2; 15.516,7)	66,1 (45,5; 94,0)	-6,7 (-13,6; 0,9)
West-Central	2.498,8 (1.694,6; 3.519,7)	96,4 (66,0; 135,1)	6.214,0 (4.247,2; 8.505,6)	78,1 (53,4; 108,3)	-19,0 (-26,2; -11,2)
Female					
Brazil	30.098,5 (20.430,2; 41.211,0)	57,8 (39,1; 80,3)	73.460,3 (50.538,4; 103.003,3)	54,8 (37,8; 76,2)	-5,3 (-12,1; 1,0)
North	1.459,3 (1.023,3; 2.032,3)	54,4 (38,4; 74,4)	4.257,7 (2.934,0; 5.880,1)	53,2 (36,5; 73,3)	-2,2 (-8,8; 4,1)
Northeast	9.063,9 (6.182,6; 12.424,4)	59,4 (40,3; 82,2)	19.381,5 (13.439,2; 26.618,2)	55,2 (38,3; 75,2)	-7,0 (-14,6; -0,8)
Southeast	13.366,8 (9.093,1; 18.349,0)	57,1 (38,8; 79,8)	33.302,4 (23.085,4; 47.217,9)	54,7 (38,0; 76,9)	-4,2 (-11,3; 3,1)
South	4.433,3 (2.980,1; 6.093,3)	55,4 (36,9; 76,5)	11.109,0 (7.589,2; 15.485,8)	53,4 (36,9; 73,9)	-3,5 (-11,2; 2,9)
West-Central	1.775,3 (1.202,5; 2.497,6)	68,8 (47,3; 96,6)	5.409,7 (3.683,9; 7.415,2)	59,6 (40,6; 81,7)	-13,4 (-23,1; -5,2)
Both					
Brazil	65.389,3 (45.034,0; 90.186,2)	66,5 (45,7; 91,2)	147.942,1 (101.812,7; 206.411,9)	61,2 (42,2; 85,5)	-7,9 (-14,3; -2,5)
North	3.298,2 (2.269,9; 4.608,0)	62,0 (43,4; 85,2)	9.201,5 (6.348,6; 12.647,4)	59,6 (41,0; 83,0)	-3,8 (-9,0; 1,2)
Northeast	20.109,9 (13.828,9; 27.506,7)	69,6 (47,8; 95,0)	39.835,6 (27.471,9; 54.618,0)	62,6 (43,3; 85,6)	-10,0 (-16,8; -4,4)
Southeast	28.230,0 (19.463,1; 39.145,2)	64,7 (44,6; 89,1)	65.223,2 (45.340,7; 92.151,4)	60,5 (42,0; 85,1)	-6,4 (-12,5; -0,3)
South	9.477,1 (6.490,1; 12.922,8)	62,4 (42,8; 85,8)	22.058,1 (15.139,7; 30.994,8)	59,0 (40,4; 83,1)	-5,5 (-12,6; 0,3)
West-Central	4.274,1 (2.865,9; 6.024,0)	82,7 (56,6; 116,0)	11.623,8 (7.974,7; 16.059,2)	68,1 (46,8; 94,0)	-17,7 (-25,1; -9,9)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

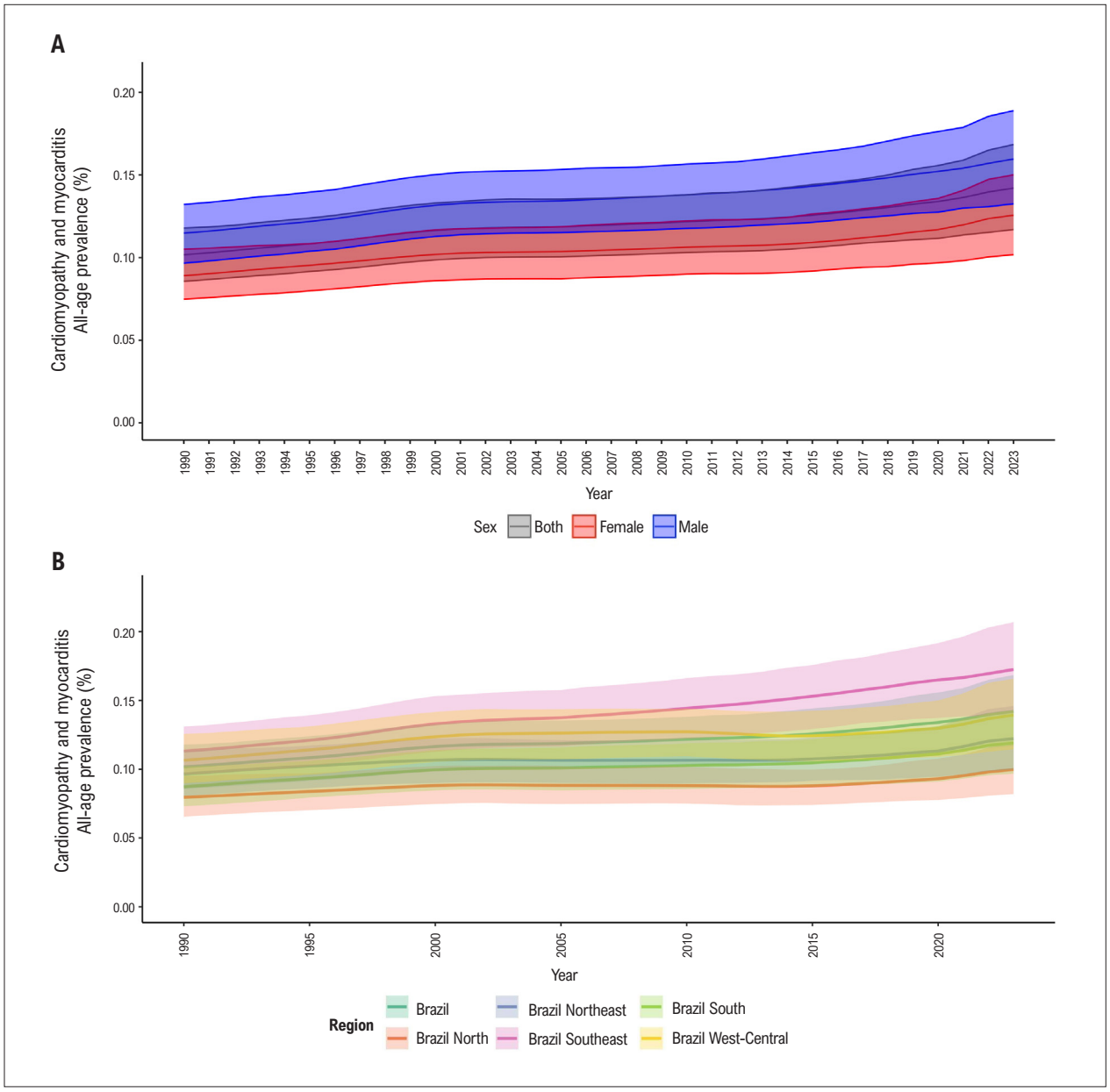

Chart 4.1 – *Cardiomyopathy and myocarditis: (A) all-age prevalence by sex in Brazil, and (B) all-age prevalence in Brazil and its geographic regions, 1990-2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

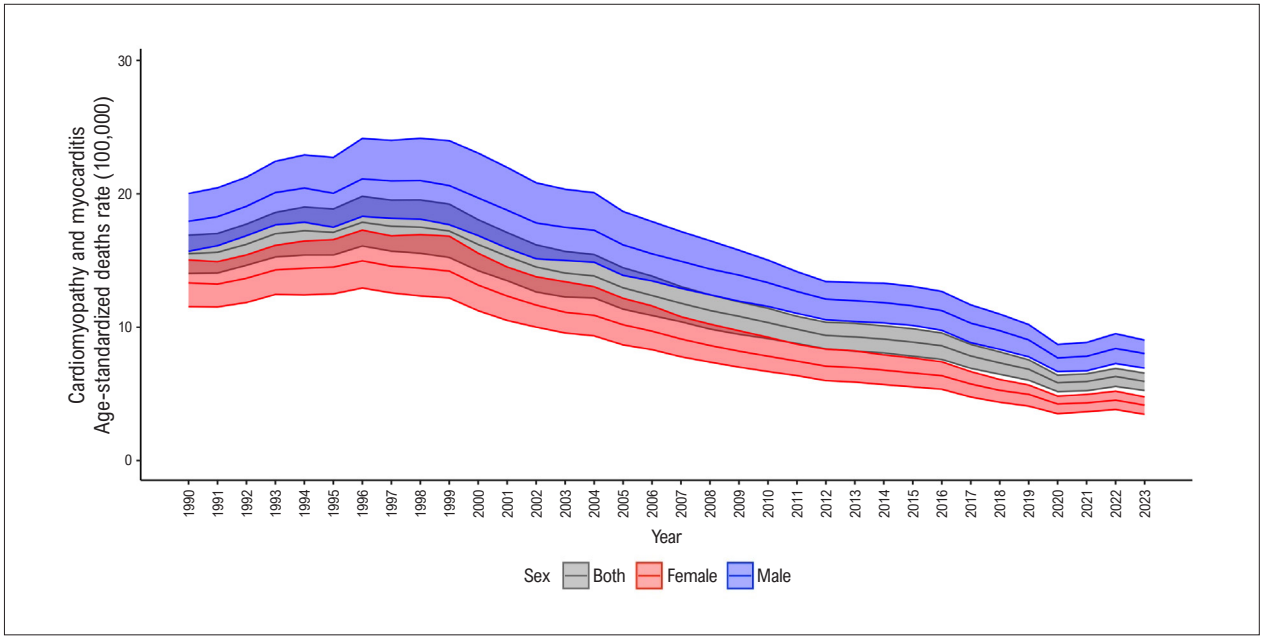

Chart 4.2 – *Cardiomyopathy and myocarditis age-standardized mortality rate, per 100,000 inhabitants, by sex, in Brazil, 1990-2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

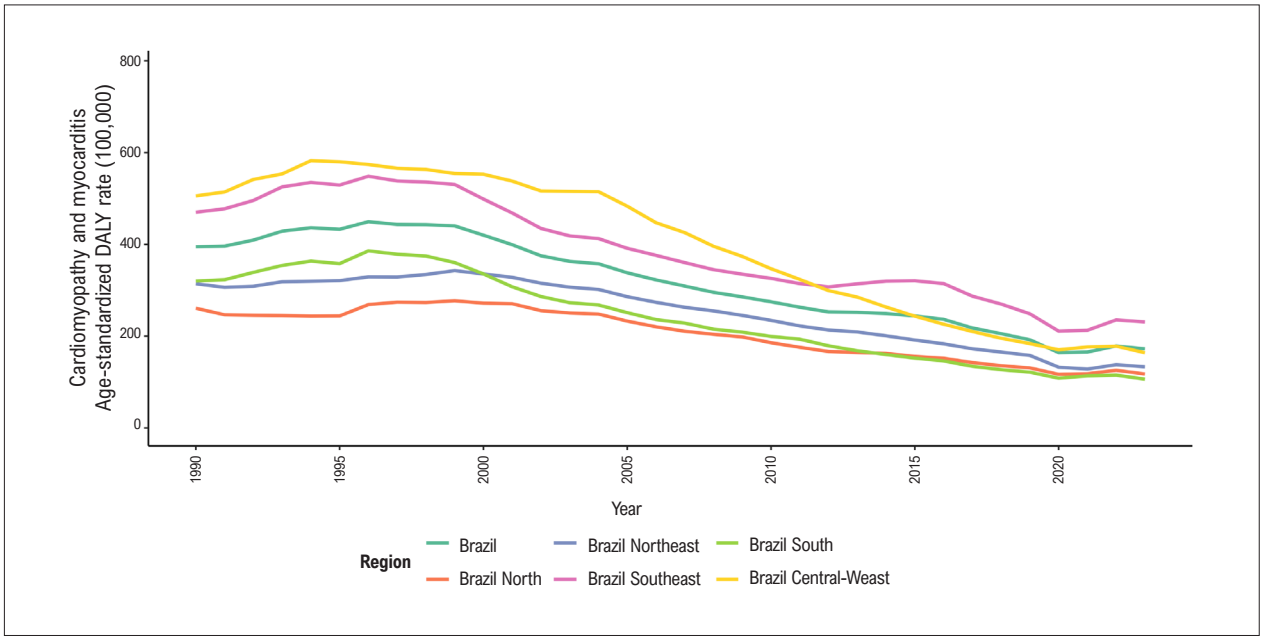

Chart 4.3 – *Age-standardized DALY (disability adjusted life year) rates, per 100,000, attributable to cardiomyopathy and myocarditis in Brazil and its geographic regions, 1990–2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

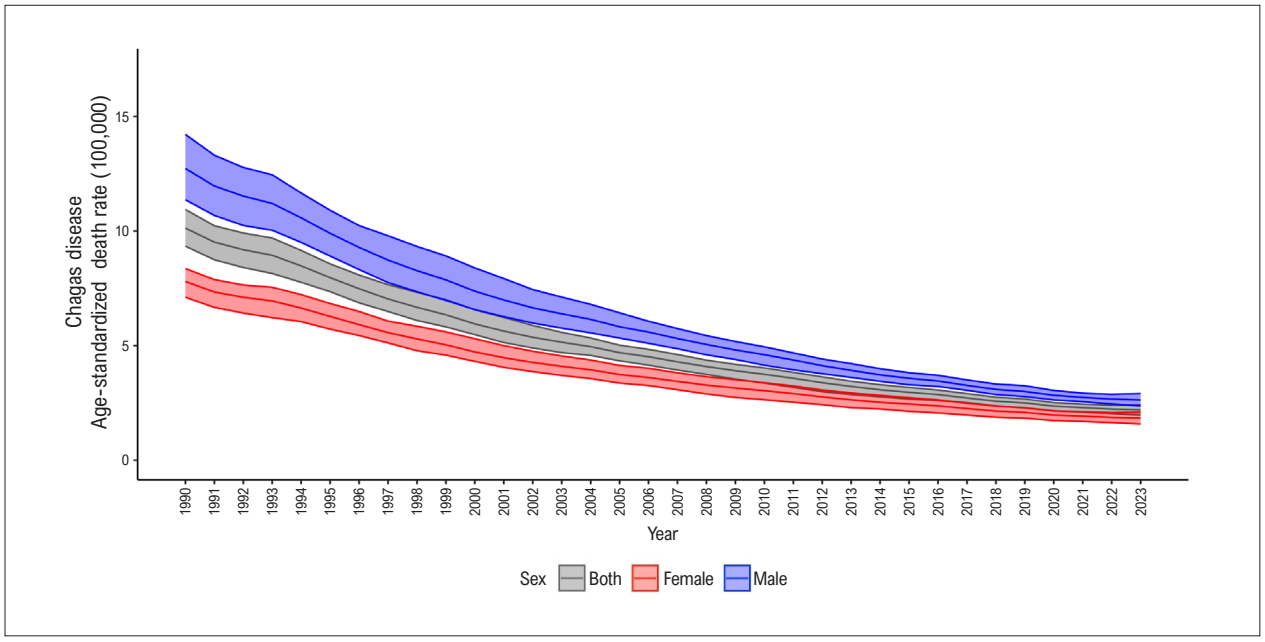

Chart 4.4 – *Chagas disease age-standardized mortality rates, according to sex, in Brazil, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

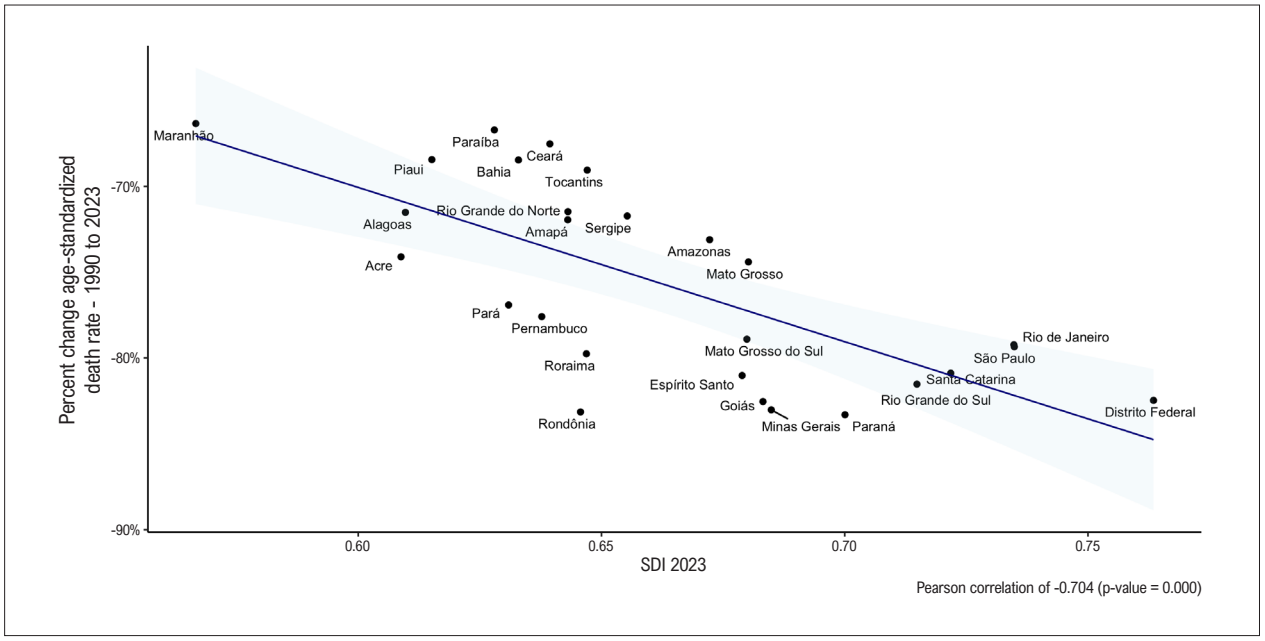

Chart 4.5 – *Correlation between the 2023 sociodemographic index and the percent change of age-standardized mortality rates, per 100,000 inhabitants, due to Chagas disease in the Brazilian Federative Units, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

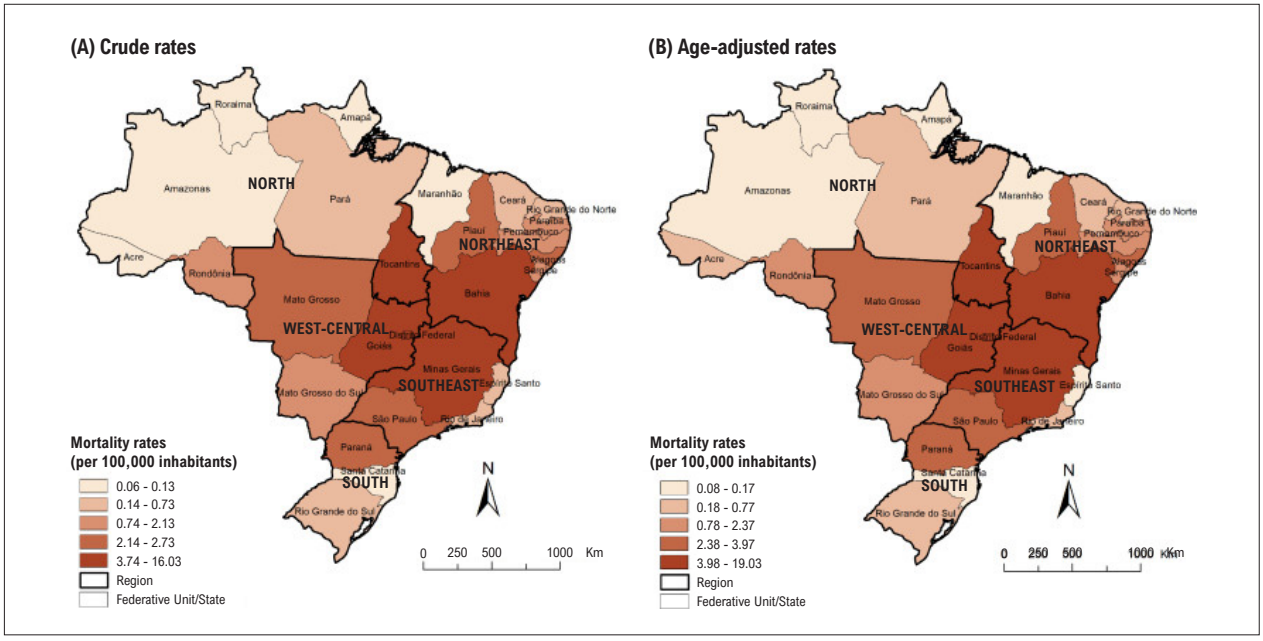

Chart 4.6 – *Spatial distribution of Chagas disease-related mortality rates (per 100,000 inhabitants) by states of residence in Brazil, 2000–2019. (A) Crude rates; (B) Age-adjusted rates. Source: Martins-Melo et al.*[128]

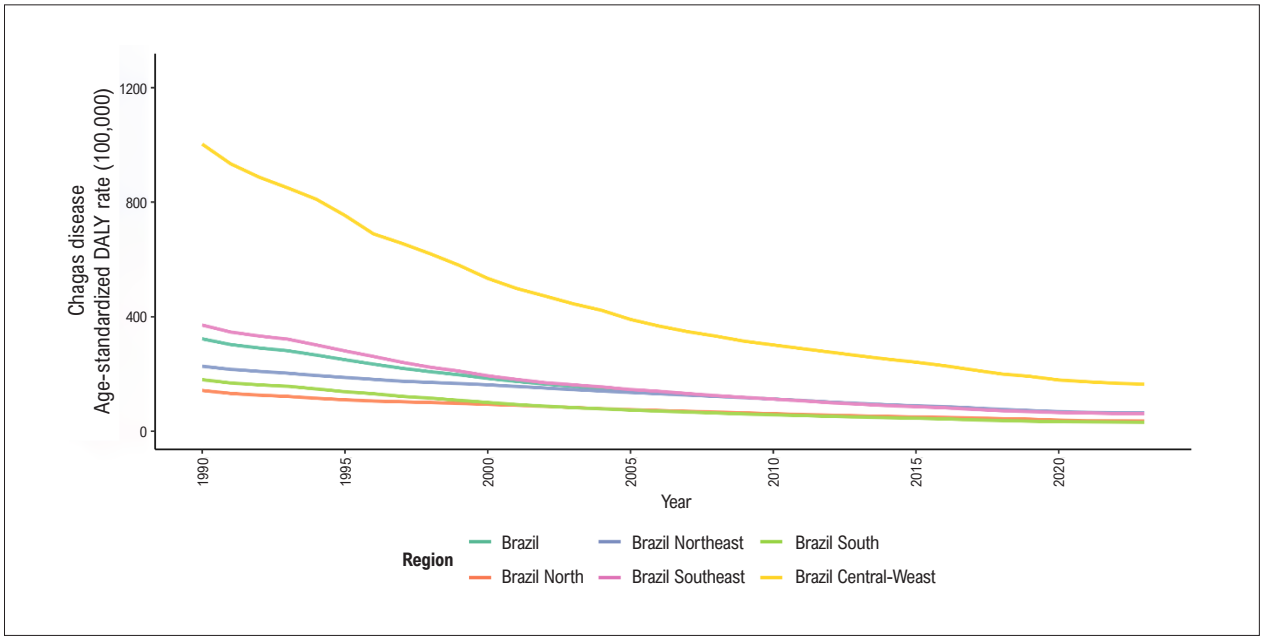

Chart 4.7 – *Chagas disease age-standardized DALY (disability-adjusted life year) rates per 100,000 in Brazil and its geographic regions, 1990–2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

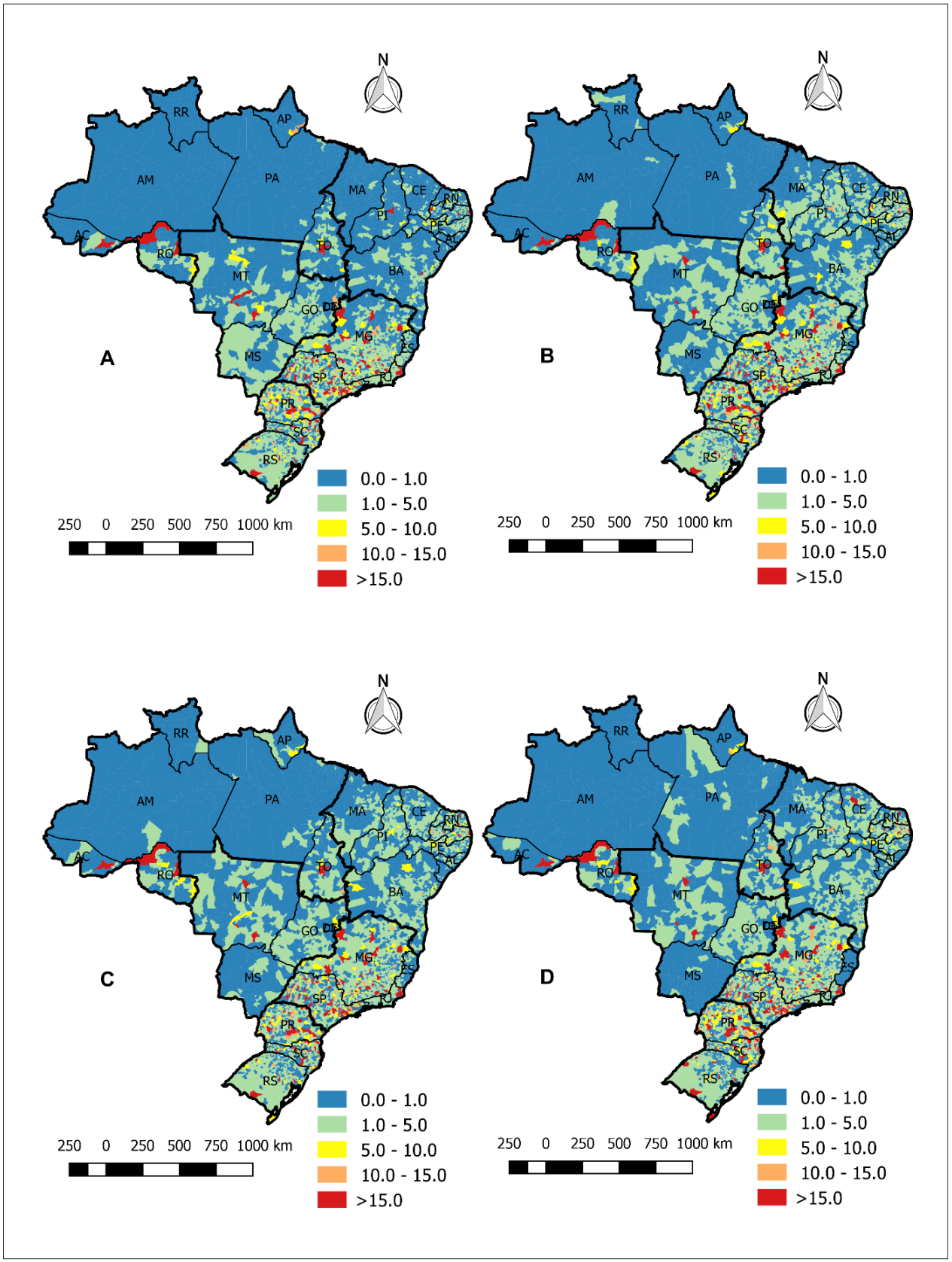

Chart 4.8 – *Relative risk of heart failure mortality of all Brazilian municipalities in the following periods: 1996-2001 (A), 2002-2007 (B), 2008-2012 (C), and 2013-2017 (D). Source: Cestari et al.*[144]

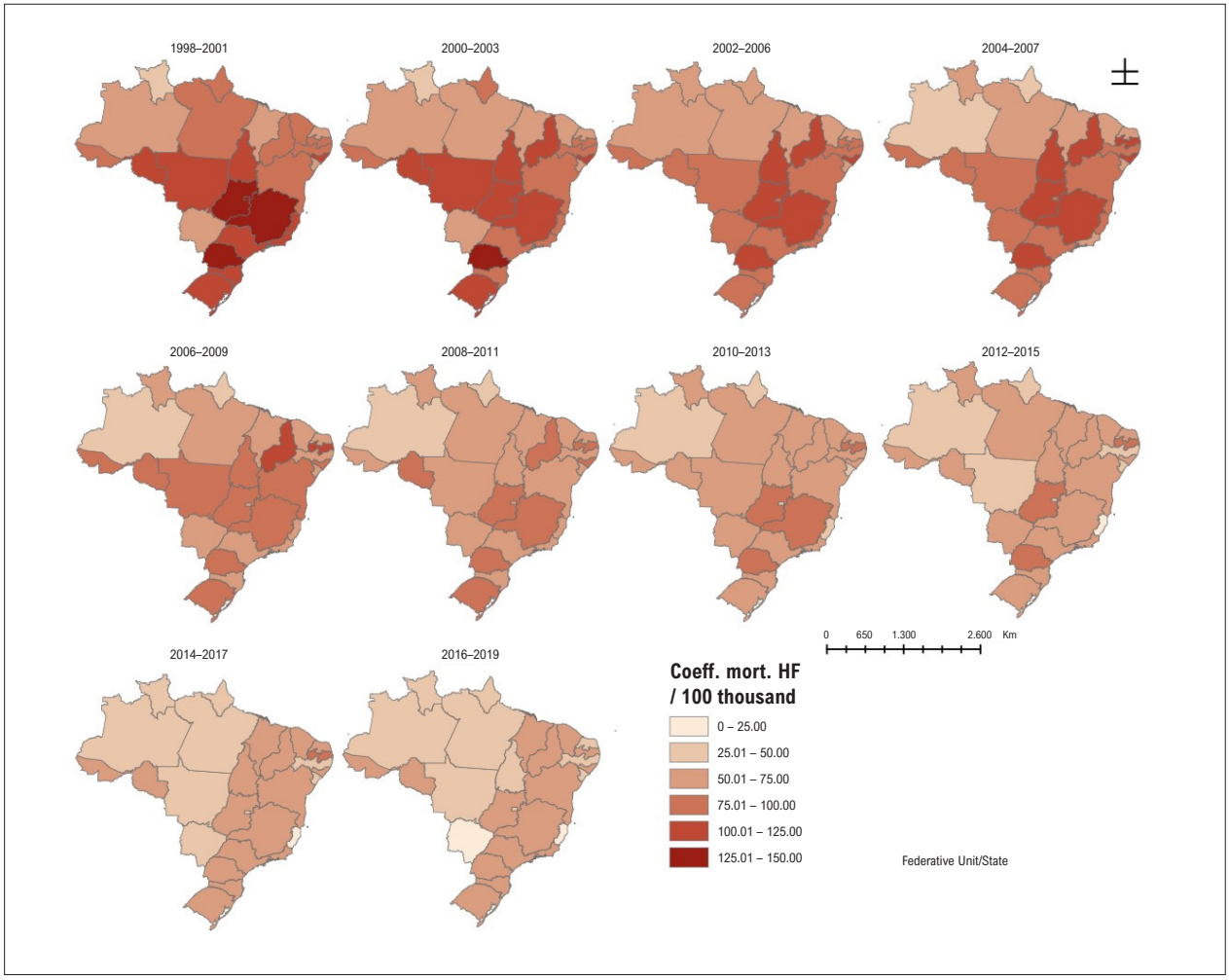

Chart 4.9 – *Spatial distribution of moving averages of heart failure (HF) mortality rates of Brazilians over 50 years of age. Brazil, 1998 to 2019. Source: Arruda et al.*[145]

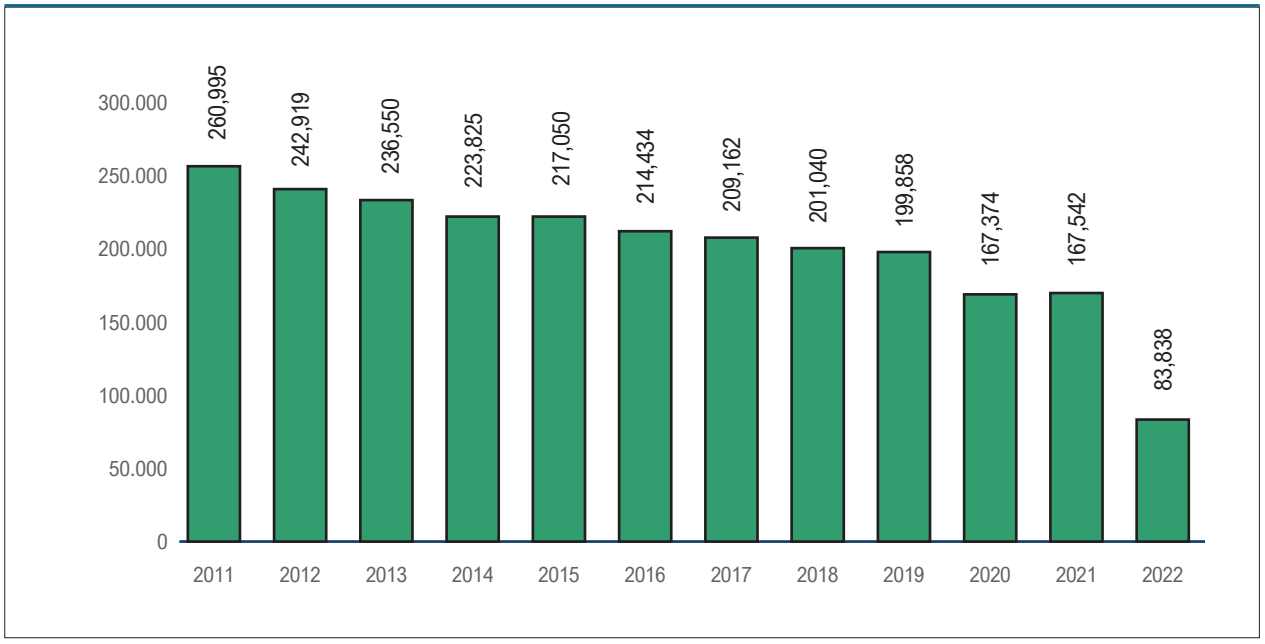

Chart 4.10 – *Historical series of hospitalizations due to heart failure from January 2011 to June 2022. Source: Cruz et al.*[152]

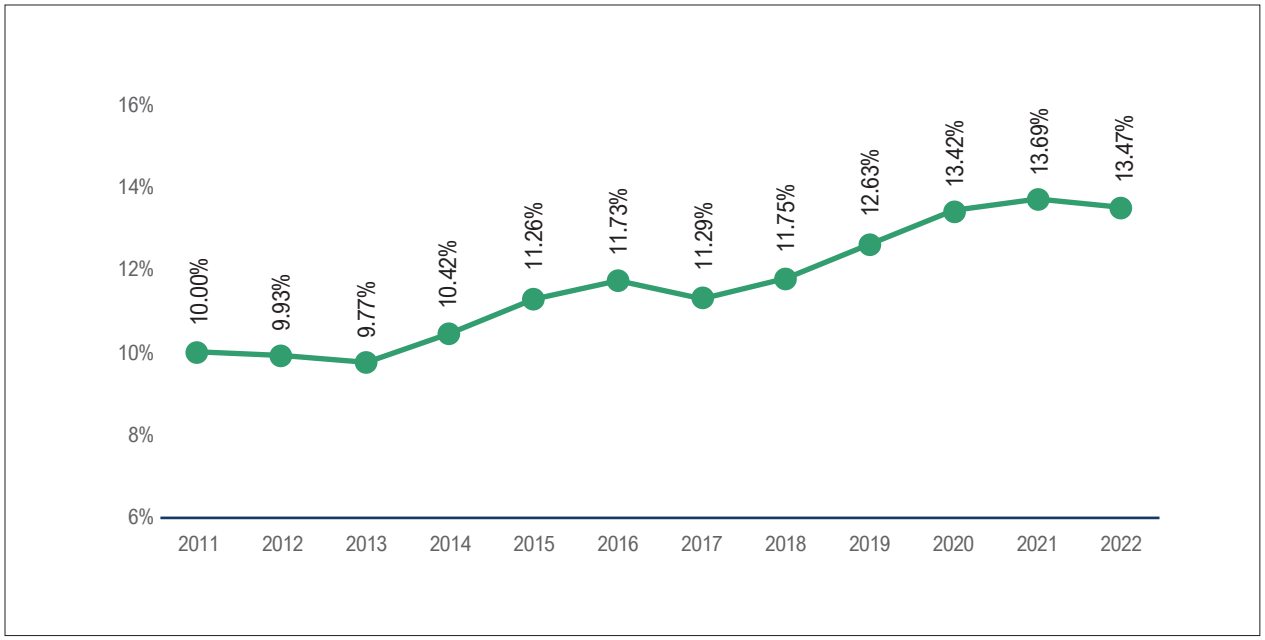

Chart 4.11 – *Historical lethality series of heart failure from 2011 to 2022. Source: Cruz et al.*[152]

CHAPTER 5 – VALVULAR HEART DISEASE

ICD-9 424; ICD-10 I34 to I38.

See Tables 5.1 through 5.14 and Charts 5.1 through 5.9.

Abbreviations used in chapter 5

ARF	Acute Rheumatic Fever
DALYs	Disability-Adjusted Life Years
GBD	Global Burden of Disease
ICD	International Classification of Diseases
NRAVD	Non-Rheumatic Aortic Valve Disease
NRMVD	Non-Rheumatic Mitral Valve Disease
NROVD	Other Non-Rheumatic Valve Disease
NRVD	Non-Rheumatic Valve Disease
PBMVC	Percutaneous Balloon Mitral Valve Commissurotomy
RHD	Rheumatic Heart Disease
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, *Sistema* Único *de Saúde*)
TAVI	Transcatheter Aortic Valve Implantation
UI	Uncertainty Interval
VHD	Valvular Heart Disease

Valvular Heart Disease in Brazil: Rheumatic Heart Disease and Non-rheumatic Valve Heart Disease

- This updated analysis summarizes epidemiological patterns of valvular heart disease (VHD) in Brazil using recent relevant publications related to VHD in Brazil since 2022, with a focus – but not restricted to – epidemiological and population based-studies, and those related to healthcare utilization found in systematic literature search, costs and outcomes, in addition to Global Burden of Disease (GBD) 2023[158-160] estimates and trends in valvular procedures and related expenditures in the Brazilian Unified Health System (SUS). This chapter covers rheumatic heart disease (RHD) and non-rheumatic valve disease (NRVD), which includes non-rheumatic aortic valve disease (NRAVD), non-rheumatic mitral valve disease (NRMVD), and other non-rheumatic valve diseases (NROVD), i.e., those not included in the aforementioned categories.

Prevalence

Rheumatic Heart Disease

- Contemporary Brazilian population-based data on RHD are scarce. Most recent publications derive from targeted screening programs or clinical cohorts rather than nationally representative surveys. School-based echocardiographic screening studies, implemented in Southeast Brazil in 2014, illustrate both the feasibility and the methodological sensitivity of latent RHD detection; simplified screening approaches may yield higher apparent prevalence that decreases after confirmatory standard echocardiography and expert adjudication.[161-163]
- According to modeled estimates from the GBD 2023 study, in Brazil there were 1,425,985.8 (95% UI, 1,158,391.9; 1,729,730.5) prevalent cases of RHD in 2023, as compared to 928,994.8 (95% UI, 759,829.0; 1,091,063.6) in 1990, while the corresponding age-standardized prevalence rate decreased from 638.7 (95% UI, 528.3; 754.7) to 628.9 (95% UI, 504.6; 755.4) per 100,000, a percent change of -1.5% (95% UI, -4.1; 1.0) (Table 5.1). There was, however, an 8.1% increase in all-ages prevalence (Chart 5.1-A). At the national level, prevalence differed by sex: in 2023, females accounted for 742,692.0 (95% UI, 602,728.6; 904,309.3) cases, with a rate of 633.0 (95% UI, 511.2; 766.2) per 100,000, whereas males accounted for 683,293.8 (95% UI, 551,499.2; 829,312.4) cases, with a rate of 623.4 (95% UI, 501.3; 756.3) per 100,000, percent changes of -1.7% (95% UI, -4.9; 1.5) in females and -1.5% (95% UI, -4.6; 1.4) in males.
- Overall, these findings indicate that observed temporal and geographic differences likely reflect a combination of demographic aging and a shift of RHD to older ages, driven by several factors intrinsic to socioeconomic development, heterogeneous access to diagnostic and therapeutic resources, and broader socioeconomic gradients that continue to shape cardiovascular outcomes across Brazil.
- Regional heterogeneity was evident in 2023, with higher RHD prevalence rates across several macro-regions (North/Northeast and West-Central parts), compared with lower rates in the South/Southeast. For reference, the 2023 regional ranking (estimates for both sexes) was: Northeast, 1,106.5 (95% UI, 881.7; 1,334.7); North, 1,103.6 (95% UI, 884.5; 1,340.0); West-Central, 929.3 (95% UI, 744.1; 1,121.5); Southeast, 357.6 (95% UI, 292.8; 426.3); and South, 60.3 (95% UI, 51.6; 70.9) per 100,000 (Table 5.1).
- At the Federative Unit level, the highest 2023 prevalence rates were observed in Minas Gerais, 1,122.9 (95% UI, 901.3; 1,364.4), Rio Grande do Norte, 1,117.9 (95% UI, 882.1; 1,353.3), and Piaui, 1,117.1 (95% UI, 894.2; 1,374.6), while the lowest rates were observed in Rio Grande do Sul, 49.1 (95% UI, 41.5; 57.8), Rio de Janeiro, 50.3 (95% UI, 42.5; 59.2), and São Paulo, 50.8 (95% UI, 43.0; 59.9) per 100,000 inhabitants.
- Changes over time were also uneven across the Federative Units: the largest increases in prevalence rates occurred in Goiás, 0.7% (95% UI, -5.0; 6.9), Mato Grosso do Sul, 0.6% (95% UI, -5.0; 6.7), and Rondônia, 0.5% (95% UI, -5.0; 6.3), while the largest decreases occurred in Rio Grande do Sul, -67.5% (95% UI, -70.7; -64.2), São Paulo, -67.0% (95% UI, -70.1; -63.9), and Rio de Janeiro, -64.0% (95% UI, -67.9; -59.7). The increases, however, were not directly related to socioeconomic indices, but decreases occurred in overall higher sociodemographic index (SDI) Federative Units (all-ages prevalence: Chart 5.1-B).

- Age-specific patterns were, in general, consistent with the natural history of RHD, with higher prevalence rates in adulthood and peak rates in older adult strata in 2023, as compared to baseline. In the age-bracket analysis, the highest 2023 age-standardized prevalence rates were recorded in the 15-49-year age group, 920.6 (95% UI, 722.4; 1,123.4), followed by the 50-69-year age group; the all-ages prevalence was 672.4 (95% UI, 546.2; 815.6) per 100,000 (Table 5.2). These age gradients highlight the cumulative sequelae of acute rheumatic fever (ARF) acquired earlier in life and underscore the importance of active case-finding, secondary prophylaxis, and long-term follow-up to prevent progression and late cardiovascular complications.

Non-Rheumatic Valve Heart Disease

- Recent Brazilian publications on NRVD have primarily focused on hospital-based cohorts, registries of valve interventions, and comparative analyses of procedural strategies, particularly for aortic stenosis and mitral disease.[164-166] These studies are informative for treatment patterns, temporal analyses, healthcare utilization, and outcomes, but are not designed to quantify population prevalence; accordingly, updates of national prevalence estimates primarily rely on modeled data sources.
- According to GBD 2023, the NRVD prevalence in Brazil increased from 131,838.4 (95% UI, 114,152.5; 152,244.1) cases in 1990 to 492,109.7 (95% UI, 416,005.0; 576,511.6) in 2023, and the age-standardized prevalence rate rose from 151.4 (95% UI, 131.1; 175.2) to 186.3 (95% UI, 157.2; 218.2) per 100,000 inhabitants, a percent change of +23.0% (95% UI, 18.5; 27.6) (Table 5.3). In 2023, there were 215,754.9 (95% UI, 181,645.7; 250,344.9) prevalent cases among women, with a rate of 146.9 (95% UI, 124.1; 170.1) per 100,000, whereas, among men, there were 276,354.8 (95% UI, 233,369.7; 329,409.1) cases, with a rate of 236.7 (95% UI, 199.1; 282.3) per 100,000. The percent change of the age-standardized rates was more pronounced among men, +26.4% (95% UI, 20.5; 31.8), than among women, +21.4% (95% UI, 16.3; 26.5).
- There was also a consistent increase in all-ages prevalence rates, consistent for both sexes and all Brazilian regions (Chart 5.2-A and 5.2-B).
- Sex differences were generally consistent with higher prevalence at older ages in both sexes, reflecting the predominance of degenerative etiologies, markedly degenerative aortic valve disease. Such differences likely reflect a combination of demographic aging and heterogeneous access to diagnostic and therapeutic resources, with deep socioeconomic drivers of trends.
- As a reflection of these socioeconomic drivers of trends, in 2023, the NRVD prevalence rates were higher in the South/Southeast regions and the Distrito Federal, at a higher SDI strata, than in the North/Northeast, at a lower SDI strata.
- The regional ranking was as follows: South, 208.4 (95% UI, 176.0; 247.8); West-Central, 193.4 (95% UI, 161.6; 228.4); Southeast, 191.6 (95% UI, 161.6; 227.3); North, 174.6 (95% UI, 147.5; 203.9); and Northeast, 163.0 (95% UI, 137.6; 191.1) per 100,000 (both sexes; Table 5.3).
- At the Federative Unit level, the highest rates were found in the Distrito Federal, 230.3 (95% UI, 187.5; 271.6), Santa Catarina, 215.1 (95% UI, 178.4; 254.3), and Rio Grande do Sul, 210.9 (95% UI, 177.1; 252.3) per 100,000. The lowest rates were observed in Piauí, 150.7 (95% UI, 127.4; 172.1), Maranhão, 152.7 (95% UI, 130.0; 177.9), and Paraíba, 155.3 (95% UI, 133.1; 181.2) per 100,000.
- From 1990 to 2023, the most pronounced age-standardized prevalence increases were observed in Tocantins, 31.5% (95% UI, 24.9; 39.1), Distrito Federal, 30.2% (95% UI, 22.1; 38.3), and Ceará, 30.2% (95% UI, 23.2; 37.4), while the lowest percent increases were observed in Rondônia, 16.4% (95% UI, 9.5; 23.5), Goiás, 16.4% (95% UI, 9.5; 23.3), and Amazonas, 17.5% (95% UI, 11.4; 24.7). No Federative Unit had a decrease in age-standardized prevalence rates (both sexes).
- The NRAVD accounted for the most substantial share of NRVD prevalence. In 2023, according to modeled estimates from the GBD 2023 study, Brazil had 378,347.6 (95% UI, 302,669.2; 463,214.0) prevalent cases, with a prevalence rate of 143.2 (95% UI, 114.1; 174.9) per 100,000. In 1990, there were 92,280.8 (95% UI, 74,273.1; 112,240.6) cases, rate of 106.4 (95% UI, 85.6; 130.4), and percent change of 34.7% (95% UI, 27.9; 41.5) (Table 5.4).
- Sex-stratified estimates for NRAVD in 2023 showed 158,646.1 (95% UI, 124,360.5; 194,715.5) cases in women *versus* 219,701.5 (95% UI, 176,957.9; 272,701.8) in men, with discrepant rates of 107.8 (95% UI, 84.9; 132.1) and 188.3 (95% UI, 150.2; 233.6) per 100,000, among women and men, respectively, an over 75% difference.
- The NRMVD accounted for the second most prevalent form of NRVD. In 2023, according to modeled estimates from the GBD 2023 study, Brazil had 114,328.0 (95% UI, 105,657.7; 123,809.5) prevalent cases, with an age-standardized prevalence rate of 43.3 (95% UI, 40.1; 46.8) per 100,000. In 1990, there were 39,683.3 (95% UI, 36,641.8; 43,078.8) prevalent cases, with a rate of 45.3 (95% UI, 41.8; 49.1) per 100,000. A percent change of -4.4% (95% UI, -6.0; -2.7) was observed in this period (Table 5.5).
- The NROVD accounted for a much lower share of NRVD prevalence. In 2023, according to modeled estimates from the GBD 2023 study, Brazil had 468.4 (95% UI, 365.1; 603.4) prevalent cases, with a prevalence rate of 0.2 (95% UI, 0.2; 0.3) per 100,000. In 1990, there were 82.1 (95% UI, 64.4; 103.9) cases, with a rate of 0.1 (95% UI, 0.1; 0.1). The percent change of the rates in the period was +207.8% (95% UI, 181.4; 237.5).
- Age gradients were particularly steep for NRVD, with the highest prevalence rates concentrated in older age groups in 2023. In the age-bracket estimates, the highest 2023 prevalence rates were observed in: 70+ years, 1,641.6 (95% UI, 1,327.7; 1,969.7), a percent change of +36.7%; and 50-69 years, 486.6 (95% UI, 404.4; 581.9), a percent change of +21.8% (Table 5.6).

- Such age gradients modeled were particularly marked for NRAVD, the main driver of trends, with the highest prevalence rates concentrated in older age groups in 2023: highest 2023 prevalence rates were observed in 70+ years, 1,270.5 (95% UI, 954.2; 1,593.7), percent change of +51.8%, and 50-69 years, 375.2 (95% UI, 293.1–471.0), percent change of +32.0% (Table 5.7).
- Age gradients were also observed for NRMVD, with the highest prevalence rates in 2023 concentrated in the age bracket of 70+ years, 375.1 (95% UI, 340.2; 406.4), with a more stable pattern, percent change of +2.3%.

Mortality

Rheumatic Heart Disease

- Brazilian studies based on mortality information systems have described long-term declines in RHD mortality, consistent with improvements in prevention and access to care, though regional inequalities remain evident.[167]
- According to the GBD 2023, in Brazil there were 3,017.9 (95% UI, 2,765.7; 3,225.2) deaths from RHD in 2023 and 2,775.5 (95% UI, 2,533.0; 3,049.1) in 1990, with age-standardized mortality rates decreasing from 2.6 (95% UI, 2.3; 2.8) to 1.2 (95% UI, 1.1; 1.3) per 100,000, a percent change of -54.2% (95% UI, -58.2; -49.6) (Table 5.8, Chart 5.3-A).
- In 2023, RHD mortality was 23% lower among males [deaths, 1,174.8 (95% UI, 1,057.3; 1,287.4); rate, 1.0 (95% UI, 0.9; 1.1) per 100,000] than among females [deaths, 1,843.1 (95% UI, 1,674.2; 1,993.7); rate, 1.3 (95% UI, 1.2; 1.4) per 100,000], and temporal trends differed slightly by sex: percent changes of -51.1% (95% UI, -57.3; -43.6) in males and -56.4% (95% UI, -61.7; -51.0) in females, although with overlapping of the uncertainty intervals.
- Overall, these findings indicate that several components may have accounted for earlier diagnosis, primordial, primary, and secondary prophylaxis, and adequate treatment of advanced valvular sequelae. At country level, such trends have a deep socioeconomic component.
- Although age-standardized rates were relatively similar, state and regional distributions in 2023 indicated higher mortality rates in parts of the Northeast and West-Central regions, with the following regional ranking: West-Central, 1.3 (95% UI, 1.2; 1.4); Northeast, 1.2 (95% UI, 1.0; 1.4); Southeast, 1.2 (95% UI, 1.0; 1.3); South, 1.1 (95% UI, 1.0; 1.3); and North, 1.0 (95% UI, 0.9; 1.1) per 100,000 (Table 5.8, Chart 5.3-B).
- Regarding the Federative Units, the highest mortality rates were observed in Sergipe, 1.4 (95% UI, 1.1; 1.5), Goiás, 1.4 (95% UI, 1.2; 1.6), and Distrito Federal, 1.4 (95% UI, 1.1; 1.6) per 100,000, whereas the lowest were observed in Amapá, 0.8 (95% UI, 0.7; 0.9), Amazonas, 0.8 (95% UI, 0.7; 1.0), and Piaui, 0.8 (95% UI, 0.6; 0.9).
- With the overall decreasing rates across the Federative Units from 1990 to 2023, the steepest declines were observed in Distrito Federal, 64.5% (95% UI, -71.3; -56.5), São Paulo, 64.5% (95% UI, -68.3; -60.1), and Rio de Janeiro, 59.1% (95% UI, -64.5; -53.2), in a similar pattern to age-standardized prevalence rates (Table 5.8). There was a significant negative correlation between percent changes of age-standardized RHD mortality rates and the SDI of the Federative Units in 2023 (Chart 5.4).

Non-Rheumatic Valve Heart Disease

- The NRVD mortality is increasingly described through registries and hospital cohorts – particularly for aortic stenosis and transcatheter valve therapies – where outcomes are shaped by frailty, comorbidities, and periprocedural complications.[164-166,168]
- According to the GBD 2023, NRVD death counts in Brazil increased from 2,416.5 (95% UI, 2,197.6; 2,624.6) in 1990 to 5,640.9 (95% UI, 5,047.5; 6,089.4) in 2023, although age-standardized mortality rates decreased from 2.8 (95% UI, 2.5; 3.1) to 2.2 (95% UI, 2.0; 2.4) per 100,000, a percent change of -22.1% (95% UI, -27.7; -14.7) (Table 5.9, Chart 5.5-A).
- In 2023, males accounted for 2,793.6 (95% UI, 2,542.8; 3,029.7) NRVD deaths, rate of 2.5 (95% UI, 2.3; 2.7) per 100,000, as compared to 2,847.3 (95% UI, 2,457.6; 3,165.0) deaths among females, rate of 1.9 (95% UI, 1.7; 2.1) per 100,000. Over time, the percent changes of mortality rates differed by sex, with a more pronounced reduction among women, -27.6% (95% UI, -34.9; -19.3), as compared to men, -15.1% (95% UI, -24.2; -4.3).
- Geographic gradients in 2023 showed higher NRVD mortality in the South and parts of the Southeast, with the following ranking by region: South, 2.9 (95% UI, 2.5; 3.2); Southeast, 2.2 (95% UI, 1.9; 2.4); West-Central, 2.2 (95% UI, 1.9; 2.4); North, 2.0 (95% UI, 1.7; 2.2); and Northeast, 1.8 (95% UI, 1.5; 2.0) (Table 5.9, Chart 5.5-B).
- Regarding the Federative Units, the highest mortality rates were recorded in Santa Catarina, 3.2 (95% UI, 2.8; 3.6), Rio Grande do Sul, 2.9 (95% UI, 2.5; 3.2), and Paraná, 2.7 (95% UI, 2.3; 3.0). The lowest rates were recorded in Piaui, 1.4 (95% UI, 1.1; 1.6), Sergipe, 1.5 (95% UI, 1.2; 1.7), and Paraíba, 1.5 (95% UI, 1.2; 1.7). The most significant increases were observed in Maranhão, 47.6% (95% UI, 12.7; 98.3), Ceará, 33.3% (95% UI, 9.0; 60.5), and Alagoas, 14.3% (95% UI, -6.8; 43.3), while the steepest declines were observed in Bahia, 50.4% (95% UI, -58.4; -40.5), Distrito Federal, 35.6% (95% UI, -46.2; -21.1), and São Paulo, 27.3% (95% UI, -33.7; -20.2). This pattern was clearly socioeconomically driven, with pronounced increases in poorer areas, where the demographic transition shows a late pattern. There was a significant negative correlation between percent changes of age-standardized NRVD mortality rates and the SDI of the Federative Units in 2023 (Chart 5.6-A).
- Similarly to prevalence trends, NRAVD was the subgroup that contributed more substantially to NRVD mortality in Brazil. In 2023, there were 4,061.4 (95% UI, 3,597.7; 4,433.8) deaths attributed to NRAVD, with an age-standardized mortality rate of 1.6 (95% UI, 1.4; 1.7) per 100,000. In 1990, there were 1,632.0 (95% UI, 1,460.9; 1,808.8) deaths attributed to NRAVD and a rate of 2.0

(95% UI, 1.7; 2.2), with a percent change of -19.8% (95% UI, -25.8; -11.7) in the period (Table 5.10). Sex-stratified mortality in 2023 showed 2,125.7 (95% UI, 1,927.5; 2,318.6) male deaths and 1,935.7 (95% UI, 1,614.5; 2,190.1) female deaths, a 9.8% difference, as opposed to that observed for RHD. Similarly to NRVD, at the Federative Unit level, there was a significant negative correlation between percent changes of age-standardized NRAVD mortality rates and the SDI (Chart 5.6-B).

- Mortality associated with NRMVD was substantially lower as compared to that associated with NRAVD, with 1,495.8 (95% UI, 1,313.3; 1,629.9) deaths in 2023 and age-standardized mortality rate of 0.6 (95% UI, 0.5 - 0.6) per 100,000. In 1990, there were 763.8 (95% UI, 676.2; 848.7) deaths, with a rate of 0.8 (95% UI, 0.7; 0.9) per 100,000. In addition, there was a more pronounced rate reduction, with a percent change of -29.4% (95% UI, -37.6; -18.8) (Table 5.11). Sex-stratified mortality in 2023 showed considerably fewer fatal events among men, 634.2 (95% UI, 563.7; 720.6), as compared to women, 861.6 (95% UI, 731.1; 982.0).
- For NROVD, conversely, modeled mortality was substantially low, with only 83.7 (95% UI, 41.5; 203.6) deaths recorded in 2023, with an extremely low mortality rate for both men and women, possibly related to lower prevalence, challenges in coding and qualification of specific causes of death.

Burden of Diease

Rheumatic Heart Disease

- According to the GBD 2023, the RHD DALYs in Brazil were 157,687.6 (95% UI, 130,544.2; 196,593.4) in 2023 as compared to 164,456.0 (95% UI, 143,297.6; 192,774.8) in 1990. In the period, the DALY rates decreased from 123.4 (95% UI, 108.0; 142.1) to 65.9 (95% UI, 54.1; 83.3) per 100,000, a percent change of -46.6% (95% UI, -52.0; -40.6) (Table 5.12).
- In 2023, DALY counts and age-standardized rates were considerably lower among males [DALYs, 68,559.9 (95% UI, 54,816.4; 86,583.2); rate, 60.9 (95% UI, 48.5; 77.2)] than among females [DALYs, 89,127.7 (95% UI, 75,826.8; 109,013.6); rate, 70.3 (95% UI, 59.2; 87.2)], with sex-specific percent changes of -42.7% (95% UI, -49.8; -36.3) and -49.6% (95% UI, -55.2; -42.6), respectively, from 1990 to 2023 (Chart 5.7-A). These trends followed a temporal pattern similar to that of the modeled mortality rates.
- As for mortality, subnational patterns mirrored mortality gradients, with higher DALY rates in the Northeast and parts of the West-Central regions. The 2023 regional ranking was as follows: Northeast, 91.4 (95% UI, 70.4; 118.8); West-Central, 84.0 (95% UI, 66.8; 109.3); North, 83.1 (95% UI, 63.8; 113.6); Southeast, 52.0 (95% UI, 44.9; 61.6); and South, 36.2 (95% UI, 32.1; 39.5) (Table 5.12).
- The Federative Units with the highest age-standardized DALY rates were Pernambuco, 97.7 (95% UI, 76.7; 126.0), Sergipe, 96.8 (95% UI, 74.7; 125.8), and Bahia, 96.4 (95% UI, 75.8; 124.0), while the lowest rates were observed in Rio Grande do Sul, 28.7 (95% UI, 25.6; 31.8), Rio de Janeiro, 34.8 (95% UI, 31.1; 38.4), and São Paulo, 35.4 (95% UI, 31.7; 38.7) (Chart 5.7-B). Temporal changes were heterogeneous, with the least pronounced reductions in Maranhão, -13.7% (95% UI, -28.4; 4.7), Amapá, -19.5% (95% UI, -28.3; -10.3), and Ceará, -20.2% (95% UI, -32.4; -10.1), contrasting with the steepest declines in São Paulo, -70.2% (95% UI, -73.5; -66.6), Distrito Federal, -68.6% (95% UI, -73.9; -61.8), and Rio de Janeiro, -65.7% (95% UI, -69.7; -61.5), reinforcing the socioeconomically-driven pattern of RHD (Table 5.12).

Non-Rheumatic Valve Heart Disease

- Conversely, according to the GBD 2023, NRVD DALY counts increased from 74,178.5 (95% UI, 67,752.1; 80,327.3) in 1990 to 127,678.4 (95% UI, 117,102.4; 136,510.2) in 2023, while DALY rates decreased from 71.8 (95% UI, 65.5; 77.9) to 49.3 (95% UI, 45.1; 52.8) per 100,000, a percent change of -31.4% (95% UI, -35.8; -24.3) in the period (Table 5.13).
- In 2023, males experienced 68,059.9 (95% UI, 63,364.5; 73,777.8) DALYs, with a rate of 58.3 (95% UI, 54.2; 63.3) per 100,000, while females experienced 59,618.6 (95% UI, 53,058.1; 65,256.6) DALYs with a rate of 41.6 (95% UI, 37.2; 45.6) per 100,000. The percent changes of rates were -26.3% (95% UI, -33.8; -17.1) and -35.8% (95% UI, -42.4; -28.0), respectively (Chart 5.8-A). The all-ages prevalence, on the other hand, increased 21.2% (95% UI, 12.2; 34.5). The trends were overall similar to those of mortality, showing a pattern of disproportionately higher DALY rates at older ages, as shown in the age-bracket analysis.
- In this setting, the slightest decrease in age-standardized DALY rates was observed in the 70+ age group, -4.6% (95% UI, -11.5; 3.4), contrasting with pronounced reductions at younger ages (Table 5.6).
- In 2023, the NRVD DALY rates were generally higher in the South and parts of the Southeast region, with the following regional ranking: South, 61.5 (95% UI, 55.8–67.0); West-Central, 50.0 (95% UI, 44.2; 55.2); Southeast, 49.0 (95% UI, 44.7; 53.0); North, 46.2 (95% UI, 42.0; 50.9); and Northeast, 42.5 (95% UI, 36.2; 48.6) per 100,000, with an opposed trend as compared to that of RHD (Table 5.13). At the Federative Unit level, the highest DALY rates were observed in Santa Catarina, 66.4 (95% UI, 59.1; 73.5), Rio Grande do Sul, 61.4 (95% UI, 55.4; 67.4), and Mato Grosso do Sul, 58.6 (95% UI, 51.0; 66.8), whereas the lowest were modeled for Piaui, 33.5 (95% UI, 28.3; 39.7), Sergipe, 35.1 (95% UI, 29.7; 40.6), and Paraíba, 35.5 (95% UI, 30.1; 40.5), also following a socioeconomic pattern, considering the inverse trends of the RHD and NRVD determinants.
- DALY rate changes varied widely across the Federative Units, with the largest increases in Maranhão, 38.1% (95% UI, 1.9; 88.9), Ceará, 31.5% (95% UI, 7.6; 57.3), and Tocantins, 18.3% (95% UI, -2.0; -43.9), while the steepest declines were observed in Bahia, 47.5% (95% UI, -56.4; -37.4), Distrito Federal, 43.1% (95% UI, -52.3; -31.6), and São Paulo, 40.5% (95% UI, -45.3; -34.9) (Chart 5.8-B).

Thus, the sociodemographic pattern of burden of disease was not as straightforward as that of mortality, although the overall steepest decreases were observed in wealthier regions.

- Trends were driven mainly by NRAVD, for which DALYs in 2023 totaled 86,860.5 (95% UI, 78,471.6; 94,206.2) with an age-standardized rate of 33.5 (95% UI, 30.2; 36.3) per 100,000. In 1990, there were 46,951.0 (95% UI, 42,570.3; 52,062.5) DALYs due to NRAVD, rate of 47.2 (95% UI, 42.8; 52.4) per 100,000, and percent change of -29.1% (95% UI, -34.6; -21.5) from 1990 to 2023 (Table 5.14). In contrast, the all-ages DALY rates increased from 31,4 (95% UI, 28,5; 34,9) per 100,000 in 1990 to 41,0 (95% UI, 37,0; 44,4) in 2023, a marked 30.3% increase. In 2023, males accounted for a higher proportion of DALY counts, 49,988.9 (95% UI, 45,697.8; 54,667.6), as compared to females, 36,871.6 (95% UI, 32,069.9; 40,829.4) (Table 5.7, Charts 5.9-A and 5.9-B).
- Similarly to the main driver of NRVD, the NRAVD age-standardized DALY rates decreased disproportionately across ages, with a slight 2.5% (95% UI, -10.0; 5.9) decrease in individuals aged 70+, especially men (Table 5.7).
- For NRMVD, DALYs in 2023 totaled 38,609.5 (95% UI, 34,948.5; 41,550.1) with an age-standardized DALY rate of 14.9 (95% UI, 13.5; 16.1) per 100,000. In 1990, DALYs due to NRMVD totaled 26,511.3 (95% UI, 23,266.7; 29,491.9), with a rate of 24.0 (95% UI, 21.1; 26.7) per 100,000, and a percent change of rates of -37.7% (95% UI, -45.4; -28.9) in the period, not much different from NRAVD. In contrast with NRVD, there was only a slight, non-significant increase in the all-ages DALY rates, 2.5% (-10.8; 17.1), showing a more stable pattern. Again, older individuals had a less pronounced reduction of DALY rates (12,4%), compared to 49.4% among those aged 15-49 years.

Recent Publications

Acute Rheumatic Fever and Rheumatic Heart Disease

- High-quality Brazilian studies have substantially advanced understanding of the contemporary epidemiology and clinical trajectory of ARF and RHD. A recent analysis of 11,061 ARF hospitalizations in SUS found 65 deaths, with 53% being male. The highest hospitalization rates were among those aged 10-14 years, while deaths were more common in the 15-19 age group. Hospitalizations were greater among non-white individuals and largely occurred in the Northeast region.[169]
- Population-based echocardiographic screening investigations conducted in school-aged children and adolescents consistently demonstrate that latent RHD is several-fold more frequent than clinically diagnosed disease, with reported crude prevalences ranging from 10 to more than 40 cases per 1,000 screened individuals when simplified screening protocols are applied.[163,170,171] However, these same studies show that prevalence estimates decline sharply – often by 50% or more – after confirmatory expert review using standardized World Heart Federation criteria in Brazil,[168] highlighting the critical influence of diagnostic methodology and adjudication on population estimates.[163,172] In addition, the implementation of family screening for individuals with known RHD, especially in vulnerable settings, holds promise as a tool for targeted, more cost-effective case-finding strategies.[173] These findings indicate that subclinical RHD remains common in endemic settings, but that careful phenotyping is essential to avoid overestimation and misclassification.
- Clinical cohort studies further elucidate the downstream burden of RHD in Brazil. Analyses of patients undergoing mitral valve interventions – particularly percutaneous balloon mitral valve commissurotomy (PBMVC) and surgical mitral valve replacement – consistently report a predominance of young and middle-aged women, who typically account for 60-70% of treated cases.[174-177] Despite progressive reductions in periprocedural mortality, these cohorts reveal substantial residual morbidity, including high rates of atrial fibrillation, need for anticoagulation, and repeat interventions during long-term follow-up.[161,174-176] In several series, more than one-third of patients required ongoing specialist care or reintervention within 10 years, underscoring the chronic nature of RHD and its sustained impact on healthcare systems. Collectively, the Brazilian literature depicts a scenario in which declining mortality coexists with a persistent, resource-intensive disease burden, underscoring the importance of secondary prevention, timely referral, and structured long-term care pathways.

Non-Rheumatic Valve Heart Disease

- Recent Brazilian publications on NRVD have focused predominantly on degenerative aortic and mitral valve disease, reflecting demographic aging and improved survival from other cardiovascular conditions. Registry-based analyses of surgical and transcatheter aortic valve implantation (TAVI) document progressive increases in patient age and comorbidity burden, with mean or median ages frequently exceeding 75 years in contemporary cohorts.[164,165,168,178]
- Despite this rising clinical complexity, these studies consistently report improvements in short-term outcomes, with in-hospital or 30-day mortality rates generally below 5-8% in recent periods, particularly in high-volume centers and among patients treated with transcatheter approaches, and with the viable possibility of safe early discharge following TAVI with minimalist approach in the public system.[164,165,168,178] These trends reflect advances in patient selection, procedural techniques, and perioperative care.
- Parallel evidence from studies of degenerative mitral valve disease highlights marked heterogeneity in referral patterns, access to advanced therapies, and procedural choice across Brazil.[174,176,179,180] The availability of catheter-based interventions for degenerative mitral valve disease is overall low, and the public health system

does not reimburse edge-to-edge repair for functional mitral regurgitation. Surgical series indicate that surgical valve repair – associated with better functional outcomes – is more frequently performed in specialized and high-volume centers, whereas delayed referral and higher rates of valve replacement are observed in less-resourced regions with impaired access to care.[175,178] Observational cohorts further suggest that patients referred at more advanced stages of disease experience worse postoperative outcomes and more extended hospital stays, emphasizing the importance of early diagnosis and equitable access to specialized care, as well as the development of excellence centers for VHD and RHD, to concentrate efforts towards population-based screening, prophylaxis, and interventional approaches.[181,182]

- Taken together, the Brazilian literature on NRVD portrays a health system facing growing demand driven by population aging, with improving procedural outcomes but persistent regional disparities that have direct implications for service organization and workforce planning.[164,166,168]

Healthcare Utilization and Costs

- Patterns of healthcare utilization for VHD in Brazil, as captured by SUS administrative data, show marked temporal variation from 2008 to 2024, reflecting long-term epidemiological transitions, procedural shifts, and the impact of the COVID-19 pandemic. The analysis focuses on three key procedures central to the management of VHD in the public health system: surgical valve procedures, PBMVC, and clinical admissions associated with VHD.

Surgical valve Procedures

- In 2008, the SUS financed 12,201 surgical open valve procedures, and, in 2013, 13,067 procedures, the highest annual volume observed in the study period. Over the subsequent decade, procedure volumes declined steadily, then rose to 12,771 in 2019, before a sharp pandemic-related contraction. In 2020, the number of surgical valve procedures fell to 9,198, followed by a further decrease to 8,808 in 2021. The volumes increased thereafter, with 11,030 procedures performed in 2022, 12,020 in 2023, and 12,784 in 2024 (Table 1.4).
- Despite this long-term reduction in procedural volume (1.5% from 2008 to 2023), total expenditures increased substantially. In 2008, SUS spending on heart valve surgery totaled approximately R$ 352 million, rising to almost R$ 407 million in 2024. Notably, the post-pandemic years were characterized by a divergence between volume and expenditure. Although procedure counts in 2019 and 2024 were almost the same, total spending considerably exceeded pre-pandemic levels, indicating a marked increase in per-procedure costs and possibly wider coverage of higher-complexity and more expensive procedures (Tables 1.4 and 1.6).
- Sex-stratified data show a persistent male predominance in surgical valve procedures, despite the prevalence and importance of RHD, which is more prevalent among women. In 2008, 6,127 procedures were performed in men and 6,074 in women, while in 2023 these numbers were 6,375 for men and 5,645 for women. Both sexes experienced similar pandemic-related declines and partial recovery, suggesting system-wide service disruption rather than sex-specific barriers to access.

Percutaneous Balloon Mitral Valve Commissurotomy

- Utilization patterns for PBMVC differed substantially from those observed for surgical valve procedures. In 2008, SUS financed 477 PBMVC procedures, a number that peaked in 2009 (511) and then declined progressively, reaching 195 procedures in 2019. During the pandemic, volumes decreased further to 129 procedures in 2020, followed by partial recovery to 159 in 2021, 167 in 2022, 181 in 2023, and 178 in 2024. Overall, valvuloplasty volumes fell by 62.1% between 2008 and 2023, associated with higher costs of balloons and adjunct devices, which became under-reimbursed by the public health system (Table 1.4).
- In contrast to surgical procedures, total expenditures for PBMVC remained outstandingly low in absolute terms throughout the study period. SUS spending decreased substantially from approximately R$ 8.70 million in 2008 to approximately R$ 2,16 million in 2024, reflecting the relatively low unit cost and short hospital stays associated with the procedure, but mainly the low rates of procedures per inhabitant in Brazil (0.15/100,000) and the underfunding of PBMVC despite the high rates of RHD. Even in years of higher activity, valvuloplasty accounted for a negligible proportion of total valve surgery expenditures (Table 1.6).
- Consistent with RHD gender patterns, sex-specific valvuloplasty patterns were striking and stable over time. Women consistently accounted for most procedures, reflecting the epidemiology of rheumatic mitral stenosis. In 1990, 380 procedures were performed in women as compared to 97 in men, and, in 2024, women accounted for 143 procedures versus 38 in men, corresponding to a female share of approximately 70% in both years.

Clinical Admissions Related to Valvular Heart Disease

- Similarly to that observed for surgical and percutaneous valvular procedures, the total number of admissions related to VHD clinical management at the SUS declined substantially from 3,237 in 2008 to 1,943 in 2023 (a 40% decrease), with a peak of 4,156 in 2009 (Table 1.3). The numbers declined dramatically during the COVID-19 period, reaching as low as 1,536 and 1,628 in 2020 and 2021, respectively. The costs adjusted for inflation were similar at the beginning and end of the period (approximately R$ 2.9 million in 2008 and almost R$ 2.8 million in 2024) (Table 1.5).
- Taken together, SUS administrative data illustrate a healthcare system facing divergent pressures across the

spectrum of VHD care. Surgical valve procedures show a sustained decline in volume but a near-doubling of total expenditures between 2008 and 2024, indicating rising procedural complexity and increasing financial burden per case. Conversely, PBMVC demonstrates a marked long-term reduction in utilization with minimal fiscal impact, presumably consistent with the epidemiological transition, but mainly due to suboptimal access to care and discrepancies between reimbursement and procedure's cost. The sharp service disruption observed in 2020-2021 and the incomplete recovery through 2024 highlight ongoing challenges in restoring elective cardiovascular care capacity within SUS. These utilization and cost patterns provide essential context for interpreting epidemiological trends and for planning future investments in VHD services in Brazil.

Table 5.1 – Rheumatic heart disease prevalence in Brazil, regions, and Federative Units, by sex, in 1990 and 2023: number, age-standardized rates, and percent change of the rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	455.454,6 (367.005,7; 539.588,6)	633,1 (520,9; 753,3)	683.293,8 (551.499,2; 829.312,4)	623,4 (501,3; 756,3)	-1,5 (-4,6; 1,4)	Male
North region	51.736,4 (40.692,6; 62.928,8)	1.100,7 (880,3; 1.340,4)	104.675,8 (83.285,6; 129.445,6)	1.095,1 (874,9; 1.350,1)	-0,5 (-5,5; 5,4)	Male
Acre	2.110,1 (1.660,0; 2.560,1)	1.096,3 (862,2; 1.351,2)	5.003,2 (3.957,4; 6.201,6)	1.095,5 (870,1; 1.359,8)	-0,1 (-8,7; 9,0)	Male
Amapá	1.363,9 (1.057,6; 1.696,3)	1.085,8 (853,2; 1.343,9)	4.312,0 (3.382,1; 5.245,3)	1.080,4 (850,0; 1.310,2)	-0,5 (-8,3; 9,6)	Male
Amazonas	10.629,8 (8.248,7; 13.125,5)	1.104,5 (869,6; 1.363,8)	23.596,1 (18.683,6; 28.963,4)	1.096,8 (874,6; 1.352,9)	-0,7 (-8,3; 8,7)	Male
Pará	25.453,2 (19.900,7; 31.553,9)	1.102,6 (889,7; 1.351,1)	49.300,2 (39.468,0; 60.240,5)	1.096,9 (880,2; 1.332,1)	-0,5 (-8,7; 10,0)	Male
Rondônia	6.164,1 (4.826,1; 7.453,0)	1.090,7 (866,6; 1.328,1)	9.503,4 (7.460,8; 11.715,9)	1.090,8 (857,6; 1.337,5)	0,0 (-7,8; 7,3)	Male
Roraima	1.274,2 (1.011,0; 1.570,3)	1.091,4 (884,8; 1.338,8)	3.824,8 (2.957,5; 4.660,0)	1.087,6 (845,0; 1.322,9)	-0,4 (-7,4; 9,6)	Male
Tocantins	4.741,1 (3.672,9; 5.815,8)	1.104,0 (872,0; 1.370,1)	9.136,2 (7.201,6; 11.263,1)	1.097,7 (863,7; 1.355,6)	-0,6 (-9,4; 10,8)	Male
Northeast region	212.892,4 (168.743,3; 256.936,3)	1.094,9 (880,8; 1.334,0)	319.476,9 (255.483,2; 390.677,3)	1.092,2 (871,6; 1.322,5)	-0,2 (-3,7; 3,5)	Male
Alagoas	12.638,6 (9.863,4; 15.254,7)	1.100,2 (885,0; 1.346,7)	17.902,2 (14.178,1; 22.164,4)	1.093,2 (867,0; 1.350,1)	-0,6 (-9,2; 6,6)	Male
Bahia	59.660,8 (46.550,6; 72.926,8)	1.086,0 (867,4; 1.332,7)	81.945,4 (64.721,3; 99.325,5)	1.084,7 (860,6; 1.326,9)	-0,1 (-8,2; 8,6)	Male
Ceará	31.502,3 (24.797,6; 38.341,1)	1.093,2 (856,0; 1.330,2)	52.051,8 (41.293,0; 63.236,8)	1.094,4 (870,5; 1.335,8)	0,1 (-7,9; 8,7)	Male
Maranhão	24.034,1 (18.790,2; 29.249,4)	1.093,8 (857,3; 1.338,3)	39.821,1 (31.953,0; 48.475,3)	1.090,4 (875,9; 1.327,1)	-0,3 (-9,9; 10,2)	Male
Paraíba	15.933,7 (12.633,4; 19.478,3)	1.105,5 (891,5; 1.348,2)	23.425,8 (18.362,7; 28.915,2)	1.104,8 (870,8; 1.357,6)	-0,1 (-8,7; 8,9)	Male
Pernambuco	36.111,9 (27.974,6; 44.164,9)	1.090,6 (853,1; 1.338,3)	51.835,3 (40.841,8; 62.956,8)	1.082,5 (858,8; 1.310,6)	-0,7 (-8,0; 9,6)	Male
Piaui	13.137,8 (10.148,1; 16.069,5)	1.121,7 (873,2; 1.378,7)	19.788,1 (15.973,2; 24.256,0)	1.114,8 (895,6; 1.370,4)	-0,6 (-8,0; 8,5)	Male
Rio Grande do Norte	12.319,5 (9.631,0; 14.852,2)	1.109,2 (888,9; 1.335,1)	19.793,1 (15.617,6; 24.466,9)	1.104,6 (870,7; 1.363,9)	-0,4 (-8,3; 8,8)	Male
Sergipe	7.553,6 (5.927,4; 9.204,5)	1.097,7 (861,8; 1.330,0)	12.914,2 (10.252,1; 16.003,9)	1.094,9 (870,3; 1.358,6)	-0,2 (-8,3; 8,5)	Male
Southeast region	130.210,1 (107.649,2; 153.850,2)	417,8 (350,1; 492,6)	164.930,1 (134.910,8; 199.569,5)	357,0 (288,2; 428,6)	-14,6 (-20,2; -8,9)	Male
Espírito Santo	14.236,1 (11.066,1; 17.426,6)	1.089,3 (861,5; 1.330,1)	22.691,0 (17.905,7; 27.926,5)	1.087,2 (862,5; 1.328,3)	-0,2 (-7,3; 7,3)	Male

Minas Gerais	88.150,1 (68.744,0; 108.477,1)	1.118,2 (891,2; 1.385,2)	124.434,4 (99.792,3; 154.629,9)	1.116,1 (889,9; 1.385,7)	-0,2 (-7,9; 7,6)	Male
Rio de Janeiro	7.599,2 (6.534,9; 8.688,2)	129,8 (112,5; 147,5)	4.691,5 (3.918,1; 5.692,0)	48,7 (41,2; 57,9)	-62,5 (-66,9; -57,1)	Male
São Paulo	20.224,7 (17.693,4; 22.923,1)	148,5 (130,5; 167,4)	13.113,2 (10.924,9; 15.579,5)	49,6 (41,7; 58,6)	-66,6 (-70,0; -62,8)	Male
South region	16.015,4 (13.988,2; 18.143,1)	166,0 (146,0; 187,6)	10.704,7 (9.057,9; 12.684,9)	58,3 (50,0; 68,7)	-64,9 (-68,5; -61,0)	Male
Paraná	6.875,5 (5.942,8; 7.827,0)	185,6 (160,6; 211,0)	4.585,1 (3.838,9; 5.483,5)	66,9 (57,0; 79,5)	-64,0 (-68,2; -59,6)	Male
Rio Grande do Sul	6.295,1 (5.560,2; 7.209,4)	156,5 (138,7; 177,9)	3.492,0 (2.935,1; 4.170,4)	50,2 (42,8; 59,6)	-67,9 (-71,3; -63,8)	Male
Santa Catarina	2.844,8 (2.490,1; 3.237,5)	147,4 (130,8; 167,4)	2.627,6 (2.228,5; 3.137,5)	58,1 (49,8; 68,3)	-60,6 (-64,9; -55,8)	Male
West-Central region	44.600,3 (35.368,8; 53.674,0)	940,6 (756,4; 1.148,0)	83.506,4 (66.175,4; 103.104,5)	922,5 (732,3; 1.128,7)	-1,9 (-7,0; 3,4)	Male
Distrito Federal	936,6 (805,4; 1.070,3)	149,7 (131,6; 169,7)	917,0 (771,5; 1.080,5)	62,9 (53,6; 73,7)	-58,0 (-62,6; -54,0)	Male
Goiás	22.558,2 (18.039,4; 27.798,3)	1.095,9 (883,7; 1.354,4)	43.463,6 (33.870,6; 54.514,6)	1.103,4 (867,5; 1.377,9)	0,7 (-8,4; 9,5)	Male
Mato Grosso	11.207,6 (8.701,4; 13.535,5)	1.094,1 (858,8; 1.323,8)	22.624,6 (17.819,1; 27.872,1)	1.089,4 (859,5; 1.336,8)	-0,4 (-9,3; 7,7)	Male
Mato Grosso do Sul	9.897,9 (7.902,7; 11.992,0)	1.101,9 (877,4; 1.340,4)	16.501,2 (13.072,7; 20.050,3)	1.100,8 (869,5; 1.330,7)	-0,1 (-7,9; 10,6)	Male
Brazil	473.540,1 (391.525,7; 557.392,3)	643,7 (533,2; 756,1)	742.692,0 (602.728,6; 904.309,3)	633,0 (511,2; 766,2)	-1,7 (-4,9; 1,5)	Female
North region	48.643,9 (39.048,6; 58.340,2)	1.107,8 (887,2; 1.358,7)	107.334,4 (85.871,4; 131.309,5)	1.111,0 (893,1; 1.356,1)	0,3 (-3,6; 4,4)	Female
Acre	1.981,1 (1.590,7; 2.372,9)	1.104,4 (887,7; 1.347,9)	5.080,2 (4.027,7; 6.147,8)	1.108,8 (882,1; 1.341,6)	0,4 (-8,3; 8,9)	Female
Amapá	1.333,4 (1.047,6; 1.605,6)	1.102,2 (880,1; 1.345,1)	4.509,9 (3.564,6; 5.519,8)	1.105,7 (876,7; 1.354,6)	0,3 (-8,0; 9,4)	Female
Amazonas	10.326,2 (8.242,2; 12.634,4)	1.112,4 (894,5; 1.379,1)	24.193,7 (19.311,3; 29.667,7)	1.117,8 (896,6; 1.370,9)	0,5 (-6,0; 7,8)	Female
Pará	24.169,0 (19.521,7; 29.258,5)	1.108,6 (890,8; 1.355,4)	50.391,6 (39.991,8; 61.731,7)	1.110,5 (884,0; 1.359,2)	0,2 (-7,2; 7,7)	Female
Rondônia	5.514,6 (4.387,1; 6.690,6)	1.099,6 (888,7; 1.359,1)	9.929,2 (7.808,7; 12.294,9)	1.105,4 (871,5; 1.361,7)	0,5 (-7,6; 8,6)	Female
Roraima	935,4 (745,1; 1.151,7)	1.090,6 (871,4; 1.337,3)	3.830,5 (3.012,2; 4.619,5)	1.095,8 (869,6; 1.315,8)	0,5 (-7,0; 8,8)	Female
Tocantins	4.384,2 (3.486,2; 5.327,4)	1.109,2 (880,2; 1.343,9)	9.399,3 (7.488,9; 11.453,5)	1.112,2 (882,6; 1.349,1)	0,3 (-7,7; 8,3)	Female
Northeast region	226.571,0 (180.341,5; 270.519,0)	1.116,2 (892,0; 1.349,9)	354.199,8 (283.935,3; 436.379,9)	1.117,0 (892,4; 1.369,3)	0,1 (-3,8; 3,2)	Female
Alagoas	13.306,2 (10.529,5; 16.027,6)	1.117,6 (881,2; 1.358,2)	20.363,6 (16.323,6; 25.332,4)	1.119,0 (900,8; 1.385,2)	0,1 (-6,7; 8,3)	Female
Bahia	62.113,1 (48.949,1; 74.891,3)	1.110,8 (896,7; 1.348,6)	91.537,5 (73.752,4; 111.707,4)	1.112,8 (892,3; 1.348,0)	0,2 (-8,2; 7,7)	Female

Ceará	34.611,5 (27.444,9; 42.020,7)	1.119,8 (897,7; 1.373,1)	57.296,8 (45.820,5; 69.443,8)	1.118,0 (885,1; 1.346,1)	-0,2 (-7,8; 7,2)	Female
Maranhão	24.272,4 (19.019,4; 29.091,4)	1.105,5 (875,5; 1.354,5)	42.351,5 (33.844,8; 52.372,8)	1.107,2 (883,7; 1.367,1)	0,2 (-7,2; 7,9)	Female
Paraíba	17.442,7 (13.966,0; 21.205,8)	1.117,5 (893,6; 1.377,9)	25.733,4 (20.582,5; 31.715,3)	1.122,3 (904,4; 1.373,7)	0,4 (-5,6; 8,8)	Female
Pernambuco	39.968,0 (31.889,1; 48.798,9)	1.120,6 (892,3; 1.363,8)	59.570,1 (47.639,0; 72.161,5)	1.122,0 (891,1; 1.348,3)	0,1 (-8,9; 8,1)	Female
Piaui	13.689,1 (10.849,8; 16.570,3)	1.120,3 (891,8; 1.374,9)	20.887,5 (16.755,2; 26.060,5)	1.116,7 (894,8; 1.387,8)	-0,3 (-9,2; 7,8)	Female
Rio Grande do Norte	13.242,5 (10.579,2; 16.205,9)	1.127,7 (904,8; 1.381,6)	21.752,6 (17.159,5; 26.548,6)	1.127,4 (889,3; 1.363,5)	0,0 (-7,5; 8,2)	Female
Sergipe	7.925,3 (6.295,6; 9.671,4)	1.120,7 (900,7; 1.371,1)	14.706,8 (11.983,8; 17.941,9)	1.121,7 (915,5; 1.363,5)	0,1 (-7,5; 8,0)	Female
Southeast region	136.866,1 (115.032,8; 158.462,2)	423,5 (358,8; 484,0)	179.960,8 (148.192,8; 217.617,4)	357,8 (293,6; 431,7)	-15,5 (-21,2; -8,6)	Female
Espírito Santo	14.202,2 (11.269,2; 17.205,1)	1.103,7 (889,5; 1.329,2)	24.643,6 (19.622,9; 30.373,0)	1.112,1 (890,8; 1.371,1)	0,8 (-8,5; 8,9)	Female
Minas Gerais	88.728,0 (70.202,0; 107.679,5)	1.117,6 (891,7; 1.333,4)	133.148,6 (108.595,7; 165.192,0)	1.127,2 (909,2; 1.392,8)	0,9 (-8,2; 10,3)	Female
Rio de Janeiro	10.062,7 (8.722,2; 11.561,4)	149,8 (131,0; 172,3)	6.050,0 (5.030,3; 7.065,5)	52,2 (44,1; 60,8)	-65,2 (-69,3; -60,3)	Female
São Paulo	23.873,1 (20.731,8; 26.967,9)	159,7 (139,6; 180,7)	16.118,5 (13.342,7; 19.113,9)	52,3 (43,9; 61,5)	-67,3 (-70,6; -63,8)	Female
South region	17.532,2 (15.306,1; 19.807,8)	168,2 (147,3; 189,9)	12.820,2 (10.741,7; 15.198,5)	62,6 (53,2; 73,7)	-62,8 (-66,8; -58,8)	Female
Paraná	7.933,4 (6.832,5; 9.111,0)	203,5 (176,6; 232,4)	6.116,7 (5.101,1; 7.338,3)	79,7 (67,2; 95,4)	-60,8 (-65,5; -55,9)	Female
Rio Grande do Sul	6.615,2 (5.730,5; 7.438,4)	147,7 (128,3; 166,2)	3.802,8 (3.142,6; 4.477,5)	48,6 (40,7; 57,1)	-67,1 (-70,7; -63,6)	Female
Santa Catarina	2.983,6 (2.574,8; 3.403,3)	145,3 (127,0; 164,6)	2.900,7 (2.441,0; 3.419,2)	57,9 (48,9; 68,0)	-60,1 (-64,6; -55,7)	Female
West-Central region	43.926,9 (35.213,1; 52.733,1)	947,9 (767,9; 1.144,3)	88.376,7 (71.425,3; 108.625,1)	934,1 (752,7; 1.137,5)	-1,5 (-6,2; 3,8)	Female
Distrito Federal	1.710,4 (1.451,0; 1.984,9)	230,0 (196,6; 265,9)	1.791,0 (1.495,5; 2.155,3)	99,3 (83,7; 117,2)	-56,8 (-62,1; -51,8)	Female
Goiás	22.489,4 (17.854,7; 27.665,8)	1.115,4 (889,8; 1.386,9)	46.223,8 (37.509,3; 57.073,7)	1.120,4 (906,8; 1.367,8)	0,5 (-7,4; 8,0)	Female
Mato Grosso	10.150,7 (8.030,7; 12.246,2)	1.104,5 (880,8; 1.350,7)	22.960,0 (18.293,0; 28.055,7)	1.110,4 (890,1; 1.353,4)	0,5 (-6,7; 7,6)	Female
Mato Grosso do Sul	9.576,5 (7.529,8; 11.753,9)	1.101,4 (872,5; 1.353,5)	17.401,9 (13.901,2; 21.382,2)	1.112,2 (886,5; 1.365,1)	1,0 (-7,2; 10,4)	Female
Brazil	928.994,8 (759.829,0; 1.091.063,6)	638,7 (528,3; 754,7)	1.425.985,8 (1.158.391,9; 1.729.730,5)	628,9 (504,6; 755,4)	-1,5 (-4,1; 1,0)	Both
North region	100.380,4 (80.557,3; 120.663,5)	1.103,6 (887,8; 1.351,9)	212.010,1 (169.257,3; 258.366,5)	1.103,6 (884,5; 1.340,0)	0,0 (-3,4; 3,8)	Both

Acre	4.091,2 (3.232,7; 4.911,4)	1.099,2 (873,4; 1.330,3)	10.083,3 (8.053,2; 12.363,0)	1.102,9 (882,6; 1.354,1)	0,3 (-5,3; 7,2)	Both
Amapá	2.697,4 (2.117,0; 3.240,5)	1.094,1 (867,7; 1.330,7)	8.821,9 (7.012,5; 10.700,5)	1.093,9 (872,3; 1.334,1)	0,0 (-5,7; 6,5)	Both
Amazonas	20.956,0 (16.685,3; 25.286,7)	1.108,0 (887,9; 1.362,8)	47.789,9 (37.935,1; 58.316,1)	1.108,0 (887,8; 1.357,6)	0,0 (-5,0; 5,1)	Both
Pará	49.622,2 (40.097,0; 60.311,0)	1.105,3 (893,7; 1.364,2)	99.691,8 (80.056,6; 121.052,1)	1.104,2 (886,2; 1.335,0)	-0,1 (-6,3; 6,5)	Both
Rondônia	11.678,7 (9.247,3; 14.106,9)	1.092,6 (871,4; 1.324,6)	19.432,6 (15.448,4; 23.743,4)	1.098,5 (873,4; 1.338,8)	0,5 (-5,0; 6,3)	Both
Roraima	2.209,6 (1.752,2; 2.704,5)	1.089,5 (874,6; 1.328,7)	7.655,3 (6.025,3; 9.281,3)	1.092,0 (866,4; 1.320,1)	0,2 (-4,8; 6,5)	Both
Tocantins	9.125,3 (7.239,0; 11.008,8)	1.105,6 (875,9; 1.337,6)	18.535,5 (14.760,2; 22.519,4)	1.105,2 (885,1; 1.343,1)	0,0 (-6,1; 6,3)	Both
Northeast region	439.463,3 (351.152,9; 527.900,5)	1.106,8 (893,3; 1.337,7)	673.676,7 (539.801,8; 816.872,4)	1.106,5 (881,7; 1.334,7)	0,0 (-2,6; 2,4)	Both
Alagoas	25.944,9 (20.493,3; 30.659,8)	1.109,8 (887,0; 1.325,3)	38.265,8 (30.866,3; 47.704,6)	1.108,5 (887,8; 1.378,2)	-0,1 (-6,3; 5,1)	Both
Bahia	121.774,0 (96.983,6; 147.348,7)	1.099,5 (886,5; 1.332,1)	173.482,9 (139.208,4; 210.233,4)	1.100,4 (873,5; 1.332,5)	0,1 (-5,4; 6,6)	Both
Ceará	66.113,8 (52.250,3; 79.946,8)	1.107,8 (883,8; 1.347,2)	109.348,6 (87.345,6; 132.193,1)	1.108,1 (876,5; 1.341,8)	0,0 (-5,5; 6,0)	Both
Maranhão	48.306,6 (37.678,7; 58.207,4)	1.099,7 (864,5; 1.318,8)	82.172,6 (65.738,7; 100.650,7)	1.100,1 (879,4; 1.346,6)	0,0 (-6,4; 6,2)	Both
Paraíba	33.376,3 (26.961,0; 40.441,1)	1.113,0 (898,6; 1.349,6)	49.159,3 (39.618,3; 59.837,4)	1.115,6 (892,1; 1.355,5)	0,2 (-5,4; 5,8)	Both
Pernambuco	76.080,0 (60.548,4; 92.065,5)	1.107,8 (887,2; 1.358,1)	111.405,3 (88.488,4; 134.704,7)	1.105,1 (874,4; 1.327,4)	-0,2 (-6,0; 5,5)	Both
Piaui	26.826,9 (21.095,8; 32.435,8)	1.121,1 (886,8; 1.388,3)	40.675,6 (32.750,1; 50.109,9)	1.117,1 (894,2; 1.374,6)	-0,4 (-6,2; 6,2)	Both
Rio Grande do Norte	25.562,0 (20.363,3; 30.647,9)	1.119,9 (897,9; 1.365,4)	41.545,7 (32.929,6; 50.553,6)	1.117,9 (882,1; 1.353,3)	-0,2 (-5,8; 5,9)	Both
Sergipe	15.478,9 (12.301,7; 18.813,0)	1.110,6 (892,8; 1.348,6)	27.621,0 (22.476,6; 33.763,7)	1.110,7 (898,7; 1.356,9)	0,0 (-5,2; 5,9)	Both
Southeast region	267.076,2 (222.098,8; 312.684,5)	420,6 (353,8; 488,4)	344.890,9 (285.383,6; 412.262,1)	357,6 (292,8; 426,3)	-15,0 (-19,8; -10,1)	Both
Espírito Santo	28.438,3 (22.354,3; 34.055,4)	1.097,0 (872,6; 1.330,2)	47.334,6 (37.641,4; 58.272,3)	1.101,1 (878,1; 1.348,6)	0,4 (-6,7; 6,0)	Both
Minas Gerais	176.878,2 (139.126,1; 214.160,0)	1.118,6 (890,7; 1.358,0)	257.583,0 (209.535,0; 316.514,3)	1.122,9 (901,3; 1.364,4)	0,4 (-5,1; 7,3)	Both
Rio de Janeiro	17.661,9 (15.343,2; 20.141,7)	139,8 (122,9; 160,4)	10.741,5 (8.957,0; 12.727,1)	50,3 (42,5; 59,2)	-64,0 (-67,9; -59,7)	Both
São Paulo	44.097,8 (38.662,4; 49.833,1)	153,7 (135,5; 172,2)	29.231,7 (24.382,1; 34.931,7)	50,8 (43,0; 59,9)	-67,0 (-70,1; -63,9)	Both

South region	33.547,6 (29.306,7; 37.923,4)	166,7 (146,9; 187,1)	23.524,9 (19.905,0; 27.846,7)	60,3 (51,6; 70,9)	-63,8 (-67,4; -60,2)	Both
Paraná	14.808,9 (12.885,9; 16.888,6)	194,7 (170,0; 220,4)	10.701,8 (8.990,8; 12.828,0)	73,3 (62,6; 86,7)	-62,3 (-66,4; -57,6)	Both
Rio Grande do Sul	12.910,3 (11.279,9; 14.607,6)	151,2 (132,6; 170,8)	7.294,8 (6.145,4; 8.670,7)	49,1 (41,5; 57,8)	-67,5 (-70,7; -64,2)	Both
Santa Catarina	5.828,5 (5.105,7; 6.627,8)	145,9 (129,3; 163,3)	5.528,3 (4.680,6; 6.599,4)	57,7 (49,3; 67,9)	-60,4 (-64,2; -56,4)	Both
West-Central region	88.527,3 (70.864,0; 106.318,7)	943,7 (763,3; 1.153,3)	171.883,1 (137.229,4; 209.586,0)	929,3 (744,1; 1.121,5)	-1,5 (-4,8; 2,1)	Both
Distrito Federal	2.646,9 (2.277,2; 3.035,5)	191,9 (166,2; 219,8)	2.708,1 (2.273,8; 3.195,7)	82,3 (69,8; 96,3)	-57,1 (-61,6; -52,7)	Both
Goiás	45.047,6 (35.839,7; 55.258,6)	1.105,2 (880,9; 1.356,7)	89.687,4 (70.787,4; 108.965,9)	1.113,1 (875,0; 1.341,3)	0,7 (-5,0; 6,9)	Both
Mato Grosso	21.358,4 (16.755,0; 25.497,2)	1.097,4 (872,0; 1.321,9)	45.584,6 (36.531,5; 56.490,2)	1.100,2 (886,8; 1.356,3)	0,3 (-5,2; 5,8)	Both
Mato Grosso do Sul	19.474,4 (15.740,9; 23.676,9)	1.100,9 (889,3; 1.340,8)	33.903,1 (27.175,9; 41.089,6)	1.107,6 (880,9; 1.347,0)	0,6 (-5,0; 6,7)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.2 – Rheumatic heart disease prevalence, deaths, and disability-adjusted life years (DALYs) by age group in Brazil, both sexes, 1990 and 2023: number, rate, and percent change of rates

Measure	Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Age
Deaths	Brazil	20,4 (16,8; 25,0)	0,1 (0,1; 0,1)	3,8 (3,1; 4,6)	0,0 (0,0; 0,0)	-78,7 (-84,1; -72,7)	under 5 years
Deaths	Brazil	167,7 (143,3; 193,6)	0,5 (0,4; 0,5)	23,6 (19,4; 28,7)	0,1 (0,1; 0,1)	-82,4 (-86,2; -78,5)	5-14 years
Deaths	Brazil	1.237,8 (1.119,8; 1.368,5)	1,6 (1,5; 1,8)	678,0 (624,0; 731,6)	0,6 (0,6; 0,7)	-61,7 (-65,9; -57,5)	15-49 years
Deaths	Brazil	860,0 (765,8; 946,9)	5,5 (4,9; 6,0)	1.187,5 (1.119,4; 1.256,9)	2,7 (2,6; 2,9)	-50,2 (-54,9; -44,4)	50-69 years
Deaths	Brazil	489,8 (435,0; 548,7)	11,5 (10,2; 12,8)	1.125,1 (963,7; 1.233,5)	7,4 (6,4; 8,1)	-35,2 (-41,8; -28,4)	70+ years
Deaths	Brazil	2.775,5 (2.533,0; 3.049,1)	1,9 (1,7; 2,0)	3.017,9 (2.765,7; 3.225,2)	1,4 (1,3; 1,5)	-23,4 (-31,2; -15,6)	All ages
Deaths	Brazil		2,6 (2,3; 2,8)		1,2 (1,1; 1,3)	-54,2 (-58,2; -49,6)	Age-standardized
DALYs	Brazil	2.253,1 (1.857,4; 2.721,0)	13,3 (11,0; 16,1)	660,2 (495,1; 827,3)	4,4 (3,3; 5,6)	-66,7 (-74,5; -58,9)	under 5 years
DALYs	Brazil	19.241,1 (15.871,2; 23.000,9)	54,1 (44,6; 64,7)	6.116,7 (4.378,7; 8.864,0)	21,5 (15,4; 31,1)	-60,3 (-68,3; -51,1)	5-14 years
DALYs	Brazil	102.758,0 (87.787,8; 125.189,5)	133,7 (114,2; 162,9)	83.235,8 (63.248,1; 112.599,5)	75,7 (57,6; 102,5)	-43,4 (-50,6; -35,6)	15-49 years
DALYs	Brazil	31.825,6 (28.443,2; 35.414,5)	202,2 (180,7; 225,0)	48.694,9 (43.688,5; 54.603,0)	111,5 (100,0; 125,0)	-44,9 (-48,9; -39,5)	50-69 years
DALYs	Brazil	8.378,3 (7.541,2; 9.270,8)	196,0 (176,4; 216,9)	18.980,0 (16.625,9; 20.804,7)	125,2 (109,7; 137,2)	-36,1 (-41,6; -30,6)	70+ years
DALYs	Brazil	164.456,0 (143.297,6; 192.774,8)	110,1 (96,0; 129,1)	157.687,6 (130.544,2; 196.593,4)	74,4 (61,6; 92,7)	-32,5 (-38,6; -26,3)	All ages
DALYs	Brazil		123,4 (108,0; 142,1)		65,9 (54,1; 83,3)	-46,6 (-52,0; -40,6)	Age-standardized
Prevalence	Brazil	8.482,0 (6.161,4; 11.132,7)	50,2 (36,5; 65,9)	6.203,4 (4.145,6; 8.648,0)	41,7 (27,9; 58,2)	-16,9 (-25,2; -10,4)	under 5 years
Prevalence	Brazil	115.192,0 (78.664,4; 166.400,5)	323,8 (221,1; 467,7)	85.079,9 (55.342,8; 123.649,1)	298,7 (194,3; 434,1)	-7,8 (-12,8; -4,3)	5-14 years
Prevalence	Brazil	681.193,9 (545.282,7; 818.865,8)	886,4 (709,5; 1.065,5)	1.011.654,6 (793.899,4; 1.234.491,7)	920,6 (722,4; 1.123,4)	3,9 (-0,4; 7,9)	15-49 years
Prevalence	Brazil	107.120,7 (90.060,8; 129.873,3)	680,5 (572,2; 825,1)	271.868,5 (226.168,6; 333.341,4)	622,4 (517,8; 763,2)	-8,5 (-12,4; -4,9)	50-69 years

Prevalence	Brazil	17.006,1 (13.961,9; 20.378,1)	397,8 (326,6; 476,7)	51.179,4 (40.852,8; 63.947,5)	337,5 (269,4; 421,7)	-15,1 (-18,4; -11,9)	70+ years
Prevalence	Brazil	928.994,8 (759.829,0; 1.091.063,6)	622,1 (508,8; 730,6)	1.425.985,8 (1.158.391,9; 1.729.730,5)	672,4 (546,2; 815,6)	8,1 (1,6; 13,1)	All ages
Prevalence	Brazil		638,7 (528,3; 754,7)		628,9 (504,6; 755,4)	-1,5 (-4,1; 1,0)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.3 – Non-rheumatic valve disease prevalence in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	75.290,3 (64.401,5; 88.302,4)	187,3 (161,0; 220,5)	276.354,8 (233.369,7; 329.409,1)	236,7 (199,1; 282,3)	26,4 (20,5; 31,8)	Male
North region	3.400,3 (2.901,8; 3.936,3)	175,3 (148,4; 203,9)	16.345,9 (13.791,7; 19.235,8)	220,4 (184,3; 259,4)	25,7 (19,9; 31,9)	Male
Acre	149,1 (127,0; 173,5)	169,5 (142,5; 197,0)	718,4 (594,6; 860,7)	220,3 (180,7; 264,3)	29,9 (19,5; 41,7)	Male
Amapá	83,4 (71,3; 97,2)	190,9 (159,6; 223,0)	593,8 (490,4; 692,2)	229,5 (188,2; 269,0)	20,2 (10,1; 28,8)	Male
Amazonas	703,3 (599,5; 815,3)	187,8 (156,4; 219,3)	3.323,0 (2.744,4; 3.975,4)	229,5 (188,8; 272,3)	22,2 (13,2; 31,5)	Male
Pará	1.674,1 (1.442,0; 1.945,9)	169,5 (144,7; 199,6)	7.522,9 (6.290,9; 8.775,2)	211,1 (176,7; 248,3)	24,5 (15,9; 34,4)	Male
Rondônia	386,2 (323,2; 454,8)	186,1 (156,4; 219,0)	1.853,7 (1.517,3; 2.206,5)	228,3 (186,1; 269,3)	22,7 (13,3; 32,2)	Male
Roraima	56,8 (48,1; 66,2)	177,1 (148,6; 207,5)	466,0 (387,7; 550,5)	220,6 (181,7; 258,0)	24,5 (16,7; 34,4)	Male
Tocantins	347,4 (297,5; 405,5)	171,0 (146,0; 199,0)	1.868,0 (1.560,9; 2.200,0)	233,8 (195,9; 275,5)	36,7 (27,3; 46,6)	Male
Northeast region	18.674,4 (16.185,9; 21.484,5)	161,2 (138,4; 185,5)	61.512,4 (51.532,1; 73.156,9)	208,1 (173,7; 247,5)	29,1 (23,5; 34,3)	Male
Alagoas	945,7 (809,8; 1.092,1)	152,9 (132,3; 176,0)	3.027,5 (2.498,1; 3.550,4)	200,5 (166,5; 234,3)	31,2 (20,5; 42,5)	Male
Bahia	5.172,0 (4.402,4; 5.975,9)	167,9 (142,3; 194,5)	17.168,7 (14.295,5; 20.636,1)	210,0 (174,4; 252,2)	25,0 (16,3; 34,3)	Male
Ceará	2.871,0 (2.466,1; 3.372,1)	157,1 (134,7; 183,1)	10.363,8 (8.711,7; 12.417,4)	213,2 (179,0; 256,1)	35,7 (26,6; 47,5)	Male
Maranhão	1.739,3 (1.494,9; 2.001,6)	148,9 (128,1; 172,3)	6.291,7 (5.362,2; 7.465,8)	195,7 (166,6; 232,3)	31,4 (23,0; 42,2)	Male
Paraíba	1.635,5 (1.390,0; 1.922,1)	154,2 (130,7; 180,9)	4.398,3 (3.684,2; 5.276,1)	196,0 (164,2; 234,7)	27,1 (18,1; 38,3)	Male
Pernambuco	3.418,0 (2.914,4; 4.021,0)	167,9 (142,5; 196,5)	10.345,6 (8.612,8; 12.151,1)	219,5 (182,2; 258,1)	30,8 (20,9; 40,3)	Male
Piaui	1.027,1 (865,6; 1.197,8)	153,9 (129,5; 180,6)	3.611,8 (3.053,3; 4.224,3)	191,5 (161,4; 223,9)	24,4 (16,1; 34,3)	Male
Rio Grande do Norte	1.258,7 (1.080,0; 1.488,2)	168,2 (143,9; 198,3)	4.087,4 (3.377,0; 4.806,9)	220,0 (181,4; 258,6)	30,8 (21,5; 41,9)	Male
Sergipe	607,1 (516,1; 714,8)	161,5 (136,3; 191,1)	2.217,5 (1.857,6; 2.583,3)	202,5 (168,9; 236,1)	25,4 (16,7; 34,5)	Male
Southeast region	35.814,2 (30.616,5; 42.069,0)	197,7 (168,9; 233,8)	128.547,3 (108.285,8; 155.038,6)	244,6 (204,8; 294,2)	23,7 (15,5; 31,7)	Male
Espírito Santo	1.308,4 (1.115,4; 1.526,0)	190,9 (161,2; 222,8)	5.635,0 (4.633,5; 6.731,5)	243,6 (200,7; 289,2)	27,6 (16,9; 37,0)	Male
Minas Gerais	8.277,3 (6.996,4; 9.774,6)	186,5 (157,4; 221,1)	30.536,9 (25.208,7; 36.541,9)	227,0 (188,1; 270,6)	21,7 (13,0; 32,3)	Male

Rio de Janeiro	7.595,3 (6.460,0; 8.942,4)	189,4 (161,5; 220,3)	23.721,8 (19.645,8; 28.404,5)	235,7 (195,2; 280,9)	24,4 (14,1; 35,2)	Male
São Paulo	18.633,1 (15.991,8; 22.099,7)	207,5 (176,8; 249,2)	68.653,7 (57.076,3; 83.773,1)	256,9 (213,0; 311,8)	23,8 (12,9; 33,9)	Male
South region	13.348,7 (11.275,3; 15.787,6)	208,8 (175,7; 247,8)	49.670,4 (41.600,2; 60.190,2)	263,0 (220,8; 317,9)	25,9 (18,1; 33,4)	Male
Paraná	4.646,7 (3.896,3; 5.449,2)	198,4 (166,2; 234,8)	17.488,7 (14.450,2; 21.053,3)	252,3 (208,8; 301,4)	27,2 (15,8; 38,0)	Male
Rio Grande do Sul	6.232,2 (5.221,7; 7.406,4)	216,9 (180,0; 257,8)	20.411,5 (16.966,8; 24.560,2)	268,4 (223,5; 322,0)	23,8 (13,3; 34,0)	Male
Santa Catarina	2.469,8 (2.100,3; 2.914,6)	209,8 (179,3; 246,3)	11.770,2 (9.682,6; 14.371,9)	270,5 (222,9; 329,3)	28,9 (17,8; 39,3)	Male
West-Central region	4.052,7 (3.439,9; 4.698,3)	192,5 (163,4; 225,6)	20.278,8 (16.967,5; 24.114,9)	243,3 (202,6; 288,8)	26,4 (19,8; 34,0)	Male
Distrito Federal	601,0 (502,9; 707,1)	229,0 (193,3; 270,3)	3.986,9 (3.249,1; 4.734,4)	304,5 (245,3; 365,3)	33,0 (22,2; 43,5)	Male
Goiás	1.854,4 (1.571,0; 2.162,8)	188,8 (159,0; 220,0)	8.572,9 (7.118,9; 10.149,0)	228,8 (191,8; 271,9)	21,2 (10,2; 32,0)	Male
Mato Grosso	732,4 (617,9; 856,0)	178,5 (151,0; 207,6)	4.126,3 (3.412,1; 4.898,4)	231,6 (191,3; 272,8)	29,7 (20,4; 39,9)	Male
Mato Grosso do Sul	864,9 (725,4; 1.009,4)	194,0 (162,8; 227,4)	3.592,7 (2.948,9; 4.327,8)	239,9 (198,8; 287,5)	23,7 (14,4; 33,8)	Male
Brazil	56.548,1 (49.821,4; 64.174,8)	121,0 (105,0; 136,9)	215.754,9 (181.645,7; 250.344,9)	146,9 (124,1; 170,1)	21,4 (16,3; 26,5)	Female
North region	2.182,5 (1.927,9; 2.482,1)	112,0 (98,0; 127,0)	10.652,0 (9.177,7; 12.309,7)	132,6 (113,3; 153,5)	18,4 (13,6; 26,3)	Female
Acre	82,4 (71,3; 93,1)	107,8 (93,3; 121,8)	466,4 (390,2; 544,4)	132,7 (110,8; 154,8)	23,1 (14,6; 30,5)	Female
Amapá	64,2 (56,5; 73,4)	119,8 (104,5; 138,9)	405,6 (349,0; 480,3)	140,9 (121,0; 166,6)	17,6 (9,8; 25,6)	Female
Amazonas	453,0 (390,6; 520,6)	117,3 (100,7; 134,9)	2.184,0 (1.832,5; 2.526,9)	134,0 (112,8; 155,0)	14,3 (7,7; 22,7)	Female
Pará	1.156,5 (1.018,2; 1.315,3)	109,7 (96,2; 124,9)	5.037,6 (4.374,7; 5.925,1)	128,6 (111,2; 150,9)	17,3 (10,6; 29,0)	Female
Rondônia	195,4 (171,9; 222,5)	120,9 (105,1; 139,4)	1.164,2 (984,6; 1.363,7)	140,6 (119,3; 165,1)	16,4 (7,9; 24,6)	Female
Roraima	30,5 (26,9; 35,2)	118,7 (102,6; 136,9)	310,3 (261,9; 362,3)	145,3 (123,1; 168,4)	22,4 (14,0; 32,2)	Female
Tocantins	200,5 (175,3; 229,0)	107,4 (93,0; 121,2)	1.084,0 (925,1; 1.255,1)	134,6 (114,8; 155,3)	25,3 (17,3; 34,2)	Female
Northeast region	13.980,2 (12.307,7; 15.872,6)	105,7 (92,8; 119,9)	47.118,7 (40.491,1; 53.965,1)	127,3 (109,5; 146,0)	20,5 (14,8; 25,8)	Female
Alagoas	721,7 (636,2; 821,8)	103,8 (91,2; 117,9)	2.497,6 (2.119,7; 2.911,3)	129,3 (109,8; 150,5)	24,6 (16,5; 33,9)	Female
Bahia	3.955,1 (3.485,8; 4.492,1)	111,0 (97,7; 126,2)	12.567,5 (10.763,6; 14.681,4)	125,9 (107,7; 147,3)	13,4 (5,7; 20,6)	Female
Ceará	2.133,2 (1.870,3; 2.464,3)	102,5 (89,7; 117,9)	7.918,3 (6.681,1; 9.172,4)	130,1 (110,0; 151,5)	26,9 (18,1; 36,1)	Female

Maranhão	1.163,4 (1.030,9; 1.336,8)	91,8 (81,4; 104,6)	4.276,1 (3.640,3; 4.922,2)	115,5 (98,1; 132,7)	25,8 (17,1; 35,0)	Female
Paraíba	1.235,2 (1.076,9; 1.427,6)	103,9 (90,5; 119,6)	3.638,8 (3.083,5; 4.140,0)	124,5 (106,3; 141,8)	19,8 (12,0; 28,5)	Female
Pernambuco	2.682,7 (2.350,1; 3.064,6)	109,8 (96,1; 125,5)	8.693,3 (7.352,4; 10.000,9)	136,5 (115,7; 157,2)	24,3 (15,6; 34,3)	Female
Piaui	724,1 (637,4; 828,6)	99,5 (87,5; 113,7)	2.622,2 (2.225,8; 2.983,5)	116,8 (99,0; 133,1)	17,3 (10,3; 24,6)	Female
Rio Grande do Norte	908,0 (788,5; 1.038,7)	109,3 (94,5; 125,1)	3.157,6 (2.657,5; 3.654,8)	133,4 (112,6; 154,7)	22,1 (13,7; 30,8)	Female
Sergipe	456,9 (397,4; 519,0)	105,0 (91,2; 119,6)	1.747,2 (1.472,6; 2.023,3)	123,7 (104,3; 143,7)	17,9 (9,9; 26,4)	Female
Southeast region	27.717,3 (24.414,8; 31.528,3)	125,8 (108,8; 142,9)	104.035,2 (86.632,3; 121.690,4)	151,8 (127,0; 176,8)	20,6 (14,7; 27,1)	Female
Espírito Santo	931,2 (814,2; 1.061,6)	124,9 (107,8; 142,9)	4.291,1 (3.584,0; 4.979,2)	152,4 (127,5; 176,7)	22,0 (13,9; 31,9)	Female
Minas Gerais	6.195,3 (5.352,9; 7.095,2)	119,8 (103,0; 138,1)	23.245,9 (19.258,5; 27.385,8)	142,4 (118,3; 167,1)	18,9 (10,5; 28,2)	Female
Rio de Janeiro	6.380,8 (5.464,6; 7.358,0)	119,7 (102,6; 138,7)	20.085,2 (16.949,7; 23.787,4)	142,8 (120,3; 168,4)	19,3 (10,8; 27,8)	Female
São Paulo	14.210,0 (12.445,3; 16.318,9)	131,9 (114,2; 151,0)	56.412,9 (47.136,0; 65.867,2)	159,7 (133,6; 186,5)	21,0 (12,1; 30,4)	Female
South region	10.061,4 (8.714,4; 11.541,7)	135,8 (118,0; 156,0)	39.194,7 (32.944,3; 46.263,3)	165,9 (140,0; 194,5)	22,2 (15,9; 28,0)	Female
Paraná	3.258,8 (2.845,3; 3.747,7)	132,2 (115,2; 152,2)	13.714,6 (11.478,6; 16.167,8)	160,9 (134,9; 188,6)	21,8 (12,5; 31,0)	Female
Rio Grande do Sul	4.945,6 (4.238,3; 5.769,8)	137,0 (117,5; 159,8)	16.393,4 (13.818,5; 19.563,3)	167,3 (141,0; 198,7)	22,1 (14,0; 33,4)	Female
Santa Catarina	1.856,9 (1.591,3; 2.153,1)	138,7 (118,8; 161,5)	9.086,8 (7.531,9; 10.594,4)	171,2 (141,9; 198,6)	23,4 (13,9; 32,1)	Female
West-Central region	2.606,7 (2.270,1; 2.982,4)	125,4 (108,1; 141,8)	14.754,3 (12.452,3; 16.995,8)	151,4 (127,4; 173,9)	20,7 (14,9; 26,8)	Female
Distrito Federal	451,6 (389,1; 521,5)	137,0 (116,6; 157,9)	3.181,9 (2.647,2; 3.793,7)	177,2 (146,3; 211,1)	29,3 (20,0; 40,3)	Female
Goiás	1.213,1 (1.046,3; 1.386,0)	124,3 (106,7; 140,5)	6.258,2 (5.280,3; 7.281,5)	143,6 (121,0; 166,4)	15,5 (8,0; 24,7)	Female
Mato Grosso	407,6 (356,9; 465,2)	116,9 (100,5; 131,6)	2.719,3 (2.309,5; 3.155,9)	145,6 (122,9; 168,3)	24,6 (16,0; 33,9)	Female
Mato Grosso do Sul	534,3 (460,2; 619,2)	126,1 (107,8; 144,8)	2.594,9 (2.207,0; 3.069,9)	149,9 (127,3; 176,3)	18,9 (11,6; 27,9)	Female
Brazil	131.838,4 (114.152,5; 152.244,1)	151,4 (131,1; 175,2)	492.109,7 (416.005,0; 576.511,6)	186,3 (157,2; 218,2)	23,0 (18,5; 27,6)	Both
North region	5.582,8 (4.862,5; 6.419,5)	143,4 (123,2; 164,8)	26.997,9 (23.000,2; 31.522,0)	174,6 (147,5; 203,9)	21,7 (17,0; 26,8)	Both
Acre	231,5 (200,3; 264,3)	141,7 (120,8; 161,8)	1.184,8 (987,0; 1.375,7)	174,9 (145,0; 203,0)	23,5 (16,8; 32,0)	Both
Amapá	147,7 (129,2; 170,5)	151,6 (131,2; 176,9)	999,4 (847,0; 1.157,2)	182,9 (153,7; 211,4)	20,7 (13,6; 27,4)	Both

Amazonas	1.156,4 (990,3; 1.337,0)	152,0 (129,1; 176,7)	5.507,0 (4.669,4; 6.467,7)	178,7 (150,6; 207,8)	17,5 (11,4; 24,7)	Both
Pará	2.830,6 (2.491,0; 3.255,1)	138,4 (120,1; 159,4)	12.560,5 (10.657,6; 14.678,3)	167,8 (143,2; 195,9)	21,2 (15,2; 28,5)	Both
Rondônia	581,5 (496,3; 673,6)	158,2 (135,5; 183,7)	3.017,9 (2.511,7; 3.579,8)	184,1 (152,2; 216,9)	16,4 (9,5; 23,5)	Both
Roraima	87,2 (75,1; 101,5)	150,8 (128,5; 174,0)	776,3 (654,9; 913,1)	183,1 (152,5; 213,1)	21,4 (15,1; 28,1)	Both
Tocantins	547,9 (477,0; 631,5)	140,0 (120,7; 159,7)	2.952,0 (2.498,8; 3.430,1)	184,1 (155,2; 213,9)	31,5 (24,9; 39,1)	Both
Northeast region	32.654,6 (28.636,0; 37.256,2)	131,6 (114,3; 150,0)	108.631,1 (91.784,1; 127.356,4)	163,0 (137,6; 191,1)	23,8 (19,5; 27,9)	Both
Alagoas	1.667,4 (1.461,8; 1.888,9)	126,9 (111,6; 143,8)	5.525,1 (4.656,4; 6.451,9)	160,3 (135,0; 187,2)	26,3 (19,3; 33,7)	Both
Bahia	9.127,1 (7.925,8; 10.376,2)	137,3 (117,9; 156,5)	29.736,2 (25.335,9; 34.887,0)	163,6 (139,3; 191,6)	19,1 (12,7; 25,8)	Both
Ceará	5.004,2 (4.333,9; 5.799,2)	128,1 (110,6; 147,5)	18.282,2 (15.422,3; 21.576,3)	166,8 (140,6; 197,2)	30,2 (23,2; 37,4)	Both
Maranhão	2.902,6 (2.528,4; 3.303,2)	119,2 (104,5; 136,1)	10.567,8 (9.020,0; 12.290,9)	152,7 (130,0; 177,9)	28,1 (21,6; 35,2)	Both
Paraíba	2.870,8 (2.486,2; 3.322,2)	127,6 (110,4; 147,5)	8.037,2 (6.869,9; 9.364,4)	155,3 (133,1; 181,2)	21,7 (15,0; 29,5)	Both
Pernambuco	6.100,7 (5.281,5; 7.056,0)	136,1 (117,7; 157,4)	19.038,9 (16.121,9; 22.206,5)	171,4 (144,9; 200,1)	25,9 (19,2; 33,1)	Both
Piaui	1.751,1 (1.510,8; 2.012,9)	125,7 (108,5; 143,7)	6.234,0 (5.270,7; 7.122,9)	150,7 (127,4; 172,1)	19,8 (14,0; 26,8)	Both
Rio Grande do Norte	2.166,7 (1.887,4; 2.485,5)	137,3 (118,6; 157,9)	7.245,1 (6.079,7; 8.431,5)	171,3 (143,8; 199,0)	24,8 (18,6; 32,7)	Both
Sergipe	1.064,0 (916,9; 1.224,6)	131,3 (113,0; 151,3)	3.964,7 (3.367,8; 4.603,5)	157,9 (133,1; 183,3)	20,3 (14,0; 26,1)	Both
Southeast region	63.531,4 (54.762,6; 73.705,8)	157,7 (136,9; 183,1)	232.582,5 (196.475,0; 277.000,2)	191,6 (161,6; 227,3)	21,5 (15,6; 27,6)	Both
Espírito Santo	2.239,6 (1.929,6; 2.565,1)	156,5 (133,3; 179,4)	9.926,1 (8.239,0; 11.839,5)	193,1 (160,2; 229,2)	23,4 (16,3; 30,4)	Both
Minas Gerais	14.472,7 (12.415,7; 16.748,2)	150,3 (129,0; 174,3)	53.782,8 (44.866,5; 63.284,8)	180,3 (150,8; 211,3)	20,0 (12,9; 27,7)	Both
Rio de Janeiro	13.976,2 (11.914,6; 16.071,7)	148,9 (127,9; 172,6)	43.807,0 (36.628,5; 51.928,7)	181,0 (151,4; 213,6)	21,6 (14,1; 29,6)	Both
São Paulo	32.843,1 (28.216,2; 37.933,9)	165,7 (143,2; 193,6)	125.066,6 (105.397,3; 149.181,4)	201,0 (169,2; 238,5)	21,3 (12,4; 28,4)	Both
South region	23.410,1 (20.155,5; 27.120,1)	169,1 (144,9; 197,7)	88.865,2 (74.805,6; 105.973,9)	208,4 (176,0; 247,8)	23,3 (17,8; 29,5)	Both
Paraná	7.905,6 (6.791,5; 9.147,0)	164,4 (140,8; 189,4)	31.203,2 (25.912,1; 37.068,3)	201,4 (167,6; 238,8)	22,5 (14,8; 29,1)	Both
Rio Grande do Sul	11.177,8 (9.537,8; 13.064,2)	171,6 (145,5; 201,6)	36.804,9 (30.831,0; 44.298,0)	210,9 (177,1; 252,3)	22,9 (15,2; 30,9)	Both

Santa Catarina	4.326,7 (3.740,8; 5.063,0)	171,6 (147,9; 199,5)	20.857,0 (17.296,0; 24.724,1)	215,1 (178,4; 254,3)	25,4 (17,2; 32,4)	Both
West-Central region	6.659,4 (5.719,0; 7.638,6)	159,4 (136,4; 184,1)	35.033,1 (29.403,5; 41.360,1)	193,4 (161,6; 228,4)	21,3 (16,4; 26,6)	Both
Distrito Federal	1.052,7 (888,4; 1.223,8)	176,9 (150,1; 204,3)	7.168,8 (5.896,3; 8.502,4)	230,3 (187,5; 271,6)	30,2 (22,1; 38,3)	Both
Goiás	3.067,5 (2.655,9; 3.534,1)	156,9 (133,7; 181,5)	14.831,1 (12.688,7; 17.457,8)	182,7 (156,6; 214,6)	16,4 (9,5; 23,3)	Both
Mato Grosso	1.140,1 (985,4; 1.316,0)	150,8 (129,5; 174,7)	6.845,5 (5.723,8; 8.082,3)	187,4 (156,0; 220,2)	24,3 (18,3; 31,1)	Both
Mato Grosso do Sul	1.399,2 (1.189,3; 1.625,3)	161,2 (137,8; 186,7)	6.187,6 (5.201,3; 7.321,8)	191,4 (160,9; 226,5)	18,7 (12,3; 25,5)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.4 – Non-rheumatic aortic valve disease prevalence in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	56.529,6 (45.276,7; 69.053,4)	140,1 (112,8; 171,4)	219.701,5 (176.957,9; 272.701,8)	188,3 (150,2; 233,6)	34,3 (26,5; 42,2)	Male
North region	2.499,1 (2.013,5; 3.043,1)	128,4 (103,2; 157,5)	12.773,1 (10.266,5; 15.461,4)	172,1 (136,6; 209,9)	34,0 (25,9; 42,3)	Male
Acre	108,5 (85,7; 131,0)	123,5 (95,3; 148,9)	562,7 (441,8; 705,0)	172,6 (133,6; 215,1)	39,8 (25,7; 56,5)	Male
Amapá	63,1 (50,6; 76,5)	143,9 (113,2; 178,3)	469,6 (368,5; 574,2)	181,3 (140,8; 223,0)	26,0 (12,1; 37,6)	Male
Amazonas	529,3 (420,6; 641,6)	140,8 (110,0; 172,6)	2.632,4 (2.037,6; 3.286,9)	181,6 (138,2; 225,5)	29,0 (16,8; 42,5)	Male
Pará	1.216,3 (990,4; 1.493,7)	122,7 (96,9; 153,5)	5.810,5 (4.624,4; 7.033,8)	162,9 (130,3; 198,8)	32,7 (21,3; 46,6)	Male
Rondônia	289,2 (230,3; 357,4)	138,7 (108,2; 172,3)	1.464,7 (1.137,9; 1.820,4)	180,4 (139,1; 221,2)	30,0 (17,8; 43,8)	Male
Roraima	42,1 (33,2; 51,9)	130,9 (103,9; 160,6)	365,5 (290,2; 449,4)	173,5 (133,8; 211,8)	32,5 (21,6; 45,5)	Male
Tocantins	250,5 (202,4; 310,7)	123,4 (99,2; 153,2)	1.467,7 (1.175,9; 1.789,5)	183,7 (146,7; 223,9)	48,9 (35,8; 63,5)	Male
Northeast region	13.322,8 (10.827,9; 16.188,2)	115,1 (91,9; 141,2)	47.364,2 (37.646,2; 58.594,4)	160,2 (126,9; 198,2)	39,1 (32,3; 46,5)	Male
Alagoas	658,3 (534,1; 810,2)	106,5 (85,6; 131,9)	2.306,7 (1.805,2; 2.858,8)	152,7 (119,9; 188,6)	43,4 (28,3; 61,1)	Male
Bahia	3.748,4 (2.977,4; 4.563,2)	121,6 (95,4; 150,0)	13.241,1 (10.585,1; 16.643,3)	161,8 (129,0; 203,3)	33,0 (21,6; 46,0)	Male
Ceará	2.031,4 (1.619,2; 2.479,9)	111,3 (88,4; 135,1)	8.033,3 (6.349,5; 10.060,8)	165,1 (130,4; 207,7)	48,4 (36,2; 66,2)	Male
Maranhão	1.202,0 (954,6; 1.462,8)	103,0 (81,9; 126,7)	4.764,2 (3.841,7; 5.965,5)	148,2 (118,7; 185,6)	43,9 (32,4; 60,7)	Male
Paraíba	1.150,9 (908,2; 1.458,9)	108,9 (86,2; 137,3)	3.349,2 (2.662,0; 4.186,7)	149,3 (118,3; 186,8)	37,0 (23,7; 50,3)	Male
Pernambuco	2.463,8 (1.966,1; 3.047,5)	121,1 (96,5; 149,8)	8.048,5 (6.283,7; 9.829,8)	170,8 (132,7; 207,7)	41,0 (26,9; 56,3)	Male
Piaui	721,1 (562,3; 887,1)	108,1 (83,1; 133,4)	2.721,2 (2.163,0; 3.314,7)	144,3 (114,3; 175,8)	33,5 (21,8; 48,5)	Male
Rio Grande do Norte	914,6 (726,5; 1.136,9)	122,5 (97,0; 152,4)	3.206,5 (2.480,4; 3.958,3)	172,5 (133,0; 212,4)	40,8 (27,9; 57,1)	Male
Sergipe	432,2 (346,9; 537,6)	115,1 (92,3; 143,2)	1.693,4 (1.326,9; 2.061,9)	154,6 (119,4; 187,9)	34,3 (22,6; 46,9)	Male
Southeast region	27.312,2 (21.740,9; 33.170,8)	149,9 (120,6; 184,2)	102.955,0 (82.188,4; 130.098,7)	196,0 (154,7; 246,7)	30,7 (20,3; 41,1)	Male
Espírito Santo	981,4 (784,6; 1.196,1)	142,9 (111,6; 174,1)	4.492,5 (3.501,4; 5.616,1)	194,3 (151,4; 241,2)	36,0 (22,0; 49,3)	Male
Minas Gerais	6.210,3 (4.876,8; 7.645,6)	139,1 (109,4; 172,9)	24.071,4 (18.962,8; 30.160,7)	179,0 (141,0; 222,3)	28,6 (17,4; 42,1)	Male

Rio de Janeiro	5.720,4 (4.565,7; 6.922,7)	142,1 (114,6; 171,7)	18.851,5 (14.693,4; 23.496,1)	187,5 (145,3; 230,4)	31,9 (17,5; 46,4)	Male
São Paulo	14.400,1 (11.681,6; 17.868,7)	159,5 (128,5; 200,1)	55.539,5 (43.567,8; 70.023,5)	208,0 (162,6; 261,4)	30,5 (15,8; 43,7)	Male
South region	10.325,4 (8.233,4; 12.636,8)	160,9 (127,7; 199,2)	40.373,3 (32.395,5; 50.868,2)	213,9 (171,4; 268,4)	33,0 (22,5; 43,2)	Male
Paraná	3.546,8 (2.801,6; 4.339,3)	150,7 (118,9; 188,0)	14.102,4 (11.091,1; 17.676,3)	203,5 (159,2; 254,4)	35,0 (19,9; 49,0)	Male
Rio Grande do Sul	4.869,2 (3.815,4; 5.988,9)	168,9 (131,6; 209,5)	16.651,6 (13.275,7; 20.801,2)	219,2 (173,3; 272,4)	29,8 (16,6; 42,5)	Male
Santa Catarina	1.909,4 (1.544,4; 2.334,2)	161,5 (130,1; 198,2)	9.619,3 (7.596,5; 12.062,6)	221,2 (175,3; 277,0)	36,9 (22,4; 51,0)	Male
West-Central region	3.070,2 (2.460,3; 3.697,9)	145,0 (114,6; 177,2)	16.235,9 (13.145,8; 19.855,6)	194,8 (155,1; 239,6)	34,4 (25,2; 44,1)	Male
Distrito Federal	474,0 (377,4; 574,1)	179,5 (142,7; 219,4)	3.331,1 (2.590,1; 4.104,9)	254,6 (195,3; 314,1)	41,8 (28,3; 55,5)	Male
Goiás	1.396,8 (1.111,7; 1.695,6)	141,4 (112,1; 172,7)	6.769,6 (5.456,7; 8.393,9)	180,6 (144,6; 223,5)	27,7 (13,3; 41,5)	Male
Mato Grosso	544,6 (426,8; 665,2)	131,9 (103,8; 162,9)	3.269,9 (2.507,5; 3.997,3)	183,4 (141,5; 224,9)	39,0 (26,5; 52,4)	Male
Mato Grosso do Sul	654,8 (518,8; 797,0)	146,3 (114,3; 179,4)	2.865,3 (2.242,2; 3.578,5)	191,3 (149,8; 237,5)	30,8 (17,7; 43,7)	Male
Brazil	35.751,2 (28.829,2; 43.555,5)	77,5 (62,0; 93,9)	158.646,1 (124.360,5; 194.715,5)	107,8 (84,9; 132,1)	39,1 (32,7; 46,7)	Female
North region	1.309,3 (1.069,1; 1.603,6)	68,9 (55,1; 85,4)	7.498,4 (6.039,0; 9.140,5)	93,8 (74,4; 115,2)	36,2 (28,2; 46,1)	Female
Acre	48,6 (38,4; 58,7)	65,4 (51,5; 80,0)	329,1 (258,4; 403,3)	94,3 (73,9; 114,7)	44,2 (31,2; 57,1)	Female
Amapá	40,5 (33,1; 49,5)	76,9 (62,0; 95,1)	290,4 (235,1; 362,8)	101,8 (81,8; 127,0)	32,4 (21,6; 46,5)	Female
Amazonas	279,8 (221,8; 346,5)	74,5 (57,3; 91,1)	1.552,2 (1.208,2; 1.867,8)	96,0 (74,5; 116,8)	28,9 (18,7; 42,2)	Female
Pará	686,4 (559,0; 844,4)	66,5 (53,5; 83,4)	3.499,4 (2.822,1; 4.339,6)	89,7 (71,4; 112,3)	35,0 (23,6; 50,1)	Female
Rondônia	119,2 (96,5; 145,2)	77,4 (60,3; 95,1)	838,5 (668,2; 1.044,4)	101,9 (81,3; 126,2)	31,7 (19,3; 44,9)	Female
Roraima	18,5 (14,5; 22,8)	76,2 (59,6; 94,0)	224,1 (176,8; 276,1)	106,9 (83,4; 130,5)	40,4 (27,3; 56,7)	Female
Tocantins	116,2 (91,0; 141,7)	64,2 (50,0; 78,1)	764,7 (607,0; 928,5)	95,2 (75,1; 114,9)	48,2 (34,4; 63,4)	Female
Northeast region	8.266,2 (6.698,0; 10.111,2)	63,1 (50,9; 77,2)	32.996,0 (25.901,4; 40.016,6)	88,9 (70,0; 108,1)	40,8 (33,3; 49,6)	Female
Alagoas	418,1 (326,1; 510,2)	61,0 (47,9; 74,4)	1.750,2 (1.384,3; 2.157,3)	90,7 (71,6; 112,0)	48,7 (36,3; 64,0)	Female
Bahia	2.412,8 (1.934,7; 2.924,7)	68,3 (54,8; 83,0)	8.795,9 (6.877,6; 10.812,5)	87,8 (69,2; 108,2)	28,5 (16,8; 38,9)	Female
Ceará	1.242,1 (986,4; 1.543,9)	60,3 (48,1; 75,1)	5.579,9 (4.330,6; 6.903,9)	91,4 (71,3; 113,0)	51,5 (37,1; 67,8)	Female

Maranhão	629,7 (493,9; 789,6)	50,4 (39,3; 63,1)	2.876,2 (2.258,4; 3.547,3)	77,8 (60,9; 95,7)	54,2 (41,2; 70,0)	Female
Paraíba	731,2 (584,8; 907,2)	62,0 (49,8; 77,0)	2.552,4 (1.991,4; 3.057,5)	86,9 (68,7; 104,4)	40,3 (28,3; 54,1)	Female
Pernambuco	1.601,7 (1.273,1; 1.961,3)	66,3 (53,3; 81,6)	6.198,5 (4.919,5; 7.443,4)	97,1 (77,3; 116,6)	46,5 (33,8; 63,2)	Female
Piaui	409,8 (325,3; 505,8)	57,1 (45,0; 70,8)	1.773,2 (1.375,2; 2.137,1)	78,8 (61,1; 95,1)	37,9 (25,0; 50,4)	Female
Rio Grande do Norte	552,9 (435,6; 676,0)	67,0 (52,5; 82,2)	2.260,7 (1.764,7; 2.734,8)	95,2 (75,0; 115,2)	42,0 (29,7; 56,4)	Female
Sergipe	267,9 (214,0; 327,9)	62,3 (49,5; 76,1)	1.209,1 (931,5; 1.497,8)	85,6 (65,8; 106,3)	37,5 (22,7; 52,3)	Female
Southeast region	17.828,1 (14.349,1; 21.772,5)	82,0 (65,8; 99,6)	77.361,4 (60.351,3; 94.372,6)	112,5 (88,4; 136,5)	37,3 (28,1; 47,8)	Female
Espírito Santo	588,5 (468,3; 715,3)	80,3 (63,9; 98,5)	3.167,0 (2.486,6; 3.877,2)	112,3 (88,7; 136,7)	39,8 (27,0; 55,8)	Female
Minas Gerais	3.894,0 (3.045,7; 4.785,7)	76,2 (59,9; 93,3)	16.961,7 (13.054,1; 21.059,1)	103,5 (80,4; 127,9)	35,9 (23,7; 49,8)	Female
Rio de Janeiro	4.012,2 (3.157,5; 5.039,7)	76,2 (59,6; 96,4)	14.705,2 (11.383,5; 18.408,6)	104,0 (80,9; 129,2)	36,6 (22,6; 49,9)	Female
São Paulo	9.333,5 (7.601,9; 11.353,3)	87,8 (71,0; 106,0)	42.527,5 (33.156,5; 52.357,7)	120,1 (94,0; 147,3)	36,8 (22,1; 51,9)	Female
South region	6.698,6 (5.363,7; 8.216,8)	91,6 (72,2; 112,5)	29.883,6 (23.395,6; 37.168,5)	126,2 (99,0; 155,5)	37,7 (28,4; 48,3)	Female
Paraná	2.125,4 (1.713,5; 2.581,0)	87,7 (70,6; 107,5)	10.323,1 (8.035,2; 12.705,4)	121,0 (94,2; 148,2)	37,9 (25,9; 52,7)	Female
Rio Grande do Sul	3.327,2 (2.638,2; 4.152,2)	93,1 (73,1; 116,3)	12.571,6 (9.893,4; 15.874,0)	127,6 (101,1; 159,8)	37,0 (24,9; 54,0)	Female
Santa Catarina	1.246,0 (985,3; 1.526,7)	94,5 (74,5; 117,4)	6.988,9 (5.416,0; 8.596,2)	131,7 (101,9; 160,8)	39,4 (24,4; 53,0)	Female
West-Central region	1.649,0 (1.326,9; 1.994,2)	81,5 (64,7; 98,9)	10.906,7 (8.611,6; 13.181,2)	112,2 (88,0; 135,9)	37,7 (29,3; 47,5)	Female
Distrito Federal	293,6 (237,5; 359,3)	92,3 (73,2; 113,1)	2.461,3 (1.932,7; 3.038,0)	137,5 (107,5; 168,9)	48,9 (35,4; 64,5)	Female
Goiás	765,5 (611,1; 930,3)	80,3 (63,0; 98,0)	4.544,3 (3.586,8; 5.586,5)	104,5 (82,3; 128,0)	30,2 (19,1; 44,1)	Female
Mato Grosso	248,2 (197,7; 302,3)	73,7 (58,3; 89,7)	1.980,6 (1.575,3; 2.431,1)	106,6 (83,5; 131,0)	44,7 (30,6; 61,8)	Female
Mato Grosso do Sul	341,8 (275,4; 420,4)	82,5 (65,0; 102,6)	1.920,5 (1.525,4; 2.382,4)	111,0 (88,0; 137,8)	34,6 (22,8; 50,6)	Female
Brazil	92.280,8 (74.273,1; 112.240,6)	106,4 (85,6; 130,4)	378.347,6 (302.669,2; 463.214,0)	143,2 (114,1; 174,9)	34,7 (27,9; 41,5)	Both
North region	3.808,3 (3.083,7; 4.598,1)	98,6 (78,9; 121,1)	20.271,5 (16.413,1; 24.685,9)	131,4 (104,5; 160,7)	33,3 (26,4; 39,7)	Both
Acre	157,1 (128,0; 189,8)	97,2 (76,7; 117,1)	891,9 (702,8; 1.076,1)	132,1 (102,8; 159,9)	35,9 (26,1; 48,1)	Both
Amapá	103,6 (85,4; 126,1)	107,1 (86,5; 131,0)	760,0 (624,5; 914,4)	139,5 (112,1; 169,2)	30,2 (20,9; 39,9)	Both

Amazonas	809,1 (642,6; 990,9)	107,2 (84,5; 131,9)	4.184,6 (3.331,4; 5.142,5)	136,1 (106,6; 167,4)	26,9 (17,8; 37,3)	Both
Pará	1.902,7 (1.555,9; 2.310,5)	93,7 (75,0; 116,2)	9.309,8 (7.484,4; 11.356,4)	124,6 (99,9; 152,5)	33,0 (24,0; 42,5)	Both
Rondônia	408,4 (329,0; 496,3)	112,3 (88,2; 138,6)	2.303,2 (1.819,4; 2.830,7)	140,8 (110,4; 172,2)	25,4 (16,0; 35,5)	Both
Roraima	60,6 (48,3; 74,1)	106,4 (83,4; 131,2)	589,6 (469,0; 727,2)	140,3 (109,0; 170,8)	31,9 (23,9; 41,2)	Both
Tocantins	366,7 (295,3; 453,5)	94,7 (75,8; 117,0)	2.232,3 (1.782,1; 2.692,7)	139,4 (110,8; 168,3)	47,3 (37,1; 58,3)	Both
Northeast region	21.589,0 (17.614,5; 26.364,5)	87,5 (70,2; 107,5)	80.360,2 (63.457,8; 98.387,5)	120,5 (95,2; 147,7)	37,8 (31,8; 43,9)	Both
Alagoas	1.076,5 (877,8; 1.294,3)	82,4 (66,3; 99,7)	4.056,9 (3.231,3; 4.956,1)	117,7 (93,5; 144,4)	42,8 (32,8; 55,4)	Both
Bahia	6.161,2 (4.965,8; 7.395,4)	93,0 (74,2; 112,9)	22.037,1 (17.714,3; 27.216,0)	121,1 (97,2; 149,3)	30,1 (20,6; 39,5)	Both
Ceará	3.273,5 (2.619,0; 4.010,2)	84,2 (67,2; 103,6)	13.613,2 (10.756,2; 16.943,8)	124,1 (97,8; 154,4)	47,3 (38,2; 59,9)	Both
Maranhão	1.831,7 (1.460,2; 2.218,3)	75,7 (60,4; 92,5)	7.640,4 (6.116,1; 9.444,4)	110,5 (87,9; 137,1)	46,0 (37,0; 57,8)	Both
Paraíba	1.882,1 (1.506,5; 2.347,2)	84,1 (66,8; 104,7)	5.901,7 (4.709,1; 7.304,1)	114,0 (91,2; 141,1)	35,5 (26,4; 45,5)	Both
Pernambuco	4.065,5 (3.319,2; 5.032,4)	91,2 (73,7; 112,5)	14.246,9 (11.324,4; 17.252,9)	128,3 (101,8; 155,3)	40,6 (30,2; 52,1)	Both
Piaui	1.130,9 (890,1; 1.388,1)	81,6 (63,5; 100,5)	4.494,4 (3.553,2; 5.296,8)	108,6 (86,0; 127,9)	33,0 (23,6; 44,6)	Both
Rio Grande do Norte	1.467,5 (1.179,0; 1.796,5)	93,3 (74,3; 114,5)	5.467,1 (4.249,9; 6.667,6)	129,1 (100,5; 157,1)	38,3 (29,2; 50,9)	Both
Sergipe	700,1 (559,1; 864,4)	86,9 (68,6; 108,2)	2.902,5 (2.260,2; 3.521,2)	115,6 (89,2; 140,4)	33,1 (24,7; 42,9)	Both
Southeast region	45.140,3 (36.217,9; 54.603,0)	112,4 (90,7; 137,1)	180.316,4 (144.028,5; 225.865,9)	148,5 (118,9; 184,9)	32,1 (23,0; 41,1)	Both
Espírito Santo	1.569,9 (1.248,4; 1.878,4)	110,4 (86,7; 133,2)	7.659,5 (5.976,4; 9.531,3)	149,0 (117,1; 184,7)	35,0 (25,4; 44,7)	Both
Minas Gerais	10.104,3 (8.100,9; 12.346,5)	105,1 (83,0; 128,7)	41.033,1 (32.147,3; 50.755,3)	137,4 (107,7; 169,6)	30,7 (21,0; 41,7)	Both
Rio de Janeiro	9.732,5 (7.768,6; 11.894,3)	104,1 (83,0; 128,5)	33.556,8 (26.178,8; 41.797,4)	138,6 (108,5; 171,5)	33,1 (22,6; 43,8)	Both
São Paulo	23.733,6 (19.152,5; 28.836,5)	120,1 (96,0; 147,8)	98.067,0 (77.521,3; 122.246,1)	157,7 (124,5; 195,5)	31,3 (18,3; 41,9)	Both
South region	17.024,0 (13.552,9; 20.687,3)	123,4 (97,9; 152,6)	70.256,9 (55.935,5; 87.700,9)	164,8 (131,2; 204,8)	33,5 (25,7; 41,2)	Both
Paraná	5.672,2 (4.592,1; 6.898,9)	118,5 (94,6; 145,4)	24.425,5 (19.155,7; 30.372,7)	157,7 (123,4; 195,6)	33,1 (21,9; 41,9)	Both
Rio Grande do Sul	8.196,4 (6.457,5; 9.972,7)	126,2 (99,1; 155,3)	29.223,2 (23.205,1; 36.851,9)	167,3 (132,8; 209,5)	32,5 (21,7; 43,1)	Both
Santa Catarina	3.155,4 (2.554,8; 3.860,0)	125,7 (100,7; 154,3)	16.608,2 (13.104,2; 20.508,7)	171,5 (135,1; 211,3)	36,4 (24,9; 46,7)	Both

West-Central region	4.719,2 (3.804,5; 5.653,8)	113,7 (90,3; 137,5)	27.142,6 (21.743,1; 33.159,6)	150,1 (118,7; 184,0)	32,0 (25,8; 40,0)	Both
Distrito Federal	767,5 (610,5; 922,5)	130,4 (103,6; 158,3)	5.792,4 (4.544,3; 7.069,9)	186,5 (145,3; 227,1)	43,0 (32,5; 52,9)	Both
Goiás	2.162,3 (1.728,2; 2.613,0)	111,2 (88,0; 134,0)	11.313,9 (9.219,7; 13.806,4)	139,5 (112,6; 170,0)	25,4 (15,5; 35,1)	Both
Mato Grosso	792,8 (640,5; 959,8)	105,7 (84,0; 129,9)	5.250,5 (4.117,6; 6.493,1)	144,0 (111,4; 178,3)	36,3 (27,8; 46,1)	Both
Mato Grosso do Sul	996,6 (793,2; 1.206,1)	115,5 (91,2; 141,1)	4.785,8 (3.800,0; 5.870,8)	148,1 (117,2; 181,9)	28,3 (18,8; 38,1)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.5 – Non-rheumatic mitral valve disease prevalence in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	18.855,2 (17.294,3; 20.611,0)	47,5 (43,7; 51,8)	57.159,3 (52.611,5; 61.824,6)	48,9 (45,1; 52,8)	2,9 (0,5; 6,0)	Male
North region	902,1 (824,7; 987,9)	47,1 (43,3; 51,3)	3.587,2 (3.278,5; 3.890,1)	48,5 (44,6; 52,3)	2,9 (-1,0; 6,6)	Male
Acre	40,7 (36,9; 44,7)	46,3 (42,2; 50,7)	156,2 (143,0; 170,5)	48,0 (44,1; 52,3)	3,7 (-2,4; 10,1)	Male
Amapá	20,4 (18,5; 22,4)	47,4 (42,9; 51,5)	125,4 (114,9; 136,5)	48,8 (45,0; 52,9)	3,0 (-1,8; 9,1)	Male
Amazonas	174,6 (158,9; 192,3)	47,4 (43,4; 51,9)	694,7 (634,8; 757,8)	48,3 (44,1; 52,7)	2,1 (-3,9; 8,5)	Male
Pará	457,3 (418,4; 500,7)	46,9 (42,8; 51,2)	1.714,6 (1.564,3; 1.863,8)	48,3 (44,0; 52,1)	2,9 (-3,7; 9,7)	Male
Rondônia	97,3 (88,4; 106,4)	47,8 (44,0; 52,0)	392,0 (356,6; 428,6)	48,4 (44,2; 52,5)	1,2 (-5,0; 6,6)	Male
Roraima	14,7 (13,2; 16,1)	46,5 (42,6; 50,8)	100,9 (92,2; 110,3)	47,4 (43,6; 51,9)	2,1 (-3,9; 9,2)	Male
Tocantins	97,1 (88,1; 107,3)	47,8 (43,8; 52,1)	403,5 (369,2; 440,0)	50,5 (46,3; 55,0)	5,5 (0,1; 13,1)	Male
Northeast region	5.370,8 (4.916,7; 5.861,8)	46,3 (42,7; 50,4)	14.240,1 (13.092,3; 15.388,5)	48,2 (44,4; 52,0)	4,2 (1,1; 7,9)	Male
Alagoas	288,6 (265,3; 313,6)	46,6 (42,7; 50,7)	726,1 (661,4; 790,7)	48,2 (44,2; 52,3)	3,4 (-2,2; 11,1)	Male
Bahia	1.430,9 (1.302,8; 1.562,5)	46,5 (42,3; 50,8)	3.957,7 (3.617,8; 4.267,8)	48,5 (44,5; 52,2)	4,2 (-1,7; 11,9)	Male
Ceará	840,5 (765,1; 922,2)	45,9 (41,9; 50,4)	2.343,5 (2.139,0; 2.537,9)	48,3 (44,1; 52,2)	5,2 (-0,4; 13,1)	Male
Maranhão	537,7 (487,2; 588,9)	46,0 (41,9; 50,3)	1.534,1 (1.393,2; 1.668,4)	47,7 (43,4; 51,8)	3,5 (-2,4; 9,1)	Male
Paraíba	486,5 (442,9; 532,8)	45,5 (41,5; 49,9)	1.054,6 (964,1; 1.152,9)	47,0 (43,1; 51,2)	3,4 (-3,6; 10,6)	Male
Pernambuco	959,0 (872,6; 1.049,3)	47,0 (42,8; 51,3)	2.315,1 (2.128,9; 2.526,9)	49,2 (45,3; 53,5)	4,6 (-1,8; 12,5)	Male
Piaui	306,9 (280,8; 335,8)	46,1 (42,3; 50,1)	895,8 (824,9; 969,0)	47,4 (43,7; 51,2)	3,0 (-3,4; 10,5)	Male
Rio Grande do Norte	345,1 (311,5; 377,1)	45,9 (41,5; 50,1)	885,9 (812,1; 959,6)	47,8 (43,8; 51,6)	4,3 (-1,7; 11,0)	Male
Sergipe	175,7 (160,7; 192,2)	46,7 (42,6; 51,2)	527,4 (483,1; 579,4)	48,3 (44,2; 52,7)	3,4 (-3,7; 11,5)	Male
Southeast region	8.554,5 (7.845,6; 9.363,0)	48,1 (44,0; 52,5)	25.861,6 (23.637,2; 28.084,7)	49,1 (45,0; 53,2)	2,1 (-1,1; 5,7)	Male
Espírito Santo	328,5 (297,4; 360,7)	48,4 (43,8; 53,0)	1.152,2 (1.050,7; 1.254,9)	49,8 (45,8; 54,0)	2,9 (-3,6; 9,4)	Male
Minas Gerais	2.078,6 (1.899,9; 2.299,9)	47,7 (43,6; 52,4)	6.523,2 (6.012,5; 7.151,4)	48,4 (44,8; 52,9)	1,5 (-5,8; 8,7)	Male

Rio de Janeiro	1.886,7 (1.706,1; 2.078,9)	47,6 (43,3; 52,0)	4.922,1 (4.506,6; 5.394,1)	48,7 (44,7; 53,2)	2,3 (-2,8; 8,8)	Male
São Paulo	4.260,8 (3.882,1; 4.691,7)	48,5 (44,3; 53,0)	13.264,0 (12.027,9; 14.450,4)	49,5 (45,0; 53,8)	2,1 (-3,9; 9,0)	Male
South region	3.040,5 (2.774,2; 3.327,1)	48,3 (44,3; 52,7)	9.391,7 (8.583,8; 10.252,9)	49,6 (45,5; 53,9)	2,7 (-1,4; 7,5)	Male
Paraná	1.105,3 (1.008,1; 1.212,4)	48,0 (43,8; 52,6)	3.416,1 (3.136,4; 3.694,4)	49,2 (45,2; 53,1)	2,6 (-2,8; 9,6)	Male
Rio Grande do Sul	1.371,4 (1.244,0; 1.507,5)	48,4 (44,1; 52,7)	3.801,2 (3.454,3; 4.144,0)	49,7 (45,4; 54,1)	2,8 (-2,9; 11,2)	Male
Santa Catarina	563,8 (515,2; 614,6)	48,7 (44,4; 53,2)	2.174,4 (2.000,5; 2.382,0)	49,8 (45,9; 54,2)	2,4 (-3,9; 9,6)	Male
West-Central region	987,3 (905,9; 1.076,6)	47,9 (44,1; 51,9)	4.078,7 (3.740,8; 4.440,6)	49,0 (45,1; 53,2)	2,3 (-1,3; 6,2)	Male
Distrito Federal	127,6 (115,5; 141,0)	50,0 (45,2; 54,7)	663,6 (611,7; 725,3)	50,6 (46,5; 55,1)	1,2 (-5,4; 8,2)	Male
Goiás	459,8 (420,0; 506,7)	47,7 (43,5; 52,1)	1.817,1 (1.657,9; 1.997,3)	48,6 (44,4; 53,2)	2,0 (-4,9; 9,1)	Male
Mato Grosso	188,4 (171,4; 206,5)	46,9 (43,0; 51,3)	862,8 (792,2; 948,2)	48,6 (44,7; 53,0)	3,6 (-3,3; 10,8)	Male
Mato Grosso do Sul	211,4 (190,9; 231,2)	48,1 (43,5; 52,3)	735,2 (675,4; 796,6)	49,1 (45,3; 53,2)	2,1 (-4,7; 10,1)	Male
Brazil	20.828,1 (19.309,5; 22.296,5)	43,6 (40,3; 46,7)	57.168,7 (52.710,1; 62.027,0)	39,1 (36,1; 42,4)	-10,4 (-12,6; -8,2)	Female
North region	870,7 (809,1; 939,5)	43,1 (39,7; 46,4)	3.127,2 (2.898,4; 3.405,8)	38,5 (35,5; 41,7)	-10,8 (-13,4; -7,5)	Female
Acre	33,8 (31,0; 37,0)	42,5 (38,8; 46,3)	137,0 (124,3; 149,3)	38,4 (34,7; 41,9)	-9,7 (-14,7; -3,7)	Female
Amapá	23,7 (22,0; 25,6)	43,0 (39,5; 46,4)	113,8 (104,3; 124,4)	38,8 (35,3; 42,2)	-9,8 (-14,3; -5,4)	Female
Amazonas	173,2 (160,4; 187,8)	42,9 (39,9; 46,4)	629,9 (576,1; 684,5)	38,0 (34,8; 41,4)	-11,5 (-16,2; -6,2)	Female
Pará	468,2 (429,2; 508,2)	43,2 (39,5; 46,8)	1.519,7 (1.411,5; 1.653,9)	38,5 (35,6; 41,9)	-10,9 (-15,2; -5,6)	Female
Rondônia	75,9 (69,9; 83,1)	43,5 (40,2; 46,9)	324,5 (297,4; 352,1)	38,6 (35,3; 41,5)	-11,4 (-16,3; -6,7)	Female
Roraima	11,9 (10,8; 12,9)	42,6 (39,2; 46,2)	85,1 (77,6; 93,0)	38,1 (34,7; 41,4)	-10,6 (-15,8; -4,4)	Female
Tocantins	84,0 (77,5; 90,8)	43,2 (39,9; 46,6)	317,1 (290,7; 346,4)	39,1 (35,9; 42,8)	-9,3 (-14,6; -3,8)	Female
Northeast region	5.717,2 (5.295,0; 6.137,0)	42,6 (39,4; 45,7)	14.112,5 (13.048,0; 15.299,4)	38,3 (35,4; 41,6)	-10,1 (-12,5; -7,7)	Female
Alagoas	303,9 (279,0; 328,2)	42,9 (39,6; 46,5)	748,3 (687,3; 813,1)	38,7 (35,5; 41,9)	-9,9 (-14,7; -4,6)	Female
Bahia	1.544,6 (1.425,3; 1.665,3)	42,8 (39,5; 46,1)	3.774,2 (3.456,8; 4.117,6)	38,1 (34,9; 41,5)	-11,0 (-15,8; -5,9)	Female
Ceará	889,7 (821,4; 957,1)	42,2 (38,9; 45,4)	2.329,2 (2.144,7; 2.522,4)	38,5 (35,4; 41,7)	-8,7 (-13,7; -4,1)	Female

Maranhão	533,2 (492,9; 580,4)	41,4 (38,2; 45,0)	1.396,2 (1.282,2; 1.519,4)	37,6 (34,5; 41,0)	-9,1 (-14,1; -3,5)	Female
Paraíba	504,4 (463,8; 545,5)	41,9 (38,6; 45,4)	1.086,7 (1.002,5; 1.180,3)	37,5 (34,6; 40,8)	-10,6 (-15,5; -5,5)	Female
Pernambuco	1.082,5 (999,7; 1.172,8)	43,6 (40,3; 47,2)	2.496,1 (2.285,0; 2.693,9)	39,3 (36,0; 42,4)	-9,7 (-14,5; -3,9)	Female
Piaui	314,5 (292,1; 337,7)	42,5 (39,4; 45,7)	849,0 (776,2; 925,8)	38,0 (34,7; 41,4)	-10,7 (-15,4; -5,4)	Female
Rio Grande do Norte	355,1 (326,1; 382,2)	42,3 (39,0; 45,5)	894,5 (821,2; 974,7)	38,1 (35,0; 41,5)	-10,0 (-15,0; -4,2)	Female
Sergipe	189,2 (173,9; 205,2)	42,8 (39,2; 46,4)	538,2 (490,5; 588,6)	38,1 (34,7; 41,6)	-10,9 (-15,2; -6,2)	Female
Southeast region	9.912,9 (9.152,3; 10.662,6)	44,0 (40,9; 47,4)	26.751,9 (24.578,8; 29.038,1)	39,3 (36,2; 42,6)	-10,6 (-13,8; -7,4)	Female
Espírito Santo	343,1 (314,3; 371,1)	44,7 (41,0; 48,4)	1.125,2 (1.027,0; 1.227,7)	40,1 (36,7; 43,7)	-10,3 (-14,4; -5,0)	Female
Minas Gerais	2.305,6 (2.138,3; 2.499,7)	43,7 (40,6; 47,2)	6.292,7 (5.726,6; 6.874,0)	38,9 (35,5; 42,5)	-11,1 (-16,1; -6,3)	Female
Rio de Janeiro	2.375,3 (2.199,3; 2.573,6)	43,7 (40,5; 47,1)	5.402,2 (4.922,9; 5.885,2)	38,8 (35,5; 42,2)	-11,0 (-15,3; -5,3)	Female
São Paulo	4.888,9 (4.465,8; 5.277,0)	44,3 (40,8; 47,7)	13.931,9 (12.764,6; 15.164,7)	39,7 (36,4; 43,1)	-10,4 (-15,4; -5,2)	Female
South region	3.368,2 (3.108,6; 3.638,3)	44,3 (40,8; 47,7)	9.322,4 (8.565,9; 10.041,2)	39,7 (36,5; 42,7)	-10,3 (-13,3; -6,8)	Female
Paraná	1.134,4 (1.044,3; 1.232,0)	44,6 (41,0; 48,3)	3.390,8 (3.090,3; 3.696,3)	39,9 (36,4; 43,4)	-10,5 (-15,3; -5,0)	Female
Rio Grande do Sul	1.621,0 (1.498,2; 1.769,8)	44,0 (40,6; 47,7)	3.824,5 (3.502,7; 4.163,9)	39,6 (36,2; 43,1)	-10,0 (-15,1; -5,4)	Female
Santa Catarina	612,7 (565,0; 663,8)	44,4 (41,0; 47,8)	2.107,2 (1.918,3; 2.278,3)	39,6 (36,3; 42,8)	-10,8 (-16,0; -5,3)	Female
West-Central region	959,2 (883,8; 1.032,0)	44,0 (40,6; 47,1)	3.854,7 (3.513,3; 4.163,9)	39,2 (35,9; 42,4)	-11,0 (-14,8; -8,0)	Female
Distrito Federal	158,3 (145,1; 171,8)	44,9 (41,2; 48,4)	722,9 (653,7; 782,1)	39,8 (36,1; 43,1)	-11,2 (-16,5; -5,1)	Female
Goiás	448,3 (411,3; 484,1)	44,2 (40,6; 47,8)	1.715,1 (1.565,6; 1.865,6)	39,1 (35,6; 42,5)	-11,4 (-17,3; -6,3)	Female
Mato Grosso	159,6 (146,5; 172,1)	43,4 (39,9; 46,7)	739,4 (674,0; 810,6)	39,0 (35,5; 42,4)	-9,9 (-14,9; -4,2)	Female
Mato Grosso do Sul	193,0 (175,3; 208,7)	43,8 (40,0; 47,5)	677,2 (615,2; 737,1)	39,0 (35,6; 42,4)	-10,8 (-16,3; -4,2)	Female
Brazil	39.683,3 (36.641,8; 43.078,8)	45,3 (41,8; 49,1)	114.328,0 (105.657,7; 123.809,5)	43,3 (40,1; 46,8)	-4,4 (-6,0; -2,7)	Both
North region	1.772,7 (1.649,9; 1.918,8)	45,0 (41,5; 48,5)	6.714,4 (6.213,8; 7.285,5)	43,2 (39,9; 46,7)	-3,9 (-6,0; -1,3)	Both
Acre	74,5 (68,3; 81,1)	44,7 (41,1; 48,8)	293,2 (267,9; 318,8)	43,0 (39,5; 46,7)	-3,8 (-7,7; 0,4)	Both

Amapá	44,1 (40,8; 47,6)	44,7 (41,1; 48,3)	239,1 (221,1; 259,3)	43,5 (40,0; 46,9)	-2,7 (-6,0; 0,8)	Both
Amazonas	347,8 (321,1; 377,1)	45,0 (41,6; 48,7)	1.324,6 (1.220,8; 1.440,3)	42,7 (39,5; 46,3)	-5,0 (-8,1; -0,9)	Both
Pará	925,5 (853,5; 1.002,3)	44,8 (41,2; 48,3)	3.234,3 (2.985,0; 3.514,2)	43,1 (39,7; 46,6)	-3,9 (-7,2; -0,2)	Both
Rondônia	173,2 (159,3; 189,2)	46,1 (42,5; 49,8)	716,6 (659,9; 777,7)	43,4 (40,1; 46,8)	-5,7 (-9,2; -2,5)	Both
Roraima	26,5 (24,2; 28,9)	44,5 (41,1; 48,6)	186,0 (170,4; 202,5)	42,8 (39,3; 46,4)	-3,9 (-8,1; 0,5)	Both
Tocantins	181,1 (166,5; 196,9)	45,5 (41,9; 49,1)	720,6 (664,4; 784,3)	44,8 (41,3; 48,7)	-1,5 (-5,5; 2,2)	Both
Northeast region	11.088,0 (10.270,2; 12.007,1)	44,3 (41,1; 48,0)	28.352,6 (26.078,6; 30.702,0)	42,6 (39,2; 46,1)	-3,9 (-5,9; -1,8)	Both
Alagoas	592,5 (546,0; 636,9)	44,6 (41,2; 48,0)	1.474,4 (1.358,0; 1.600,1)	42,7 (39,4; 46,3)	-4,3 (-8,0; -0,4)	Both
Bahia	2.975,5 (2.736,3; 3.201,1)	44,4 (40,9; 47,9)	7.732,0 (7.085,3; 8.334,9)	42,7 (39,1; 46,0)	-4,0 (-8,4; 0,4)	Both
Ceará	1.730,2 (1.598,3; 1.883,8)	43,9 (40,6; 47,8)	4.672,7 (4.298,4; 5.064,3)	42,7 (39,3; 46,3)	-2,8 (-7,0; 1,5)	Both
Maranhão	1.070,8 (987,8; 1.161,3)	43,6 (40,3; 47,2)	2.930,3 (2.681,9; 3.184,8)	42,2 (38,6; 45,9)	-3,0 (-7,0; 0,9)	Both
Paraíba	991,0 (910,7; 1.075,0)	43,7 (40,2; 47,4)	2.141,2 (1.981,0; 2.324,2)	41,5 (38,4; 45,0)	-5,1 (-9,6; -1,1)	Both
Pernambuco	2.041,5 (1.882,2; 2.213,5)	45,1 (41,5; 48,9)	4.811,2 (4.423,3; 5.213,6)	43,3 (39,9; 46,9)	-4,0 (-7,9; 0,2)	Both
Piaui	621,4 (572,1; 671,2)	44,2 (40,7; 47,6)	1.744,8 (1.612,7; 1.892,1)	42,2 (39,0; 45,7)	-4,6 (-8,4; -0,7)	Both
Rio Grande do Norte	700,2 (643,7; 756,0)	44,1 (40,6; 47,6)	1.780,5 (1.637,6; 1.926,1)	42,2 (38,8; 45,6)	-4,2 (-8,2; -0,1)	Both
Sergipe	364,9 (336,7; 396,9)	44,6 (41,0; 48,5)	1.065,5 (980,7; 1.165,3)	42,4 (39,0; 46,3)	-4,8 (-9,2; -0,2)	Both
Southeast region	18.467,4 (17.075,1; 20.048,3)	45,6 (42,0; 49,5)	52.613,5 (48.508,6; 56.900,7)	43,4 (40,0; 46,8)	-4,9 (-7,3; -2,5)	Both
Espírito Santo	671,7 (614,6; 727,5)	46,4 (42,4; 50,2)	2.277,4 (2.100,8; 2.486,5)	44,3 (40,9; 48,2)	-4,5 (-8,8; -0,1)	Both
Minas Gerais	4.384,1 (4.052,5; 4.757,1)	45,4 (42,0; 49,2)	12.815,9 (11.845,7; 14.005,2)	43,0 (39,8; 46,9)	-5,1 (-9,1; -1,6)	Both
Rio de Janeiro	4.261,9 (3.914,3; 4.636,4)	45,0 (41,5; 48,9)	10.324,3 (9.446,3; 11.238,7)	42,7 (39,3; 46,4)	-5,1 (-8,1; -1,3)	Both
São Paulo	9.149,7 (8.446,3; 9.924,7)	45,9 (42,3; 49,9)	27.195,9 (25.010,9; 29.400,5)	43,7 (40,2; 47,1)	-4,9 (-8,3; -1,0)	Both
South region	6.408,7 (5.915,3; 6.931,2)	45,9 (42,4; 49,5)	18.714,1 (17.088,9; 20.281,2)	43,9 (40,1; 47,4)	-4,4 (-6,5; -1,8)	Both
Paraná	2.239,7 (2.061,8; 2.426,5)	46,2 (42,4; 49,9)	6.806,8 (6.236,4; 7.389,5)	43,9 (40,3; 47,5)	-4,9 (-8,4; -0,6)	Both

Rio Grande do Sul	2.992,5 (2.747,9; 3.255,5)	45,6 (42,0; 49,3)	7.625,6 (6.983,9; 8.281,9)	43,8 (40,2; 47,6)	-4,0 (-7,5; 0,0)	Both
Santa Catarina	1.176,5 (1.076,4; 1.269,0)	46,2 (42,4; 49,7)	4.281,7 (3.947,6; 4.636,5)	44,0 (40,7; 47,5)	-4,8 (-8,9; -0,5)	Both
West-Central region	1.946,4 (1.793,2; 2.102,0)	46,0 (42,5; 49,5)	7.933,4 (7.273,7; 8.587,1)	43,6 (40,1; 46,9)	-5,1 (-7,4; -2,7)	Both
Distrito Federal	285,9 (263,5; 310,6)	46,8 (43,2; 50,2)	1.386,6 (1.264,2; 1.498,8)	44,1 (40,4; 47,5)	-5,7 (-10,1; -1,4)	Both
Goiás	908,1 (836,2; 984,6)	45,9 (42,3; 49,7)	3.532,2 (3.255,0; 3.849,6)	43,4 (40,0; 47,0)	-5,6 (-9,3; -1,2)	Both
Mato Grosso	348,0 (321,6; 376,3)	45,3 (42,0; 48,8)	1.602,2 (1.485,7; 1.746,8)	43,6 (40,5; 47,4)	-3,8 (-8,1; 0,4)	Both
Mato Grosso do Sul	404,4 (367,3; 437,0)	46,0 (42,1; 49,7)	1.412,4 (1.301,5; 1.527,3)	43,6 (40,3; 47,0)	-5,3 (-8,5; -0,6)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.6 – Non-rheumatic valve disease prevalence, deaths, and disability-adjusted life years (DALYs) by age group in Brazil, both sexes, 1990 and 2023: number, rate, and percent change of rates

Measure	Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Age
Deaths	Brazil	595,1 (531,2; 658,6)	0,8 (0,7; 0,9)	477,5 (443,7; 515,3)	0,4 (0,4; 0,5)	-43,9 (-50,2; -34,9)	15-49 years
Deaths	Brazil	843,5 (768,1; 910,2)	5,4 (4,9; 5,8)	1.667,8 (1.573,0; 1.770,4)	3,8 (3,6; 4,1)	-28,7 (-34,3; -21,0)	50-69 years
Deaths	Brazil	978,0 (868,4; 1.077,0)	22,9 (20,3; 25,2)	3.495,6 (2.975,7; 3.839,1)	23,1 (19,6; 25,3)	0,8 (-7,7; 11,3)	70+ years
Deaths	Brazil	2.416,5 (2.197,6; 2.624,6)	1,6 (1,5; 1,8)	5.640,9 (5.047,5; 6.089,4)	2,7 (2,4; 2,9)	64,4 (50,4; 82,0)	All ages
Deaths	Brazil		2,8 (2,5; 3,1)		2,2 (2,0; 2,4)	-22,1 (-27,7; -14,7)	Age-standardized
DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)		under 5 years
DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)		5-14 years
DALYs	Brazil	32.522,0 (28.945,8; 36.095,1)	42,3 (37,7; 47,0)	24.625,7 (22.822,8; 26.612,7)	22,4 (20,8; 24,2)	-47,0 (-53,1; -38,4)	15-49 years
DALYs	Brazil	26.089,6 (23.682,2; 28.143,8)	165,7 (150,5; 178,8)	50.355,5 (47.199,9; 53.641,2)	115,3 (108,1; 122,8)	-30,4 (-35,7; -23,1)	50-69 years
DALYs	Brazil	15.566,8 (13.905,3; 17.036,4)	364,1 (325,3; 398,5)	52.697,2 (46.058,6; 58.359,7)	347,5 (303,8; 384,9)	-4,6 (-11,5; 3,4)	70+ years
DALYs	Brazil	74.178,5 (67.752,1; 80.327,3)	49,7 (45,4; 53,8)	127.678,4 (117.102,4; 136.510,2)	60,2 (55,2; 64,4)	21,2 (12,2; 34,5)	All ages
DALYs	Brazil		71,8 (65,5; 77,9)		49,3 (45,1; 52,8)	-31,4 (-35,8; -24,3)	Age-standardized
Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	under 5 years
Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	5-14 years
Prevalence	Brazil	17.637,1 (14.488,3; 22.053,4)	22,9 (18,9; 28,7)	30.687,8 (24.536,0; 39.215,3)	27,9 (22,3; 35,7)	21,7 (13,7; 28,0)	15-49 years
Prevalence	Brazil	62.875,6 (52.552,9; 75.247,3)	399,4 (333,9; 478,0)	212.515,2 (176.650,3; 254.166,3)	486,6 (404,4; 581,9)	21,8 (16,6; 27,9)	50-69 years
Prevalence	Brazil	51.325,6 (42.448,4; 60.950,8)	1.200,6 (992,9; 1.425,7)	248.906,7 (201.309,2; 298.655,5)	1.641,6 (1.327,7; 1.969,7)	36,7 (29,6; 43,0)	70+ years
Prevalence	Brazil	131.838,4 (114.152,5; 152.244,1)	88,3 (76,4; 102,0)	492.109,7 (416.005,0; 576.511,6)	232,0 (196,2; 271,8)	162,8 (148,9; 174,8)	All ages
Prevalence	Brazil		151,4 (131,1; 175,2)		186,3 (157,2; 218,2)	23,0 (18,5; 27,6)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.7 – Non-rheumatic aortic valve disease prevalence, deaths, and disability-adjusted life years (DALYs) by age group in Brazil, both sexes, 1990 and 2023: number, rate, and percent change of rates

Measure	Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Age
Deaths	Brazil	333,6 (293,1; 376,4)	0,4 (0,4; 0,5)	266,4 (241,2; 290,8)	0,2 (0,2; 0,3)	-44,1 (-52,2; -34,2)	15-49 years
Deaths	Brazil	558,2 (502,5; 610,2)	3,5 (3,2; 3,9)	1.093,1 (1.017,7; 1.175,1)	2,5 (2,3; 2,7)	-29,4 (-35,7; -20,9)	50-69 years
Deaths	Brazil	740,2 (653,9; 824,4)	17,3 (15,3; 19,3)	2.701,9 (2.291,7; 2.983,1)	17,8 (15,1; 19,7)	2,9 (-5,9; 13,7)	70+ years
Deaths	Brazil	1.632,0 (1.460,9; 1.808,8)	1,1 (1,0; 1,2)	4.061,4 (3.597,7; 4.433,8)	1,9 (1,7; 2,1)	75,2 (60,3; 93,7)	All ages
Deaths	Brazil		2,0 (1,7; 2,2)		1,6 (1,4; 1,7)	-19,8 (-25,8; -11,7)	Age-standardized
DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)		under 5 years
DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)		5-14 years
DALYs	Brazil	18.136,7 (15.844,6; 20.531,2)	23,6 (20,6; 26,7)	13.676,7 (12.335,4; 14.977,4)	12,4 (11,2; 13,6)	-47,3 (-55,0; -38,0)	15-49 years
DALYs	Brazil	17.159,1 (15.448,0; 18.831,1)	109,0 (98,1; 119,6)	32.898,9 (30.255,8; 35.501,2)	75,3 (69,3; 81,3)	-30,9 (-36,8; -23,0)	50-69 years
DALYs	Brazil	11.655,1 (10.351,5; 12.748,5)	272,6 (242,1; 298,2)	40.285,0 (35.149,5; 45.095,4)	265,7 (231,8; 297,4)	-2,5 (-10,0; 5,9)	70+ years
DALYs	Brazil	46.951,0 (42.570,3; 52.062,5)	31,4 (28,5; 34,9)	86.860,5 (78.471,6; 94.206,2)	41,0 (37,0; 44,4)	30,3 (19,2; 45,4)	All ages
DALYs	Brazil		47,2 (42,8; 52,4)		33,5 (30,2; 36,3)	-29,1 (-34,6; -21,5)	Age-standardized
Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	under 5 years
Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	5-14 years
Prevalence	Brazil	11.766,0 (8.763,5; 15.753,9)	15,3 (11,4; 20,5)	21.817,0 (15.902,7; 29.293,9)	19,9 (14,5; 26,7)	29,7 (18,6; 38,7)	15-49 years
Prevalence	Brazil	44.739,8 (34.894,0; 56.553,3)	284,2 (221,7; 359,3)	163.891,3 (128.024,9; 205.700,8)	375,2 (293,1; 471,0)	32,0 (25,5; 40,4)	50-69 years
Prevalence	Brazil	35.775,0 (26.811,6; 45.346,8)	836,8 (627,2; 1.060,7)	192.639,3 (144.687,8; 241.650,5)	1.270,5 (954,2; 1.593,7)	51,8 (42,9; 62,6)	70+ years
Prevalence	Brazil	92.280,8 (74.273,1; 112.240,6)	61,8 (49,7; 75,2)	378.347,6 (302.669,2; 463.214,0)	178,4 (142,7; 218,4)	188,7 (169,3; 205,7)	All ages
Prevalence	Brazil		106,4 (85,6; 130,4)		143,2 (114,1; 174,9)	34,7 (27,9; 41,5)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.8 – Rheumatic heart disease deaths in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	1.088,2 (926,2; 1.240,9)	2,1 (1,8; 2,4)	1.174,8 (1.057,3; 1.287,4)	1,0 (0,9; 1,1)	-51,1 (-57,3; -43,6)	Male
North region	43,5 (35,3; 52,3)	1,5 (1,2; 1,7)	68,8 (58,6; 79,1)	0,9 (0,7; 1,0)	-41,2 (-50,4; -28,5)	Male
Acre	2,6 (1,9; 3,4)	1,8 (1,4; 2,3)	3,5 (2,7; 4,4)	1,0 (0,7; 1,2)	-47,6 (-62,9; -24,5)	Male
Amapá	0,9 (0,7; 1,2)	1,3 (1,0; 1,6)	2,5 (2,0; 3,1)	0,8 (0,7; 1,0)	-37,0 (-53,8; -12,9)	Male
Amazonas	6,7 (5,3; 8,3)	1,2 (0,9; 1,4)	12,8 (10,6; 15,8)	0,8 (0,6; 1,0)	-33,6 (-48,9; -11,1)	Male
Pará	21,4 (17,0; 26,1)	1,4 (1,1; 1,7)	31,1 (25,5; 37,9)	0,8 (0,7; 1,0)	-42,8 (-55,6; -24,5)	Male
Rondônia	6,5 (4,9; 8,4)	1,9 (1,5; 2,5)	8,2 (6,5; 10,2)	1,0 (0,8; 1,2)	-49,1 (-62,4; -32,4)	Male
Roraima	0,7 (0,5; 1,0)	1,2 (0,9; 1,5)	1,6 (1,3; 2,1)	0,6 (0,5; 0,8)	-44,8 (-59,8; -22,2)	Male
Tocantins	4,7 (3,5; 6,2)	1,8 (1,3; 2,5)	9,2 (6,9; 11,7)	1,1 (0,9; 1,4)	-38,9 (-56,6; -14,0)	Male
Northeast region	245,1 (185,0; 312,7)	1,6 (1,2; 2,0)	311,2 (241,9; 396,1)	1,0 (0,8; 1,3)	-35,6 (-52,5; -12,6)	Male
Alagoas	14,4 (10,6; 18,6)	1,7 (1,3; 2,2)	16,7 (12,9; 21,0)	1,1 (0,8; 1,3)	-37,1 (-53,6; -13,5)	Male
Bahia	74,2 (57,2; 92,2)	1,8 (1,4; 2,1)	90,8 (71,6; 114,6)	1,1 (0,9; 1,4)	-36,6 (-53,8; -15,8)	Male
Ceará	24,8 (18,2; 32,1)	1,1 (0,8; 1,5)	40,4 (31,1; 50,7)	0,8 (0,6; 1,0)	-26,5 (-47,3; 3,4)	Male
Maranhão	23,0 (15,5; 34,4)	1,4 (1,0; 2,2)	37,1 (28,4; 48,8)	1,1 (0,8; 1,4)	-23,1 (-51,2; 20,5)	Male
Paraíba	18,3 (13,6; 23,5)	1,5 (1,1; 1,9)	23,0 (17,9; 29,2)	1,0 (0,8; 1,3)	-30,8 (-50,9; -3,0)	Male
Pernambuco	57,5 (44,1; 73,2)	2,1 (1,6; 2,6)	57,6 (45,2; 72,3)	1,2 (0,9; 1,5)	-43,2 (-57,2; -25,1)	Male
Piaui	9,6 (6,8; 13,0)	1,1 (0,8; 1,5)	13,8 (10,1; 18,4)	0,7 (0,5; 1,0)	-34,5 (-57,1; -3,2)	Male
Rio Grande do Norte	12,6 (9,3; 16,9)	1,4 (1,1; 1,9)	18,1 (13,5; 23,6)	1,0 (0,7; 1,3)	-32,1 (-54,4; -5,9)	Male
Sergipe	10,6 (7,8; 13,3)	2,2 (1,6; 2,7)	13,7 (10,7; 17,4)	1,2 (0,9; 1,5)	-44,2 (-58,7; -22,9)	Male
Southeast region	563,3 (498,8; 637,1)	2,4 (2,1; 2,8)	516,0 (455,1; 585,3)	1,0 (0,9; 1,1)	-58,3 (-65,2; -51,4)	Male
Espírito Santo	18,3 (14,9; 22,0)	2,0 (1,6; 2,4)	23,5 (19,5; 28,8)	1,1 (0,9; 1,3)	-47,5 (-59,4; -31,2)	Male
Minas Gerais	148,2 (128,8; 171,9)	2,6 (2,2; 3,0)	154,7 (131,1; 177,4)	1,2 (1,0; 1,4)	-53,3 (-61,9; -44,2)	Male
Rio de Janeiro	107,2 (93,0; 120,8)	2,1 (1,8; 2,4)	80,1 (70,1; 92,5)	0,8 (0,7; 1,0)	-60,3 (-65,7; -53,5)	Male
São Paulo	289,6 (258,3; 328,3)	2,5 (2,2; 2,9)	257,7 (219,8; 296,9)	1,0 (0,8; 1,1)	-61,2 (-67,8; -54,2)	Male
South region	166,2 (138,5; 196,7)	2,1 (1,8; 2,5)	182,9 (155,7; 215,7)	1,0 (0,9; 1,2)	-51,9 (-60,2; -40,0)	Male
Paraná	72,0 (60,4; 84,0)	2,4 (2,0; 2,8)	81,5 (70,4; 93,7)	1,2 (1,0; 1,4)	-50,0 (-57,9; -38,5)	Male
Rio Grande do Sul	60,8 (51,0; 71,8)	1,8 (1,5; 2,1)	56,3 (46,7; 66,9)	0,8 (0,7; 1,0)	-55,2 (-63,7; -43,4)	Male
Santa Catarina	33,3 (27,0; 40,8)	2,2 (1,8; 2,7)	45,1 (37,4; 55,7)	1,1 (0,9; 1,3)	-52,9 (-64,4; -38,7)	Male
West-Central region	70,2 (56,9; 83,4)	2,3 (1,8; 2,7)	95,9 (82,1; 113,1)	1,1 (1,0; 1,3)	-50,7 (-60,0; -35,9)	Male
Distrito Federal	14,8 (12,0; 17,8)	3,4 (2,7; 4,1)	17,1 (14,3; 20,9)	1,2 (1,0; 1,5)	-63,5 (-71,5; -52,5)	Male
Goiás	34,3 (27,1; 41,0)	2,5 (2,0; 2,9)	45,8 (38,0; 55,2)	1,2 (1,0; 1,4)	-51,7 (-61,6; -36,9)	Male
Mato Grosso	10,4 (7,9; 13,6)	1,6 (1,3; 2,1)	18,5 (14,3; 23,3)	1,0 (0,8; 1,2)	-38,7 (-53,9; -14,8)	Male

Mato Grosso do Sul	10,6 (8,5; 13,0)	1,7 (1,4; 2,1)	14,5 (12,1; 17,9)	1,0 (0,8; 1,2)	-44,7 (-57,4; -26,5)	Male
Brazil	1.687,3 (1.483,7; 1.883,9)	3,0 (2,6; 3,3)	1.843,1 (1.674,2; 1.993,7)	1,3 (1,2; 1,4)	-56,4 (-61,7; -51,0)	Female
North region	55,6 (46,5; 66,3)	1,9 (1,6; 2,3)	92,5 (79,5; 106,1)	1,1 (0,9; 1,2)	-45,0 (-54,5; -34,7)	Female
Acre	2,9 (2,2; 4,0)	2,5 (1,9; 3,2)	5,5 (4,5; 6,7)	1,4 (1,2; 1,7)	-43,5 (-59,5; -22,6)	Female
Amapá	1,0 (0,8; 1,3)	1,2 (1,0; 1,6)	2,5 (2,0; 3,2)	0,8 (0,6; 0,9)	-38,8 (-55,2; -17,1)	Female
Amazonas	9,1 (7,3; 11,6)	1,6 (1,3; 2,0)	16,4 (13,0; 21,0)	0,9 (0,7; 1,1)	-44,4 (-59,7; -27,3)	Female
Pará	28,6 (23,3; 35,4)	1,9 (1,6; 2,3)	42,4 (33,8; 53,8)	1,0 (0,8; 1,3)	-46,8 (-61,9; -29,1)	Female
Rondônia	8,2 (6,7; 9,7)	3,0 (2,5; 3,6)	13,4 (10,5; 16,8)	1,5 (1,2; 1,9)	-49,7 (-62,7; -32,7)	Female
Roraima	1,0 (0,8; 1,4)	2,2 (1,7; 2,7)	3,1 (2,5; 4,0)	1,2 (1,0; 1,5)	-45,1 (-60,7; -26,3)	Female
Tocantins	4,7 (3,2; 7,3)	1,9 (1,3; 3,1)	9,1 (7,4; 11,0)	1,1 (0,9; 1,3)	-42,2 (-63,6; -12,3)	Female
Northeast region	364,5 (284,2; 457,1)	2,2 (1,8; 2,8)	466,4 (391,0; 546,8)	1,3 (1,1; 1,5)	-42,4 (-55,8; -22,6)	Female
Alagoas	24,5 (18,1; 33,2)	2,9 (2,1; 3,9)	29,0 (23,4; 34,6)	1,5 (1,2; 1,8)	-47,6 (-63,8; -23,7)	Female
Bahia	122,9 (98,4; 149,0)	2,6 (2,1; 3,2)	140,4 (117,2; 164,5)	1,5 (1,2; 1,7)	-44,7 (-57,6; -26,1)	Female
Ceará	38,6 (27,9; 53,4)	1,6 (1,2; 2,2)	58,0 (47,4; 68,1)	1,0 (0,8; 1,2)	-38,1 (-58,5; -11,2)	Female
Maranhão	19,9 (10,6; 35,0)	1,2 (0,7; 2,2)	40,5 (32,4; 49,1)	1,1 (0,9; 1,3)	-12,4 (-53,0; 60,8)	Female
Paraíba	30,6 (21,5; 42,4)	2,3 (1,6; 3,3)	37,6 (30,4; 44,6)	1,4 (1,1; 1,6)	-41,4 (-59,6; -10,4)	Female
Pernambuco	81,8 (65,1; 101,7)	2,8 (2,2; 3,4)	95,5 (80,3; 111,7)	1,5 (1,3; 1,8)	-45,2 (-58,0; -26,5)	Female
Piaui	12,8 (9,0; 18,8)	1,4 (1,0; 2,1)	16,9 (13,6; 20,4)	0,8 (0,6; 0,9)	-45,1 (-65,2; -15,8)	Female
Rio Grande do Norte	19,4 (15,2; 24,5)	2,0 (1,6; 2,6)	27,6 (22,1; 32,8)	1,2 (1,0; 1,4)	-40,5 (-55,7; -18,0)	Female
Sergipe	14,1 (10,6; 17,9)	2,8 (2,1; 3,5)	20,8 (16,6; 24,7)	1,5 (1,2; 1,7)	-46,6 (-61,3; -27,3)	Female
Southeast region	913,1 (820,3; 1.005,7)	3,5 (3,2; 3,9)	859,1 (738,1; 964,5)	1,3 (1,1; 1,5)	-62,5 (-67,8; -56,4)	Female
Espírito Santo	27,8 (22,8; 33,4)	2,9 (2,5; 3,5)	34,2 (27,1; 42,9)	1,3 (1,0; 1,6)	-56,5 (-67,2; -42,5)	Female
Minas Gerais	233,8 (206,1; 264,1)	3,7 (3,2; 4,2)	246,0 (206,0; 290,1)	1,6 (1,3; 1,9)	-57,5 (-64,9; -47,5)	Female
Rio de Janeiro	173,5 (151,5; 195,1)	2,9 (2,5; 3,2)	153,7 (129,4; 178,1)	1,2 (1,0; 1,4)	-58,6 (-65,2; -50,8)	Female
São Paulo	478,0 (427,2; 530,6)	3,8 (3,4; 4,2)	425,2 (368,0; 478,7)	1,3 (1,1; 1,4)	-66,9 (-71,4; -62,1)	Female
South region	248,5 (216,3; 280,5)	2,8 (2,5; 3,2)	280,1 (235,2; 319,9)	1,2 (1,1; 1,4)	-56,1 (-63,5; -47,8)	Female
Paraná	115,5 (101,4; 129,7)	3,7 (3,3; 4,2)	123,6 (105,1; 141,7)	1,5 (1,3; 1,7)	-59,6 (-66,9; -52,1)	Female
Rio Grande do Sul	87,7 (74,6; 100,0)	2,2 (1,9; 2,5)	91,6 (77,9; 107,1)	1,0 (0,9; 1,2)	-54,2 (-61,6; -45,2)	Female
Santa Catarina	45,3 (37,0; 54,2)	2,8 (2,3; 3,4)	64,9 (50,6; 79,0)	1,3 (1,0; 1,5)	-55,7 (-66,6; -41,7)	Female
West-Central region	105,5 (89,1; 125,0)	3,5 (3,0; 4,1)	145,0 (124,8; 167,3)	1,5 (1,3; 1,7)	-58,4 (-66,4; -48,4)	Female
Distrito Federal	21,3 (17,5; 25,8)	4,3 (3,5; 5,1)	26,4 (20,8; 33,3)	1,5 (1,2; 1,8)	-65,8 (-75,3; -55,0)	Female
Goiás	55,4 (46,7; 64,9)	4,0 (3,4; 4,7)	71,6 (59,2; 83,9)	1,6 (1,4; 1,9)	-59,9 (-67,8; -50,0)	Female

Mato Grosso	13,3 (10,1; 17,0)	2,4 (1,9; 3,1)	25,2 (20,6; 30,2)	1,3 (1,0; 1,5)	-47,7 (-61,7; -28,0)	Female
Mato Grosso do Sul	15,6 (12,7; 18,6)	2,7 (2,2; 3,2)	21,8 (17,3; 27,3)	1,3 (1,0; 1,6)	-52,7 (-64,5; -36,6)	Female
Brazil	2.775,5 (2.533,0; 3.049,1)	2,6 (2,3; 2,8)	3.017,9 (2.765,7; 3.225,2)	1,2 (1,1; 1,3)	-54,2 (-58,2; -49,6)	Both
North region	99,1 (85,1; 114,6)	1,7 (1,5; 1,9)	161,3 (144,5; 177,1)	1,0 (0,9; 1,1)	-43,0 (-49,9; -35,0)	Both
Acre	5,5 (4,4; 6,7)	2,1 (1,8; 2,6)	9,1 (7,7; 10,6)	1,2 (1,0; 1,4)	-44,4 (-57,1; -29,3)	Both
Amapá	1,9 (1,6; 2,3)	1,2 (1,0; 1,4)	5,0 (4,3; 5,9)	0,8 (0,7; 0,9)	-36,7 (-48,5; -20,9)	Both
Amazonas	15,9 (13,1; 18,9)	1,4 (1,2; 1,6)	29,2 (24,6; 34,1)	0,8 (0,7; 1,0)	-39,6 (-51,3; -26,6)	Both
Pará	50,0 (42,6; 58,9)	1,7 (1,4; 2,0)	73,5 (61,8; 85,1)	0,9 (0,8; 1,1)	-45,0 (-54,8; -33,1)	Both
Rondônia	14,7 (12,5; 17,2)	2,4 (2,1; 2,8)	21,5 (18,2; 25,4)	1,3 (1,1; 1,5)	-48,0 (-58,3; -36,3)	Both
Roraima	1,8 (1,4; 2,2)	1,6 (1,3; 1,9)	4,8 (4,1; 5,6)	0,9 (0,8; 1,1)	-42,6 (-54,8; -26,8)	Both
Tocantins	9,4 (7,2; 12,0)	1,9 (1,5; 2,5)	18,3 (15,2; 21,3)	1,1 (0,9; 1,3)	-40,1 (-55,1; -22,2)	Both
Northeast region	609,6 (514,4; 716,3)	2,0 (1,7; 2,3)	777,6 (668,7; 892,2)	1,2 (1,0; 1,4)	-39,6 (-51,5; -25,1)	Both
Alagoas	38,9 (31,1; 48,0)	2,3 (1,8; 2,9)	45,7 (38,4; 53,1)	1,3 (1,1; 1,5)	-43,7 (-57,7; -24,0)	Both
Bahia	197,1 (168,6; 229,1)	2,2 (1,9; 2,6)	231,2 (198,4; 262,1)	1,3 (1,1; 1,5)	-41,3 (-52,6; -28,4)	Both
Ceará	63,4 (50,8; 79,3)	1,4 (1,1; 1,7)	98,4 (83,1; 112,3)	0,9 (0,8; 1,0)	-33,6 (-49,7; -15,5)	Both
Maranhão	42,9 (30,1; 56,6)	1,3 (1,0; 1,8)	77,6 (66,1; 91,8)	1,1 (0,9; 1,3)	-18,3 (-43,3; 16,5)	Both
Paraíba	48,8 (38,8; 61,3)	1,9 (1,5; 2,5)	60,6 (51,6; 69,2)	1,2 (1,0; 1,4)	-37,6 (-53,7; -17,3)	Both
Pernambuco	139,3 (118,5; 162,7)	2,5 (2,1; 2,9)	153,1 (132,3; 174,7)	1,4 (1,2; 1,6)	-44,3 (-55,2; -31,4)	Both
Piaui	22,4 (17,6; 28,6)	1,3 (1,0; 1,7)	30,7 (25,8; 36,2)	0,8 (0,6; 0,9)	-40,6 (-56,0; -20,4)	Both
Rio Grande do Norte	32,1 (26,6; 38,5)	1,8 (1,5; 2,1)	45,7 (38,8; 53,5)	1,1 (0,9; 1,3)	-37,1 (-50,8; -20,4)	Both
Sergipe	24,7 (20,5; 29,4)	2,5 (2,1; 2,9)	34,6 (29,2; 39,4)	1,4 (1,1; 1,5)	-45,4 (-57,3; -31,4)	Both
Southeast region	1.476,4 (1.366,3; 1.596,8)	3,0 (2,8; 3,3)	1.375,1 (1.219,1; 1.498,9)	1,2 (1,0; 1,3)	-60,7 (-65,3; -56,1)	Both
Espírito Santo	46,1 (39,8; 53,2)	2,5 (2,2; 2,9)	57,7 (48,8; 67,3)	1,2 (1,0; 1,4)	-52,8 (-61,8; -42,5)	Both
Minas Gerais	382,0 (347,4; 421,2)	3,2 (2,9; 3,5)	400,7 (346,5; 448,9)	1,4 (1,2; 1,6)	-55,6 (-62,3; -49,4)	Both
Rio de Janeiro	280,7 (257,1; 310,1)	2,5 (2,3; 2,8)	233,9 (205,0; 259,1)	1,0 (0,9; 1,1)	-59,1 (-64,5; -53,2)	Both
São Paulo	767,6 (709,9; 825,5)	3,2 (3,0; 3,5)	682,9 (601,7; 751,1)	1,1 (1,0; 1,3)	-64,5 (-68,3; -60,1)	Both
South region	414,7 (372,4; 465,1)	2,5 (2,2; 2,8)	462,9 (404,8; 516,0)	1,1 (1,0; 1,3)	-54,2 (-60,6; -47,9)	Both
Paraná	187,5 (170,7; 208,1)	3,1 (2,8; 3,4)	205,1 (179,5; 226,4)	1,4 (1,2; 1,5)	-55,6 (-61,8; -49,9)	Both
Rio Grande do Sul	148,6 (132,8; 167,2)	2,0 (1,8; 2,3)	147,9 (129,5; 165,2)	0,9 (0,8; 1,0)	-54,5 (-60,5; -48,1)	Both
Santa Catarina	78,6 (68,2; 91,2)	2,5 (2,2; 2,9)	110,0 (94,1; 125,6)	1,2 (1,0; 1,3)	-54,3 (-62,5; -45,3)	Both
West-Central region	175,7 (152,9; 201,3)	2,9 (2,5; 3,3)	241,0 (214,4; 266,9)	1,3 (1,2; 1,4)	-54,8 (-61,3; -47,4)	Both

Distrito Federal	36,2 (31,6; 42,1)	3,8 (3,4; 4,5)	43,5 (36,2; 51,5)	1,4 (1,1; 1,6)	-64,5 (-71,3; -56,5)	Both
Goiás	89,7 (77,8; 102,7)	3,3 (2,8; 3,7)	117,5 (101,2; 131,6)	1,4 (1,2; 1,6)	-56,3 (-63,4; -49,2)	Both
Mato Grosso	23,7 (19,6; 28,8)	2,0 (1,7; 2,4)	43,8 (36,7; 50,9)	1,1 (1,0; 1,3)	-42,9 (-56,1; -28,3)	Both
Mato Grosso do Sul	26,1 (22,6; 30,1)	2,2 (1,9; 2,5)	36,2 (30,7; 42,3)	1,1 (0,9; 1,3)	-48,8 (-57,3; -37,4)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.9 – Non-rheumatic valve disease deaths in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	1.221,6 (1.098,4; 1.347,2)	3,0 (2,6; 3,3)	2.793,6 (2.542,8; 3.029,7)	2,5 (2,3; 2,7)	-15,1 (-24,2; -4,3)	Male
North region	48,3 (41,8; 55,0)	2,5 (2,1; 2,8)	168,4 (147,9; 191,5)	2,3 (2,0; 2,7)	-5,3 (-19,0; 16,0)	Male
Acre	1,8 (1,4; 2,2)	2,0 (1,6; 2,4)	6,0 (4,7; 7,4)	1,9 (1,4; 2,3)	-7,0 (-33,8; 27,1)	Male
Amapá	1,2 (1,0; 1,4)	2,7 (2,2; 3,2)	6,3 (5,2; 7,6)	2,5 (2,0; 3,0)	-7,3 (-29,9; 25,5)	Male
Amazonas	10,2 (8,4; 11,9)	2,7 (2,2; 3,2)	36,5 (30,5; 43,2)	2,6 (2,2; 3,1)	-4,3 (-25,3; 26,1)	Male
Pará	24,3 (20,4; 28,4)	2,4 (2,0; 2,8)	75,8 (63,6; 88,7)	2,2 (1,9; 2,6)	-9,4 (-27,6; 18,3)	Male
Rondônia	6,5 (5,4; 7,8)	3,0 (2,5; 3,6)	19,3 (15,5; 23,3)	2,5 (2,0; 3,0)	-17,0 (-35,6; 9,4)	Male
Roraima	0,8 (0,7; 1,0)	2,4 (1,9; 3,0)	4,3 (3,4; 5,3)	2,2 (1,7; 2,7)	-8,2 (-32,2; 18,0)	Male
Tocantins	3,5 (2,8; 4,2)	2,4 (1,9; 2,8)	20,3 (15,5; 25,2)	2,6 (2,0; 3,2)	9,8 (-18,9; 45,1)	Male
Northeast region	256,1 (210,0; 310,2)	2,2 (1,8; 2,7)	599,7 (485,6; 713,8)	2,1 (1,7; 2,5)	-6,3 (-28,8; 21,4)	Male
Alagoas	10,7 (8,5; 13,3)	1,7 (1,4; 2,1)	33,3 (26,4; 40,3)	2,3 (1,8; 2,7)	34,8 (0,0; 76,8)	Male
Bahia	107,5 (88,8; 129,2)	3,5 (2,9; 4,2)	170,0 (138,5; 201,7)	2,1 (1,7; 2,5)	-38,9 (-53,6; -21,5)	Male
Ceará	21,9 (17,6; 26,9)	1,2 (1,0; 1,5)	94,5 (76,1; 111,3)	2,0 (1,6; 2,3)	59,5 (20,4; 108,1)	Male
Maranhão	17,0 (12,1; 24,2)	1,4 (1,0; 2,0)	63,5 (48,8; 79,9)	2,0 (1,5; 2,5)	40,5 (-7,4; 117,9)	Male
Paraíba	12,5 (9,8; 15,3)	1,2 (1,0; 1,5)	36,0 (28,9; 44,2)	1,6 (1,3; 2,0)	34,5 (-0,1; 80,6)	Male
Pernambuco	56,6 (46,5; 67,5)	2,7 (2,3; 3,3)	115,8 (96,3; 137,2)	2,5 (2,1; 3,0)	-7,9 (-28,4; 16,2)	Male
Piaui	8,8 (6,7; 11,2)	1,3 (1,0; 1,7)	30,4 (23,3; 38,1)	1,6 (1,3; 2,1)	21,4 (-14,3; 72,3)	Male
Rio Grande do Norte	13,9 (10,8; 17,2)	1,9 (1,4; 2,3)	36,4 (28,1; 45,4)	2,0 (1,5; 2,5)	5,4 (-23,8; 48,0)	Male
Sergipe	7,2 (5,8; 8,6)	1,9 (1,5; 2,3)	19,8 (15,6; 24,5)	1,9 (1,5; 2,3)	-0,8 (-25,6; 32,9)	Male
Southeast region	626,5 (566,7; 683,1)	3,3 (3,0; 3,6)	1.253,9 (1.132,8; 1.395,4)	2,5 (2,2; 2,8)	-23,7 (-32,3; -12,1)	Male
Espírito Santo	21,8 (18,1; 25,6)	3,1 (2,6; 3,6)	59,7 (50,3; 70,5)	2,7 (2,3; 3,3)	-11,5 (-29,0; 15,5)	Male
Minas Gerais	144,7 (125,3; 162,6)	3,1 (2,7; 3,6)	309,5 (269,9; 355,7)	2,4 (2,1; 2,7)	-23,7 (-36,0; -5,7)	Male
Rio de Janeiro	120,0 (104,5; 134,7)	2,9 (2,5; 3,3)	216,0 (187,1; 248,7)	2,3 (2,0; 2,6)	-20,5 (-31,9; -2,0)	Male
São Paulo	340,0 (314,6; 367,7)	3,6 (3,3; 3,9)	668,8 (596,4; 749,1)	2,7 (2,4; 3,0)	-25,9 (-33,6; -16,5)	Male
South region	227,9 (197,6; 257,9)	3,6 (3,1; 4,1)	572,0 (510,7; 650,3)	3,3 (2,9; 3,7)	-8,0 (-21,0; 11,4)	Male
Paraná	78,5 (68,3; 89,2)	3,3 (2,8; 3,8)	190,4 (169,3; 218,1)	2,9 (2,6; 3,3)	-12,2 (-25,9; 8,1)	Male
Rio Grande do Sul	104,7 (89,8; 118,0)	3,7 (3,1; 4,2)	241,0 (212,8; 275,5)	3,4 (3,0; 3,9)	-5,7 (-20,1; 17,4)	Male
Santa Catarina	44,8 (38,7; 51,3)	3,8 (3,3; 4,4)	140,6 (122,6; 163,3)	3,6 (3,1; 4,1)	-6,7 (-22,7; 13,5)	Male

West-Central region	62,9 (53,3; 72,1)	2,9 (2,4; 3,3)	199,6 (172,0; 232,9)	2,5 (2,1; 2,9)	-12,8 (-28,7; 10,7)	Male
Distrito Federal	10,1 (8,4; 11,5)	3,6 (3,0; 4,1)	29,9 (24,8; 35,5)	2,4 (2,0; 2,9)	-32,6 (-46,9; -8,4)	Male
Goiás	28,2 (23,6; 32,9)	2,8 (2,3; 3,2)	89,3 (76,1; 105,5)	2,5 (2,1; 2,9)	-10,9 (-29,5; 15,1)	Male
Mato Grosso	10,9 (8,9; 13,0)	2,5 (2,1; 3,0)	40,6 (31,8; 48,8)	2,4 (1,9; 2,9)	-2,6 (-25,0; 27,4)	Male
Mato Grosso do Sul	13,8 (11,5; 16,4)	3,0 (2,5; 3,6)	39,9 (33,0; 48,1)	2,8 (2,3; 3,3)	-9,1 (-28,4; 18,9)	Male
Brazil	1.194,9 (1.048,6; 1.341,5)	2,7 (2,3; 3,0)	2.847,3 (2.457,6; 3.165,0)	1,9 (1,7; 2,1)	-27,6 (-34,9; -19,3)	Female
North region	37,4 (32,0; 43,4)	2,0 (1,7; 2,3)	127,0 (107,2; 149,1)	1,6 (1,4; 1,9)	-19,2 (-32,0; -2,2)	Female
Acre	1,3 (1,0; 1,7)	1,8 (1,4; 2,2)	5,3 (4,3; 6,4)	1,5 (1,2; 1,8)	-15,7 (-37,5; 13,7)	Female
Amapá	1,1 (0,9; 1,4)	2,0 (1,6; 2,4)	5,6 (4,3; 7,2)	2,0 (1,5; 2,5)	-2,2 (-28,0; 29,4)	Female
Amazonas	6,7 (5,5; 8,0)	1,9 (1,5; 2,3)	23,0 (17,9; 29,0)	1,5 (1,1; 1,8)	-22,9 (-40,8; 0,5)	Female
Pará	21,4 (17,7; 25,5)	2,1 (1,7; 2,4)	63,0 (50,4; 77,7)	1,6 (1,3; 2,0)	-20,7 (-40,5; 3,0)	Female
Rondônia	4,1 (3,3; 5,0)	2,8 (2,3; 3,4)	14,2 (11,4; 17,2)	1,9 (1,5; 2,3)	-34,3 (-50,0; -12,8)	Female
Roraima	0,5 (0,4; 0,6)	1,9 (1,5; 2,4)	2,8 (2,3; 3,6)	1,5 (1,2; 1,8)	-22,0 (-42,5; 6,3)	Female
Tocantins	2,3 (1,8; 3,0)	1,8 (1,4; 2,3)	13,1 (10,5; 15,9)	1,6 (1,3; 2,0)	-8,9 (-33,7; 24,7)	Female
Northeast region	274,2 (219,2; 336,6)	2,2 (1,7; 2,7)	575,0 (465,3; 685,9)	1,5 (1,2; 1,8)	-30,2 (-45,8; -9,1)	Female
Alagoas	12,4 (9,7; 15,5)	1,9 (1,5; 2,3)	35,3 (29,3; 43,6)	1,9 (1,5; 2,3)	-0,3 (-22,6; 38,1)	Female
Bahia	124,2 (101,9; 149,9)	3,6 (2,9; 4,4)	154,5 (125,4; 180,3)	1,5 (1,2; 1,7)	-58,9 (-67,1; -48,0)	Female
Ceará	25,2 (19,9; 32,2)	1,3 (1,0; 1,6)	92,2 (75,5; 110,7)	1,4 (1,2; 1,7)	13,2 (-15,6; 48,0)	Female
Maranhão	9,6 (6,8; 13,3)	0,8 (0,6; 1,1)	49,3 (39,0; 61,0)	1,3 (1,0; 1,6)	64,3 (13,5; 149,0)	Female
Paraíba	15,5 (12,0; 19,9)	1,4 (1,1; 1,8)	40,4 (32,7; 49,6)	1,3 (1,1; 1,6)	-6,5 (-29,9; 30,3)	Female
Pernambuco	59,3 (48,3; 71,7)	2,5 (2,0; 3,0)	124,3 (103,8; 145,5)	1,9 (1,6; 2,3)	-22,0 (-40,0; 1,6)	Female
Piaui	8,1 (5,9; 10,7)	1,2 (0,9; 1,6)	26,9 (20,4; 33,9)	1,2 (0,9; 1,5)	-1,8 (-32,7; 38,0)	Female
Rio Grande do Norte	13,0 (9,7; 17,1)	1,6 (1,2; 2,1)	35,6 (27,5; 44,0)	1,4 (1,1; 1,8)	-11,1 (-36,1; 30,6)	Female
Sergipe	6,9 (5,4; 8,5)	1,6 (1,3; 2,0)	16,5 (13,4; 20,5)	1,2 (0,9; 1,4)	-29,4 (-46,5; -5,8)	Female
Southeast region	580,0 (526,8; 639,7)	2,7 (2,5; 3,0)	1.365,6 (1.144,8; 1.531,4)	2,0 (1,7; 2,2)	-27,5 (-36,5; -18,7)	Female
Espírito Santo	21,9 (18,2; 25,8)	3,0 (2,5; 3,6)	59,7 (48,0; 73,2)	2,1 (1,7; 2,6)	-29,1 (-45,4; -7,5)	Female
Minas Gerais	131,9 (115,5; 151,6)	2,6 (2,2; 3,0)	319,5 (264,8; 366,3)	1,9 (1,6; 2,2)	-26,8 (-38,0; -14,0)	Female
Rio de Janeiro	128,4 (111,5; 145,4)	2,5 (2,1; 2,9)	255,1 (211,0; 294,4)	1,8 (1,5; 2,1)	-28,6 (-38,7; -17,0)	Female
São Paulo	297,8 (275,1; 322,6)	2,9 (2,6; 3,1)	731,2 (610,9; 839,9)	2,1 (1,7; 2,4)	-27,7 (-35,8; -18,3)	Female
South region	246,9 (212,6; 285,8)	3,5 (3,0; 4,1)	601,3 (496,4; 686,5)	2,6 (2,1; 2,9)	-27,1 (-37,7; -14,5)	Female

Paraná	88,5 (76,0; 103,1)	3,8 (3,2; 4,4)	205,2 (169,6; 236,5)	2,5 (2,0; 2,8)	-34,3 (-44,5; -23,1)	Female
Rio Grande do Sul	109,7 (94,6; 126,7)	3,2 (2,7; 3,8)	248,7 (204,9; 284,7)	2,5 (2,1; 2,8)	-22,8 (-35,2; -9,3)	Female
Santa Catarina	48,7 (41,8; 57,1)	4,0 (3,4; 4,7)	147,4 (120,6; 174,8)	2,9 (2,4; 3,5)	-26,3 (-39,6; -9,6)	Female
West-Central region	56,4 (48,0; 66,8)	2,8 (2,3; 3,3)	178,5 (148,2; 211,2)	1,9 (1,6; 2,3)	-31,9 (-47,0; -12,9)	Female
Distrito Federal	8,8 (7,3; 10,5)	2,8 (2,3; 3,3)	28,8 (22,0; 36,4)	1,7 (1,3; 2,2)	-38,4 (-53,8; -20,5)	Female
Goiás	27,6 (23,3; 33,2)	2,9 (2,4; 3,5)	80,7 (65,1; 98,5)	1,9 (1,5; 2,3)	-34,1 (-51,4; -13,4)	Female
Mato Grosso	8,1 (6,4; 9,9)	2,4 (1,9; 2,9)	30,3 (24,7; 37,4)	1,7 (1,4; 2,1)	-27,7 (-43,3; -2,6)	Female
Mato Grosso do Sul	11,9 (9,9; 14,2)	2,9 (2,4; 3,5)	38,8 (31,5; 47,7)	2,3 (1,9; 2,8)	-21,7 (-40,2; 4,9)	Female
Brazil	2.416,5 (2.197,6; 2.624,6)	2,8 (2,5; 3,1)	5.640,9 (5.047,5; 6.089,4)	2,2 (2,0; 2,4)	-22,1 (-27,7; -14,7)	Both
North region	85,7 (76,5; 95,6)	2,2 (2,0; 2,5)	295,4 (262,3; 330,3)	2,0 (1,7; 2,2)	-12,4 (-22,6; 1,4)	Both
Acre	3,1 (2,7; 3,7)	1,9 (1,6; 2,2)	11,3 (9,5; 13,3)	1,7 (1,4; 2,0)	-11,4 (-27,2; 11,1)	Both
Amapá	2,3 (2,0; 2,7)	2,3 (2,0; 2,6)	11,9 (10,1; 13,8)	2,2 (1,9; 2,6)	-2,9 (-19,1; 17,8)	Both
Amazonas	16,8 (14,5; 19,2)	2,3 (2,0; 2,6)	59,5 (51,3; 69,2)	2,0 (1,7; 2,3)	-13,5 (-27,6; 9,4)	Both
Pará	45,7 (40,1; 51,5)	2,2 (2,0; 2,5)	138,8 (118,8; 160,9)	1,9 (1,6; 2,2)	-15,2 (-27,6; 1,8)	Both
Rondônia	10,6 (9,1; 12,1)	3,0 (2,6; 3,4)	33,5 (28,5; 38,1)	2,2 (1,9; 2,5)	-26,3 (-39,7; -11,6)	Both
Roraima	1,3 (1,1; 1,6)	2,2 (1,8; 2,6)	7,1 (5,9; 8,5)	1,8 (1,5; 2,2)	-15,7 (-32,0; 4,7)	Both
Tocantins	5,8 (5,0; 6,8)	2,1 (1,8; 2,5)	33,4 (27,9; 39,5)	2,1 (1,8; 2,5)	1,3 (-16,2; 24,9)	Both
Northeast region	530,3 (458,8; 617,4)	2,2 (1,9; 2,6)	1.174,8 (991,1; 1.354,4)	1,8 (1,5; 2,0)	-19,7 (-34,0; -2,4)	Both
Alagoas	23,1 (19,5; 27,0)	1,8 (1,5; 2,1)	68,6 (58,5; 79,3)	2,0 (1,7; 2,4)	14,3 (-6,8; 43,3)	Both
Bahia	231,7 (201,4; 267,2)	3,6 (3,1; 4,1)	324,5 (269,6; 372,6)	1,8 (1,5; 2,0)	-50,4 (-58,4; -40,5)	Both
Ceará	47,1 (40,6; 55,8)	1,3 (1,1; 1,5)	186,8 (156,5; 213,3)	1,7 (1,4; 1,9)	33,3 (9,0; 60,5)	Both
Maranhão	26,6 (21,0; 33,1)	1,1 (0,9; 1,4)	112,8 (91,3; 134,2)	1,6 (1,3; 1,9)	47,6 (12,7; 98,3)	Both
Paraíba	28,0 (23,7; 33,2)	1,3 (1,1; 1,6)	76,4 (62,9; 87,1)	1,5 (1,2; 1,7)	11,2 (-9,3; 37,6)	Both
Pernambuco	115,8 (101,4; 133,4)	2,6 (2,3; 3,0)	240,0 (204,7; 273,2)	2,2 (1,9; 2,5)	-15,8 (-29,3; 1,5)	Both
Piaui	16,9 (14,1; 20,7)	1,3 (1,0; 1,6)	57,3 (46,9; 68,0)	1,4 (1,1; 1,6)	9,3 (-14,9; 42,4)	Both
Rio Grande do Norte	27,0 (22,7; 32,3)	1,7 (1,5; 2,1)	71,9 (58,7; 85,2)	1,7 (1,4; 2,0)	-3,7 (-26,5; 21,7)	Both
Sergipe	14,1 (12,1; 16,4)	1,8 (1,5; 2,0)	36,4 (29,9; 42,9)	1,5 (1,2; 1,7)	-16,0 (-32,0; 5,4)	Both
Southeast region	1.206,4 (1.120,6; 1.287,5)	3,0 (2,7; 3,2)	2.619,5 (2.302,7; 2.861,3)	2,2 (1,9; 2,4)	-26,1 (-32,4; -19,1)	Both
Espírito Santo	43,7 (38,4; 49,7)	3,1 (2,7; 3,5)	119,4 (102,5; 138,0)	2,4 (2,1; 2,8)	-21,2 (-33,0; -6,1)	Both

Minas Gerais	276,6 (248,8; 306,6)	2,9 (2,5; 3,2)	628,9 (542,7; 699,5)	2,1 (1,8; 2,4)	-25,4 (-33,9; -14,9)	Both
Rio de Janeiro	248,4 (225,4; 273,8)	2,7 (2,4; 3,0)	471,1 (413,2; 519,6)	2,0 (1,8; 2,2)	-25,9 (-33,5; -16,0)	Both
São Paulo	637,7 (599,3; 672,6)	3,2 (3,0; 3,4)	1.400,0 (1.235,7; 1.545,0)	2,3 (2,0; 2,6)	-27,3 (-33,7; -20,2)	Both
South region	474,8 (425,4; 522,8)	3,6 (3,2; 4,0)	1.173,3 (1.022,4; 1.295,5)	2,9 (2,5; 3,2)	-18,8 (-27,2; -8,2)	Both
Paraná	167,0 (149,3; 185,7)	3,6 (3,1; 4,0)	395,6 (347,1; 441,4)	2,7 (2,3; 3,0)	-24,6 (-32,2; -15,2)	Both
Rio Grande do Sul	214,4 (192,9; 236,5)	3,4 (3,0; 3,8)	489,7 (423,2; 545,3)	2,9 (2,5; 3,2)	-15,5 (-25,2; -2,8)	Both
Santa Catarina	93,4 (83,5; 104,8)	3,9 (3,5; 4,4)	287,9 (249,3; 321,4)	3,2 (2,8; 3,6)	-17,7 (-27,7; -6,4)	Both
West-Central region	119,3 (105,2; 133,9)	2,8 (2,5; 3,2)	378,1 (330,3; 422,9)	2,2 (1,9; 2,4)	-23,2 (-34,0; -6,1)	Both
Distrito Federal	18,9 (16,7; 21,3)	3,1 (2,7; 3,5)	58,6 (48,6; 68,3)	2,0 (1,6; 2,4)	-35,6 (-46,2; -21,1)	Both
Goiás	55,7 (48,6; 62,8)	2,8 (2,5; 3,3)	170,0 (146,9; 193,2)	2,2 (1,9; 2,5)	-23,5 (-35,2; -7,8)	Both
Mato Grosso	19,0 (16,2; 22,2)	2,4 (2,1; 2,9)	70,8 (59,6; 82,4)	2,1 (1,7; 2,4)	-15,6 (-30,6; 3,5)	Both
Mato Grosso do Sul	25,7 (22,5; 28,9)	3,0 (2,6; 3,4)	78,7 (66,8; 90,1)	2,5 (2,1; 2,9)	-16,0 (-30,0; 3,3)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.10 – Non-rheumatic aortic valve disease deaths in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	918,5 (812,8; 1.026,4)	2,2 (2,0; 2,5)	2.125,7 (1.927,5; 2.318,6)	1,9 (1,7; 2,1)	-14,5 (-24,0; -2,5)	Male
North region	35,3 (30,0; 40,8)	1,9 (1,6; 2,1)	123,7 (106,6; 141,4)	1,7 (1,5; 2,0)	-5,9 (-20,3; 14,0)	Male
Acre	1,3 (1,0; 1,6)	1,5 (1,1; 1,8)	4,4 (3,4; 5,5)	1,4 (1,1; 1,8)	-5,8 (-32,3; 30,2)	Male
Amapá	0,9 (0,7; 1,1)	2,1 (1,7; 2,5)	4,8 (3,8; 5,8)	1,9 (1,5; 2,3)	-8,5 (-30,4; 22,7)	Male
Amazonas	7,8 (6,5; 9,3)	2,2 (1,8; 2,6)	28,8 (23,9; 34,2)	2,1 (1,7; 2,5)	-3,3 (-25,7; 26,8)	Male
Pará	17,6 (14,5; 21,4)	1,8 (1,5; 2,2)	55,0 (45,9; 64,5)	1,6 (1,3; 1,9)	-10,1 (-30,0; 15,6)	Male
Rondônia	4,7 (3,9; 5,8)	2,3 (1,9; 2,7)	14,3 (11,4; 17,7)	1,9 (1,5; 2,3)	-17,6 (-37,3; 8,3)	Male
Roraima	0,6 (0,5; 0,8)	1,9 (1,5; 2,4)	3,4 (2,6; 4,2)	1,7 (1,4; 2,2)	-8,4 (-33,5; 22,6)	Male
Tocantins	2,2 (1,7; 2,8)	1,6 (1,2; 2,0)	13,1 (9,8; 16,5)	1,7 (1,3; 2,1)	6,9 (-22,9; 44,3)	Male
Northeast region	192,1 (153,3; 236,4)	1,7 (1,3; 2,1)	434,3 (342,5; 524,5)	1,5 (1,2; 1,8)	-10,2 (-33,6; 18,3)	Male
Alagoas	7,2 (5,5; 9,0)	1,2 (0,9; 1,4)	22,7 (17,7; 28,3)	1,6 (1,2; 2,0)	35,5 (-1,0; 83,7)	Male
Bahia	88,2 (71,6; 106,2)	2,9 (2,3; 3,5)	124,7 (99,5; 150,2)	1,6 (1,2; 1,9)	-45,8 (-59,7; -29,6)	Male
Ceará	15,6 (12,3; 19,2)	0,9 (0,7; 1,1)	68,8 (54,0; 82,7)	1,4 (1,1; 1,7)	62,0 (18,2; 118,4)	Male
Maranhão	11,7 (8,1; 16,9)	1,0 (0,7; 1,4)	47,0 (35,6; 60,0)	1,5 (1,1; 1,9)	49,7 (-0,7; 144,5)	Male
Paraíba	8,4 (6,5; 10,5)	0,8 (0,6; 1,0)	25,5 (19,9; 31,6)	1,2 (0,9; 1,4)	41,0 (4,4; 95,4)	Male
Pernambuco	39,4 (31,3; 48,0)	1,9 (1,5; 2,4)	82,3 (66,0; 98,5)	1,8 (1,4; 2,2)	-6,5 (-29,2; 21,4)	Male
Piaui	6,0 (4,2; 7,8)	0,9 (0,7; 1,2)	22,1 (17,1; 28,3)	1,2 (0,9; 1,5)	29,0 (-14,0; 90,7)	Male
Rio Grande do Norte	10,7 (8,1; 13,6)	1,4 (1,1; 1,8)	27,4 (20,8; 34,4)	1,5 (1,1; 1,9)	3,1 (-26,8; 45,6)	Male
Sergipe	5,0 (4,0; 6,2)	1,3 (1,1; 1,6)	13,8 (10,6; 17,6)	1,3 (1,0; 1,7)	-0,2 (-27,4; 33,5)	Male
Southeast region	473,0 (426,7; 523,9)	2,5 (2,3; 2,8)	970,1 (865,7; 1.100,5)	2,0 (1,7; 2,2)	-22,1 (-30,7; -9,8)	Male
Espírito Santo	15,6 (12,8; 18,6)	2,3 (1,9; 2,7)	43,2 (35,7; 51,3)	2,0 (1,7; 2,4)	-11,2 (-30,3; 16,7)	Male
Minas Gerais	110,9 (95,5; 126,9)	2,4 (2,1; 2,8)	244,1 (209,7; 281,6)	1,9 (1,6; 2,2)	-21,9 (-34,6; -2,4)	Male
Rio de Janeiro	86,7 (74,1; 98,5)	2,1 (1,8; 2,4)	167,8 (144,8; 194,7)	1,8 (1,5; 2,1)	-15,3 (-28,5; 6,9)	Male
São Paulo	259,9 (239,3; 280,1)	2,8 (2,5; 3,0)	515,0 (459,9; 581,2)	2,1 (1,8; 2,3)	-25,3 (-33,9; -15,2)	Male
South region	171,9 (147,7; 196,9)	2,7 (2,3; 3,1)	447,9 (394,9; 512,8)	2,6 (2,3; 3,0)	-4,8 (-20,5; 15,5)	Male
Paraná	59,0 (51,2; 68,0)	2,5 (2,1; 2,9)	146,8 (128,9; 168,5)	2,3 (2,0; 2,6)	-10,3 (-26,0; 9,9)	Male
Rio Grande do Sul	78,7 (67,4; 90,5)	2,8 (2,4; 3,2)	190,0 (164,8; 217,7)	2,7 (2,4; 3,1)	-1,7 (-19,3; 24,1)	Male
Santa Catarina	34,2 (28,9; 40,2)	3,0 (2,5; 3,5)	111,1 (95,6; 129,8)	2,9 (2,4; 3,3)	-3,2 (-21,2; 16,7)	Male
West-Central region	46,2 (38,8; 54,2)	2,2 (1,8; 2,5)	149,7 (128,1; 174,3)	1,9 (1,6; 2,2)	-12,4 (-29,4; 9,8)	Male

Distrito Federal	7,2 (5,9; 8,3)	2,7 (2,2; 3,1)	22,1 (18,2; 26,6)	1,8 (1,5; 2,2)	-31,3 (-48,0; -8,4)	Male
Goiás	21,1 (17,7; 24,6)	2,1 (1,8; 2,5)	68,2 (57,4; 81,4)	1,9 (1,6; 2,3)	-10,5 (-28,9; 16,8)	Male
Mato Grosso	7,8 (6,4; 9,6)	1,8 (1,5; 2,2)	29,8 (23,7; 36,2)	1,8 (1,4; 2,2)	-2,5 (-27,4; 28,0)	Male
Mato Grosso do Sul	10,1 (8,4; 11,9)	2,3 (1,9; 2,7)	29,6 (24,0; 35,2)	2,1 (1,7; 2,5)	-9,4 (-30,5; 18,5)	Male
Brazil	713,4 (618,4; 817,8)	1,7 (1,4; 2,0)	1.935,7 (1.614,5; 2.190,1)	1,3 (1,1; 1,5)	-23,5 (-33,0; -13,9)	Female
North region	20,5 (17,2; 24,5)	1,2 (1,0; 1,5)	78,6 (65,1; 94,4)	1,0 (0,9; 1,2)	-16,5 (-30,4; 1,7)	Female
Acre	0,7 (0,6; 0,9)	1,1 (0,9; 1,4)	3,4 (2,7; 4,2)	1,0 (0,8; 1,3)	-8,4 (-31,6; 23,1)	Female
Amapá	0,7 (0,6; 0,9)	1,4 (1,1; 1,7)	3,8 (2,9; 4,8)	1,4 (1,0; 1,8)	1,1 (-25,1; 36,3)	Female
Amazonas	4,0 (3,3; 5,0)	1,3 (1,0; 1,6)	15,4 (11,7; 19,6)	1,0 (0,8; 1,3)	-21,5 (-41,2; 3,5)	Female
Pará	11,4 (9,3; 14,0)	1,2 (1,0; 1,5)	37,4 (28,7; 47,4)	1,0 (0,8; 1,3)	-18,4 (-38,4; 8,4)	Female
Rondônia	2,3 (1,8; 2,9)	1,9 (1,5; 2,4)	9,5 (7,7; 11,9)	1,3 (1,0; 1,6)	-32,2 (-50,1; -7,1)	Female
Roraima	0,3 (0,2; 0,4)	1,4 (1,1; 1,8)	1,9 (1,5; 2,5)	1,1 (0,9; 1,4)	-20,6 (-43,5; 9,4)	Female
Tocantins	1,1 (0,8; 1,4)	1,0 (0,8; 1,3)	7,2 (5,6; 8,8)	0,9 (0,7; 1,1)	-10,3 (-36,0; 24,3)	Female
Northeast region	173,2 (137,1; 212,5)	1,4 (1,1; 1,8)	372,2 (291,3; 450,4)	1,0 (0,8; 1,2)	-32,9 (-48,7; -12,5)	Female
Alagoas	6,7 (5,3; 8,3)	1,1 (0,8; 1,3)	21,4 (17,2; 26,2)	1,1 (0,9; 1,4)	5,0 (-22,7; 44,3)	Female
Bahia	95,0 (76,6; 117,0)	2,8 (2,3; 3,5)	104,0 (82,9; 123,8)	1,0 (0,8; 1,2)	-65,8 (-73,5; -56,3)	Female
Ceará	13,6 (10,3; 17,2)	0,7 (0,6; 0,9)	56,9 (45,3; 69,4)	0,9 (0,7; 1,1)	19,4 (-11,6; 58,7)	Female
Maranhão	5,2 (3,7; 7,1)	0,5 (0,3; 0,7)	32,4 (24,4; 40,4)	0,9 (0,7; 1,1)	82,8 (23,1; 174,0)	Female
Paraíba	9,2 (7,2; 11,7)	0,9 (0,7; 1,1)	27,1 (21,4; 33,8)	0,9 (0,7; 1,1)	-0,8 (-26,8; 35,8)	Female
Pernambuco	27,7 (22,3; 34,5)	1,2 (1,0; 1,5)	79,2 (64,7; 94,2)	1,2 (1,0; 1,5)	-1,5 (-26,3; 27,0)	Female
Piaui	4,0 (2,9; 5,4)	0,6 (0,5; 0,9)	16,6 (12,0; 21,0)	0,7 (0,5; 0,9)	12,1 (-25,6; 64,3)	Female
Rio Grande do Norte	8,1 (5,8; 10,3)	1,0 (0,7; 1,3)	24,4 (17,6; 31,0)	1,0 (0,7; 1,2)	-6,6 (-34,3; 36,5)	Female
Sergipe	3,7 (2,9; 4,5)	0,9 (0,7; 1,2)	10,1 (7,9; 12,4)	0,7 (0,6; 0,9)	-23,5 (-43,4; 2,4)	Female
Southeast region	341,4 (303,8; 383,1)	1,7 (1,5; 1,9)	937,2 (757,0; 1.070,2)	1,3 (1,1; 1,5)	-21,7 (-31,1; -8,9)	Female
Espírito Santo	11,6 (9,4; 14,2)	1,7 (1,4; 2,1)	37,8 (29,3; 47,5)	1,3 (1,0; 1,7)	-23,3 (-42,0; -0,8)	Female
Minas Gerais	76,2 (64,1; 89,8)	1,6 (1,3; 1,9)	229,1 (184,1; 271,5)	1,3 (1,1; 1,6)	-16,3 (-30,1; 2,3)	Female
Rio de Janeiro	73,7 (62,3; 87,4)	1,5 (1,3; 1,8)	173,4 (140,9; 205,0)	1,2 (1,0; 1,4)	-21,8 (-34,8; -4,4)	Female
São Paulo	180,0 (161,3; 200,9)	1,8 (1,7; 2,1)	497,0 (404,9; 582,7)	1,4 (1,1; 1,6)	-24,5 (-34,0; -12,2)	Female
South region	148,0 (124,7; 176,0)	2,3 (1,9; 2,7)	432,5 (351,2; 509,5)	1,8 (1,5; 2,2)	-19,0 (-32,4; -3,2)	Female
Paraná	47,9 (39,9; 57,9)	2,3 (1,9; 2,7)	139,8 (114,5; 168,0)	1,7 (1,4; 2,0)	-25,6 (-38,5; -9,3)	Female
Rio Grande do Sul	68,1 (57,0; 81,2)	2,1 (1,8; 2,5)	183,5 (148,9; 215,4)	1,8 (1,5; 2,1)	-14,2 (-29,3; 3,2)	Female
Santa Catarina	31,9 (26,5; 38,0)	2,8 (2,3; 3,3)	109,2 (88,0; 133,8)	2,2 (1,7; 2,7)	-21,8 (-36,3; -3,4)	Female

West-Central region	30,3 (25,5; 37,4)	1,7 (1,4; 2,1)	115,2 (92,8; 140,1)	1,2 (1,0; 1,5)	-27,5 (-42,9; -6,5)	Female
Distrito Federal	4,7 (3,9; 5,7)	1,7 (1,4; 2,1)	19,0 (14,0; 24,3)	1,1 (0,8; 1,5)	-33,4 (-48,6; -11,2)	Female
Goiás	14,7 (12,0; 18,3)	1,8 (1,4; 2,2)	51,7 (40,7; 64,0)	1,2 (1,0; 1,6)	-29,3 (-47,5; -7,8)	Female
Mato Grosso	4,2 (3,2; 5,3)	1,4 (1,1; 1,8)	18,7 (14,6; 22,6)	1,1 (0,9; 1,3)	-23,8 (-41,9; 2,2)	Female
Mato Grosso do Sul	6,8 (5,5; 8,3)	1,9 (1,5; 2,3)	25,9 (20,0; 32,4)	1,5 (1,2; 1,9)	-17,9 (-37,7; 9,9)	Female
Brazil	1.632,0 (1.460,9; 1.808,8)	2,0 (1,7; 2,2)	4.061,4 (3.597,7; 4.433,8)	1,6 (1,4; 1,7)	-19,8 (-25,8; -11,7)	Both
North region	55,8 (49,1; 63,4)	1,6 (1,4; 1,8)	202,3 (175,3; 226,8)	1,4 (1,2; 1,6)	-11,5 (-21,4; 1,6)	Both
Acre	2,0 (1,7; 2,4)	1,3 (1,1; 1,6)	7,8 (6,5; 9,4)	1,2 (1,0; 1,5)	-7,9 (-25,3; 16,8)	Both
Amapá	1,6 (1,4; 1,9)	1,7 (1,4; 2,0)	8,6 (7,3; 10,2)	1,6 (1,4; 1,9)	-2,5 (-19,1; 20,8)	Both
Amazonas	11,9 (10,1; 13,7)	1,7 (1,5; 2,0)	44,1 (37,1; 50,7)	1,5 (1,3; 1,7)	-12,1 (-27,9; 9,1)	Both
Pará	29,0 (25,0; 34,2)	1,5 (1,3; 1,8)	92,4 (76,8; 107,3)	1,3 (1,1; 1,5)	-14,4 (-29,2; 3,5)	Both
Rondônia	7,0 (6,0; 8,1)	2,1 (1,8; 2,4)	23,8 (20,1; 27,8)	1,6 (1,3; 1,9)	-26,0 (-38,7; -10,1)	Both
Roraima	0,9 (0,8; 1,1)	1,7 (1,4; 2,0)	5,3 (4,4; 6,4)	1,4 (1,2; 1,7)	-15,7 (-32,3; 7,8)	Both
Tocantins	3,3 (2,7; 3,9)	1,3 (1,1; 1,5)	20,3 (16,7; 24,1)	1,3 (1,1; 1,5)	-0,4 (-21,0; 26,5)	Both
Northeast region	365,3 (315,6; 428,8)	1,6 (1,3; 1,8)	806,5 (673,1; 944,0)	1,2 (1,0; 1,4)	-22,5 (-36,6; -5,0)	Both
Alagoas	13,9 (11,7; 16,6)	1,1 (0,9; 1,3)	44,2 (37,1; 52,2)	1,3 (1,1; 1,6)	18,3 (-3,7; 51,1)	Both
Bahia	183,2 (157,5; 214,7)	2,9 (2,5; 3,4)	228,7 (189,5; 266,9)	1,2 (1,0; 1,4)	-57,1 (-64,9; -47,9)	Both
Ceará	29,1 (24,6; 34,6)	0,8 (0,7; 1,0)	125,6 (104,9; 146,6)	1,1 (0,9; 1,3)	39,4 (13,8; 74,1)	Both
Maranhão	16,9 (13,2; 21,5)	0,7 (0,6; 0,9)	79,4 (64,1; 94,5)	1,2 (0,9; 1,4)	58,3 (20,2; 126,4)	Both
Paraíba	17,6 (15,0; 20,9)	0,8 (0,7; 1,0)	52,7 (43,0; 61,4)	1,0 (0,8; 1,2)	18,2 (-3,8; 51,5)	Both
Pernambuco	67,2 (57,9; 78,8)	1,6 (1,4; 1,8)	161,4 (138,2; 186,6)	1,5 (1,3; 1,7)	-5,3 (-22,0; 14,1)	Both
Piaui	9,9 (8,1; 12,4)	0,8 (0,6; 1,0)	38,7 (31,0; 46,1)	0,9 (0,7; 1,1)	20,6 (-7,8; 56,8)	Both
Rio Grande do Norte	18,7 (15,5; 22,8)	1,2 (1,0; 1,5)	51,8 (41,2; 62,3)	1,2 (1,0; 1,4)	-2,5 (-26,4; 26,8)	Both
Sergipe	8,6 (7,4; 10,2)	1,1 (0,9; 1,3)	23,9 (19,4; 29,0)	1,0 (0,8; 1,2)	-11,8 (-29,0; 11,7)	Both
Southeast region	814,5 (742,3; 893,1)	2,1 (1,9; 2,3)	1.907,3 (1.649,3; 2.096,2)	1,6 (1,4; 1,8)	-22,9 (-30,2; -14,1)	Both
Espírito Santo	27,2 (23,5; 31,7)	2,0 (1,7; 2,3)	80,9 (67,5; 94,8)	1,6 (1,4; 1,9)	-18,1 (-32,3; -0,2)	Both
Minas Gerais	187,1 (165,2; 210,3)	2,0 (1,7; 2,3)	473,2 (404,8; 525,8)	1,6 (1,4; 1,8)	-19,9 (-29,4; -7,6)	Both
Rio de Janeiro	160,4 (141,8; 181,0)	1,8 (1,6; 2,0)	341,2 (294,5; 379,3)	1,4 (1,2; 1,6)	-20,0 (-29,2; -7,1)	Both
São Paulo	439,8 (408,6; 471,5)	2,3 (2,1; 2,5)	1.012,0 (885,9; 1.124,6)	1,7 (1,5; 1,9)	-26,1 (-32,9; -18,5)	Both
South region	319,8 (281,9; 361,3)	2,5 (2,2; 2,9)	880,4 (762,3; 978,2)	2,2 (1,9; 2,4)	-12,9 (-22,4; 0,4)	Both

Paraná	106,9 (94,6; 121,0)	2,4 (2,1; 2,7)	286,6 (247,7; 321,7)	2,0 (1,7; 2,2)	-18,7 (-27,8; -7,3)	Both
Rio Grande do Sul	146,8 (129,6; 164,7)	2,4 (2,1; 2,8)	373,5 (319,9; 419,9)	2,2 (1,9; 2,5)	-9,1 (-20,6; 6,1)	Both
Santa Catarina	66,1 (58,2; 76,2)	2,9 (2,5; 3,3)	220,3 (188,3; 247,0)	2,5 (2,1; 2,8)	-13,7 (-25,3; -0,8)	Both
West-Central region	76,5 (66,6; 87,9)	2,0 (1,7; 2,3)	264,9 (224,9; 299,9)	1,6 (1,3; 1,8)	-20,7 (-32,1; -5,0)	Both
Distrito Federal	11,9 (10,4; 13,8)	2,1 (1,8; 2,5)	41,1 (33,0; 48,8)	1,4 (1,1; 1,7)	-32,7 (-43,8; -17,5)	Both
Goiás	35,8 (30,9; 41,8)	2,0 (1,7; 2,3)	119,9 (101,9; 136,4)	1,6 (1,3; 1,8)	-20,4 (-33,5; -1,3)	Both
Mato Grosso	12,0 (10,3; 14,1)	1,7 (1,4; 2,0)	48,5 (41,0; 57,0)	1,4 (1,2; 1,7)	-13,6 (-30,6; 5,0)	Both
Mato Grosso do Sul	16,9 (14,7; 19,2)	2,1 (1,8; 2,4)	55,4 (45,8; 64,8)	1,8 (1,5; 2,1)	-14,6 (-28,7; 4,4)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.11 – Non-rheumatic mitral valve disease deaths in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	293,0 (244,8; 349,4)	0,7 (0,6; 0,8)	634,2 (563,7; 720,6)	0,6 (0,5; 0,6)	-18,6 (-32,6; -2,2)	Male
North region	12,3 (10,0; 15,1)	0,6 (0,5; 0,7)	41,8 (35,6; 49,7)	0,6 (0,5; 0,7)	-5,4 (-25,4; 22,8)	Male
Acre	0,5 (0,4; 0,6)	0,5 (0,4; 0,7)	1,5 (1,1; 1,9)	0,4 (0,3; 0,6)	-13,3 (-42,4; 28,6)	Male
Amapá	0,3 (0,2; 0,3)	0,5 (0,4; 0,7)	1,4 (1,1; 1,9)	0,5 (0,4; 0,7)	-3,7 (-35,3; 40,5)	Male
Amazonas	2,2 (1,7; 2,8)	0,5 (0,4; 0,7)	7,3 (5,6; 9,5)	0,5 (0,4; 0,6)	-10,1 (-37,6; 34,3)	Male
Pará	6,3 (4,8; 8,1)	0,6 (0,4; 0,8)	19,2 (15,2; 24,5)	0,5 (0,4; 0,7)	-9,9 (-36,0; 31,7)	Male
Rondônia	1,7 (1,3; 2,1)	0,7 (0,5; 0,9)	4,7 (3,6; 6,1)	0,6 (0,4; 0,8)	-16,7 (-40,9; 22,8)	Male
Roraima	0,2 (0,1; 0,2)	0,4 (0,3; 0,6)	0,8 (0,6; 1,2)	0,4 (0,3; 0,5)	-9,2 (-42,7; 38,5)	Male
Tocantins	1,2 (0,9; 1,6)	0,7 (0,6; 1,0)	6,9 (5,1; 8,9)	0,9 (0,6; 1,1)	15,7 (-19,6; 62,4)	Male
Northeast region	61,1 (46,3; 80,5)	0,5 (0,4; 0,7)	156,1 (118,3; 200,6)	0,5 (0,4; 0,7)	4,4 (-26,2; 49,1)	Male
Alagoas	3,3 (2,6; 4,4)	0,5 (0,4; 0,6)	10,1 (7,6; 12,7)	0,7 (0,5; 0,8)	33,3 (-7,2; 90,9)	Male
Bahia	18,5 (14,4; 23,9)	0,6 (0,4; 0,7)	43,1 (33,1; 55,4)	0,5 (0,4; 0,7)	-6,3 (-32,4; 32,4)	Male
Ceará	5,9 (4,4; 7,7)	0,3 (0,2; 0,4)	24,2 (18,5; 30,4)	0,5 (0,4; 0,6)	55,4 (11,2; 124,8)	Male
Maranhão	5,0 (3,1; 7,4)	0,4 (0,2; 0,6)	15,3 (10,9; 21,0)	0,5 (0,3; 0,6)	16,7 (-25,5; 99,6)	Male
Paraíba	3,8 (2,9; 5,0)	0,4 (0,3; 0,5)	9,7 (7,2; 12,6)	0,4 (0,3; 0,6)	19,3 (-15,4; 77,8)	Male
Pernambuco	16,6 (13,1; 21,4)	0,8 (0,6; 1,0)	32,1 (24,4; 40,7)	0,7 (0,5; 0,9)	-12,4 (-37,0; 20,6)	Male
Piaui	2,7 (1,9; 3,8)	0,4 (0,3; 0,6)	7,7 (5,4; 10,5)	0,4 (0,3; 0,6)	2,9 (-32,8; 62,6)	Male
Rio Grande do Norte	3,1 (2,2; 4,3)	0,4 (0,3; 0,6)	8,3 (5,8; 11,8)	0,4 (0,3; 0,6)	10,3 (-30,0; 83,0)	Male
Sergipe	2,1 (1,6; 2,8)	0,5 (0,4; 0,7)	5,7 (4,1; 7,4)	0,5 (0,4; 0,7)	-4,2 (-32,4; 41,0)	Male
Southeast region	149,1 (125,6; 173,3)	0,8 (0,6; 0,9)	270,5 (234,0; 307,3)	0,5 (0,5; 0,6)	-30,3 (-42,7; -13,7)	Male
Espírito Santo	6,0 (4,6; 7,6)	0,8 (0,6; 1,0)	15,6 (12,4; 20,4)	0,7 (0,5; 0,9)	-14,2 (-38,4; 27,6)	Male
Minas Gerais	32,8 (25,8; 40,2)	0,7 (0,5; 0,9)	61,9 (51,6; 73,5)	0,5 (0,4; 0,6)	-31,5 (-48,5; -8,3)	Male
Rio de Janeiro	32,5 (26,0; 39,3)	0,7 (0,6; 0,9)	45,9 (38,1; 54,7)	0,5 (0,4; 0,6)	-36,4 (-50,2; -15,4)	Male
São Paulo	77,9 (67,5; 88,2)	0,8 (0,7; 0,9)	147,0 (127,2; 168,7)	0,6 (0,5; 0,7)	-28,9 (-40,2; -14,9)	Male
South region	54,3 (42,4; 66,1)	0,8 (0,6; 1,0)	118,3 (98,1; 141,1)	0,7 (0,5; 0,8)	-19,7 (-38,2; 7,3)	Male
Paraná	18,8 (14,4; 23,2)	0,8 (0,6; 0,9)	41,3 (34,1; 49,7)	0,6 (0,5; 0,7)	-19,8 (-39,1; 6,9)	Male
Rio Grande do Sul	25,2 (19,8; 30,9)	0,8 (0,7; 1,0)	48,7 (40,4; 58,1)	0,7 (0,6; 0,8)	-19,8 (-38,5; 8,6)	Male
Santa Catarina	10,3 (8,1; 12,9)	0,8 (0,6; 1,0)	28,3 (23,0; 35,8)	0,7 (0,6; 0,9)	-19,8 (-39,3; 10,9)	Male
West-Central region	16,2 (12,7; 20,2)	0,7 (0,5; 0,8)	47,5 (39,0; 59,1)	0,6 (0,5; 0,7)	-15,3 (-36,7; 20,0)	Male
Distrito Federal	2,9 (2,2; 3,6)	0,9 (0,7; 1,1)	7,3 (5,7; 9,6)	0,6 (0,4; 0,7)	-37,9 (-56,3; -4,8)	Male
Goiás	6,8 (5,1; 8,6)	0,6 (0,5; 0,8)	20,0 (15,7; 25,7)	0,5 (0,4; 0,7)	-13,6 (-38,4; 26,3)	Male

Mato Grosso	3,0 (2,3; 3,9)	0,6 (0,5; 0,8)	10,3 (7,9; 13,4)	0,6 (0,4; 0,8)	-4,6 (-32,5; 43,1)	Male
Mato Grosso do Sul	3,6 (2,8; 4,6)	0,7 (0,6; 0,9)	10,0 (7,9; 13,1)	0,7 (0,5; 0,9)	-9,2 (-35,6; 33,4)	Male
Brazil	470,9 (403,9; 545,1)	0,9 (0,8; 1,1)	861,6 (731,1; 982,0)	0,6 (0,5; 0,7)	-36,9 (-47,8; -25,9)	Female
North region	16,4 (13,5; 19,9)	0,7 (0,6; 0,9)	44,7 (37,6; 53,5)	0,5 (0,5; 0,7)	-26,8 (-44,0; -6,7)	Female
Acre	0,6 (0,5; 0,8)	0,7 (0,5; 0,9)	1,7 (1,4; 2,2)	0,5 (0,4; 0,6)	-30,5 (-52,8; 0,4)	Female
Amapá	0,4 (0,3; 0,5)	0,6 (0,5; 0,8)	1,7 (1,2; 2,1)	0,5 (0,4; 0,7)	-12,7 (-40,4; 21,4)	Female
Amazonas	2,6 (2,0; 3,3)	0,6 (0,5; 0,7)	7,1 (5,4; 9,1)	0,4 (0,3; 0,5)	-28,8 (-51,8; 0,9)	Female
Pará	9,7 (7,7; 12,1)	0,8 (0,6; 1,0)	23,5 (18,9; 30,3)	0,6 (0,5; 0,8)	-27,5 (-50,3; -3,5)	Female
Rondônia	1,8 (1,4; 2,2)	0,9 (0,7; 1,1)	4,3 (3,3; 5,5)	0,5 (0,4; 0,7)	-41,3 (-59,6; -15,7)	Female
Roraima	0,2 (0,1; 0,2)	0,5 (0,4; 0,7)	0,8 (0,6; 1,1)	0,4 (0,3; 0,5)	-30,9 (-55,0; 3,1)	Female
Tocantins	1,2 (0,9; 1,6)	0,8 (0,6; 1,0)	5,6 (4,3; 7,1)	0,7 (0,5; 0,9)	-9,9 (-39,7; 33,5)	Female
Northeast region	98,4 (76,7; 126,7)	0,7 (0,5; 0,9)	190,7 (150,4; 245,2)	0,5 (0,4; 0,7)	-27,5 (-48,9; 1,9)	Female
Alagoas	5,6 (4,2; 7,3)	0,8 (0,6; 1,0)	13,3 (10,5; 17,5)	0,7 (0,5; 0,9)	-9,7 (-37,8; 33,4)	Female
Bahia	28,5 (22,0; 37,1)	0,7 (0,6; 1,0)	47,7 (36,9; 60,4)	0,5 (0,4; 0,6)	-35,0 (-55,3; -9,3)	Female
Ceará	11,1 (8,6; 14,7)	0,5 (0,4; 0,7)	33,0 (26,0; 41,3)	0,5 (0,4; 0,7)	2,1 (-30,3; 42,9)	Female
Maranhão	4,2 (2,8; 5,9)	0,3 (0,2; 0,4)	15,6 (11,5; 21,2)	0,4 (0,3; 0,6)	31,7 (-16,2; 114,4)	Female
Paraíba	6,1 (4,6; 8,1)	0,5 (0,4; 0,7)	12,2 (9,4; 15,9)	0,4 (0,3; 0,5)	-18,5 (-44,4; 22,0)	Female
Pernambuco	31,0 (24,6; 39,0)	1,2 (1,0; 1,5)	42,9 (34,0; 54,1)	0,7 (0,5; 0,9)	-44,4 (-59,6; -24,7)	Female
Piaui	4,0 (2,8; 5,5)	0,5 (0,4; 0,8)	9,7 (7,2; 13,3)	0,4 (0,3; 0,6)	-20,6 (-49,2; 22,5)	Female
Rio Grande do Norte	4,8 (3,6; 6,5)	0,6 (0,4; 0,8)	10,3 (7,4; 13,8)	0,4 (0,3; 0,6)	-22,7 (-50,2; 14,7)	Female
Sergipe	3,1 (2,4; 4,0)	0,7 (0,5; 0,9)	6,0 (4,7; 7,9)	0,4 (0,3; 0,6)	-39,6 (-57,7; -14,0)	Female
Southeast region	233,6 (202,4; 266,0)	1,0 (0,9; 1,1)	406,9 (340,1; 456,3)	0,6 (0,5; 0,7)	-39,2 (-49,1; -29,4)	Female
Espírito Santo	10,1 (8,0; 12,5)	1,2 (1,0; 1,5)	20,9 (16,3; 26,1)	0,8 (0,6; 0,9)	-38,9 (-57,1; -15,9)	Female
Minas Gerais	54,4 (45,8; 63,7)	1,0 (0,8; 1,1)	84,8 (69,1; 101,4)	0,5 (0,4; 0,6)	-46,1 (-57,9; -34,1)	Female
Rio de Janeiro	53,7 (45,3; 62,7)	1,0 (0,8; 1,1)	77,9 (64,3; 91,2)	0,6 (0,5; 0,7)	-41,0 (-53,0; -28,5)	Female
São Paulo	115,4 (102,4; 129,6)	1,0 (0,9; 1,1)	223,3 (188,0; 255,1)	0,6 (0,5; 0,7)	-35,4 (-45,7; -26,0)	Female
South region	96,9 (80,2; 115,9)	1,2 (1,0; 1,5)	159,6 (132,7; 192,8)	0,7 (0,6; 0,8)	-43,7 (-56,4; -29,8)	Female
Paraná	39,8 (33,0; 47,1)	1,5 (1,2; 1,8)	61,9 (50,2; 75,2)	0,7 (0,6; 0,9)	-49,4 (-61,0; -36,7)	Female
Rio Grande do Sul	40,6 (33,4; 48,5)	1,1 (0,9; 1,3)	61,3 (49,9; 72,8)	0,6 (0,5; 0,8)	-41,3 (-55,7; -25,9)	Female
Santa Catarina	16,5 (13,2; 20,0)	1,2 (0,9; 1,4)	36,5 (28,9; 45,6)	0,7 (0,6; 0,9)	-38,6 (-54,6; -19,1)	Female
West-Central region	25,5 (20,4; 30,9)	1,0 (0,8; 1,3)	59,8 (47,9; 71,6)	0,6 (0,5; 0,7)	-41,1 (-57,9; -20,5)	Female
Distrito Federal	4,0 (3,2; 5,0)	1,0 (0,8; 1,3)	9,0 (6,9; 11,5)	0,5 (0,4; 0,7)	-49,3 (-65,2; -28,9)	Female
Goiás	12,6 (10,0; 15,6)	1,1 (0,9; 1,4)	27,4 (21,2; 33,6)	0,6 (0,5; 0,8)	-43,5 (-60,9; -20,5)	Female

Mato Grosso	3,9 (2,9; 5,0)	0,9 (0,7; 1,2)	11,0 (8,6; 14,0)	0,6 (0,5; 0,8)	-35,8 (-52,9; -8,2)	Female
Mato Grosso do Sul	5,0 (3,9; 6,2)	1,0 (0,8; 1,3)	12,4 (9,6; 15,5)	0,7 (0,6; 0,9)	-30,0 (-52,1; -0,3)	Female
Brazil	763,8 (676,2; 848,7)	0,8 (0,7; 0,9)	1.495,8 (1.313,3; 1.629,9)	0,6 (0,5; 0,6)	-29,4 (-37,6; -18,8)	Both
North region	28,7 (25,1; 32,9)	0,7 (0,6; 0,8)	86,5 (74,7; 98,3)	0,6 (0,5; 0,6)	-17,3 (-30,8; -1,6)	Both
Acre	1,1 (0,9; 1,3)	0,6 (0,5; 0,7)	3,2 (2,6; 3,9)	0,5 (0,4; 0,6)	-22,2 (-40,8; -0,3)	Both
Amapá	0,7 (0,5; 0,8)	0,6 (0,5; 0,7)	3,1 (2,5; 3,7)	0,5 (0,4; 0,6)	-6,7 (-28,3; 21,5)	Both
Amazonas	4,8 (4,0; 5,6)	0,6 (0,5; 0,7)	14,4 (11,9; 17,5)	0,5 (0,4; 0,5)	-20,2 (-37,5; 3,6)	Both
Pará	16,0 (13,5; 18,8)	0,7 (0,6; 0,8)	42,7 (35,6; 50,9)	0,6 (0,5; 0,7)	-20,1 (-36,9; 1,3)	Both
Rondônia	3,4 (2,9; 4,1)	0,8 (0,6; 0,9)	9,0 (7,4; 11,0)	0,6 (0,5; 0,7)	-29,5 (-45,7; -10,1)	Both
Roraima	0,4 (0,3; 0,4)	0,5 (0,4; 0,5)	1,6 (1,3; 2,1)	0,4 (0,3; 0,5)	-19,5 (-40,7; 9,0)	Both
Tocantins	2,4 (2,0; 3,0)	0,8 (0,6; 0,9)	12,5 (10,2; 15,1)	0,8 (0,6; 0,9)	2,5 (-20,6; 33,9)	Both
Northeast region	159,5 (129,2; 191,0)	0,6 (0,5; 0,7)	346,8 (284,0; 412,1)	0,5 (0,4; 0,6)	-15,1 (-35,1; 10,3)	Both
Alagoas	8,9 (7,1; 10,8)	0,6 (0,5; 0,8)	23,3 (19,3; 27,9)	0,7 (0,6; 0,8)	6,0 (-18,9; 39,3)	Both
Bahia	47,0 (38,2; 57,6)	0,7 (0,5; 0,8)	90,8 (74,8; 107,5)	0,5 (0,4; 0,6)	-23,1 (-41,1; -1,7)	Both
Ceará	17,0 (13,7; 20,8)	0,4 (0,3; 0,5)	57,1 (46,8; 67,2)	0,5 (0,4; 0,6)	20,9 (-7,5; 58,8)	Both
Maranhão	9,2 (7,0; 11,9)	0,4 (0,3; 0,5)	30,8 (24,4; 38,3)	0,4 (0,3; 0,5)	22,8 (-15,5; 77,0)	Both
Paraíba	9,9 (7,9; 12,2)	0,4 (0,4; 0,5)	21,9 (17,9; 26,1)	0,4 (0,3; 0,5)	-4,2 (-26,7; 28,6)	Both
Pernambuco	47,6 (39,4; 56,4)	1,0 (0,8; 1,2)	75,0 (62,4; 88,3)	0,7 (0,6; 0,8)	-33,2 (-48,4; -13,8)	Both
Piaui	6,7 (5,2; 8,5)	0,5 (0,4; 0,6)	17,4 (13,8; 21,3)	0,4 (0,3; 0,5)	-10,9 (-35,4; 24,3)	Both
Rio Grande do Norte	7,9 (6,1; 9,9)	0,5 (0,4; 0,6)	18,6 (14,7; 23,1)	0,4 (0,3; 0,5)	-9,9 (-36,9; 20,8)	Both
Sergipe	5,3 (4,3; 6,3)	0,6 (0,5; 0,7)	11,7 (9,6; 14,3)	0,5 (0,4; 0,6)	-25,4 (-42,8; -1,2)	Both
Southeast region	382,7 (344,8; 418,0)	0,9 (0,8; 1,0)	677,3 (581,8; 750,4)	0,6 (0,5; 0,6)	-35,1 (-42,4; -27,3)	Both
Espírito Santo	16,1 (13,8; 18,6)	1,0 (0,9; 1,2)	36,5 (30,3; 43,9)	0,7 (0,6; 0,9)	-29,2 (-42,9; -7,0)	Both
Minas Gerais	87,2 (75,5; 98,5)	0,8 (0,7; 1,0)	146,8 (125,8; 166,7)	0,5 (0,4; 0,6)	-40,0 (-49,0; -29,1)	Both
Rio de Janeiro	86,2 (74,8; 96,7)	0,9 (0,7; 1,0)	123,8 (108,4; 140,0)	0,5 (0,5; 0,6)	-39,3 (-48,1; -29,1)	Both
São Paulo	193,2 (177,2; 208,2)	0,9 (0,8; 1,0)	370,3 (324,5; 410,8)	0,6 (0,5; 0,7)	-31,8 (-39,5; -23,7)	Both
South region	151,2 (131,2; 170,4)	1,0 (0,9; 1,2)	277,8 (240,6; 314,2)	0,7 (0,6; 0,8)	-34,6 (-45,0; -20,9)	Both
Paraná	58,6 (50,9; 66,1)	1,1 (1,0; 1,3)	103,2 (88,0; 117,6)	0,7 (0,6; 0,8)	-38,9 (-48,9; -27,0)	Both
Rio Grande do Sul	65,8 (57,4; 74,2)	1,0 (0,9; 1,1)	110,0 (96,0; 124,1)	0,7 (0,6; 0,7)	-32,9 (-44,3; -20,0)	Both
Santa Catarina	26,8 (23,0; 30,7)	1,0 (0,9; 1,2)	64,7 (54,7; 75,7)	0,7 (0,6; 0,8)	-30,6 (-44,0; -13,7)	Both
West-Central region	41,7 (35,6; 47,9)	0,9 (0,7; 1,0)	107,4 (91,7; 124,0)	0,6 (0,5; 0,7)	-30,5 (-44,6; -11,7)	Both
Distrito Federal	6,9 (5,9; 8,1)	1,0 (0,8; 1,1)	16,3 (13,2; 20,0)	0,5 (0,4; 0,7)	-44,1 (-56,2; -28,4)	Both

Goiás	19,4 (16,4; 22,4)	0,9 (0,7; 1,0)	47,4 (39,1; 55,9)	0,6 (0,5; 0,7)	-32,1 (-47,0; -11,1)	Both
Mato Grosso	6,8 (5,5; 8,3)	0,7 (0,6; 0,9)	21,2 (17,3; 25,5)	0,6 (0,5; 0,7)	-21,9 (-40,5; 1,0)	Both
Mato Grosso do Sul	8,6 (7,3; 10,1)	0,9 (0,7; 1,0)	22,4 (18,4; 26,9)	0,7 (0,6; 0,8)	-20,8 (-39,0; 2,6)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.12 – Rheumatic heart disease disability-adjusted life years (DALYs) in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	70.662,7 (59.069,8; 85.299,7)	106,2 (89,1; 125,6)	68.559,9 (54.816,4; 86.583,2)	60,9 (48,5; 77,2)	-42,7 (-49,8; -36,3)	Male
North region	4.631,6 (3.551,8; 6.185,2)	104,5 (80,7; 137,4)	7.376,4 (5.376,3; 10.178,8)	79,2 (58,2; 108,0)	-24,2 (-32,3; -16,0)	Male
Acre	232,8 (177,9; 306,7)	123,4 (95,2; 161,6)	367,5 (268,1; 489,6)	83,3 (62,0; 109,5)	-32,5 (-45,9; -18,3)	Male
Amapá	112,1 (83,9; 153,9)	95,1 (72,3; 126,2)	301,7 (217,6; 419,6)	78,3 (57,0; 106,9)	-17,6 (-30,9; -3,7)	Male
Amazonas	842,3 (627,8; 1.187,2)	92,7 (70,8; 127,2)	1.584,2 (1.139,9; 2.214,2)	76,5 (55,8; 105,2)	-17,5 (-27,9; -5,3)	Male
Pará	2.269,7 (1.726,7; 3.013,9)	103,8 (80,4; 136,0)	3.428,9 (2.450,3; 4.837,7)	78,1 (56,2; 109,1)	-24,8 (-36,3; -12,1)	Male
Rondônia	622,1 (466,3; 812,4)	120,3 (92,2; 152,2)	719,4 (518,7; 954,5)	82,6 (60,1; 109,5)	-31,3 (-42,5; -18,7)	Male
Roraima	98,7 (71,9; 132,9)	92,1 (68,0; 121,6)	241,4 (169,5; 338,9)	71,4 (51,2; 99,0)	-22,5 (-35,7; -7,2)	Male
Tocantins	453,9 (326,4; 613,9)	112,7 (83,0; 149,4)	733,3 (553,1; 967,6)	88,0 (66,5; 115,9)	-21,9 (-36,7; -5,7)	Male
Northeast region	21.717,7 (16.298,9; 28.409,9)	113,8 (85,5; 147,6)	25.523,0 (19.075,2; 33.775,2)	86,5 (64,7; 113,9)	-24,0 (-36,5; -12,4)	Male
Alagoas	1.292,4 (943,7; 1.707,9)	117,8 (87,2; 152,5)	1.421,5 (1.039,6; 1.893,5)	87,0 (63,7; 115,7)	-26,1 (-39,5; -12,0)	Male
Bahia	6.451,9 (5.005,9; 8.319,0)	118,6 (92,0; 151,1)	6.905,2 (5.191,9; 9.080,4)	89,6 (67,5; 118,3)	-24,5 (-37,5; -11,9)	Male
Ceará	2.564,1 (1.825,4; 3.496,2)	91,8 (66,2; 122,9)	3.750,4 (2.719,0; 5.017,7)	78,3 (56,8; 105,4)	-14,8 (-27,4; -1,0)	Male
Maranhão	2.232,2 (1.610,4; 3.026,5)	106,8 (77,0; 144,7)	3.206,2 (2.323,3; 4.091,9)	88,9 (64,6; 113,3)	-16,7 (-35,4; 3,2)	Male
Paraíba	1.587,4 (1.166,5; 2.123,1)	110,9 (82,1; 147,8)	1.846,7 (1.364,4; 2.506,0)	85,7 (63,2; 115,9)	-22,7 (-36,0; -8,4)	Male
Pernambuco	4.573,1 (3.487,7; 5.875,4)	137,3 (104,3; 175,1)	4.397,5 (3.335,0; 5.832,4)	90,9 (68,8; 120,6)	-33,8 (-45,6; -20,8)	Male
Piaui	1.057,4 (765,7; 1.487,9)	93,8 (67,4; 129,1)	1.390,2 (999,9; 1.886,5)	77,6 (56,1; 106,0)	-17,2 (-31,1; -3,1)	Male
Rio Grande do Norte	1.128,9 (844,2; 1.505,7)	104,1 (79,4; 136,9)	1.529,8 (1.108,0; 2.053,7)	84,5 (61,5; 114,3)	-18,9 (-33,8; -4,5)	Male
Sergipe	830,2 (620,3; 1.078,7)	129,4 (99,0; 165,3)	1.075,6 (810,3; 1.391,5)	91,2 (68,8; 118,5)	-29,5 (-41,6; -15,5)	Male
Southeast region	31.012,6 (27.111,2; 35.665,4)	107,7 (94,2; 122,4)	22.858,1 (19.317,3; 27.592,8)	46,7 (38,9; 56,9)	-56,6 (-62,5; -50,4)	Male
Espírito Santo	1.505,9 (1.195,2; 1.921,3)	124,2 (99,4; 156,5)	1.804,0 (1.360,6; 2.425,0)	84,6 (63,6; 115,2)	-31,9 (-43,8; -18,8)	Male
Minas Gerais	10.905,2 (8.952,9; 13.638,1)	148,4 (123,4; 182,0)	10.377,6 (8.016,1; 13.954,0)	88,5 (67,9; 121,3)	-40,4 (-49,9; -31,6)	Male

Rio de Janeiro	5.169,2 (4.466,0; 5.892,5)	85,9 (75,2; 97,6)	2.652,8 (2.329,0; 2.969,9)	28,3 (24,5; 31,8)	-67,1 (-71,8; -61,5)	Male
São Paulo	13.432,3 (11.949,3; 15.092,9)	96,1 (85,8; 108,2)	8.023,7 (6.839,4; 9.239,2)	30,6 (26,2; 34,9)	-68,2 (-72,8; -62,8)	Male
South region	7.868,6 (6.650,1; 9.326,8)	80,6 (68,5; 94,8)	5.762,6 (4.997,8; 6.720,6)	31,9 (27,5; 37,6)	-60,4 (-67,0; -51,3)	Male
Paraná	3.463,9 (2.948,6; 4.032,1)	93,7 (79,7; 107,9)	2.602,0 (2.255,0; 2.998,8)	38,5 (33,3; 44,8)	-58,9 (-64,8; -50,7)	Male
Rio Grande do Sul	2.834,8 (2.382,3; 3.351,0)	68,9 (57,9; 81,3)	1.707,0 (1.441,8; 1.993,9)	25,1 (21,1; 29,4)	-63,6 (-69,9; -54,9)	Male
Santa Catarina	1.570,0 (1.301,8; 1.930,1)	81,6 (67,3; 99,3)	1.453,7 (1.226,4; 1.786,4)	32,5 (27,2; 40,1)	-60,2 (-69,3; -48,6)	Male
West-Central region	5.432,2 (4.369,4; 6.825,3)	126,4 (102,8; 155,1)	7.039,7 (5.371,6; 9.226,3)	78,0 (59,6; 102,4)	-38,3 (-48,7; -27,8)	Male
Distrito Federal	774,0 (631,7; 931,4)	124,4 (102,5; 148,6)	595,2 (498,3; 725,9)	39,8 (33,5; 48,3)	-68,0 (-74,5; -58,3)	Male
Goiás	2.660,9 (2.112,4; 3.366,6)	141,9 (113,8; 175,7)	3.512,9 (2.658,8; 4.714,3)	88,8 (67,0; 118,5)	-37,4 (-48,0; -25,1)	Male
Mato Grosso	1.044,7 (791,7; 1.411,9)	110,3 (84,9; 145,0)	1.688,7 (1.245,4; 2.325,7)	82,5 (61,4; 112,9)	-25,2 (-37,1; -10,8)	Male
Mato Grosso do Sul	952,6 (744,9; 1.225,2)	114,4 (90,8; 145,5)	1.242,9 (903,6; 1.692,4)	82,4 (60,0; 112,8)	-28,0 (-38,7; -15,4)	Male
Brazil	93.793,3 (79.906,3; 106.997,2)	139,5 (119,7; 157,7)	89.127,7 (75.826,8; 109.013,6)	70,3 (59,2; 87,2)	-49,6 (-55,2; -42,6)	Female
North region	4.971,8 (3.875,0; 6.436,3)	122,8 (98,0; 154,4)	8.232,9 (6.332,8; 11.153,4)	86,8 (67,1; 116,9)	-29,3 (-37,2; -20,9)	Female
Acre	240,7 (178,7; 310,5)	144,8 (111,6; 182,5)	436,9 (333,6; 560,1)	98,9 (76,7; 124,9)	-31,7 (-45,8; -16,3)	Female
Amapá	112,9 (83,3; 151,8)	98,1 (73,3; 129,7)	302,8 (220,0; 423,7)	76,6 (56,4; 105,8)	-21,9 (-33,3; -10,5)	Female
Amazonas	923,8 (680,9; 1.251,9)	109,1 (83,3; 142,5)	1.721,9 (1.265,7; 2.369,1)	81,9 (60,6; 111,2)	-24,9 (-36,3; -12,8)	Female
Pará	2.501,7 (1.936,1; 3.248,8)	122,9 (96,3; 155,5)	3.812,5 (2.898,7; 5.106,5)	85,3 (65,2; 113,8)	-30,6 (-41,4; -19,1)	Female
Rondônia	665,1 (538,4; 822,1)	155,4 (127,3; 187,2)	909,5 (688,0; 1.174,7)	100,4 (76,0; 129,2)	-35,4 (-47,4; -22,0)	Female
Roraima	97,6 (73,9; 127,3)	129,6 (100,6; 161,4)	303,9 (226,5; 404,5)	91,6 (69,2; 120,7)	-29,3 (-43,9; -13,7)	Female
Tocantins	430,0 (311,2; 574,4)	117,2 (84,2; 159,2)	745,5 (556,8; 994,0)	88,0 (65,9; 117,4)	-24,9 (-43,3; -6,5)	Female
Northeast region	27.049,3 (21.220,0; 34.080,4)	137,8 (109,0; 172,3)	31.456,7 (24.407,5; 40.324,3)	95,6 (73,5; 124,3)	-30,6 (-41,8; -17,0)	Female
Alagoas	1.677,4 (1.283,9; 2.127,6)	154,3 (119,1; 197,4)	1.926,4 (1.490,5; 2.429,5)	103,2 (79,7; 130,8)	-33,1 (-47,6; -14,9)	Female
Bahia	8.876,3 (7.149,4; 10.679,0)	159,4 (129,1; 190,3)	8.835,3 (6.918,7; 11.127,8)	102,4 (79,7; 130,0)	-35,8 (-47,0; -23,3)	Female
Ceará	3.271,9 (2.395,1; 4.311,6)	110,8 (81,2; 146,5)	4.437,9 (3.292,1; 5.870,5)	83,8 (61,5; 112,3)	-24,4 (-39,6; -8,4)	Female

Maranhão	2.058,7 (1.416,4; 2.966,9)	97,7 (67,0; 140,8)	3.332,4 (2.482,1; 4.463,2)	87,3 (65,2; 116,7)	-10,7 (-36,3; 16,1)	Female
Paraíba	2.089,7 (1.554,8; 2.780,4)	139,0 (104,0; 184,4)	2.383,0 (1.811,0; 3.003,0)	98,8 (73,7; 126,0)	-28,9 (-44,9; -8,1)	Female
Pernambuco	5.481,4 (4.374,8; 6.695,7)	158,8 (127,2; 192,4)	5.790,8 (4.549,7; 7.283,5)	103,1 (80,5; 130,7)	-35,1 (-45,5; -21,2)	Female
Piaui	1.196,0 (878,8; 1.662,2)	103,7 (77,5; 140,8)	1.513,9 (1.101,5; 2.035,5)	78,9 (56,9; 107,7)	-23,9 (-39,4; -4,1)	Female
Rio Grande do Norte	1.439,1 (1.121,1; 1.807,0)	128,0 (100,7; 159,4)	1.866,1 (1.417,4; 2.427,9)	92,8 (69,6; 122,5)	-27,5 (-39,4; -13,7)	Female
Sergipe	958,8 (738,8; 1.202,3)	147,1 (113,5; 182,1)	1.370,8 (1.061,5; 1.769,7)	101,4 (78,1; 131,2)	-31,1 (-44,7; -13,6)	Female
Southeast region	43.832,7 (38.654,2; 49.135,7)	147,3 (130,6; 163,7)	32.363,6 (28.283,4; 37.162,7)	56,6 (48,9; 65,7)	-61,6 (-66,4; -55,9)	Female
Espírito Santo	1.878,7 (1.492,8; 2.308,1)	159,3 (128,6; 195,2)	2.215,5 (1.737,4; 2.845,5)	94,7 (73,1; 122,5)	-40,6 (-51,1; -27,7)	Female
Minas Gerais	14.326,3 (12.042,3; 16.675,8)	193,5 (165,3; 224,6)	13.042,0 (10.421,3; 16.671,2)	100,1 (78,9; 132,9)	-48,3 (-55,4; -39,6)	Female
Rio de Janeiro	7.618,1 (6.643,3; 8.563,5)	114,7 (100,6; 128,4)	4.706,3 (4.056,4; 5.368,2)	40,3 (35,0; 45,8)	-64,9 (-70,0; -58,6)	Female
São Paulo	20.009,6 (17.931,1; 22.510,3)	139,4 (125,2; 156,7)	12.399,8 (10.827,7; 14.056,9)	39,5 (34,4; 44,7)	-71,6 (-75,9; -66,8)	Female
South region	11.038,3 (9.644,9; 12.556,4)	109,0 (95,2; 123,5)	8.361,5 (7.267,6; 9.492,0)	40,0 (35,0; 45,6)	-63,3 (-69,3; -56,8)	Female
Paraná	5.295,1 (4.679,1; 5.960,2)	142,7 (126,0; 161,1)	3.795,4 (3.230,2; 4.275,1)	48,6 (41,8; 54,9)	-66,0 (-71,3; -60,5)	Female
Rio Grande do Sul	3.743,0 (3.205,0; 4.325,0)	84,5 (72,9; 96,7)	2.576,5 (2.262,2; 2.970,4)	32,0 (28,0; 36,9)	-62,1 (-68,3; -54,1)	Female
Santa Catarina	2.000,2 (1.658,5; 2.389,1)	103,1 (85,3; 123,0)	1.989,6 (1.613,3; 2.374,2)	39,4 (32,1; 47,1)	-61,8 (-71,1; -50,8)	Female
West-Central region	6.901,1 (5.650,5; 8.097,6)	170,6 (142,1; 198,0)	8.713,0 (7.025,3; 10.988,4)	89,4 (71,7; 113,8)	-47,6 (-55,4; -38,5)	Female
Distrito Federal	1.060,8 (875,0; 1.254,9)	158,9 (130,9; 189,1)	891,6 (714,1; 1.106,3)	48,7 (39,0; 60,0)	-69,4 (-76,9; -60,8)	Female
Goiás	3.580,5 (2.935,1; 4.207,6)	199,8 (167,4; 234,7)	4.394,2 (3.519,9; 5.566,9)	102,7 (82,0; 131,4)	-48,6 (-56,0; -39,3)	Female
Mato Grosso	1.109,5 (859,0; 1.426,6)	138,3 (110,4; 173,3)	1.919,8 (1.464,3; 2.522,4)	92,8 (70,7; 122,6)	-32,9 (-45,0; -19,6)	Female
Mato Grosso do Sul	1.150,4 (908,3; 1.428,7)	148,0 (118,0; 179,7)	1.507,4 (1.184,8; 1.946,1)	93,1 (72,7; 121,6)	-37,1 (-47,3; -23,9)	Female
Brazil	164.456,0 (143.297,6; 192.774,8)	123,4 (108,0; 142,1)	157.687,6 (130.544,2; 196.593,4)	65,9 (54,1; 83,3)	-46,6 (-52,0; -40,6)	Both
North region	9.603,4 (7.521,5; 12.798,4)	113,3 (90,2; 146,8)	15.609,3 (11.891,7; 21.506,2)	83,1 (63,8; 113,6)	-26,7 (-33,9; -19,7)	Both
Acre	473,5 (375,3; 615,8)	133,3 (108,1; 168,8)	804,4 (608,1; 1.065,4)	91,3 (69,9; 119,6)	-31,6 (-42,0; -20,5)	Both
Amapá	225,0 (168,1; 310,8)	96,2 (72,9; 130,3)	604,5 (444,2; 862,2)	77,5 (57,7; 109,0)	-19,5 (-28,3; -10,3)	Both

Amazonas	1.766,0 (1.336,4; 2.449,5)	100,7 (78,4; 135,5)	3.306,0 (2.452,9; 4.568,5)	79,2 (59,5; 107,7)	-21,3 (-30,2; -12,9)	Both
Pará	4.771,4 (3.683,4; 6.295,0)	113,1 (89,2; 144,9)	7.241,4 (5.439,7; 9.932,4)	81,7 (61,8; 111,4)	-27,8 (-36,5; -19,3)	Both
Rondônia	1.287,3 (1.050,7; 1.640,2)	135,8 (114,1; 167,2)	1.628,9 (1.245,7; 2.141,2)	91,7 (69,7; 120,9)	-32,5 (-42,4; -23,5)	Both
Roraima	196,3 (149,6; 257,1)	107,9 (85,1; 136,3)	545,3 (398,9; 753,4)	81,5 (60,6; 110,6)	-24,4 (-36,2; -13,8)	Both
Tocantins	883,9 (661,9; 1.169,0)	114,6 (86,7; 149,5)	1.478,8 (1.125,7; 1.917,1)	88,0 (67,2; 114,1)	-23,2 (-36,5; -11,3)	Both
Northeast region	48.767,0 (39.892,4; 62.212,1)	126,4 (103,7; 159,5)	56.979,7 (43.928,0; 73.320,3)	91,4 (70,4; 118,8)	-27,7 (-38,0; -17,8)	Both
Alagoas	2.969,8 (2.371,4; 3.809,2)	137,0 (111,0; 172,3)	3.347,8 (2.580,3; 4.308,0)	95,8 (73,7; 124,1)	-30,1 (-41,4; -16,9)	Both
Bahia	15.328,2 (12.788,7; 18.667,8)	139,6 (117,3; 168,4)	15.740,4 (12.322,2; 19.996,2)	96,4 (75,8; 124,0)	-31,0 (-41,7; -22,0)	Both
Ceará	5.836,0 (4.430,8; 7.764,0)	101,9 (77,9; 135,3)	8.188,4 (6.015,7; 10.922,0)	81,3 (59,5; 109,1)	-20,2 (-32,4; -10,1)	Both
Maranhão	4.290,9 (3.121,8; 5.637,9)	102,2 (74,9; 133,0)	6.538,6 (4.886,7; 8.553,9)	88,2 (66,1; 115,3)	-13,7 (-28,4; 4,7)	Both
Paraíba	3.677,1 (2.854,5; 4.871,5)	126,1 (97,4; 166,3)	4.229,7 (3.190,8; 5.419,8)	92,7 (69,5; 120,5)	-26,5 (-39,0; -14,8)	Both
Pernambuco	10.054,5 (8.404,4; 12.322,0)	149,0 (125,0; 179,8)	10.188,3 (8.034,1; 12.995,5)	97,7 (76,7; 126,0)	-34,5 (-44,5; -24,7)	Both
Piaui	2.253,5 (1.708,3; 3.087,4)	99,0 (75,7; 132,0)	2.904,2 (2.106,9; 3.967,3)	78,4 (56,8; 108,6)	-20,8 (-32,0; -10,5)	Both
Rio Grande do Norte	2.568,0 (2.062,3; 3.283,0)	116,8 (93,9; 146,4)	3.395,9 (2.617,8; 4.441,8)	89,0 (68,1; 117,3)	-23,8 (-35,3; -14,6)	Both
Sergipe	1.789,0 (1.424,8; 2.290,0)	138,8 (111,9; 175,2)	2.446,4 (1.886,5; 3.153,7)	96,8 (74,7; 125,8)	-30,2 (-40,1; -18,7)	Both
Southeast region	74.845,3 (67.619,7; 83.835,1)	128,3 (116,6; 142,6)	55.221,7 (48.211,7; 64.269,3)	52,0 (44,9; 61,6)	-59,4 (-63,6; -54,6)	Both
Espírito Santo	3.384,5 (2.741,7; 4.223,7)	142,0 (116,5; 173,6)	4.019,5 (3.169,5; 5.300,0)	89,9 (69,5; 120,5)	-36,7 (-44,8; -27,7)	Both
Minas Gerais	25.231,5 (21.359,7; 30.334,2)	171,6 (145,7; 204,3)	23.419,6 (18.726,0; 30.838,0)	94,6 (74,4; 127,9)	-44,8 (-51,6; -36,4)	Both
Rio de Janeiro	12.787,4 (11.564,6; 14.181,0)	101,3 (91,8; 111,7)	7.359,0 (6.568,4; 8.107,2)	34,8 (31,1; 38,4)	-65,7 (-69,7; -61,5)	Both
São Paulo	33.441,9 (30.928,6; 36.419,7)	118,5 (109,2; 128,3)	20.423,5 (18.284,0; 22.276,6)	35,4 (31,7; 38,7)	-70,2 (-73,5; -66,6)	Both
South region	18.907,0 (16.997,4; 21.198,9)	95,1 (85,6; 106,8)	14.124,1 (12.581,0; 15.396,1)	36,2 (32,1; 39,5)	-62,0 (-66,9; -56,9)	Both
Paraná	8.758,9 (7.945,3; 9.708,0)	118,4 (107,3; 132,0)	6.397,4 (5.675,1; 6.984,2)	43,8 (39,0; 47,9)	-63,0 (-67,7; -58,5)	Both
Rio Grande do Sul	6.577,8 (5.849,4; 7.416,1)	77,0 (68,8; 86,1)	4.283,4 (3.805,6; 4.724,8)	28,7 (25,6; 31,8)	-62,6 (-67,4; -57,4)	Both
Santa Catarina	3.570,2 (3.102,1; 4.108,3)	92,4 (80,5; 106,0)	3.443,3 (2.976,1; 3.905,5)	36,0 (31,1; 40,8)	-61,0 (-67,7; -53,8)	Both

West-Central region	12.333,3 (10.155,5; 14.972,2)	148,1 (124,3; 176,0)	15.752,7 (12.581,9; 20.399,1)	84,0 (66,8; 109,3)	-43,3 (-50,3; -36,3)	Both
Distrito Federal	1.834,8 (1.585,3; 2.109,6)	142,2 (124,1; 163,9)	1.486,8 (1.265,5; 1.728,8)	44,6 (38,1; 51,7)	-68,6 (-73,9; -61,8)	Both
Goiás	6.241,4 (5.123,7; 7.569,1)	170,6 (142,6; 202,8)	7.907,1 (6.208,4; 10.290,0)	96,1 (75,0; 126,0)	-43,6 (-51,1; -35,6)	Both
Mato Grosso	2.154,2 (1.712,1; 2.823,8)	123,0 (99,4; 156,7)	3.608,5 (2.730,4; 4.808,8)	87,7 (67,1; 116,9)	-28,7 (-38,4; -18,9)	Both
Mato Grosso do Sul	2.103,0 (1.672,9; 2.626,1)	130,6 (105,5; 159,0)	2.750,3 (2.134,4; 3.667,5)	88,0 (68,0; 118,5)	-32,6 (-40,4; -23,5)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.13 – Non-rheumatic valve disease disability-adjusted life years (DALYs) in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	39.499,0 (35.325,9; 44.044,6)	79,2 (70,9; 87,7)	68.059,9 (63.364,5; 73.777,8)	58,3 (54,2; 63,3)	-26,3 (-33,8; -17,1)	Male
North region	1.608,0 (1.392,7; 1.861,7)	61,6 (53,5; 70,1)	4.519,7 (4.003,4; 5.088,0)	56,3 (49,6; 63,6)	-8,5 (-22,3; 10,9)	Male
Acre	61,3 (47,8; 77,0)	52,3 (41,5; 64,0)	164,1 (130,8; 206,3)	45,5 (36,0; 57,6)	-12,9 (-36,6; 16,6)	Male
Amapá	39,0 (30,6; 46,4)	63,3 (51,8; 74,7)	181,7 (149,1; 218,1)	60,4 (49,9; 72,9)	-4,5 (-27,1; 25,8)	Male
Amazonas	337,3 (281,0; 397,7)	66,9 (56,7; 78,1)	1.023,0 (854,5; 1.219,5)	62,5 (52,5; 73,8)	-6,6 (-26,3; 20,9)	Male
Pará	788,7 (657,2; 936,2)	60,5 (51,0; 70,6)	2.011,8 (1.687,2; 2.362,3)	52,7 (44,4; 61,7)	-13,0 (-31,2; 12,5)	Male
Rondônia	239,9 (195,6; 290,0)	76,8 (63,9; 91,5)	495,6 (407,6; 596,0)	59,1 (48,5; 71,1)	-23,0 (-40,7; -2,6)	Male
Roraima	33,3 (25,7; 41,7)	58,9 (47,5; 73,1)	125,2 (100,7; 152,0)	51,4 (41,5; 62,0)	-12,7 (-35,4; 12,2)	Male
Tocantins	108,4 (85,6; 133,8)	48,7 (39,0; 59,1)	518,3 (416,6; 635,2)	63,2 (50,5; 77,6)	29,7 (-3,9; 70,6)	Male
Northeast region	7.585,1 (6.153,3; 9.222,9)	56,8 (46,2; 68,4)	15.409,2 (12.601,5; 18.524,2)	51,4 (42,0; 61,9)	-9,4 (-31,3; 16,4)	Male
Alagoas	331,4 (258,0; 417,0)	44,1 (35,1; 54,6)	896,9 (721,6; 1.079,2)	57,0 (45,7; 68,6)	29,3 (-4,2; 69,7)	Male
Bahia	3.166,4 (2.591,7; 3.854,2)	87,6 (72,4; 106,1)	4.430,0 (3.645,9; 5.312,9)	54,4 (44,7; 65,3)	-37,9 (-52,1; -21,2)	Male
Ceará	638,3 (509,2; 795,5)	31,3 (25,0; 38,3)	2.346,5 (1.926,6; 2.762,7)	47,9 (39,3; 56,4)	53,2 (16,6; 103,7)	Male
Maranhão	537,6 (371,2; 775,7)	38,4 (27,2; 54,6)	1.672,2 (1.300,1; 2.098,4)	49,8 (38,7; 62,2)	29,6 (-15,1; 101,5)	Male
Paraíba	334,6 (263,8; 414,9)	30,3 (24,0; 37,3)	923,7 (744,8; 1.119,4)	41,0 (33,1; 49,9)	35,6 (0,3; 80,8)	Male
Pernambuco	1.743,5 (1.422,3; 2.103,6)	73,3 (60,1; 87,5)	2.932,8 (2.439,1; 3.466,3)	61,0 (50,9; 72,3)	-16,8 (-35,6; 6,1)	Male
Piaui	252,4 (190,6; 322,9)	33,5 (25,3; 42,0)	774,1 (607,3; 958,6)	41,2 (32,3; 51,1)	23,1 (-12,5; 70,6)	Male
Rio Grande do Norte	378,0 (295,7; 468,0)	46,1 (36,1; 56,6)	918,6 (721,0; 1.128,9)	49,0 (38,3; 60,1)	6,1 (-22,6; 45,2)	Male
Sergipe	202,9 (164,0; 245,7)	46,6 (38,0; 56,0)	514,3 (411,8; 629,8)	45,3 (36,3; 55,5)	-2,7 (-26,1; 30,6)	Male
Southeast region	20.931,1 (18.846,0; 23.063,3)	90,9 (82,2; 99,9)	29.777,3 (27.088,7; 33.151,8)	57,4 (52,2; 64,0)	-36,8 (-44,2; -28,1)	Male
Espírito Santo	691,8 (573,9; 805,7)	80,6 (67,1; 93,9)	1.465,2 (1.239,9; 1.718,5)	64,2 (54,2; 75,4)	-20,3 (-36,8; 2,9)	Male
Minas Gerais	4.790,3 (4.151,2; 5.402,2)	86,0 (74,9; 96,7)	7.267,3 (6.372,9; 8.268,0)	55,1 (48,6; 62,4)	-35,9 (-45,3; -23,5)	Male

Rio de Janeiro	4.018,3 (3.520,6; 4.495,8)	80,0 (69,7; 89,9)	5.224,4 (4.642,0; 5.936,5)	53,2 (47,3; 60,3)	-33,4 (-42,1; -21,8)	Male
São Paulo	11.430,7 (10.480,1; 12.564,0)	98,8 (91,4; 107,3)	15.820,4 (14.205,3; 17.576,8)	59,7 (53,7; 66,3)	-39,6 (-46,4; -31,6)	Male
South region	7.219,7 (6.311,8; 8.115,7)	92,2 (80,3; 104,3)	13.262,3 (11.712,8; 14.945,1)	71,8 (63,5; 80,8)	-22,2 (-33,1; -8,7)	Male
Paraná	2.494,0 (2.182,9; 2.842,0)	86,3 (75,9; 98,6)	4.582,7 (4.072,8; 5.154,6)	66,6 (59,3; 75,2)	-22,8 (-33,9; -8,2)	Male
Rio Grande do Sul	3.318,0 (2.901,4; 3.715,2)	96,0 (83,5; 107,5)	5.381,4 (4.760,4; 6.109,8)	74,0 (65,9; 84,0)	-22,9 (-33,4; -7,3)	Male
Santa Catarina	1.407,7 (1.209,4; 1.607,7)	95,9 (83,1; 109,6)	3.298,2 (2.892,7; 3.831,5)	76,3 (66,7; 88,6)	-20,4 (-33,9; -5,2)	Male
West-Central region	2.155,1 (1.815,3; 2.489,9)	74,6 (63,7; 85,9)	5.091,4 (4.437,8; 5.874,0)	58,9 (51,1; 68,1)	-21,0 (-34,7; -0,3)	Male
Distrito Federal	375,0 (308,2; 431,6)	91,2 (76,7; 104,6)	755,1 (631,3; 905,8)	55,0 (46,1; 65,9)	-39,7 (-51,9; -20,3)	Male
Goiás	946,5 (788,9; 1.122,1)	72,6 (61,2; 85,0)	2.277,9 (1.930,1; 2.685,4)	58,9 (49,9; 69,2)	-19,0 (-36,2; 4,6)	Male
Mato Grosso	387,0 (306,9; 469,9)	64,8 (53,1; 77,2)	1.060,2 (846,9; 1.267,3)	56,7 (44,9; 67,9)	-12,4 (-33,1; 13,5)	Male
Mato Grosso do Sul	446,5 (370,8; 530,7)	78,2 (65,5; 93,5)	998,1 (846,0; 1.197,7)	65,7 (55,6; 78,8)	-15,9 (-32,9; 8,2)	Male
Brazil	34.679,5 (30.746,6; 38.786,7)	64,9 (57,5; 72,2)	59.618,6 (53.058,1; 65.256,6)	41,6 (37,2; 45,6)	-35,8 (-42,4; -28,0)	Female
North region	1.168,6 (996,3; 1.363,1)	46,7 (40,0; 53,9)	3.088,8 (2.654,6; 3.578,4)	36,6 (31,4; 42,4)	-21,5 (-33,7; -5,8)	Female
Acre	44,4 (34,3; 55,5)	43,4 (34,5; 53,5)	131,9 (107,4; 159,8)	35,1 (28,6; 41,9)	-19,1 (-39,4; 7,7)	Female
Amapá	34,2 (27,2; 43,0)	47,6 (38,8; 58,1)	140,2 (110,3; 179,3)	44,2 (35,0; 56,3)	-7,0 (-31,1; 23,4)	Female
Amazonas	203,4 (170,0; 247,0)	42,1 (35,2; 50,9)	573,2 (449,5; 706,5)	32,8 (25,8; 40,6)	-22,0 (-39,2; 1,4)	Female
Pará	647,3 (535,0; 779,7)	48,9 (41,0; 58,0)	1.510,7 (1.231,6; 1.830,5)	37,1 (30,3; 44,8)	-24,2 (-42,2; -2,1)	Female
Rondônia	145,8 (116,0; 177,2)	63,2 (51,7; 76,6)	340,3 (275,5; 413,0)	40,5 (32,8; 48,9)	-36,0 (-50,5; -15,7)	Female
Roraima	18,7 (14,2; 23,8)	45,8 (35,6; 56,5)	82,7 (65,9; 105,8)	34,4 (27,6; 42,7)	-24,9 (-45,1; 5,6)	Female
Tocantins	74,7 (57,2; 98,6)	35,9 (28,2; 45,2)	309,8 (252,8; 375,4)	37,6 (30,6; 45,4)	4,8 (-22,3; 43,6)	Female
Northeast region	7.261,0 (5.879,2; 8.896,2)	49,9 (40,1; 61,0)	12.677,3 (10.451,3; 14.801,4)	34,8 (28,7; 40,6)	-30,3 (-47,5; -9,2)	Female
Alagoas	341,2 (267,5; 429,2)	43,1 (33,9; 53,7)	837,7 (689,3; 1.020,3)	43,5 (35,9; 53,0)	0,8 (-25,7; 38,5)	Female
Bahia	3.157,8 (2.569,2; 3.813,1)	80,5 (65,8; 97,3)	3.439,0 (2.845,4; 3.947,9)	35,3 (29,3; 40,7)	-56,1 (-66,0; -43,8)	Female
Ceará	663,5 (526,1; 850,1)	29,3 (23,6; 37,3)	1.979,5 (1.667,5; 2.324,6)	32,9 (27,6; 38,6)	12,3 (-17,2; 47,1)	Female

Maranhão	281,0 (198,8; 388,3)	19,4 (13,9; 26,1)	1.151,5 (906,7; 1.409,4)	30,6 (24,1; 37,4)	58,0 (9,8; 137,1)	Female
Paraíba	388,1 (297,6; 496,8)	31,4 (24,2; 39,9)	872,3 (716,1; 1.037,3)	30,8 (25,4; 36,7)	-2,0 (-26,9; 34,7)	Female
Pernambuco	1.689,8 (1.362,1; 2.037,5)	62,7 (50,9; 75,2)	2.685,5 (2.256,7; 3.129,6)	43,0 (36,1; 49,9)	-31,4 (-47,8; -10,5)	Female
Piaui	220,8 (161,6; 294,3)	27,2 (20,3; 35,8)	582,9 (460,0; 711,5)	26,6 (21,0; 32,4)	-2,4 (-32,4; 37,6)	Female
Rio Grande do Norte	338,5 (261,4; 442,1)	37,6 (29,0; 49,1)	752,1 (594,8; 904,9)	32,4 (25,6; 39,0)	-13,9 (-37,8; 23,9)	Female
Sergipe	180,4 (144,1; 222,0)	37,4 (29,9; 45,5)	376,7 (312,5; 451,1)	26,7 (22,1; 31,9)	-28,6 (-46,2; -5,3)	Female
Southeast region	17.334,8 (15.661,2; 19.117,3)	68,7 (62,5; 75,5)	27.774,6 (24.448,1; 30.437,5)	42,0 (37,1; 46,2)	-38,9 (-46,1; -31,4)	Female
Espírito Santo	661,4 (550,5; 778,6)	73,8 (61,6; 86,7)	1.293,9 (1.056,0; 1.573,3)	47,6 (38,9; 57,9)	-35,4 (-51,2; -16,6)	Female
Minas Gerais	4.077,0 (3.605,4; 4.655,4)	67,4 (59,6; 77,1)	6.406,1 (5.458,4; 7.172,9)	40,4 (34,8; 45,5)	-40,1 (-49,1; -30,8)	Female
Rio de Janeiro	3.692,9 (3.206,6; 4.133,6)	62,8 (54,8; 70,4)	5.423,9 (4.725,9; 6.070,4)	40,9 (35,6; 45,9)	-34,8 (-43,2; -24,0)	Female
São Paulo	8.903,5 (8.229,4; 9.734,3)	71,9 (66,2; 77,9)	14.650,8 (12.785,6; 16.411,1)	42,9 (37,5; 47,8)	-40,4 (-47,1; -33,4)	Female
South region	7.078,0 (6.167,9; 8.085,5)	84,5 (73,3; 96,7)	11.962,6 (10.277,6; 13.520,2)	52,7 (45,5; 59,8)	-37,6 (-46,2; -27,0)	Female
Paraná	2.703,9 (2.329,9; 3.131,0)	92,1 (79,4; 106,4)	4.246,5 (3.638,1; 4.871,5)	51,5 (44,2; 59,2)	-44,1 (-52,9; -34,8)	Female
Rio Grande do Sul	3.018,2 (2.622,1; 3.442,1)	77,4 (67,6; 88,2)	4.745,0 (4.095,6; 5.315,7)	51,1 (44,2; 57,5)	-33,9 (-43,7; -23,3)	Female
Santa Catarina	1.355,9 (1.157,5; 1.570,8)	89,2 (76,6; 102,8)	2.971,0 (2.511,8; 3.427,7)	57,8 (48,7; 66,6)	-35,2 (-46,1; -21,9)	Female
West-Central region	1.837,1 (1.549,2; 2.181,7)	67,3 (56,9; 79,6)	4.115,3 (3.474,2; 4.830,4)	42,1 (35,4; 49,4)	-37,5 (-50,9; -20,3)	Female
Distrito Federal	298,1 (243,9; 358,9)	65,4 (54,4; 77,9)	626,4 (499,5; 770,4)	35,2 (28,0; 43,3)	-46,1 (-58,8; -31,2)	Female
Goiás	886,8 (736,4; 1.063,5)	71,2 (60,3; 85,2)	1.857,8 (1.521,9; 2.237,8)	42,6 (34,8; 51,3)	-40,2 (-55,6; -22,3)	Female
Mato Grosso	275,2 (221,6; 340,2)	56,6 (45,7; 68,2)	735,6 (610,5; 886,0)	38,4 (31,8; 46,1)	-32,2 (-47,7; -8,0)	Female
Mato Grosso do Sul	377,0 (308,2; 452,2)	69,8 (58,2; 82,9)	895,5 (728,9; 1.099,9)	52,1 (42,4; 63,9)	-25,3 (-43,2; -2,5)	Female
Brazil	74.178,5 (67.752,1; 80.327,3)	71,8 (65,5; 77,9)	127.678,4 (117.102,4; 136.510,2)	49,3 (45,1; 52,8)	-31,4 (-35,8; -24,3)	Both
North region	2.776,6 (2.442,8; 3.117,0)	54,3 (48,3; 60,6)	7.608,5 (6.924,0; 8.367,5)	46,2 (42,0; 50,9)	-14,9 (-24,3; -2,2)	Both
Acre	105,7 (87,9; 126,7)	48,1 (41,4; 56,5)	296,0 (251,2; 345,6)	40,2 (34,4; 47,0)	-16,4 (-32,6; 3,8)	Both

Amapá	73,2 (62,8; 84,6)	54,6 (47,6; 62,6)	321,9 (277,5; 371,3)	52,1 (44,9; 59,9)	-4,5 (-19,9; 16,8)	Both
Amazonas	540,7 (466,0; 618,7)	54,6 (47,2; 61,5)	1.596,2 (1.404,8; 1.822,4)	47,1 (41,3; 53,8)	-13,8 (-27,1; 7,7)	Both
Pará	1.436,0 (1.241,0; 1.632,9)	54,7 (48,0; 61,9)	3.522,4 (3.111,2; 4.004,4)	44,6 (39,3; 50,8)	-18,4 (-30,0; -0,9)	Both
Rondônia	385,7 (330,0; 442,9)	70,8 (61,8; 80,4)	836,0 (715,9; 957,4)	49,7 (42,6; 56,9)	-29,8 (-43,2; -16,5)	Both
Roraima	52,1 (43,0; 61,6)	53,1 (44,8; 62,4)	207,9 (171,4; 248,7)	42,9 (35,3; 50,7)	-19,3 (-35,8; 1,0)	Both
Tocantins	183,2 (155,3; 215,0)	42,5 (36,5; 49,6)	828,0 (704,3; 964,3)	50,3 (42,9; 58,9)	18,3 (-2,0; 43,9)	Both
Northeast region	14.846,1 (12.767,5; 17.096,8)	53,3 (46,4; 61,4)	28.086,5 (23.939,4; 32.162,1)	42,5 (36,2; 48,6)	-20,3 (-34,9; -4,3)	Both
Alagoas	672,6 (566,9; 791,5)	43,7 (37,2; 50,4)	1.734,6 (1.483,2; 2.010,7)	49,6 (42,5; 57,8)	13,7 (-7,3; 41,0)	Both
Bahia	6.324,1 (5.537,4; 7.242,3)	84,2 (73,4; 96,0)	7.869,0 (6.766,4; 8.965,3)	44,2 (38,0; 50,4)	-47,5 (-56,4; -37,4)	Both
Ceará	1.301,7 (1.107,1; 1.538,2)	30,3 (26,0; 35,7)	4.326,0 (3.673,9; 4.941,2)	39,8 (34,0; 45,4)	31,5 (7,6; 57,3)	Both
Maranhão	818,6 (635,2; 1.023,9)	28,7 (22,6; 35,6)	2.823,7 (2.344,0; 3.334,4)	39,7 (32,8; 46,7)	38,1 (1,9; 88,9)	Both
Paraíba	722,8 (617,5; 847,5)	30,9 (26,3; 36,3)	1.796,0 (1.520,9; 2.055,5)	35,5 (30,1; 40,5)	15,0 (-4,5; 40,6)	Both
Pernambuco	3.433,3 (2.989,6; 3.955,1)	67,7 (59,4; 78,1)	5.618,3 (4.867,9; 6.403,9)	51,0 (44,2; 58,2)	-24,6 (-36,9; -10,1)	Both
Piaui	473,2 (394,0; 573,5)	30,3 (25,3; 36,6)	1.357,0 (1.142,7; 1.605,1)	33,5 (28,3; 39,7)	10,6 (-13,3; 39,0)	Both
Rio Grande do Norte	716,5 (594,1; 841,1)	41,7 (34,8; 48,9)	1.670,8 (1.401,3; 1.932,8)	40,0 (33,5; 46,4)	-4,2 (-26,1; 19,8)	Both
Sergipe	383,3 (330,7; 444,3)	41,6 (36,4; 48,1)	891,0 (753,7; 1.032,7)	35,1 (29,7; 40,6)	-15,8 (-30,9; 4,5)	Both
Southeast region	38.265,9 (35.243,3; 41.349,2)	79,2 (73,3; 85,2)	57.552,0 (52.517,5; 62.280,4)	49,0 (44,7; 53,0)	-38,2 (-43,4; -32,1)	Both
Espírito Santo	1.353,3 (1.183,1; 1.540,9)	77,1 (67,8; 87,2)	2.759,0 (2.457,1; 3.134,8)	55,3 (49,2; 62,6)	-28,3 (-39,3; -14,1)	Both
Minas Gerais	8.867,3 (8.042,9; 9.703,5)	76,3 (69,1; 83,1)	13.673,4 (12.328,2; 14.977,2)	47,3 (42,7; 51,5)	-38,0 (-44,5; -30,4)	Both
Rio de Janeiro	7.711,2 (6.990,3; 8.431,8)	70,8 (64,1; 77,5)	10.648,3 (9.659,7; 11.610,5)	46,2 (42,0; 50,3)	-34,8 (-40,9; -27,4)	Both
São Paulo	20.334,2 (18.956,5; 21.761,5)	84,8 (79,3; 90,0)	30.471,2 (27.646,6; 33.279,4)	50,4 (45,7; 55,2)	-40,5 (-45,3; -34,9)	Both
South region	14.297,6 (12.863,7; 15.666,4)	88,4 (79,5; 97,3)	25.224,9 (22.943,8; 27.381,4)	61,5 (55,8; 67,0)	-30,5 (-36,9; -21,6)	Both
Paraná	5.197,9 (4.685,0; 5.748,2)	89,4 (80,3; 98,8)	8.829,2 (7.958,6; 9.671,6)	58,6 (52,8; 64,5)	-34,4 (-40,8; -26,8)	Both
Rio Grande do Sul	6.336,2 (5.722,5; 6.938,5)	86,3 (77,8; 94,6)	10.126,4 (9.118,8; 11.130,0)	61,4 (55,4; 67,4)	-28,8 (-35,8; -19,2)	Both

Santa Catarina	2.763,6 (2.471,0; 3.079,5)	92,7 (83,3; 103,7)	6.269,3 (5.584,7; 6.921,6)	66,4 (59,1; 73,5)	-28,4 (-36,5; -18,9)	Both
West-Central region	3.992,2 (3.530,9; 4.489,5)	71,0 (63,4; 80,1)	9.206,6 (8.186,4; 10.146,8)	50,0 (44,2; 55,2)	-29,6 (-38,9; -14,5)	Both
Distrito Federal	673,2 (592,6; 756,0)	77,0 (68,0; 86,3)	1.381,5 (1.191,0; 1.585,5)	43,8 (37,4; 50,5)	-43,1 (-52,3; -31,6)	Both
Goiás	1.833,3 (1.613,7; 2.062,1)	71,9 (63,6; 80,8)	4.135,7 (3.664,8; 4.683,4)	50,3 (44,5; 57,0)	-30,1 (-40,9; -14,7)	Both
Mato Grosso	662,1 (547,9; 775,4)	61,1 (52,6; 71,3)	1.795,8 (1.520,9; 2.055,7)	47,4 (40,1; 54,7)	-22,3 (-36,1; -4,5)	Both
Mato Grosso do Sul	823,5 (723,0; 922,2)	74,2 (65,2; 84,1)	1.893,6 (1.647,9; 2.156,4)	58,6 (51,0; 66,8)	-21,1 (-33,5; -4,7)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 5.14 – Non-rheumatic aortic valve disease disability-adjusted life years (DALYs) in Brazil, regions, and Federative Units, by sex, 1990 and 2023: number, age-standardized rate, and percent change of rates

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	29.012,2 (25.551,4; 32.696,2)	59,0 (52,3; 66,6)	49.988,9 (45.697,8; 54.667,6)	43,0 (39,3; 47,2)	-27,1 (-35,7; -17,7)	Male
North region	1.139,4 (973,0; 1.337,8)	44,9 (38,6; 52,6)	3.198,1 (2.799,1; 3.633,3)	40,5 (35,5; 46,1)	-9,9 (-23,5; 8,9)	Male
Acre	42,9 (32,4; 54,5)	37,5 (29,4; 46,4)	114,7 (90,4; 147,7)	32,5 (25,5; 41,4)	-13,4 (-37,0; 16,1)	Male
Amapá	29,1 (23,0; 35,6)	48,9 (40,0; 58,4)	133,9 (107,7; 161,6)	45,5 (36,6; 54,5)	-7,0 (-30,3; 22,4)	Male
Amazonas	253,0 (211,6; 303,5)	51,5 (43,1; 60,9)	779,8 (642,1; 925,1)	48,5 (40,4; 57,2)	-5,8 (-27,8; 22,4)	Male
Pará	552,4 (456,9; 674,3)	43,6 (36,2; 53,2)	1.398,9 (1.165,9; 1.655,9)	37,2 (31,1; 43,8)	-14,8 (-33,6; 8,5)	Male
Rondônia	169,9 (139,4; 208,6)	56,5 (46,9; 68,5)	355,1 (289,1; 432,7)	42,8 (34,8; 52,1)	-24,3 (-42,1; -1,4)	Male
Roraima	25,3 (19,4; 32,4)	46,4 (37,2; 57,8)	95,7 (75,1; 118,9)	40,2 (31,7; 49,3)	-13,4 (-36,3; 13,9)	Male
Tocantins	66,9 (51,0; 83,6)	31,6 (24,4; 39,1)	319,9 (242,7; 404,5)	39,3 (29,9; 49,6)	24,6 (-8,6; 70,0)	Male
Northeast region	5.493,9 (4.317,5; 6.789,4)	41,9 (33,3; 51,5)	10.712,4 (8.582,1; 13.090,1)	35,9 (28,8; 43,8)	-14,3 (-36,0; 11,7)	Male
Alagoas	213,1 (163,2; 269,8)	29,2 (23,1; 36,7)	588,5 (465,1; 729,6)	37,8 (30,0; 46,7)	29,1 (-5,8; 77,6)	Male
Bahia	2.519,4 (2.013,1; 3.076,8)	70,8 (57,4; 85,8)	3.125,7 (2.517,6; 3.810,6)	38,3 (30,9; 46,8)	-45,9 (-58,9; -30,8)	Male
Ceará	437,6 (339,2; 547,0)	21,8 (17,0; 27,0)	1.631,3 (1.304,7; 1.959,8)	33,4 (26,7; 40,1)	53,1 (13,1; 106,6)	Male
Maranhão	360,8 (244,3; 539,1)	26,3 (18,3; 38,5)	1.187,1 (910,9; 1.510,0)	35,6 (27,4; 45,3)	35,6 (-11,2; 120,1)	Male
Paraíba	217,5 (168,6; 274,6)	19,9 (15,5; 24,9)	633,0 (499,8; 780,4)	28,2 (22,3; 34,8)	41,2 (3,5; 95,3)	Male
Pernambuco	1.164,3 (918,6; 1.420,3)	50,1 (39,7; 60,9)	1.998,7 (1.664,5; 2.395,6)	41,8 (34,9; 50,3)	-16,5 (-35,5; 7,6)	Male
Piaui	164,0 (115,7; 216,8)	22,3 (15,9; 29,0)	540,5 (424,8; 687,5)	28,8 (22,5; 36,5)	29,3 (-11,7; 83,6)	Male
Rio Grande do Norte	281,1 (214,7; 352,0)	34,7 (26,6; 43,5)	663,9 (517,2; 835,8)	35,5 (27,5; 44,7)	2,3 (-26,4; 41,8)	Male
Sergipe	136,0 (107,6; 169,7)	31,9 (25,5; 39,3)	343,9 (267,1; 431,3)	30,6 (23,9; 38,4)	-3,9 (-29,7; 28,5)	Male
Southeast region	15.510,8 (13.852,8; 17.379,0)	68,2 (61,3; 75,6)	22.308,1 (20.007,9; 24.929,7)	43,1 (38,7; 48,2)	-36,8 (-44,4; -27,3)	Male
Espírito Santo	478,5 (398,2; 576,8)	57,1 (47,9; 68,4)	1.016,3 (844,4; 1.202,4)	44,8 (37,1; 53,0)	-21,5 (-39,0; 0,8)	Male
Minas Gerais	3.606,3 (3.097,6; 4.107,8)	65,4 (56,7; 74,8)	5.547,1 (4.793,9; 6.316,4)	42,0 (36,3; 47,7)	-35,8 (-46,1; -22,0)	Male

Rio de Janeiro	2.842,7 (2.454,0; 3.266,0)	57,4 (49,8; 66,1)	3.930,8 (3.445,3; 4.521,7)	40,1 (35,0; 45,9)	-30,2 (-40,0; -15,8)	Male
São Paulo	8.583,4 (7.839,6; 9.477,5)	75,2 (69,0; 82,1)	11.814,0 (10.567,9; 13.239,5)	44,8 (40,1; 50,2)	-40,4 (-47,7; -32,1)	Male
South region	5.333,9 (4.597,9; 6.066,4)	69,1 (60,4; 79,6)	10.069,1 (8.810,9; 11.403,3)	54,7 (47,8; 62,0)	-20,9 (-33,1; -6,9)	Male
Paraná	1.841,9 (1.591,4; 2.115,7)	64,6 (56,1; 74,4)	3.441,6 (3.015,9; 3.942,6)	50,2 (44,0; 57,5)	-22,3 (-34,5; -7,8)	Male
Rio Grande do Sul	2.441,2 (2.115,3; 2.746,3)	71,6 (61,9; 81,8)	4.113,1 (3.615,8; 4.708,6)	56,6 (49,7; 65,1)	-21,0 (-33,3; -4,1)	Male
Santa Catarina	1.050,8 (899,2; 1.243,3)	72,8 (62,2; 85,4)	2.514,4 (2.150,4; 2.942,9)	58,8 (50,4; 68,5)	-19,2 (-33,4; -2,6)	Male
West-Central region	1.534,1 (1.284,8; 1.819,5)	54,7 (46,2; 64,2)	3.701,2 (3.166,3; 4.255,4)	43,2 (36,9; 49,7)	-21,0 (-35,1; -1,7)	Male
Distrito Federal	257,7 (212,1; 305,3)	65,6 (54,8; 76,5)	543,0 (444,8; 658,5)	40,2 (33,1; 48,3)	-38,8 (-52,3; -21,2)	Male
Goiás	690,6 (573,2; 812,7)	54,3 (45,8; 63,4)	1.688,9 (1.406,1; 1.996,0)	43,9 (36,7; 51,8)	-19,0 (-36,1; 4,1)	Male
Mato Grosso	268,6 (207,8; 329,4)	46,7 (38,0; 57,1)	752,9 (601,7; 914,4)	40,8 (32,6; 49,6)	-12,7 (-35,0; 15,2)	Male
Mato Grosso do Sul	317,2 (263,3; 384,3)	57,0 (47,5; 67,3)	716,4 (584,4; 863,7)	47,5 (38,8; 57,0)	-16,8 (-35,9; 6,4)	Male
Brazil	17.938,8 (15.757,2; 20.942,6)	36,1 (31,5; 41,3)	36.871,6 (32.069,9; 40.829,4)	25,4 (22,2; 28,1)	-29,6 (-38,0; -20,3)	Female
North region	540,6 (456,8; 643,3)	24,8 (21,1; 29,4)	1.701,5 (1.409,6; 2.016,9)	20,9 (17,3; 24,7)	-15,7 (-28,5; 0,6)	Female
Acre	20,1 (15,7; 25,8)	22,9 (18,0; 28,4)	76,2 (60,7; 92,5)	21,1 (16,9; 25,7)	-7,9 (-31,6; 24,0)	Female
Amapá	18,2 (14,5; 23,4)	28,0 (23,0; 35,4)	84,6 (64,2; 110,7)	28,0 (21,2; 36,2)	-0,1 (-26,4; 32,4)	Female
Amazonas	105,6 (86,8; 131,8)	25,0 (21,0; 30,7)	344,2 (268,7; 438,6)	20,5 (16,0; 26,0)	-17,8 (-36,7; 11,2)	Female
Pará	286,2 (237,1; 352,6)	24,5 (20,6; 30,1)	789,6 (610,6; 995,6)	19,9 (15,4; 25,2)	-18,6 (-37,1; 5,4)	Female
Rondônia	71,3 (55,2; 90,8)	37,5 (30,1; 46,5)	207,4 (167,0; 252,2)	25,5 (20,7; 31,3)	-32,0 (-47,8; -6,2)	Female
Roraima	10,2 (7,3; 13,7)	29,4 (22,3; 37,8)	51,8 (39,3; 67,9)	23,1 (18,3; 29,4)	-21,4 (-44,0; 10,9)	Female
Tocantins	29,0 (21,6; 37,6)	17,1 (13,3; 21,6)	147,8 (115,9; 180,2)	18,3 (14,3; 22,3)	6,8 (-22,9; 46,1)	Female
Northeast region	3.900,1 (3.152,2; 4.841,0)	28,5 (22,9; 35,1)	7.323,4 (5.883,6; 8.764,5)	19,8 (15,8; 23,7)	-30,6 (-47,5; -8,7)	Female
Alagoas	158,0 (123,3; 199,1)	21,7 (17,1; 26,7)	449,3 (360,7; 543,9)	23,4 (18,8; 28,4)	8,2 (-20,1; 48,2)	Female
Bahia	2.120,3 (1.730,6; 2.607,2)	56,8 (46,0; 69,4)	2.080,7 (1.690,4; 2.433,8)	21,0 (16,9; 24,5)	-63,1 (-71,7; -53,1)	Female
Ceará	297,4 (228,4; 379,4)	14,2 (11,0; 17,8)	1.088,4 (876,5; 1.327,6)	17,7 (14,2; 21,6)	25,0 (-7,3; 67,8)	Female

Maranhão	130,4 (92,0; 179,7)	9,8 (6,9; 13,3)	674,5 (509,3; 842,2)	18,0 (13,6; 22,5)	84,2 (23,3; 170,0)	Female
Paraíba	198,1 (155,9; 257,6)	16,8 (13,3; 21,5)	524,1 (416,5; 631,3)	18,0 (14,2; 21,7)	7,1 (-19,9; 43,9)	Female
Pernambuco	648,2 (516,0; 817,4)	25,9 (20,7; 32,5)	1.521,0 (1.240,5; 1.795,1)	24,1 (19,6; 28,3)	-7,2 (-31,3; 19,0)	Female
Piaui	90,9 (65,8; 124,2)	12,3 (9,0; 16,6)	317,0 (237,8; 394,5)	14,2 (10,6; 17,7)	14,9 (-21,7; 68,8)	Female
Rio Grande do Norte	176,0 (131,4; 227,0)	20,5 (15,3; 26,3)	463,8 (354,7; 570,2)	19,5 (14,8; 24,1)	-4,8 (-32,5; 36,2)	Female
Sergipe	80,8 (63,4; 101,7)	18,0 (14,1; 22,5)	204,5 (160,1; 246,5)	14,5 (11,3; 17,5)	-19,5 (-40,0; 6,8)	Female
Southeast region	8.944,8 (7.903,4; 10.163,6)	37,8 (33,6; 42,5)	17.519,8 (14.939,2; 19.685,5)	26,0 (22,2; 29,2)	-31,4 (-39,3; -19,9)	Female
Espírito Santo	293,1 (239,6; 360,0)	36,2 (30,0; 44,0)	731,8 (573,7; 912,0)	26,5 (20,8; 33,0)	-26,9 (-44,5; -5,6)	Female
Minas Gerais	2.069,3 (1.774,6; 2.417,0)	36,5 (31,2; 42,0)	4.234,2 (3.541,0; 4.915,0)	26,1 (21,9; 30,2)	-28,4 (-39,9; -12,8)	Female
Rio de Janeiro	1.857,2 (1.575,0; 2.174,6)	33,3 (28,2; 38,8)	3.362,5 (2.830,7; 3.936,7)	24,6 (20,7; 28,8)	-26,1 (-36,8; -10,4)	Female
São Paulo	4.725,3 (4.238,9; 5.246,1)	40,9 (36,5; 45,4)	9.191,3 (7.827,7; 10.542,9)	26,5 (22,6; 30,3)	-35,3 (-42,8; -25,9)	Female
South region	3.702,5 (3.114,3; 4.412,2)	47,6 (40,2; 55,8)	7.918,8 (6.648,8; 9.264,9)	34,4 (28,8; 40,2)	-27,7 (-39,3; -13,1)	Female
Paraná	1.258,7 (1.043,4; 1.506,7)	47,5 (39,8; 56,7)	2.652,6 (2.194,1; 3.157,6)	32,0 (26,3; 38,1)	-32,8 (-43,8; -18,6)	Female
Rio Grande do Sul	1.661,6 (1.405,6; 1.965,4)	44,7 (37,9; 52,2)	3.232,3 (2.723,5; 3.728,2)	33,7 (28,5; 38,9)	-24,6 (-36,4; -9,3)	Female
Santa Catarina	782,2 (652,1; 935,6)	55,7 (46,9; 66,0)	2.033,8 (1.677,4; 2.437,7)	39,6 (32,5; 47,5)	-29,0 (-42,3; -13,1)	Female
West-Central region	850,8 (702,5; 1.049,1)	35,9 (30,2; 43,8)	2.408,2 (1.954,9; 2.918,9)	25,0 (20,3; 30,3)	-30,4 (-44,5; -10,4)	Female
Distrito Federal	137,0 (113,1; 171,4)	35,5 (29,9; 43,0)	375,0 (284,7; 470,6)	21,5 (16,3; 26,8)	-39,6 (-52,8; -20,8)	Female
Goiás	407,4 (336,0; 510,0)	37,2 (30,9; 46,2)	1.082,3 (873,4; 1.344,2)	25,1 (20,2; 31,1)	-32,5 (-49,1; -11,2)	Female
Mato Grosso	121,5 (93,7; 158,7)	29,6 (23,5; 37,4)	406,3 (321,1; 485,5)	22,0 (17,3; 26,4)	-25,8 (-44,3; -0,8)	Female
Mato Grosso do Sul	184,9 (150,4; 227,6)	38,7 (31,7; 47,2)	544,5 (424,9; 677,3)	31,8 (24,9; 39,6)	-17,8 (-37,5; 9,1)	Female
Brazil	46.951,0 (42.570,3; 52.062,5)	47,2 (42,8; 52,4)	86.860,5 (78.471,6; 94.206,2)	33,5 (30,2; 36,3)	-29,1 (-34,6; -21,5)	Both
North region	1.680,0 (1.485,0; 1.911,2)	35,1 (31,0; 39,7)	4.899,6 (4.353,8; 5.430,1)	30,4 (26,8; 33,9)	-13,4 (-23,3; 0,3)	Both
Acre	63,0 (51,7; 76,9)	30,6 (26,0; 36,3)	190,8 (159,2; 229,2)	26,7 (22,2; 32,0)	-12,8 (-30,4; 9,2)	Both
Amapá	47,3 (40,1; 56,1)	37,8 (32,6; 43,7)	218,5 (187,5; 255,0)	36,5 (31,2; 42,4)	-3,3 (-19,7; 20,5)	Both

Amazonas	358,7 (302,2; 419,2)	38,3 (32,4; 43,8)	1.124,0 (970,3; 1.284,5)	33,9 (29,5; 38,7)	-11,5 (-26,7; 9,9)	Both
Pará	838,5 (722,5; 984,5)	34,1 (29,4; 40,0)	2.188,5 (1.873,6; 2.510,5)	28,3 (24,2; 32,5)	-17,0 (-30,6; 0,8)	Both
Rondônia	241,2 (203,3; 280,1)	48,2 (41,3; 55,1)	562,5 (474,8; 652,1)	34,1 (28,8; 39,5)	-29,3 (-41,4; -14,3)	Both
Roraima	35,4 (29,2; 42,6)	39,1 (33,0; 46,5)	147,5 (118,6; 176,4)	31,6 (25,6; 37,9)	-19,1 (-36,1; 2,7)	Both
Tocantins	95,9 (78,2; 113,2)	24,6 (20,6; 28,9)	467,7 (389,4; 564,0)	28,8 (24,0; 34,7)	16,9 (-7,7; 48,5)	Both
Northeast region	9.394,0 (8.101,0; 11.017,6)	35,0 (30,1; 40,8)	18.035,8 (15.246,0; 20.986,9)	27,2 (23,0; 31,7)	-22,2 (-37,4; -3,3)	Both
Alagoas	371,1 (311,6; 440,9)	25,3 (21,6; 30,0)	1.037,8 (876,0; 1.238,0)	30,0 (25,4; 35,7)	18,3 (-4,7; 53,9)	Both
Bahia	4.639,8 (4.020,6; 5.407,2)	63,9 (55,7; 74,3)	5.206,4 (4.454,2; 6.032,6)	29,1 (24,8; 33,7)	-54,5 (-63,2; -45,4)	Both
Ceará	735,0 (610,8; 879,3)	17,8 (15,0; 21,1)	2.719,7 (2.288,1; 3.159,6)	24,9 (20,9; 29,0)	39,9 (12,4; 74,7)	Both
Maranhão	491,2 (374,5; 648,2)	17,9 (13,9; 23,3)	1.861,7 (1.533,8; 2.251,1)	26,3 (21,6; 31,8)	47,3 (8,2; 109,3)	Both
Paraíba	415,6 (350,2; 492,1)	18,2 (15,5; 21,7)	1.157,0 (966,2; 1.346,9)	22,7 (18,9; 26,5)	24,4 (0,8; 57,5)	Both
Pernambuco	1.812,5 (1.538,3; 2.125,0)	37,2 (31,9; 43,5)	3.519,7 (3.025,5; 4.100,0)	32,0 (27,5; 37,3)	-13,9 (-29,9; 5,3)	Both
Piaui	254,9 (209,0; 315,1)	17,1 (14,0; 21,1)	857,5 (700,6; 1.035,1)	21,0 (17,2; 25,4)	22,8 (-5,3; 58,2)	Both
Rio Grande do Norte	457,1 (381,4; 543,4)	27,3 (22,9; 32,5)	1.127,7 (941,1; 1.350,8)	26,8 (22,5; 32,3)	-1,6 (-23,9; 26,1)	Both
Sergipe	216,7 (183,8; 258,3)	24,5 (20,9; 29,0)	548,4 (458,6; 663,7)	21,7 (18,2; 26,3)	-11,3 (-29,0; 11,2)	Both
Southeast region	24.455,7 (22.441,9; 26.971,3)	52,3 (47,9; 57,4)	39.827,9 (35.834,5; 43.521,7)	33,7 (30,4; 36,7)	-35,6 (-41,4; -28,7)	Both
Espírito Santo	771,6 (671,1; 902,0)	46,5 (40,8; 54,3)	1.748,1 (1.503,3; 2.010,9)	35,0 (30,1; 40,2)	-24,8 (-37,8; -7,9)	Both
Minas Gerais	5.675,5 (5.086,1; 6.395,5)	50,4 (44,8; 56,5)	9.781,3 (8.631,9; 10.779,6)	33,6 (29,6; 36,9)	-33,4 (-41,8; -24,6)	Both
Rio de Janeiro	4.699,9 (4.236,9; 5.300,3)	44,5 (40,0; 50,1)	7.293,2 (6.474,6; 8.066,0)	31,3 (27,8; 34,7)	-29,7 (-36,8; -20,4)	Both
São Paulo	13.308,7 (12.315,6; 14.431,4)	57,4 (53,1; 61,9)	21.005,2 (18.803,4; 23.154,3)	34,7 (31,0; 38,2)	-39,6 (-44,9; -33,0)	Both
South region	9.036,4 (8.136,3; 10.249,7)	58,2 (52,2; 66,0)	17.987,9 (15.995,9; 19.891,6)	43,7 (38,9; 48,4)	-24,8 (-32,8; -13,9)	Both
Paraná	3.100,6 (2.797,2; 3.548,4)	56,1 (50,2; 63,6)	6.094,2 (5.400,4; 6.761,7)	40,5 (35,7; 45,0)	-27,9 (-35,8; -18,5)	Both
Rio Grande do Sul	4.102,8 (3.692,3; 4.600,7)	57,6 (51,7; 64,4)	7.345,4 (6.471,8; 8.183,0)	44,0 (38,7; 48,9)	-23,5 (-32,4; -11,3)	Both
Santa Catarina	1.833,1 (1.637,2; 2.119,6)	64,4 (56,9; 74,1)	4.548,2 (3.963,8; 5.079,1)	48,6 (42,3; 54,3)	-24,6 (-34,1; -13,2)	Both

West-Central region	2.384,9 (2.072,1; 2.766,2)	45,5 (40,0; 52,2)	6.109,4 (5.326,7; 6.859,4)	33,6 (29,1; 37,8)	-26,2 (-36,1; -12,3)	Both
Distrito Federal	394,7 (341,0; 455,7)	49,2 (43,5; 56,8)	918,0 (773,6; 1.064,2)	29,6 (24,9; 34,4)	-39,9 (-49,9; -26,9)	Both
Goiás	1.098,0 (940,2; 1.279,8)	45,9 (39,9; 53,2)	2.771,2 (2.387,4; 3.164,3)	34,0 (29,4; 38,7)	-25,8 (-37,8; -8,3)	Both
Mato Grosso	390,0 (323,5; 464,7)	38,9 (33,3; 45,5)	1.159,3 (970,5; 1.349,6)	31,3 (26,1; 36,4)	-19,7 (-34,7; -1,3)	Both
Mato Grosso do Sul	502,2 (435,0; 577,8)	48,2 (42,2; 55,6)	1.261,0 (1.069,9; 1.443,5)	39,2 (33,4; 44,9)	-18,7 (-31,0; -1,2)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

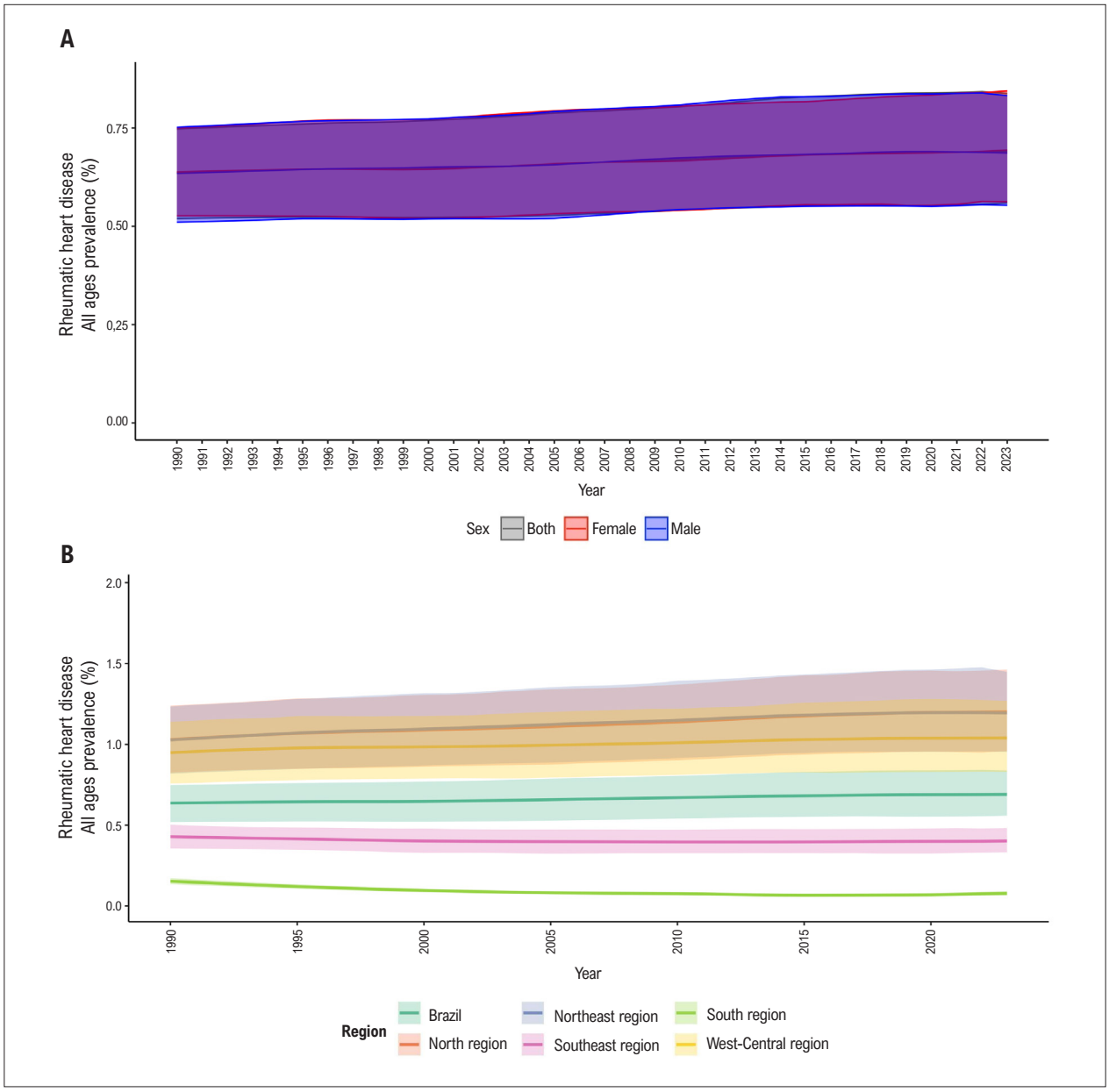

Chart 5.1 – *A: All-ages prevalence rates of rheumatic heart disease in Brazil from 1990 to 2023. B: All-ages prevalent cases of rheumatic heart disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

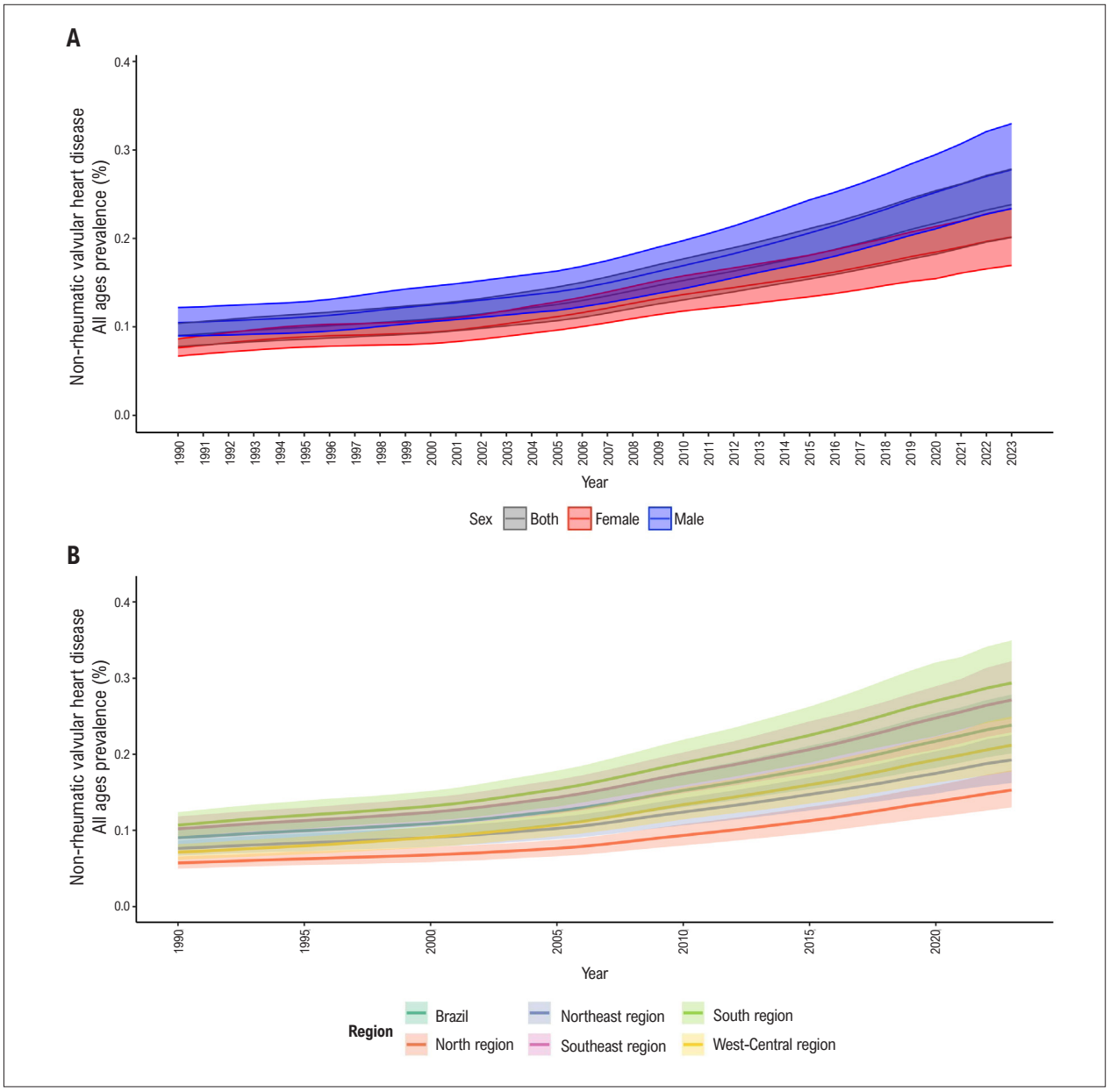

Chart 5.2 – *A: All-ages prevalence rates of non-rheumatic valve disease in Brazil from 1990 to 2023. B: All-ages prevalence rates of non-rheumatic valve disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

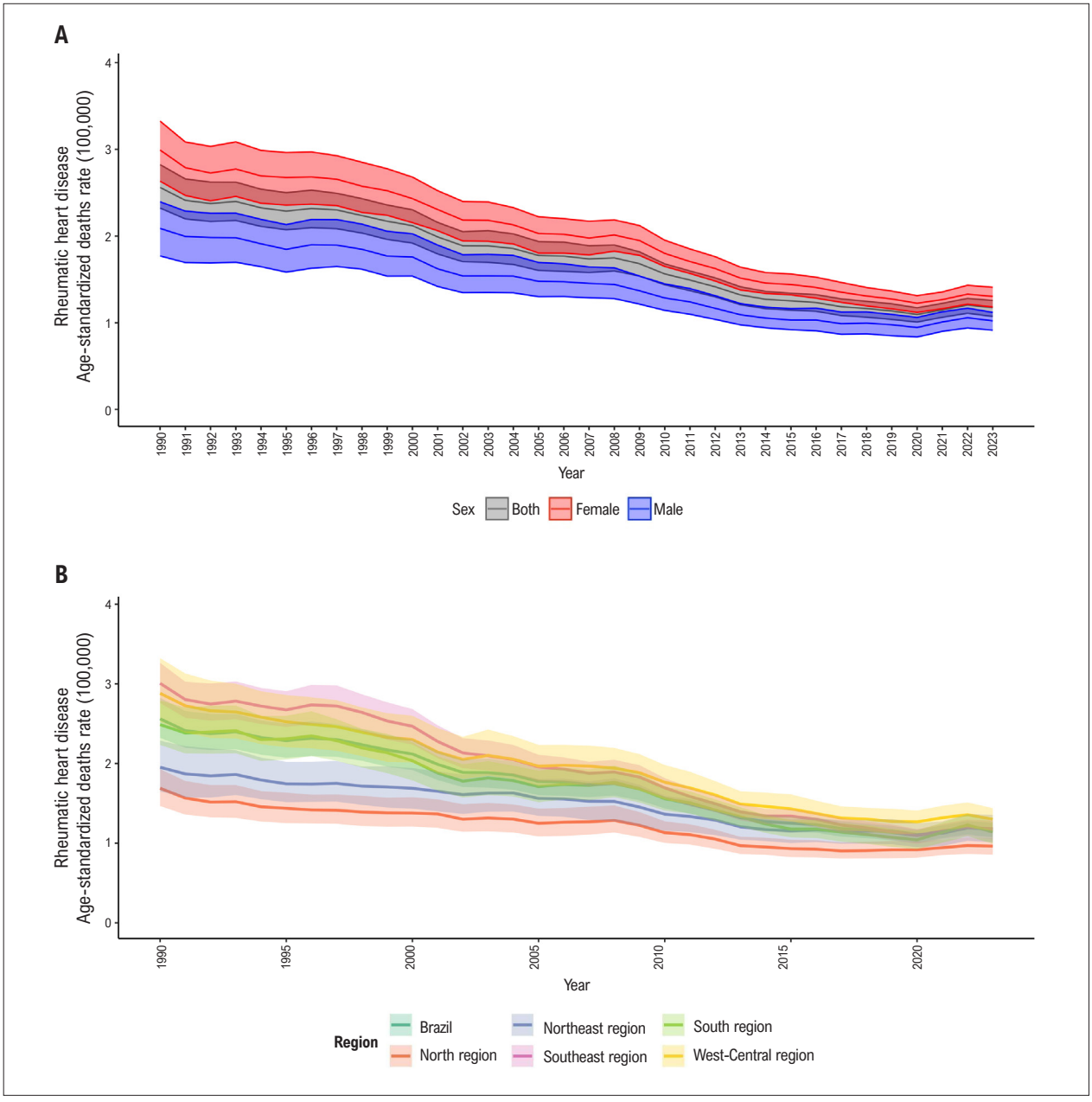

Chart 5.3 – *A: Age-standardized mortality rates attributable to rheumatic heart disease in Brazil by sex from 1990 to 2023. B: Age-standardized mortality rates attributable to rheumatic heart disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

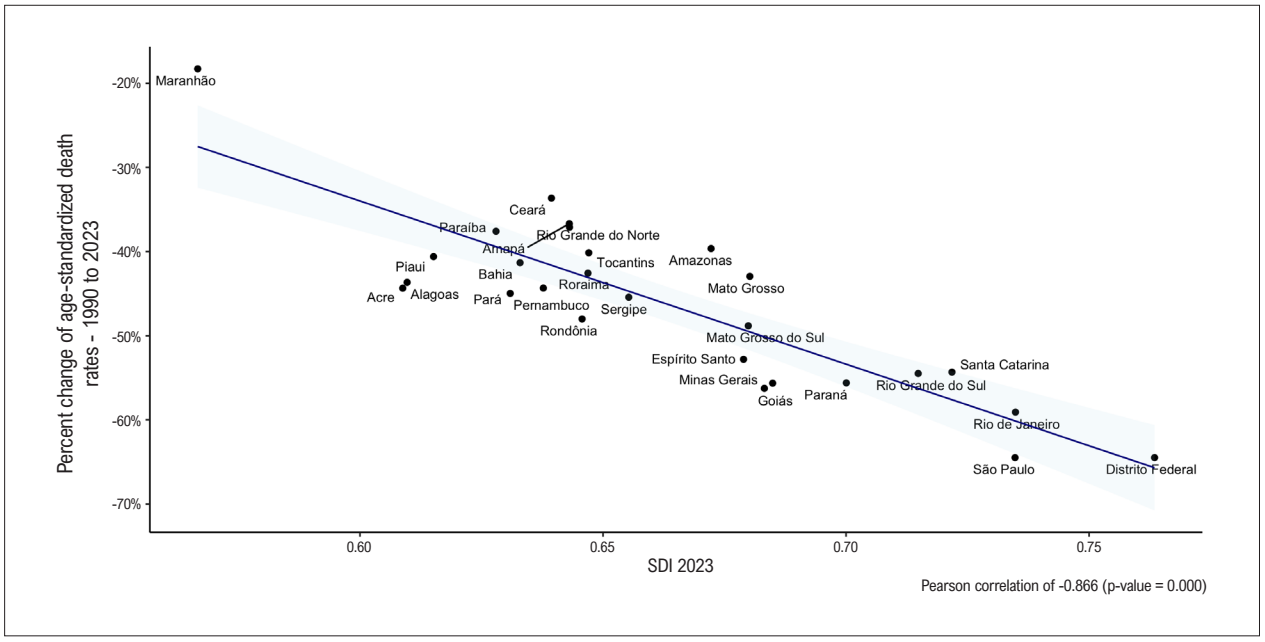

Chart 5.4 – *Correlation between the SDI of the Brazilian Federative Units in 2023 and the percent change of age-standardized mortality rates from rheumatic heart disease from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

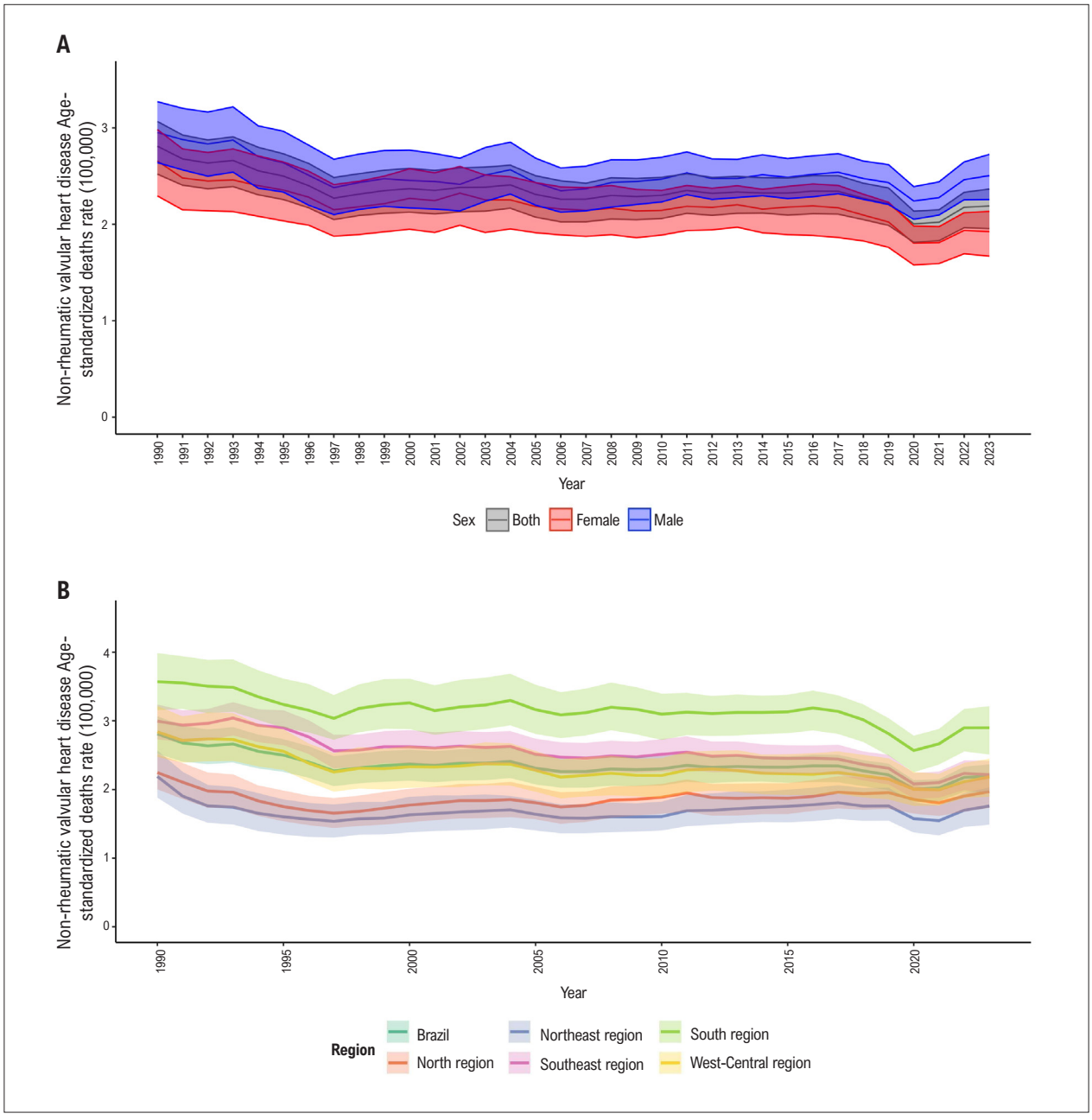

Chart 5.5 – *A: Age-standardized mortality rates attributable to non-rheumatic valve disease in Brazil by sex from 1990 to 2023. B: Age-standardized mortality rates attributable to non-rheumatic valve disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

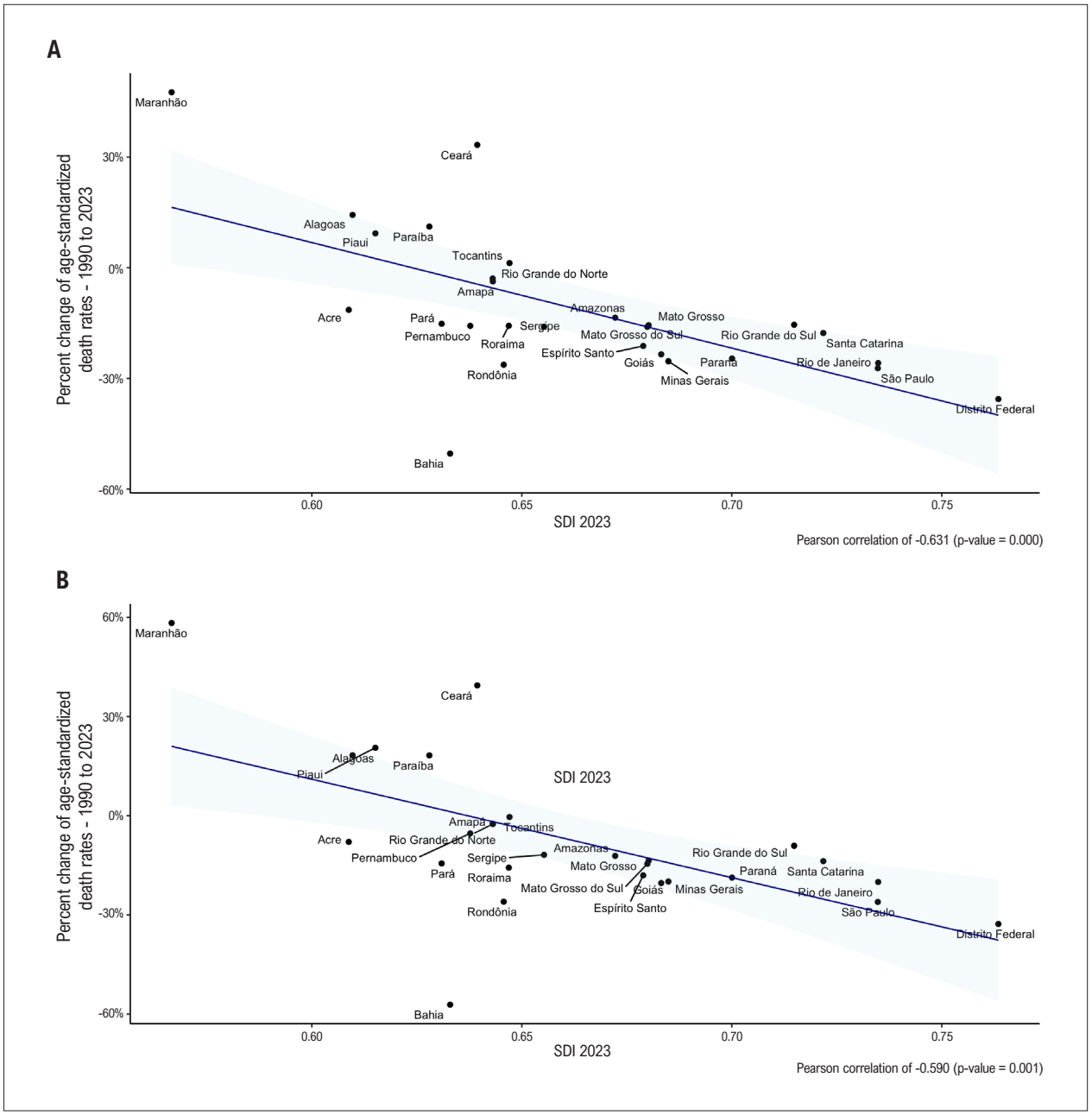

Chart 5.6 – *Correlation between the percent change in age-standardized mortality rates from 1990 to 2023 attributable to non-rheumatic valve disease (A) and non-rheumatic aortic valve disease (B) and the SDI in 2023 in the Brazilian states. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

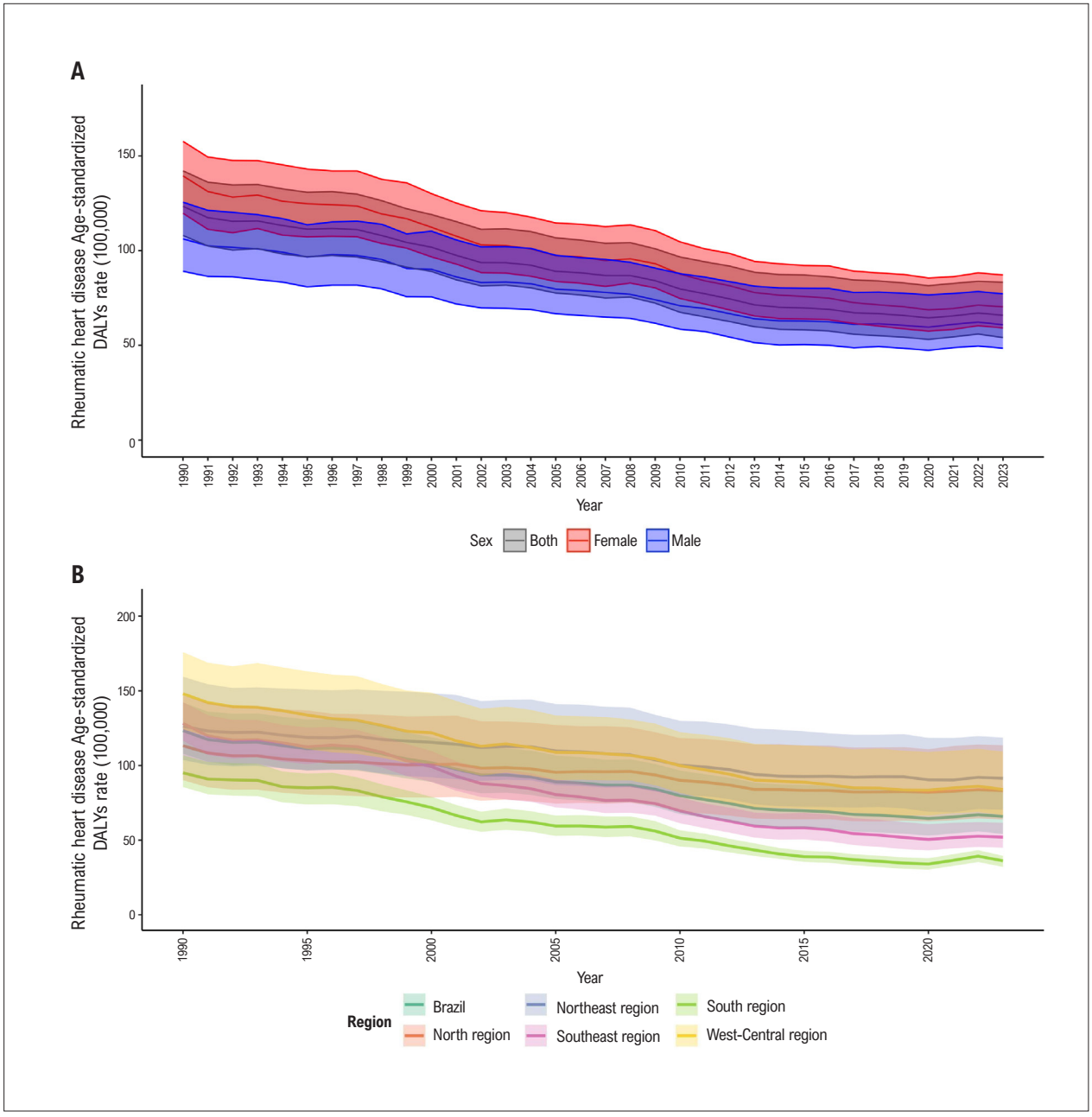

Chart 5.7 – *A: Age-standardized DALY rates attributable to rheumatic heart disease in Brazil, by sex, from 1990 to 2023. B: Age-standardized DALY rates attributable to rheumatic heart disease in Brazil, by region, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

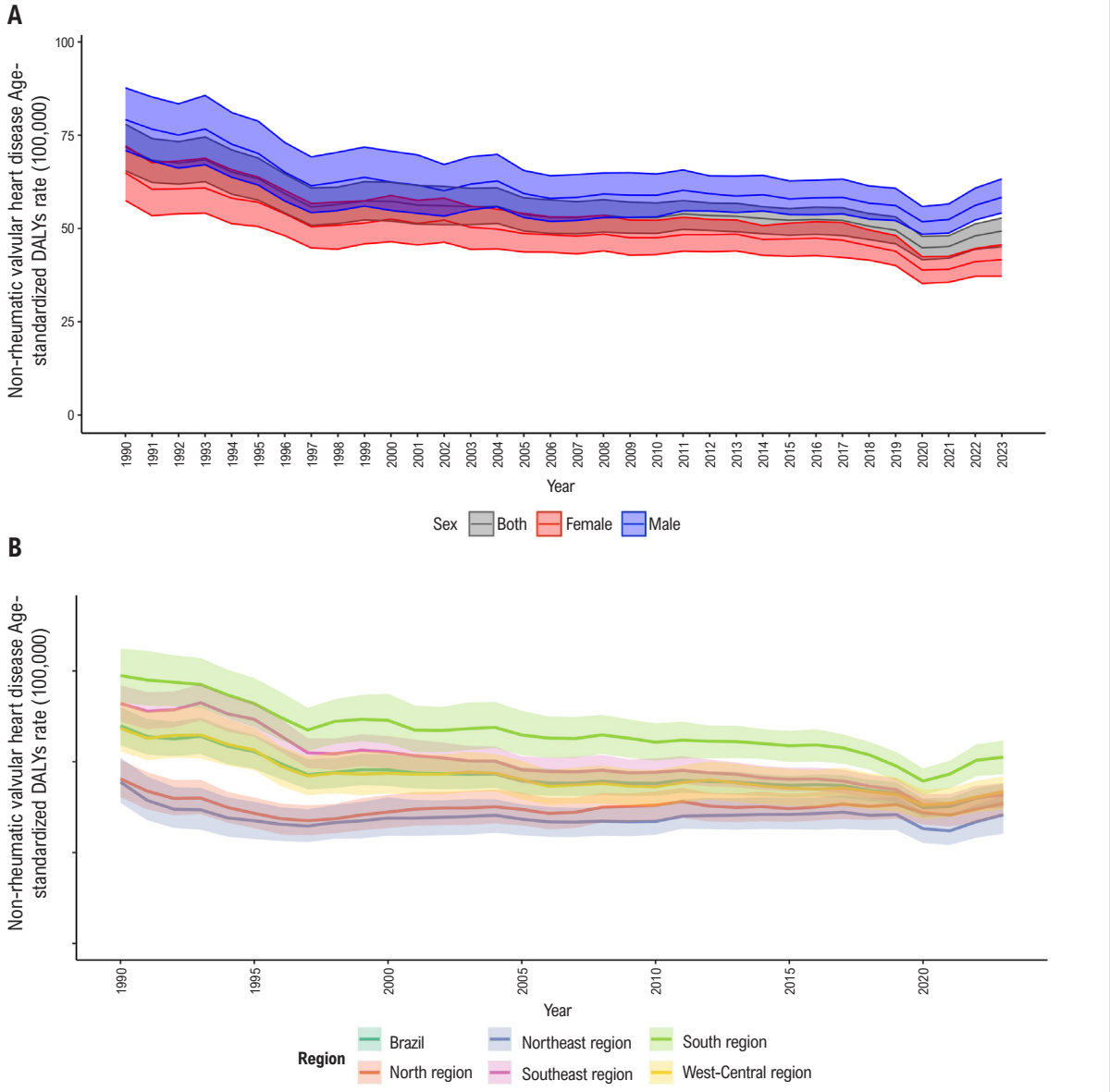

Chart 5.8 – *A: Age-standardized DALY rates attributable to non-rheumatic valve disease in Brazil by sex from 1990 to 2023. B: Age-standardized DALY rates attributable to non-rheumatic valve disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

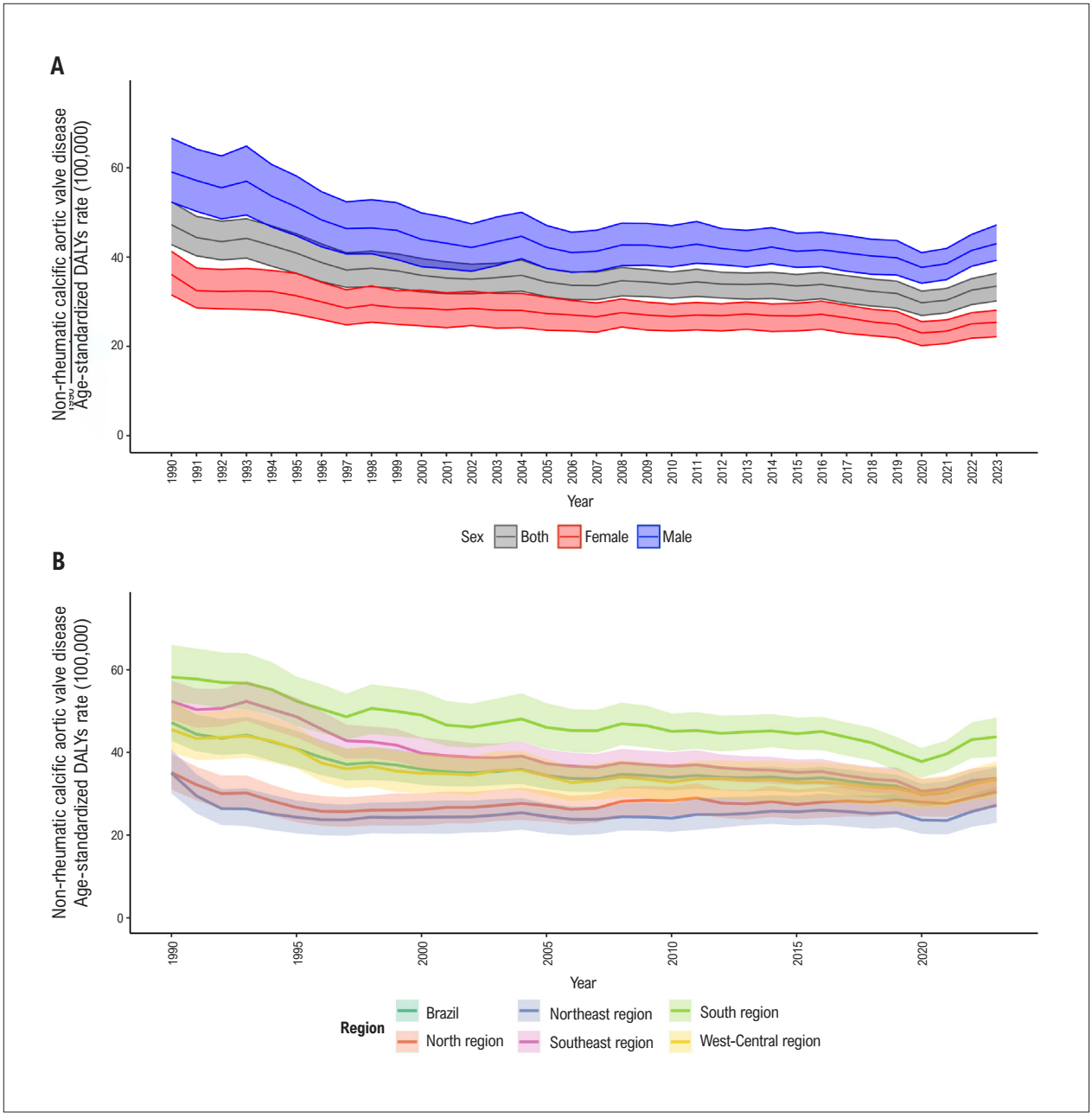

Chart 5.9 – *A: Age-standardized DALY rates attributable to non-rheumatic aortic valve disease in Brazil by sex from 1990 to 2023. B: Age-standardized DALY rates attributable to non-rheumatic aortic valve disease in Brazil by region from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 6 – ATRIAL FIBRILLATION AND FLUTTER

ICD-10 I48.

See Tables 6.1 through 6.4 and Charts 6.1 through 6.3.

Abbreviations used in chapter 6

AF	Atrial Fibrillation
BNP	B-type Natriuretic Peptide
ChD	Chagas Disease
CI	Confidence Interval
DALYs	Disability-Adjusted Life Years
DATASUS	Department of Information and Data Processing of the Brazilian Unified Health System
ECG	Electrocardiogram
ELSA-Brasil	The Brazilian Longitudinal Study of Adult Health
FU	Federative Unit
GBD	Global Burden of Disease
HR	Hazard Ratio
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th Revision
IMPACT-AF	Multifaceted Intervention to Improve Treatment With Oral Anticoagulants in Atrial Fibrillation
INR	International Normalized Ratio
IQR	Interquartile Range
OR	Odds Ratio
PPP	Purchasing Power Parity
REPLICCAR II	Registro Paulista de Cirurgia Cardiovascular
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
TTR	Time in Therapeutic Range
UI	Uncertainty Interval
VKA	Vitamin K Antagonists

Prevalence and Incidence

- The prevalence of atrial fibrillation (AF) and atrial flutter varies according to the setting (population vs healthcare-based studies) characteristics of the population included in the studies, particularly because AF prevalence is highly associated with increasing age and presence of comorbidities.
- According to the GBD Study 2023 estimates, the age-standardized prevalence rates of AF and atrial flutter remained stable in Brazil from 1990 to 2023, 813 (95% UI, 630-1017) and 806 (95% UI, 623-999), respectively, per 100,000 inhabitants, for both sexes. However, crude prevalence rates more than doubled in the period, 447 per 100,000 in 1990 (95% UI, 346-567) and 999 (95% UI, 772-1249) in 2023, revealing that the stability in age-standardized rates relates to population aging. Importantly, higher crude mortality rates result in a greater impact of the disease on the health systems, with more individuals per 100,000 living with the disease, who will need health system support (Table 6-1 and Chart 6.1). Stratifying by Brazilian Federative Units (FUs), the prevalence rate of AF and atrial flutter is similar in most Brazilian FUs (Table 6-2).
- Population-based studies have shown AF prevalence varying from 0.3% to 2.5%.[183-185] In the ELSA-Brasil cohort study, which included 14,424 adults with valid ECG (45.8% men; mean age 51 years, age range 35-74 years), the AF and atrial flutter prevalence was 0.3% (men, 0.5%; women, 0.2%), with the highest prevalence in the age group of 65-74 years (women: OR 17; 95% CI, 2.1-135.9; men: OR 52.3; 95% CI, 3.1-881.8).[183] When self-report was added to the AF definition in the ELSA-Brasil, the AF prevalence rose to 2.5%, but differences in patients' characteristics were observed between ECG-diagnosed AF and self-reported AF.[184]
- In the ELSA-Brasil study including 2,088 participants aged ≥60 years (mean age 65 years; 53% women), the AF prevalence was 4.2%. In multivariable analysis, heart failure, left bundle branch block, left atrial enlargement, and reduced left ventricular ejection fraction were independently associated with prevalent AF and atrial flutter. Risk prediction analysis showed that 12–13% of participants in sinus rhythm were at high 5-year risk of developing AF according to the CHARGE-AF and EHR scores.[186]
- Telehealth centers across Brazil have provided information on the prevalence of AF and atrial flutter based on ECG from primary care.[187-189] In the Telehealth Network of Minas Gerais including 1,558,421 individuals (mean age, 51±18 years; 40.2% men) with ECG performed between 2010 and 2017, the AF prevalence was 1.33%, higher in men (1.81% vs. 1.02%), and increasing with age (OR 1.08; CI 95%, 1.08-1.08), reaching 7.0% in octogenarians (8.4% in men vs. 5.9% in women).[187] In 676,621 ECGs (mean age, 51±19 years; 57.5% women) from the Federal University of São Paulo telemedicine center (2009-2016), 7-year AF prevalence of 2.2% and countrywide 2025-projected AF prevalence of 1.7% were observed.[188]
- In a prospective cross-sectional study conducted in primary care in Joinville, Brazil, including 1,000 elderly (mean age, 69±7 years; 57% women), the prevalence of AF was 3.0%. Of the individuals with AF, 50% were previously undiagnosed.[190]
- Enhanced screening for individuals at higher AF risk may increase diagnosis. In the RITMO study, a cross-sectional study including 408 asymptomatic elderly (≥65 years) with hypertension or heart failure, a stepwise screening strategy was used to detect AF. First, 13 (3.2%) of those individuals were diagnosed with AF. Next step was 7-day home ECG monitoring with a portable device (Kardia 6L)

for individuals at high AF risk (n=120) based on the 'Stroke Risk Analysis'. Atrial fibrillation episodes were detected in 43/120 individuals, approximately one-third of the group. Overall, the combined strategy increased AF detection to 13.7% (56/408), substantially higher than detection by single-timepoint ECG alone.[191]

Mortality

- In the GBD Study 2023, the number of deaths due to AF in Brazil has increased almost five times from 1990 to 2023, from 2,593 (95% UI, 2,302-2,825) in 1990 to 12,417 (95% UI, 10,322-13,781) in 2023. This rise reflects population growth and aging, because estimated age-standardized mortality rate in Brazil for both sexes remained stable from 1990 to 2023, when it was 5.0 per 100,000 (95% UI, 4.1-5.5) (Chart 6.2 and Table 6-1). However, age-standardized mortality rate increased for specific subgroups, such as men (12.2%; 95% UI, 1.4-23.2), and in the North (18.1%; 95% UI, 8.0-31.4) and West-Central regions (13.7%; 95% UI, 4.2-24.6), while remained stable for females and in the South, Southeast, and Northeast regions. Table 6-3 shows the AF-related number of deaths, age-standardized mortality rates per 100,000 inhabitants in 1990 and 2023, and percent change of the rates in the period, for males, females, and for both sexes, in Brazil and its regions and FUs. The FUs with the highest mortality rates in 2023 were Rio Grande do Sul, Rondônia, Paraná, Mato Grosso, and Pará, while those with the lowest were Distrito Federal, Maranhão, Ceará, and Pernambuco.
- The GBD Study 2023 estimates in Table 6-1 show the steep increase in AF deaths in older age groups, with age-standardized mortality rates per 100,000 varying from 0.1 (95% UI, 0.1-0.1) in the 15-49-year age group, 2.6 (95% UI, 2.5-2.8) in the 50-69-year, to 73.5 (95% UI, 59.9-82.1) in the 70+ age group, resembling the global epidemiology of AF.
- The GBD Study 2023 uses the sociodemographic index (SDI) as an estimate of the socioeconomic level of a location. As demonstrated in Chart 6.3, there was no association between the SDI in 2023 and the percent change in AF age-standardized mortality rates from 1990 to 2023 ($r = -0.267$, $p = 0.18$), revealing that socioeconomic level was not a driver of mortality changes across Brazilian FUs, possibly because there are factors acting in opposite directions related to socioeconomic levels that determine the final variation. For example, higher-SDI regions may have better access to diagnosis and management (including anticoagulation), which tends to reduce mortality;[192] however, they also show a higher prevalence of cardiovascular risk factors and longer life expectancy, leading to a greater burden of AF.[193] Conversely, lower-SDI regions may have a lower detected prevalence of AF, but worse access to timely diagnosis and treatment, which can increase case-fatality rates.[194]
- In a nationwide retrospective epidemiological study in Brazil (1996–2022), based on mortality data from the Department of Information and Data Processing of the Brazilian Unified Health System (DATASUS), a total of 1,201,327 deaths related to AF and stroke were recorded. Stroke accounted for the vast majority of deaths (94.5%), while AF and atrial flutter contributed to 5.5% of the cases. Over the 26-year period, mortality due to AF and atrial flutter increased markedly (≈729%), whereas stroke mortality showed a modest decline (~25%). Deaths were predominantly concentrated in the Southeast region, where there is more infrastructure for AF detection, and in older adults (≥ 60 years), with a higher proportion of women among AF and atrial flutter deaths and men among stroke deaths. Most deaths occurred in hospital settings (73.6%), followed by home (20.9%), reflecting the clinical severity of these conditions.[195]
- From a dataset of 1,558,421 ECGs from primary care patients (Telehealth Network of Minas Gerais linked to the Brazilian Mortality Information System), the overall mortality rate was 3.34% in a mean follow-up of 3.68 years. After adjusting for age and comorbidities, patients living with AF had a higher risk of overall (HR 2.10; 95% CI, 2.03–2.17) and cardiovascular (HR 2.06; 95% CI, 1.86–2.29) death, with increased risk in women, who lost their survival advantage over men when AF was present.[196]
- In a 10-year follow-up of 1,462 individuals aged ≥ 60 years (mean age, 69 years; 61% women) included in 1997 in the Bambuí Cohort Study, AF or atrial flutter was independently associated with an increase in all-cause mortality among patients with (HR 2.35; 95% CI, 1.53-3.62) and without (HR 1.92; 95% CI, 1.05-3.51) Chagas disease (ChD).[197]
- The RECALL registry was a multicenter prospective registry that included and followed 4,585 patients with AF up for one year at 89 sites across Brazil from April 2012 to August 2019. Death occurred in 8.8/100 patients/year (95% CI, 8.0-9.6) and was associated in multivariable models with older age, permanent AF, New York Heart Association class III/IV, chronic kidney disease, peripheral arterial disease, stroke, chronic obstructive pulmonary disease, and dementia. The use of anticoagulant drugs was associated with lower mortality and patients with time in therapeutic range (TTR) < 60% had higher mortality and more major bleeding events compared to patients with TTR ≥ 60%.[198]

Burden of Disease

- According to the GBD Study 2023 estimates, DALY trends reveal the same pattern of mortality trends: while the numbers increased, the age-standardized DALY rates for Brazil remained stable, from 120 (95% UI, 99-148) per 100,000 in 1990 to 125 (95% UI, 102-160) in 2023, varying in 2023 from 15 (95% UI, 11-21) in the 15-49 age group to 1,368 (95% UI, 1,130-1,680) in the age group of 70 years and older (Table 6-1). Regarding sex-specific trends in the GBD Study 2023, Brazilian males have a greater AF burden than females, in accordance with global data, showing age-standardized DALY rates per 100,000 of 144 (95% UI, 118-184) for men and 111 (95% UI, 89-140) for women (Table 6-4).

Complications

- Atrial fibrillation is related to adverse clinical outcomes other than death, such as stroke, hospitalizations, bleeding, and dementia.[199-203]

- Of all 429 cases of stroke (87.2% ischemic strokes) that occurred in the city of Joinville in 2015 and were included in a registry, AF was detected in 11.4% of all patients and in 58% of the cardioembolic strokes.[199] Between 2017 and 2020, of the 3,303 cases of ischemic stroke in the same city, 11% had AF. Of these patients with AF, 258 (71.6%) had a previous diagnosis of the disease, and 102 (28.3%) were newly diagnosed after the stroke. Of the patients with a previously diagnosed AF, 170 (47.2%) were on anticoagulants and 88 (24.4%) were on other medications.[203]
- In a cohort of 1,121 ischemic stroke patients in a 12-year follow-up, AF was independently associated with increased overall (HR 1.82; 95% CI, 1.43-2.31) and cardiovascular (HR 2.07; 95% CI, 1.36-3.14) mortality.[201]
- In the RECALL prospective registry of AF patients, the incidence rate of stroke was 2.5/100 patients/years (2.1-3.0), while that of systemic embolism was 3.5/100 patients/years (2.8-4.4). Major bleeding occurred in 2.0/100 patients/years (1.6-2.4), and hospitalization in 19.6/100 patients/years (18.4-20.9). The latter was mainly related to cardiovascular causes as compared to bleeding (2.7/100 patients/years, 95% CI, 2.2-3.2).[198]

Risk Factors for Atrial Fibrillation/Flutter

- Data from the Telehealth Network of Minas Gerais with ECGs of 1,558,421 individuals (mean age, 51±18 years; 40.2% men) performed between 2010 and 2017 have revealed, in multivariable models adjusted for age and sex, that the following self-reported comorbidities were related to the presence of AF: ChD (OR 3.08; 95% CI, 2.91-3.25), previous myocardial infarction (OR 1.74; 95% CI, 1.56-1.93), chronic obstructive pulmonary disease (OR 1.48; 95% CI, 1.33-1.66), hypertension (OR 1.31; 95% CI, 1.27-1.34), and dyslipidemia (OR 1.09; 95% CI, 1.03-1.16). Current smoking and diabetes were not associated with prevalent AF.[196]
- In the RECALL prospective registry of AF patients, the most common risk factors were hypertension (77.9%), previous cardiovascular events (37.3%), and diabetes (30%).[198]
- In a cross-sectional analysis of the ELSA-Brasil cohort study, the cardiovascular health score proposed by the American Heart Association was not associated with prevalent AF at baseline (80/13,141 valid ECGs, 0.8%).[204,205]

Associated Comorbidities

Atrial fibrillation and other heart diseases

- AF is correlated with other concomitant cardiovascular diseases. On echocardiogram, AF was associated with heart disease (OR 3.9; 95% CI, 2.1 - 7.2, p < 0.001) in 1,518 patients (mean age, 58±16 years; 66% female) from a waiting list for echocardiogram in primary care.[206] In a study sample of 300 elderly monitored with pacemakers, the incidence of AF was 22% in a 435-day follow-up,[207] and, in another sample with patients with pacemakers and chronic kidney disease in a 1-year follow-up, the incidence of AF reached 85%.[208] In another study of 186 patients with pacemakers from a single center in Southern Brazil [52% women, median age 67 years (IQR 57-76)], the prevalence of AF was 25.3%, with an incidence of 5.64 cases/100 persons-year.[209] Among patients with cardiovascular disease visiting the emergency department, the prevalence of AF was 40% of those with decompensated heart failure[210] and 44% of those with valvular heart disease.[211]

Perioperative atrial fibrillation and cardiovascular surgery

- Of patients undergoing cardiac surgery, 12% to 33% had AF in the postoperative period.[212-215] Surgeries for valve replacement were associated with a higher occurrence of AF (31-33%) during hospitalization as compared to coronary artery bypass grafting (12-16%). Advanced age, mitral valve disease, and no beta-blocker use were associated with postoperative AF in valvular surgery.[216]
- In a multicenter observational study using the REPLICCAR II registry including 3,803 patients undergoing coronary artery bypass grafting, postoperative AF occurred in 15.9% of patients. After propensity score matching, postoperative AF remained strongly associated with longer intensive care unit stay and ventilation time, stroke, and infectious complications, such as pneumonia and sepsis. In multivariable analysis, acute renal dysfunction and longer intensive care unit length of stay were independently associated with postoperative AF.[217]
- A quality improvement program on hospital mortality has shown to reduce postoperative AF from 4.4% to 1.5%, p < 0.0001.[181]

Atrial fibrillation and Chagas disease

- Atrial fibrillation has been consistently associated with ChD and increases the risk of death in patients with ChD.[218-221] In a systematic review and meta-analysis, AF prevalence was significantly higher in patients with ChD (OR 2.11; 95% CI, 1.40-3.19).[220]
- In a large sample of 264,324 patients undergoing tele-ECG in primary health care units, AF was observed in 5.35% of those with ChD and in 1.65% of those without ChD (OR 3.15; 95% CI, 2.83-3.51), adjusted for age, sex, and self-reported comorbidities.[218]
- In the Bambuí Cohort Study, 1,462 participants aged ≥ 60 years (mean age, 69 years; ChD n = 557, 38.1%), with baseline ECG, were followed up for 10 years. Atrial fibrillation was more frequently observed in subjects with ChD [6.1% vs 3.4% (OR 3.43; 95% CI, 1.87-6.32)], adjusted for age, sex, and clinical variables, in whom it was an independent risk factor for death (HR 2.35; 95% CI, 1.53-3.62), adjusted for age, sex, clinical variables, and B-type natriuretic peptide (BNP) levels.[197]

Health Care Utilization and Cost

- According to data from the DATASUS, there were 517,432 hospitalizations for AF from 2008 to 2024, ranging from 25,283 in 2021 to 32,753 in 2019, just before the COVID-19

pandemic, revealing the reduction in hospitalizations for AF in the pandemic period. From 2008 to 2024, the total cost due to AF hospitalizations after adjusting for Brazilian inflation was R$ 458,255,317.81, and, in international dollars converted to purchasing power parity (PPP)-adjusted 2025 US$, $ 149,764,868.64. This scenario reveals that, even for values adjusted for inflation, there was a 63% increase in costs with AF hospitalizations, corroborating the higher number of individuals living with the disease.

- Regarding ablation procedures for AF and atrial flutter and using data from the DATASUS, 2,678 procedures were performed by the Brazilian Unified Health System (SUS) from 2008 to 2024. There was an annual reduction in the number of procedures in 2020 and 2021, during the COVID-19 pandemic, as compared to 2019 (163 procedures vs 120 in 2020 and 161 in 2021), with recovery in 2022 (234 procedures). After adjusting for Brazilian inflation, the cost for AF ablation from 2008 to 2024 was R$ 22,947,246.74, seven times higher in 2024 as compared to 2008. In international dollars converted to PPP-adjusted 2025 US$, that cost was US$ 6,264,514.68.

Awareness, Treatment, and Control

Anticoagulation

- There has been a high variation in the use of anticoagulation in patients with AF, from 1.5% to 91%.[187,188,222,223] Studies with samples from primary care were more likely to have low anticoagulation use as compared to samples recruited from tertiary centers or cardiologists, as detailed below. In primary care centers of 658 municipalities of Minas Gerais state, mean anticoagulant use was reported by 1.5%, while, in the IMPACT-AF trial, 91% of patients enrolled in Brazil (n = 360), mostly on cardiologist care at tertiary centers, were on oral anticoagulation at baseline.[187,222] In a prospective cross-sectional study conducted in primary care in Joinville, Brazil, including 1,000 elderly individuals (mean age 69±7 years; 57% women), 33% of those previously diagnosed were not receiving anticoagulation despite clinical indication.[190]
- In the population-based ELSA-Brasil cohort study, from 185 participants with prevalent AF and a CHA_2DS_2-VASc score ≥ 2, only 20 (10.8%) used anticoagulants. Stroke prevention in this group was associated with a higher age (1.8% vs 17.7% in those aged ≤ 54 and ≥ 65 years, respectively; p = 0.013). A trend towards a reduced anticoagulant use was observed in women (7.1% vs. 16.4% in women and men, respectively; p = 0.055).[184]
- This sex-specific treatment gap has also been revealed in a prospective multicenter registry from private hospitals including 1,955 patients presenting with AF to emergency departments across 32 tertiary hospitals in Brazil. Men were more prevalent (58%) and younger than women (61±17 vs. 71±15 years), but the latter had higher thromboembolic risk (CHA_2DS_2-VASc score 4 for women vs. 2) and a greater indication for anticoagulation, largely driven by older age and higher comorbidity burden. However, despite guideline indications, a substantial proportion of patients, particularly women, were not receiving anticoagulant therapy (23% of women vs. 18%).[224]
- In the RECALL prospective registry of AF patients, the mean (standard deviation) CHA_2DS_2-VASc score was 3.2 (1.6); median HAS-BLED score was 2 (2, 3). At baseline, 78% of patients were on anticoagulants [62.6% on vitamin K antagonists (VKA) and 37.4% on direct oral anticoagulants]. The primary reasons for not using an oral anticoagulant were physician judgment (24.6%) and difficulty in controlling (14.7%) or performing (9.9%) INR.[198]
- Anticoagulation use has been associated with lower risk of death in the RECALL prospective registry of patients with AF.[198] In a cohort of 200 ischemic stroke patients with AF, anticoagulant use was inversely associated with all-cause mortality (oral anticoagulant time-dependent effect: multivariable HR 0.47; 95% CI, 0.30–0.50) and stroke mortality (oral anticoagulant time-dependent effect ≥ 6 months: multivariable OR 0.09; 95% CI, 0.01–0.65).[223]
- In a prospective cohort including 1,350 patients with AF (mean age, 69.2 years; 53.6% women) treated with VKA and followed up for a median of 17 months, the annual incidence of thromboembolic events and cardiovascular death was 4.4%, and major or clinically relevant non-major bleeding was 3.24%. Previous thromboembolism, TTR < 50%, and reduced kidney function (eGFR < 45 mL/min/1.73 m²) were independent predictors of thromboembolic events and cardiovascular death. Prior bleeding and the presence of mechanical valve prosthesis were independently associated with bleeding events. The composite outcome of thromboembolic and bleeding events occurred at a rate of 8.7% per year and was associated with prior bleeding, poor anticoagulation control (TTR < 41%), and left atrial enlargement (>44 mm).[225]
- The quality of warfarin therapy has been evaluated using the parameter TTR in different samples in Brazil. The TTR of anticoagulation for AF has ranged from 31% to 67% in studies.[193,217,218-221] In a single-center experience, anticoagulation delivered by a dedicated clinic, run by a multidisciplinary team of hematologists and pharmacists, was able to improve TTR in a population with low literacy being cared in the SUS.[226]

Rhythm or rate control (medication, cardioversion, catheter ablation)

- A cross-sectional study with 167 AF patients has found that rate control was more common than rhythm control as treatment strategy (79% vs. 21%; p < 0.001).[227]
- Data from 125 primary care centers have shown that, of 301 patients with AF, 91 (30.2%) were receiving neither rate nor rhythm control therapy. Of the remaining, 70% used only rate control agents and 30% used at least one antiarrhythmic drug.[188]
- In the RECALL prospective registry of patients with AF, 4.4% had a history of previous AF ablation, 0.9% atrioventricular node ablation with pacemaker implantation, and 25.2% had a previous cardioversion. Nearly 30% used an antiarrhythmic drug for rhythm control, led by amiodarone.

For heart rate control, 69.5% used beta-blockers, 25.7% were receiving non-dihydropyridine calcium channel blockers, and 15.8% were on digitalis.[198]

Impact of the Covid-19 Pandemic

- There was a reduction in AF hospitalizations and procedures during the pandemic period, in 2020 and 2021. This reduction was probably related to indirect effects of the pandemic, when there was a decrease in cardiovascular hospitalizations in general, in Brazil and worldwide, because elective procedures were postponed, contact with health system was avoided, and cardiovascular care was disrupted.[151,228,229] From 2022 onwards, there was a return to the previous trends.

Future Research

- Data from population-based cohort studies regarding AF incidence and determinants in Brazil are underway.
- Screening of AF in population-based or selected populations using ECG or devices, including wearables and longer duration patches, should bring information on the relevance of including this strategy in primary care or specialized centers.
- Studies using artificial intelligence algorithms to predict AF from ECGs have been developed, including some derived from Brazilian data.[230,231] These artificial intelligence algorithms may be a tool to improve AF risk stratification and personalize screening strategies according to risk.
- Strategies to reduce gaps in AF treatment must be developed, including evaluating the cost-effectiveness of incorporating direct oral anticoagulants into the public health system.
- Implementation strategies to enhance anticoagulation use among patients with AF should be encouraged, particularly in primary care settings.

Table 6.1 – Number and all-age and age-standardized rates of death, DALYs, and prevalence of atrial fibrillation, by age groups, in Brazil, in 1990 and 2023, and the percent change of rates in the period

Age group	Variable	Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change ((95% UI)
15-49 years	Deaths	Brazil	42,1 (37,3; 46,2)	0,1 (0,0; 0,1)	125,7 (118,4; 133,7)	0,1 (0,1; 0,1)	108,9 (86,4; 138,5)
50-69 years	Deaths	Brazil	309,0 (288,0; 329,0)	2,0 (1,8; 2,1)	1.153,8 (1.100,0; 1.217,9)	2,6 (2,5; 2,8)	34,6 (24,8; 45,1)
70+ years	Deaths	Brazil	2.242,1 (1.958,9; 2.459,2)	52,4 (45,8; 57,5)	11.138,3 (9.080,0; 12.453,9)	73,5 (59,9; 82,1)	40,1 (27,7; 52,6)
All ages	Deaths	Brazil	2.593,1 (2.302,4; 2.825,7)	1,7 (1,5; 1,9)	12.417,7 (10.322,5; 13.781,7)	5,9 (4,9; 6,5)	237,2 (208,0; 266,9)
Age-standardized	Deaths	Brazil		4,7 (4,0; 5,2)		5,0 (4,1; 5,5)	6,6 (-1,5; 14,6)
< 5 yeras	DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
5-14 years	DALYs	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
15-49 years	DALYs	Brazil	7.024,2 (4.786,3; 10.163,7)	9,1 (6,2; 13,2)	16.761,6 (11.953,0; 23.540,8)	15,3 (10,9; 21,4)	66,9 (54,9; 82,2)
50-69 years	DALYs	Brazil	32.796,4 (24.274,4; 46.748,7)	208,4 (154,2; 297,0)	100.420,8 (75.697,2; 141.339,9)	229,9 (173,3; 323,6)	10,3 (6,0; 15,7)
70+ years	DALYs	Brazil	49.432,0 (39.841,3; 61.253,5)	1.156,3 (932,0; 1.432,8)	207.466,2 (171.339,5; 254.755,7)	1.368,3 (1.130,0; 1.680,2)	18,3 (11,2; 25,4)
All ages	DALYs	Brazil	89.252,6 (70.854,7; 116.534,6)	59,8 (47,4; 78,0)	324.648,6 (261.940,9; 415.784,8)	153,1 (123,5; 196,1)	156,1 (143,9; 173,4)
Age-standardized	DALYs	Brazil		120,4 (97,6; 153,7)		125,7 (101,6; 160,2)	4,4 (0,4; 8,8)
<5 years	Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)
5-14 years	Prevalence	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)
15-49 years	Prevalence	Brazil	61.896,7 (37.511,1; 92.289,4)	80,5 (48,8; 120,1)	134.528,7 (81.818,1; 201.406,7)	122,4 (74,5; 183,3)	52,0 (47,3; 57,1)
50-69 years	Prevalence	Brazil	301.271,3 (218.664,7; 411.444,2)	1.914,0 (1.389,2; 2.613,9)	857.033,6 (623.327,1; 1.187.036,2)	1.962,2 (1.427,1; 2.717,7)	2,5 (0,3; 4,4)
70+ years	Prevalence	Brazil	304.765,0 (222.820,9; 410.471,7)	7.129,0 (5.212,2; 9.601,6)	1.127.387,7 (830.535,5; 1.486.870,5)	7.435,3 (5.477,5; 9.806,1)	4,3 (0,9; 8,2)
All ages	Prevalence	Brazil	667.933,1 (516.033,2; 846.711,5)	447,3 (345,6; 567,0)	2.118.950,1 (1.636.171,8; 2.647.772,3)	999,1 (771,5; 1.248,5)	123,4 (115,8; 131,0)
Age-standardized	Prevalence	Brazil		812,7 (630,1; 1.017,6)		806,2 (623,0; 999,4)	-0,8 (-2,3; 0,5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 6.2 – Number of cases and age-standardized prevalence rates of atrial fibrillation, by sex, in 1990 and 2023, in Brazil, Brazilian regions, and Federative Units, and the percent change of rates

Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	372.376,6 (287.440,9; 470.590,3)	978,5 (757,6; 1.221,4)	1.132.497,7 (871.025,7; 1.424.654,8)	981,1 (755,7; 1.219,2)	0,3 (-1,6; 2,1)	Male
North region	17.056,0 (13.161,5; 21.853,4)	934,6 (724,8; 1.168,1)	69.556,5 (53.463,2; 89.361,4)	946,8 (720,6; 1.195,4)	1,3 (-2,6; 5,4)	Male
Acre	792,8 (600,0; 1.008,4)	946,2 (719,8; 1.190,8)	3.100,8 (2.362,1; 3.946,3)	954,9 (729,2; 1.219,3)	0,9 (-6,3; 6,6)	Male
Amapá	386,0 (294,4; 498,6)	929,2 (715,6; 1.177,6)	2.407,0 (1.841,0; 3.136,9)	935,6 (710,3; 1.198,5)	0,7 (-5,2; 9,3)	Male
Amazonas	3.341,5 (2.564,5; 4.344,3)	954,0 (733,3; 1.201,0)	13.671,7 (10.503,7; 17.592,5)	955,9 (733,3; 1.204,7)	0,2 (-6,1; 7,5)	Male
Pará	8.742,1 (6.731,1; 11.120,2)	934,0 (726,4; 1.174,8)	33.328,9 (25.550,8; 42.815,8)	945,2 (723,2; 1.201,5)	1,2 (-5,4; 7,9)	Male
Rondônia	1.799,3 (1.405,2; 2.362,4)	933,4 (721,7; 1.194,9)	7.738,6 (5.952,0; 9.846,8)	963,1 (733,4; 1.211,8)	3,2 (-4,3; 10,0)	Male
Roraima	278,4 (213,1; 360,5)	940,0 (723,3; 1.197,4)	1.992,1 (1.516,7; 2.614,4)	955,9 (733,9; 1.207,8)	1,7 (-4,7; 8,3)	Male
Tocantins	1.716,0 (1.299,2; 2.249,2)	897,0 (689,1; 1.154,4)	7.317,5 (5.730,9; 9.230,9)	919,6 (719,8; 1.156,4)	2,5 (-3,5; 10,6)	Male
Northeast region	106.720,6 (82.532,4; 134.735,8)	951,9 (743,2; 1.197,5)	282.465,5 (217.958,3; 354.806,5)	958,1 (738,1; 1.196,9)	0,6 (-1,5; 2,8)	Male
Alagoas	5.780,5 (4.462,4; 7.363,5)	969,0 (761,9; 1.224,5)	14.593,0 (11.290,1; 18.525,7)	977,6 (758,3; 1.242,0)	0,9 (-4,4; 6,0)	Male
Bahia	28.959,9 (22.396,1; 36.476,7)	972,8 (757,4; 1.225,5)	80.344,0 (62.484,2; 101.478,2)	983,0 (762,9; 1.242,3)	1,0 (-4,3; 6,3)	Male
Ceará	16.799,8 (12.997,2; 21.236,2)	945,8 (732,3; 1.187,2)	45.851,6 (36.126,0; 57.812,8)	942,0 (739,8; 1.189,2)	-0,4 (-6,4; 5,4)	Male
Maranhão	10.261,6 (7.916,0; 13.119,8)	915,1 (711,7; 1.158,6)	29.283,8 (22.693,0; 37.128,2)	914,6 (706,4; 1.152,0)	-0,1 (-8,1; 5,9)	Male
Paraíba	9.884,8 (7.663,5; 12.728,2)	952,9 (742,5; 1.210,8)	21.480,7 (16.712,2; 27.257,7)	959,4 (745,0; 1.208,4)	0,7 (-5,4; 7,6)	Male
Pernambuco	18.612,3 (14.224,1; 23.947,7)	949,7 (733,9; 1.206,1)	44.711,7 (34.459,1; 56.021,8)	955,6 (730,6; 1.191,6)	0,6 (-6,2; 7,5)	Male
Piaui	5.937,4 (4.584,2; 7.569,1)	920,0 (719,4; 1.174,5)	17.505,9 (13.334,1; 22.568,5)	930,7 (707,9; 1.196,8)	1,2 (-5,7; 7,4)	Male
Rio Grande do Norte	6.953,1 (5.430,1; 8.907,9)	951,5 (747,1; 1.207,7)	17.932,4 (13.877,9; 22.657,6)	965,0 (744,7; 1.214,6)	1,4 (-4,4; 9,9)	Male
Sergipe	3.531,2 (2.707,3; 4.476,8)	961,5 (741,4; 1.210,5)	10.762,4 (8.196,4; 13.623,5)	988,6 (750,9; 1.260,1)	2,8 (-3,7; 8,8)	Male
Southeast region	169.394,6 (130.065,0; 214.584,5)	995,7 (765,0; 1.245,1)	516.610,9 (397.793,5; 646.841,2)	996,5 (769,0; 1.236,5)	0,1 (-3,3; 3,7)	Male
Espírito Santo	6.311,6 (4.917,0; 8.045,0)	967,6 (747,5; 1.217,0)	22.354,9 (17.102,7; 28.427,5)	981,0 (749,8; 1.239,8)	1,4 (-5,5; 8,1)	Male

Minas Gerais	40.398,2 (30.981,0; 51.151,6)	967,8 (743,1; 1.221,5)	129.227,2 (99.905,0; 164.146,9)	971,4 (749,2; 1.227,5)	0,4 (-6,8; 8,4)	Male
Rio de Janeiro	37.406,8 (28.639,3; 49.128,6)	985,5 (774,6; 1.262,3)	96.753,6 (74.538,9; 122.605,5)	978,0 (757,0; 1.234,8)	-0,8 (-8,8; 6,1)	Male
São Paulo	85.278,0 (65.435,4; 107.494,6)	1.016,7 (778,5; 1.269,2)	268.275,1 (205.254,3; 340.790,1)	1.017,5 (779,4; 1.289,5)	0,1 (-6,0; 6,9)	Male
South region	60.450,4 (46.408,4; 76.651,5)	1.004,0 (777,9; 1.257,9)	184.269,1 (142.040,8; 234.605,2)	996,5 (767,5; 1.247,3)	-0,7 (-4,3; 3,2)	Male
Paraná	21.800,3 (16.743,9; 27.680,3)	987,7 (764,6; 1.240,3)	67.770,2 (52.174,1; 87.547,6)	994,0 (761,8; 1.267,3)	0,6 (-6,3; 8,6)	Male
Rio Grande do Sul	27.624,6 (21.044,7; 34.839,3)	1.019,7 (783,1; 1.280,4)	73.929,3 (56.605,0; 93.238,8)	997,1 (767,4; 1.248,3)	-2,2 (-8,6; 4,9)	Male
Santa Catarina	11.025,5 (8.364,7; 14.102,9)	998,5 (777,6; 1.254,5)	42.569,7 (32.434,5; 55.009,6)	999,6 (775,5; 1.275,0)	0,1 (-7,6; 5,8)	Male
West-Central region	18.754,9 (14.422,4; 24.295,0)	950,3 (739,4; 1.206,5)	79.595,7 (61.832,5; 100.729,3)	962,9 (750,3; 1.202,2)	1,3 (-2,1; 4,0)	Male
Distrito Federal	2.332,6 (1.765,3; 3.001,4)	953,2 (738,6; 1.199,3)	12.815,1 (9.964,7; 16.477,9)	974,4 (760,9; 1.234,7)	2,2 (-3,4; 8,3)	Male
Goiás	8.740,0 (6.671,2; 11.238,9)	946,3 (730,6; 1.199,5)	35.349,2 (27.328,9; 44.806,6)	953,1 (745,2; 1.203,1)	0,7 (-5,7; 7,0)	Male
Mato Grosso	3.613,0 (2.804,0; 4.668,1)	939,2 (730,2; 1.177,9)	16.971,3 (12.998,0; 21.487,6)	964,6 (736,3; 1.210,4)	2,7 (-4,1; 9,6)	Male
Mato Grosso do Sul	4.069,4 (3.093,6; 5.196,8)	967,0 (752,0; 1.224,4)	14.460,2 (11.130,2; 18.256,4)	975,5 (753,6; 1.225,2)	0,9 (-4,8; 7,9)	Male
Brazil	295.556,5 (228.399,1; 373.999,7)	672,9 (521,6; 850,6)	986.452,3 (763.459,6; 1.242.458,9)	668,3 (516,9; 841,2)	-0,7 (-2,7; 1,3)	Female
North region	11.464,2 (8.866,6; 14.503,5)	644,0 (499,1; 813,1)	50.909,1 (39.317,6; 64.854,3)	644,4 (496,5; 813,9)	0,1 (-3,4; 3,4)	Female
Acre	448,4 (343,6; 566,8)	650,2 (494,3; 809,3)	2.246,7 (1.742,4; 2.827,9)	651,2 (500,8; 826,7)	0,2 (-5,6; 6,6)	Female
Amapá	325,4 (242,2; 410,5)	641,1 (481,8; 809,3)	1.803,6 (1.393,7; 2.264,3)	638,9 (489,0; 815,5)	-0,3 (-6,6; 7,3)	Female
Amazonas	2.287,8 (1.735,4; 2.913,9)	654,7 (496,1; 836,0)	10.373,7 (7.962,9; 13.186,8)	651,2 (497,6; 830,2)	-0,5 (-6,4; 5,7)	Female
Pará	6.321,2 (4.895,2; 7.962,8)	644,8 (499,0; 809,3)	24.860,1 (19.201,7; 31.765,9)	643,4 (495,4; 812,3)	-0,2 (-5,7; 5,4)	Female
Rondônia	901,8 (691,8; 1.169,2)	642,9 (493,5; 813,2)	5.296,2 (4.035,5; 6.688,0)	653,7 (495,3; 829,1)	1,7 (-3,6; 8,4)	Female
Roraima	142,5 (108,2; 182,7)	647,1 (494,4; 822,8)	1.331,6 (1.004,3; 1.701,8)	649,7 (494,3; 821,1)	0,4 (-4,8; 6,1)	Female
Tocantins	1.037,1 (781,5; 1.342,3)	615,7 (467,4; 784,2)	4.997,3 (3.792,1; 6.332,6)	624,3 (471,7; 796,4)	1,4 (-4,7; 7,5)	Female
Northeast region	82.833,7 (63.666,5; 105.278,9)	653,6 (502,7; 823,9)	244.980,8 (189.542,9; 307.711,8)	654,5 (504,6; 824,4)	0,1 (-1,9; 2,8)	Female

Alagoas	4.368,7 (3.316,1; 5.532,9)	662,8 (502,5; 840,0)	12.903,0 (9.854,5; 16.576,0)	670,5 (509,7; 866,0)	1,2 (-5,4; 9,4)	Female
Bahia	22.864,3 (17.313,7; 29.177,2)	666,7 (503,2; 848,3)	67.957,6 (52.904,5; 85.365,4)	669,1 (518,2; 843,0)	0,4 (-5,5; 6,0)	Female
Ceará	12.960,7 (9.998,2; 16.370,2)	649,8 (501,4; 813,3)	39.905,9 (30.559,0; 49.993,6)	646,1 (492,4; 815,7)	-0,6 (-7,1; 4,6)	Female
Maranhão	7.498,5 (5.647,1; 9.616,0)	629,8 (475,2; 799,4)	23.030,9 (17.719,7; 29.052,6)	623,3 (478,4; 788,4)	-1,0 (-6,7; 6,0)	Female
Paraíba	7.531,9 (5.813,5; 9.726,7)	653,9 (506,3; 836,2)	19.633,4 (14.911,1; 24.717,3)	658,9 (497,5; 836,1)	0,8 (-5,5; 8,0)	Female
Pernambuco	15.222,4 (11.603,0; 19.300,0)	651,2 (499,3; 819,4)	41.683,9 (31.934,9; 53.337,6)	650,7 (498,2; 832,6)	-0,1 (-5,9; 6,6)	Female
Piaui	4.345,8 (3.304,3; 5.529,8)	632,3 (483,0; 800,7)	14.418,1 (11.071,5; 18.243,1)	635,4 (487,7; 806,6)	0,5 (-5,4; 6,9)	Female
Rio Grande do Norte	5.284,6 (4.096,5; 6.772,7)	655,0 (508,7; 837,9)	15.902,1 (12.245,0; 20.533,7)	661,2 (507,8; 853,4)	1,0 (-5,4; 8,3)	Female
Sergipe	2.756,8 (2.131,5; 3.510,2)	660,8 (514,6; 834,3)	9.545,9 (7.245,7; 12.100,7)	674,6 (510,5; 858,0)	2,1 (-3,9; 9,3)	Female
Southeast region	140.957,3 (108.774,4; 178.770,6)	682,4 (528,5; 863,1)	467.138,2 (361.317,3; 591.246,5)	677,1 (524,3; 855,7)	-0,8 (-4,1; 2,7)	Female
Espírito Santo	4.631,9 (3.529,2; 5.883,1)	664,1 (502,5; 836,9)	18.870,4 (14.522,3; 24.195,8)	667,6 (513,6; 854,2)	0,5 (-6,8; 7,0)	Female
Minas Gerais	32.218,9 (24.510,2; 40.841,4)	664,3 (504,8; 837,6)	108.991,4 (83.370,2; 137.354,7)	660,1 (503,8; 832,1)	-0,6 (-6,4; 5,8)	Female
Rio de Janeiro	34.155,3 (26.154,8; 43.730,2)	673,4 (520,7; 850,7)	94.642,4 (73.156,9; 119.649,2)	666,5 (515,1; 841,1)	-1,0 (-6,8; 5,1)	Female
São Paulo	69.951,2 (53.562,7; 88.784,2)	697,2 (539,1; 879,2)	244.634,1 (186.749,2; 310.163,0)	690,0 (527,7; 877,4)	-1,0 (-7,0; 4,4)	Female
South region	48.045,9 (36.894,3; 60.629,2)	692,5 (532,6; 870,5)	160.146,3 (123.048,7; 202.965,3)	677,8 (522,7; 855,8)	-2,1 (-7,0; 1,9)	Female
Paraná	15.464,5 (11.809,3; 19.737,5)	681,6 (523,6; 860,1)	57.216,5 (44.278,5; 72.749,0)	673,4 (523,1; 854,1)	-1,2 (-7,9; 5,9)	Female
Rio Grande do Sul	24.034,3 (18.480,9; 30.544,6)	700,8 (536,0; 892,8)	66.986,3 (51.653,2; 85.938,5)	679,0 (523,8; 872,9)	-3,1 (-9,5; 4,2)	Female
Santa Catarina	8.547,1 (6.491,6; 10.897,7)	688,6 (525,6; 880,2)	35.943,5 (27.588,6; 45.575,3)	682,6 (525,6; 868,8)	-0,9 (-7,3; 6,1)	Female
West-Central region	12.255,3 (9.485,0; 15.616,7)	655,2 (504,5; 821,8)	63.277,9 (49.191,0; 80.701,9)	655,6 (507,1; 827,9)	0,1 (-3,2; 2,9)	Female
Distrito Federal	1.923,3 (1.467,6; 2.434,8)	655,8 (500,0; 832,1)	11.878,8 (9.135,7; 15.085,1)	664,1 (510,7; 834,8)	1,3 (-4,5; 7,6)	Female
Goiás	5.762,2 (4.355,8; 7.237,7)	652,3 (499,1; 816,5)	28.007,7 (21.426,1; 35.662,4)	649,3 (494,9; 827,9)	-0,5 (-5,9; 4,9)	Female
Mato Grosso	1.994,3 (1.527,6; 2.553,6)	647,6 (495,6; 824,9)	12.029,7 (9.174,5; 15.328,0)	657,3 (501,8; 830,5)	1,5 (-4,4; 8,2)	Female
Mato Grosso do Sul	2.575,5 (1.977,4; 3.243,6)	667,3 (511,4; 844,4)	11.361,7 (8.688,7; 14.362,4)	660,7 (504,8; 830,5)	-1,0 (-6,5; 5,2)	Female

Brazil	667.933,1 (516.033,2; 846.711,5)	812,7 (630,1; 1.017,6)	2.118.950,1 (1.636.171,8; 2.647.772,3)	806,2 (623,0; 999,4)	-0,8 (-2,3; 0,5)	Both
North region	28.520,2 (22.161,9; 36.414,7)	787,6 (611,4; 982,5)	120.465,6 (92.586,7; 154.057,6)	789,2 (604,4; 991,8)	0,2 (-2,8; 3,2)	Both
Acre	1.241,2 (933,7; 1.572,9)	812,2 (618,5; 1.019,1)	5.347,4 (4.109,6; 6.758,8)	797,7 (611,1; 1.009,6)	-1,8 (-6,5; 2,5)	Both
Amapá	711,4 (548,5; 907,5)	769,6 (591,0; 969,7)	4.210,6 (3.211,2; 5.426,5)	779,4 (590,1; 987,9)	1,3 (-3,0; 5,4)	Both
Amazonas	5.629,3 (4.342,9; 7.188,7)	801,6 (615,4; 1.006,2)	24.045,3 (18.541,3; 30.753,3)	793,8 (604,3; 999,6)	-1,0 (-6,1; 3,4)	Both
Pará	15.063,3 (11.691,3; 19.075,7)	783,4 (611,0; 978,3)	58.189,0 (44.863,2; 74.623,2)	786,7 (604,1; 996,7)	0,4 (-4,4; 5,2)	Both
Rondônia	2.701,1 (2.086,1; 3.530,3)	806,8 (624,1; 1.032,2)	13.034,7 (9.949,0; 16.534,8)	806,9 (613,4; 1.015,3)	0,0 (-5,5; 4,5)	Both
Roraima	420,9 (321,5; 543,1)	808,0 (623,9; 1.023,8)	3.323,7 (2.547,7; 4.306,0)	802,8 (620,5; 1.014,4)	-0,6 (-5,2; 3,4)	Both
Tocantins	2.753,0 (2.087,7; 3.607,6)	759,2 (584,7; 959,8)	12.314,8 (9.546,8; 15.704,4)	771,3 (595,7; 974,2)	1,6 (-2,7; 6,9)	Both
Northeast region	189.554,4 (147.153,3; 239.985,6)	792,6 (618,2; 996,2)	527.446,3 (408.158,9; 659.544,4)	789,2 (608,7; 985,5)	-0,4 (-1,9; 1,2)	Both
Alagoas	10.149,2 (7.883,2; 12.912,1)	806,4 (629,5; 1.012,8)	27.496,0 (21.179,3; 35.061,0)	804,5 (618,6; 1.022,1)	-0,2 (-4,5; 4,4)	Both
Bahia	51.824,3 (39.733,2; 65.693,0)	807,9 (621,2; 1.017,6)	148.301,6 (116.628,3; 185.493,8)	810,5 (633,6; 1.015,6)	0,3 (-3,1; 4,1)	Both
Ceará	29.760,5 (23.049,7; 37.367,7)	788,4 (612,2; 984,5)	85.757,5 (66.755,1; 107.687,6)	777,5 (603,2; 980,1)	-1,4 (-6,1; 2,6)	Both
Maranhão	17.760,1 (13.654,4; 22.554,0)	766,4 (591,3; 972,9)	52.314,7 (40.226,4; 65.281,3)	758,7 (582,5; 953,1)	-1,0 (-6,0; 3,4)	Both
Paraíba	17.416,7 (13.529,3; 22.330,2)	794,5 (623,5; 1.003,0)	41.114,1 (31.487,5; 51.949,9)	789,6 (603,7; 998,6)	-0,6 (-4,6; 3,4)	Both
Pernambuco	33.834,7 (25.876,4; 42.804,5)	786,2 (605,5; 995,7)	86.395,6 (66.054,8; 109.196,0)	779,9 (595,1; 984,0)	-0,8 (-5,2; 4,0)	Both
Piaui	10.283,2 (7.924,2; 12.961,3)	770,6 (597,9; 975,5)	31.924,0 (24.436,0; 40.362,8)	770,0 (588,8; 973,6)	-0,1 (-4,4; 4,1)	Both
Rio Grande do Norte	12.237,7 (9.551,9; 15.687,0)	795,0 (622,5; 1.014,5)	33.834,5 (26.021,6; 42.652,1)	794,8 (608,1; 1.001,6)	0,0 (-4,9; 5,9)	Both
Sergipe	6.288,0 (4.892,5; 7.970,4)	801,2 (625,4; 1.009,1)	20.308,3 (15.400,2; 25.927,1)	811,2 (614,7; 1.029,5)	1,2 (-3,1; 5,5)	Both
Southeast region	310.352,0 (238.135,9; 392.498,3)	821,2 (633,6; 1.029,3)	983.749,1 (759.928,1; 1.229.887,4)	815,0 (630,9; 1.017,7)	-0,7 (-4,0; 1,9)	Both
Espírito Santo	10.943,5 (8.413,0; 13.782,6)	809,4 (623,1; 1.011,4)	41.225,4 (31.631,5; 52.810,1)	807,8 (620,6; 1.033,7)	-0,2 (-5,3; 4,8)	Both
Minas Gerais	72.617,1 (55.873,0; 91.531,4)	802,6 (613,9; 1.015,6)	238.218,6 (183.198,1; 299.175,2)	800,0 (612,8; 1.001,9)	-0,3 (-5,1; 4,2)	Both

Rio de Janeiro	71.562,2 (55.122,0; 92.671,9)	804,0 (632,2; 1.019,7)	191.396,0 (148.710,0; 241.039,8)	795,8 (621,0; 998,6)	-1,0 (-6,4; 3,2)	Both
São Paulo	155.229,2 (117.667,5; 195.471,8)	839,6 (640,6; 1.055,0)	512.909,2 (393.263,3; 646.858,6)	830,3 (638,3; 1.045,5)	-1,1 (-6,3; 2,6)	Both
South region	108.496,3 (83.717,5; 137.557,0)	834,4 (645,4; 1.044,7)	344.415,4 (265.352,7; 437.951,4)	818,1 (630,2; 1.030,6)	-2,0 (-4,3; 0,8)	Both
Paraná	37.264,9 (28.751,9; 47.289,3)	830,2 (638,8; 1.043,7)	124.986,7 (96.714,6; 158.934,3)	816,2 (631,0; 1.028,6)	-1,7 (-6,5; 3,5)	Both
Rio Grande do Sul	51.658,9 (39.806,9; 65.356,3)	838,6 (648,5; 1.058,5)	140.915,6 (108.827,0; 177.926,9)	816,9 (632,5; 1.032,2)	-2,6 (-7,2; 1,7)	Both
Santa Catarina	19.572,5 (15.065,5; 24.906,8)	831,6 (645,9; 1.046,9)	78.513,1 (60.190,3; 100.269,4)	823,4 (632,2; 1.046,1)	-1,0 (-5,3; 3,0)	Both
West-Central region	31.010,3 (23.989,2; 40.130,8)	804,2 (624,1; 1.010,6)	142.873,7 (111.524,3; 180.677,4)	796,7 (621,7; 999,1)	-0,9 (-3,4; 0,8)	Both
Distrito Federal	4.255,9 (3.250,6; 5.485,2)	784,5 (609,9; 991,8)	24.693,9 (19.262,0; 31.311,8)	794,8 (618,8; 1.015,0)	1,3 (-2,0; 4,8)	Both
Goiás	14.502,2 (11.201,1; 18.734,6)	800,6 (618,1; 1.006,6)	63.356,9 (48.917,1; 80.080,2)	789,2 (614,4; 1.000,6)	-1,4 (-6,5; 2,2)	Both
Mato Grosso	5.607,3 (4.340,8; 7.199,9)	807,0 (625,0; 1.012,3)	29.001,0 (22.474,8; 36.752,9)	806,7 (624,0; 1.014,1)	0,0 (-5,4; 4,6)	Both
Mato Grosso do Sul	6.644,9 (5.123,6; 8.467,8)	821,6 (637,0; 1.037,9)	25.821,9 (20.152,8; 32.625,9)	806,2 (628,9; 1.008,4)	-1,9 (-5,7; 2,1)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 6.3 – Number of deaths and age-standardized mortality rates of atrial fibrillation, by sex, in 1990 and 2023, in Brazil, Brazilian regions, and Federative Units, and the percent change of rates

Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	1.115,1 (996,8; 1.229,4)	4,7 (4,1; 5,2)	5.104,4 (4.465,4; 5.633,6)	5,2 (4,5; 5,8)	12,2 (1,4; 23,2)	Male
North region	43,5 (38,7; 48,4)	4,4 (3,9; 5,0)	315,6 (277,0; 350,6)	5,5 (4,8; 6,1)	23,9 (11,0; 39,7)	Male
Acre	2,1 (1,9; 2,5)	4,5 (3,8; 5,1)	13,0 (10,8; 15,5)	5,0 (4,1; 6,1)	13,0 (-9,1; 40,7)	Male
Amapá	1,3 (1,1; 1,5)	4,8 (4,1; 5,7)	11,0 (9,1; 13,0)	5,6 (4,6; 6,7)	15,6 (-7,4; 42,5)	Male
Amazonas	8,9 (7,7; 10,1)	4,9 (4,1; 5,8)	63,1 (53,6; 74,7)	6,0 (5,1; 7,2)	22,3 (2,2; 48,4)	Male
Pará	23,0 (20,1; 25,8)	4,0 (3,5; 4,6)	146,9 (124,1; 167,8)	5,2 (4,4; 6,0)	28,9 (9,7; 52,9)	Male
Rondônia	4,1 (3,7; 4,7)	5,3 (4,6; 6,2)	38,2 (32,0; 43,8)	6,1 (5,0; 7,0)	14,4 (-5,7; 41,3)	Male
Roraima	0,5 (0,4; 0,6)	4,9 (4,1; 5,7)	6,5 (5,5; 7,8)	5,8 (4,9; 6,9)	18,8 (-4,5; 47,5)	Male
Tocantins	3,5 (3,1; 4,0)	8,1 (6,8; 9,6)	36,9 (30,5; 44,0)	5,3 (4,4; 6,4)	-34,6 (-48,3; -17,6)	Male
Northeast region	359,3 (306,3; 414,5)	4,5 (3,8; 5,3)	1.346,1 (1.144,4; 1.545,3)	4,9 (4,2; 5,6)	9,0 (-7,8; 28,9)	Male
Alagoas	19,2 (16,9; 22,2)	4,7 (4,1; 5,6)	70,0 (58,9; 80,8)	5,7 (4,8; 6,7)	21,0 (-1,7; 46,9)	Male
Bahia	97,0 (81,0; 112,7)	4,5 (3,8; 5,3)	380,9 (321,8; 434,9)	4,9 (4,2; 5,6)	8,6 (-8,2; 29,0)	Male
Ceará	60,4 (50,6; 70,7)	4,9 (4,1; 5,9)	215,5 (181,0; 246,3)	4,5 (3,8; 5,2)	-8,1 (-22,4; 10,3)	Male
Maranhão	20,7 (16,4; 26,5)	2,7 (2,1; 3,6)	145,8 (119,2; 176,0)	5,3 (4,3; 6,5)	94,1 (44,1; 161,2)	Male
Paraíba	37,5 (31,8; 44,4)	4,8 (4,0; 5,8)	107,8 (90,5; 128,5)	5,2 (4,3; 6,2)	8,0 (-14,4; 35,4)	Male
Pernambuco	64,7 (56,3; 74,1)	4,8 (4,1; 5,6)	191,7 (166,6; 220,4)	4,8 (4,1; 5,5)	-1,6 (-17,3; 15,4)	Male
Piaui	18,7 (15,4; 23,0)	4,2 (3,3; 5,3)	92,5 (73,7; 112,7)	5,2 (4,1; 6,3)	24,8 (-7,3; 60,6)	Male
Rio Grande do Norte	26,4 (22,1; 31,4)	4,6 (3,8; 5,6)	89,5 (73,6; 108,2)	5,0 (4,1; 6,0)	8,2 (-16,3; 40,1)	Male
Sergipe	14,7 (12,6; 17,1)	4,8 (4,1; 5,7)	52,3 (42,4; 61,9)	5,6 (4,5; 6,7)	16,1 (-5,5; 41,2)	Male
Southeast region	488,7 (441,1; 537,7)	4,7 (4,2; 5,3)	2.275,4 (2.005,1; 2.523,8)	5,2 (4,6; 5,8)	11,5 (-0,4; 23,7)	Male
Espírito Santo	20,1 (17,4; 22,6)	4,6 (3,9; 5,1)	97,4 (81,7; 113,7)	5,1 (4,3; 6,0)	12,6 (-4,7; 31,1)	Male
Minas Gerais	126,8 (113,3; 140,7)	4,7 (4,1; 5,3)	641,5 (562,5; 723,2)	5,4 (4,7; 6,1)	14,4 (1,5; 30,0)	Male
Rio de Janeiro	107,8 (95,9; 119,2)	4,7 (4,1; 5,3)	425,6 (365,4; 481,5)	5,2 (4,4; 6,0)	11,5 (-3,3; 27,3)	Male
São Paulo	234,0 (210,3; 257,5)	4,7 (4,1; 5,3)	1.110,9 (977,3; 1.235,2)	5,2 (4,5; 5,8)	9,7 (-2,4; 22,3)	Male
South region	175,6 (158,6; 193,0)	5,1 (4,5; 5,7)	827,9 (728,5; 924,8)	5,8 (5,0; 6,5)	13,7 (-0,7; 29,1)	Male
Paraná	61,9 (54,8; 67,6)	4,8 (4,2; 5,4)	315,0 (276,9; 356,5)	5,8 (5,0; 6,6)	19,5 (1,8; 37,6)	Male
Rio Grande do Sul	83,0 (74,9; 91,9)	5,4 (4,7; 6,1)	345,8 (302,6; 392,7)	5,9 (5,1; 6,7)	8,8 (-6,9; 26,3)	Male
Santa Catarina	30,8 (26,8; 34,3)	4,8 (4,2; 5,5)	167,1 (143,5; 188,1)	5,6 (4,7; 6,5)	16,5 (-0,2; 35,3)	Male
West-Central region	47,9 (43,1; 53,1)	4,3 (3,7; 4,8)	339,5 (298,0; 379,9)	5,2 (4,5; 5,8)	20,9 (6,1; 36,8)	Male
Distrito Federal	4,4 (3,9; 4,9)	3,8 (3,3; 4,4)	38,4 (32,0; 45,4)	3,9 (3,2; 4,7)	1,8 (-16,7; 26,5)	Male
Goiás	22,2 (19,8; 24,9)	4,0 (3,5; 4,6)	146,4 (127,4; 166,0)	4,9 (4,2; 5,6)	21,6 (2,4; 43,3)	Male
Mato Grosso	9,4 (8,1; 10,5)	4,6 (3,8; 5,3)	81,8 (69,9; 93,1)	6,2 (5,2; 7,1)	34,7 (14,2; 62,6)	Male
Mato Grosso do Sul	11,9 (10,6; 13,5)	4,7 (4,1; 5,5)	72,9 (61,3; 85,6)	5,8 (4,8; 6,9)	23,0 (3,2; 44,7)	Male

Brazil	1.478,1 (1.259,3; 1.635,1)	4,7 (3,9; 5,2)	7.313,3 (5.750,0; 8.275,7)	4,8 (3,8; 5,4)	2,8 (-6,3; 13,4)	Female
North region	50,7 (42,6; 56,6)	4,3 (3,5; 4,9)	353,9 (278,6; 415,9)	4,9 (3,9; 5,8)	13,8 (0,3; 29,7)	Female
Acre	2,0 (1,7; 2,3)	5,0 (4,0; 6,0)	16,7 (13,1; 20,0)	5,3 (4,2; 6,3)	5,6 (-14,1; 31,8)	Female
Amapá	1,7 (1,3; 2,0)	4,0 (3,0; 4,7)	13,8 (10,5; 16,7)	5,2 (4,0; 6,3)	32,4 (10,2; 62,9)	Female
Amazonas	10,0 (8,3; 11,3)	4,7 (3,8; 5,4)	74,7 (58,8; 90,2)	5,3 (4,1; 6,4)	11,8 (-6,1; 36,6)	Female
Pará	29,8 (24,8; 33,8)	4,1 (3,3; 4,7)	170,2 (130,5; 204,5)	4,6 (3,6; 5,6)	13,8 (-2,9; 34,8)	Female
Rondônia	3,2 (2,7; 3,6)	5,3 (4,4; 6,1)	34,2 (28,2; 40,9)	5,3 (4,3; 6,4)	1,2 (-16,7; 21,8)	Female
Roraima	0,4 (0,3; 0,5)	4,4 (3,6; 5,2)	5,6 (4,6; 6,6)	4,8 (3,9; 5,7)	10,6 (-11,8; 39,6)	Female
Tocantins	3,7 (3,0; 4,4)	7,2 (5,6; 8,7)	38,7 (30,2; 47,3)	5,0 (3,9; 6,2)	-29,9 (-44,9; -10,3)	Female
Northeast region	444,7 (360,7; 519,6)	4,4 (3,6; 5,2)	1.763,2 (1.371,2; 2.070,9)	4,3 (3,4; 5,1)	-2,8 (-17,0; 13,3)	Female
Alagoas	23,9 (19,2; 27,9)	4,7 (3,7; 5,5)	86,3 (69,0; 101,9)	4,6 (3,7; 5,4)	-2,9 (-20,7; 19,9)	Female
Bahia	123,3 (95,4; 146,7)	4,2 (3,2; 5,0)	522,3 (400,2; 614,6)	4,5 (3,6; 5,3)	8,0 (-7,4; 25,0)	Female
Ceará	78,5 (62,9; 96,1)	5,2 (4,0; 6,3)	297,6 (230,6; 357,3)	4,3 (3,4; 5,1)	-17,0 (-31,0; -1,5)	Female
Maranhão	17,2 (12,6; 22,5)	2,0 (1,5; 2,7)	141,9 (108,0; 178,6)	3,7 (2,8; 4,6)	83,3 (38,3; 150,2)	Female
Paraíba	45,2 (35,2; 56,2)	5,1 (3,9; 6,4)	138,1 (105,7; 167,9)	4,1 (3,2; 4,9)	-20,2 (-35,9; -2,2)	Female
Pernambuco	85,7 (71,7; 98,3)	4,9 (4,0; 5,7)	274,7 (222,5; 318,5)	4,2 (3,4; 4,8)	-14,6 (-26,0; -1,6)	Female
Piaui	24,1 (18,1; 30,9)	4,8 (3,5; 6,2)	120,3 (90,2; 153,7)	4,9 (3,7; 6,2)	2,4 (-22,4; 39,4)	Female
Rio Grande do Norte	28,7 (21,0; 36,3)	4,0 (2,9; 5,2)	116,9 (89,3; 146,2)	4,2 (3,3; 5,3)	4,8 (-18,3; 35,3)	Female
Sergipe	18,0 (14,8; 21,0)	5,3 (4,3; 6,2)	65,2 (51,7; 77,6)	4,5 (3,6; 5,3)	-15,5 (-30,1; 1,7)	Female
Southeast region	695,3 (594,9; 764,6)	4,7 (4,0; 5,3)	3.515,2 (2.771,7; 4.059,4)	4,9 (3,9; 5,6)	2,8 (-8,7; 16,0)	Female
Espírito Santo	23,6 (20,3; 26,6)	4,6 (3,9; 5,3)	130,1 (101,4; 153,3)	4,5 (3,5; 5,3)	-2,9 (-15,1; 15,0)	Female
Minas Gerais	156,3 (133,1; 172,8)	4,5 (3,8; 5,0)	858,3 (665,7; 1.005,3)	4,8 (3,8; 5,6)	7,2 (-6,4; 23,1)	Female
Rio de Janeiro	184,2 (157,4; 203,9)	4,9 (4,1; 5,5)	745,9 (588,0; 860,6)	4,9 (3,9; 5,6)	-0,4 (-12,8; 13,0)	Female
São Paulo	331,2 (284,9; 365,1)	4,8 (4,0; 5,3)	1.780,8 (1.418,0; 2.056,7)	4,9 (3,9; 5,7)	3,1 (-9,3; 16,9)	Female
South region	238,4 (203,8; 267,1)	5,1 (4,3; 5,9)	1.283,5 (1.018,5; 1.481,3)	5,5 (4,3; 6,3)	6,3 (-5,9; 20,5)	Female
Paraná	68,0 (58,6; 76,1)	4,7 (3,9; 5,4)	441,3 (347,6; 513,1)	5,4 (4,3; 6,3)	14,0 (-1,9; 32,6)	Female
Rio Grande do Sul	131,2 (113,1; 148,3)	5,5 (4,6; 6,2)	593,7 (460,2; 694,0)	5,7 (4,4; 6,6)	4,0 (-8,6; 17,9)	Female
Santa Catarina	39,2 (33,4; 44,2)	4,8 (4,0; 5,5)	248,5 (195,2; 292,8)	5,1 (4,0; 6,1)	6,4 (-10,3; 25,4)	Female
West-Central region	48,9 (42,0; 54,7)	4,2 (3,5; 4,8)	397,5 (311,5; 456,9)	4,6 (3,6; 5,3)	8,2 (-4,6; 24,4)	Female
Distrito Federal	6,0 (5,1; 6,7)	3,6 (2,9; 4,1)	57,6 (43,7; 68,9)	3,7 (2,8; 4,4)	3,8 (-15,1; 24,2)	Female
Goiás	23,2 (20,1; 26,4)	4,2 (3,5; 4,8)	176,0 (133,8; 207,5)	4,5 (3,4; 5,3)	7,5 (-9,0; 27,3)	Female
Mato Grosso	8,1 (6,7; 9,4)	4,5 (3,6; 5,4)	80,2 (65,3; 96,3)	5,2 (4,2; 6,2)	14,7 (-3,9; 40,8)	Female
Mato Grosso do Sul	11,6 (9,7; 13,2)	4,7 (3,8; 5,4)	83,7 (64,0; 99,3)	5,2 (4,0; 6,1)	10,1 (-7,2; 31,9)	Female
Brazil	2.593,1 (2.302,4; 2.825,7)	4,7 (4,0; 5,2)	12.417,7 (10.322,5; 13.781,7)	5,0 (4,1; 5,5)	6,6 (-1,5; 14,6)	Both

North region	94,2 (83,0; 103,2)	4,4 (3,7; 4,8)	669,4 (568,1; 750,0)	5,2 (4,3; 5,8)	18,1 (8,0; 31,4)	Both
Acre	4,1 (3,7; 4,6)	4,7 (4,0; 5,3)	29,7 (24,7; 34,3)	5,2 (4,3; 6,0)	9,3 (-7,3; 29,4)	Both
Amapá	2,9 (2,5; 3,3)	4,2 (3,5; 4,8)	24,8 (20,3; 28,7)	5,4 (4,4; 6,2)	27,5 (10,3; 48,6)	Both
Amazonas	18,9 (16,3; 20,8)	4,8 (4,0; 5,4)	137,7 (116,3; 159,1)	5,6 (4,7; 6,5)	16,1 (1,7; 34,6)	Both
Pará	52,8 (45,7; 58,4)	4,1 (3,4; 4,6)	317,1 (260,0; 367,0)	4,9 (4,0; 5,7)	19,8 (7,1; 39,4)	Both
Rondônia	7,3 (6,6; 8,1)	5,3 (4,6; 6,0)	72,4 (61,4; 82,8)	5,7 (4,8; 6,6)	7,5 (-6,3; 22,1)	Both
Roraima	0,9 (0,8; 1,0)	4,7 (4,1; 5,2)	12,0 (10,2; 13,9)	5,3 (4,4; 6,1)	13,0 (-4,5; 31,4)	Both
Tocantins	7,2 (6,3; 8,2)	7,5 (6,5; 8,6)	75,6 (62,1; 87,3)	5,2 (4,2; 6,0)	-31,5 (-41,3; -19,4)	Both
Northeast region	804,0 (683,1; 908,8)	4,5 (3,7; 5,1)	3.109,3 (2.550,6; 3.517,8)	4,6 (3,8; 5,2)	2,0 (-10,1; 14,1)	Both
Alagoas	43,1 (36,7; 48,1)	4,7 (3,9; 5,3)	156,3 (129,5; 177,6)	5,0 (4,2; 5,7)	6,2 (-8,1; 22,8)	Both
Bahia	220,3 (180,9; 253,5)	4,3 (3,5; 5,0)	903,3 (729,2; 1.030,8)	4,7 (3,8; 5,3)	8,3 (-3,2; 21,3)	Both
Ceará	139,0 (116,1; 159,8)	5,1 (4,2; 5,9)	513,1 (420,0; 584,9)	4,4 (3,6; 5,0)	-13,2 (-24,6; -1,7)	Both
Maranhão	37,9 (31,3; 46,2)	2,3 (1,9; 2,9)	287,8 (239,3; 337,1)	4,3 (3,6; 5,1)	85,0 (45,3; 136,0)	Both
Paraíba	82,7 (69,9; 96,1)	5,0 (4,1; 5,8)	245,8 (199,9; 284,6)	4,5 (3,7; 5,2)	-9,3 (-23,2; 4,9)	Both
Pernambuco	150,4 (129,7; 167,7)	4,9 (4,2; 5,5)	466,4 (395,2; 522,3)	4,4 (3,7; 4,9)	-9,4 (-19,8; 1,5)	Both
Piaui	42,9 (35,2; 51,3)	4,5 (3,6; 5,5)	212,8 (167,5; 248,8)	5,0 (4,0; 5,9)	12,0 (-8,7; 36,8)	Both
Rio Grande do Norte	55,2 (45,3; 64,2)	4,3 (3,5; 5,0)	206,4 (166,7; 247,9)	4,5 (3,7; 5,4)	6,2 (-11,5; 28,8)	Both
Sergipe	32,7 (28,3; 36,4)	5,1 (4,3; 5,7)	117,5 (96,5; 134,7)	4,9 (4,1; 5,6)	-2,3 (-15,2; 11,5)	Both
Southeast region	1.184,0 (1.057,8; 1.283,4)	4,7 (4,1; 5,2)	5.790,6 (4.813,8; 6.525,2)	5,0 (4,2; 5,7)	6,3 (-3,1; 16,4)	Both
Espírito Santo	43,7 (37,7; 47,7)	4,6 (3,9; 5,1)	227,5 (184,7; 259,2)	4,8 (3,8; 5,4)	3,4 (-7,4; 16,2)	Both
Minas Gerais	283,1 (250,9; 308,4)	4,6 (4,0; 5,1)	1.499,8 (1.215,4; 1.711,3)	5,1 (4,1; 5,8)	10,3 (-1,2; 22,4)	Both
Rio de Janeiro	292,0 (258,7; 318,4)	4,8 (4,2; 5,4)	1.171,5 (978,1; 1.312,6)	5,0 (4,2; 5,6)	3,7 (-6,1; 15,0)	Both
São Paulo	565,2 (507,1; 611,1)	4,8 (4,2; 5,2)	2.891,8 (2.437,3; 3.266,3)	5,0 (4,2; 5,7)	5,9 (-3,6; 16,7)	Both
South region	414,1 (368,5; 452,9)	5,1 (4,4; 5,7)	2.111,4 (1.755,8; 2.368,2)	5,6 (4,6; 6,3)	9,3 (-0,7; 21,6)	Both
Paraná	129,9 (115,6; 141,5)	4,8 (4,1; 5,3)	756,3 (631,1; 847,6)	5,6 (4,6; 6,2)	16,3 (4,8; 30,6)	Both
Rio Grande do Sul	214,2 (191,5; 234,8)	5,4 (4,7; 6,1)	939,5 (778,2; 1.059,0)	5,8 (4,8; 6,5)	6,1 (-5,7; 18,5)	Both
Santa Catarina	70,0 (62,4; 76,2)	4,8 (4,2; 5,3)	415,7 (347,2; 473,5)	5,3 (4,4; 6,1)	10,1 (-1,6; 24,7)	Both
West-Central region	96,8 (85,3; 105,6)	4,2 (3,6; 4,7)	736,9 (611,9; 818,5)	4,8 (4,0; 5,4)	13,7 (4,2; 24,6)	Both
Distrito Federal	10,4 (9,3; 11,4)	3,6 (3,1; 4,0)	96,0 (77,2; 111,7)	3,8 (3,0; 4,4)	4,4 (-9,7; 20,9)	Both
Goiás	45,4 (40,2; 49,9)	4,1 (3,5; 4,6)	322,3 (266,8; 359,4)	4,7 (3,8; 5,2)	13,8 (1,5; 26,0)	Both
Mato Grosso	17,5 (15,3; 19,5)	4,5 (3,9; 5,1)	162,0 (136,8; 183,5)	5,6 (4,7; 6,4)	23,9 (9,2; 41,3)	Both
Mato Grosso do Sul	23,5 (20,4; 25,9)	4,7 (3,9; 5,2)	156,6 (129,2; 178,7)	5,4 (4,5; 6,2)	16,2 (2,4; 32,3)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 6.4 – Number of DALYs and age-standardized DALY rates due to atrial fibrillation, in 1990 and 2023, in Brazil, according to sex, and percent change of the rates

Age group	Sex	Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)
< 5 years	Male	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
5-14 years	Male	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
15-49 years	Male	Brazil	4.162,9 (2.796,8; 6.044,8)	11,0 (7,4; 16,0)	10.127,2 (7.154,8; 14.379,3)	18,7 (13,2; 26,6)	70,1 (55,7; 90,3)
50-69 years	Male	Brazil	18.678,9 (13.567,0; 26.700,7)	247,4 (179,7; 353,6)	57.111,2 (43.388,0; 80.399,1)	279,4 (212,3; 393,4)	13,0 (7,8; 19,5)
70+ years	Male	Brazil	23.202,4 (18.561,2; 29.351,4)	1.217,2 (973,7; 1.539,7)	92.309,1 (75.620,0; 113.874,9)	1.437,4 (1.177,5; 1.773,2)	18,1 (11,6; 25,2)
All ages	Male	Brazil	46.044,2 (36.069,2; 60.878,5)	62,4 (48,9; 82,5)	159.547,5 (129.541,2; 206.348,0)	154,8 (125,7; 200,2)	148,2 (135,1; 164,0)
Age-standardized	Male	Brazil		134,2 (109,2; 172,9)		144,3 (118,0; 184,4)	7,6 (2,7; 12,7)
< 5 years	Female	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
5-14 years	Female	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
15-49 years	Female	Brazil	2.861,3 (1.959,9; 4.092,0)	7,3 (5,0; 10,5)	6.634,5 (4.799,6; 9.308,3)	11,9 (8,6; 16,7)	62,2 (45,8; 79,9)
50-69 years	Female	Brazil	14.117,4 (10.574,9; 20.015,6)	172,4 (129,1; 244,4)	43.309,6 (32.650,8; 60.304,3)	186,4 (140,5; 259,5)	8,1 (2,9; 13,9)
70+ years	Female	Brazil	26.229,6 (21.374,1; 31.613,0)	1.107,3 (902,3; 1.334,6)	115.157,1 (92.809,3; 139.387,8)	1.317,5 (1.061,8; 1.594,7)	19,0 (10,2; 28,6)
All ages	Female	Brazil	43.208,4 (34.612,7; 55.585,9)	57,2 (45,8; 73,6)	165.101,2 (132.237,1; 208.650,1)	151,4 (121,3; 191,4)	164,7 (147,2; 185,0)
Age-standardized	Female	Brazil		108,6 (88,0; 136,6)		110,9 (88,8; 140,3)	2,1 (-3,0; 8,2)
< 5 years	Both	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
5-14 years	Both	Brazil	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)	
15-49 years	Both	Brazil	7.024,2 (4.786,3; 10.163,7)	9,1 (6,2; 13,2)	16.761,6 (11.953,0; 23.540,8)	15,3 (10,9; 21,4)	66,9 (54,9; 82,2)
50-69 years	Both	Brazil	32.796,4 (24.274,4; 46.748,7)	208,4 (154,2; 297,0)	100.420,8 (75.697,2; 141.339,9)	229,9 (173,3; 323,6)	10,3 (6,0; 15,7)
70+ years	Both	Brazil	49.432,0 (39.841,3; 61.253,5)	1.156,3 (932,0; 1.432,8)	207.466,2 (171.339,5; 254.755,7)	1.368,3 (1.130,0; 1.680,2)	18,3 (11,2; 25,4)
All ages	Both	Brazil	89.252,6 (70.854,7; 116.534,6)	59,8 (47,4; 78,0)	324.648,6 (261.940,9; 415.784,8)	153,1 (123,5; 196,1)	156,1 (143,9; 173,4)
Age-standardized	Both	Brazil		120,4 (97,6; 153,7)		125,7 (101,6; 160,2)	4,4 (0,4; 8,8)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

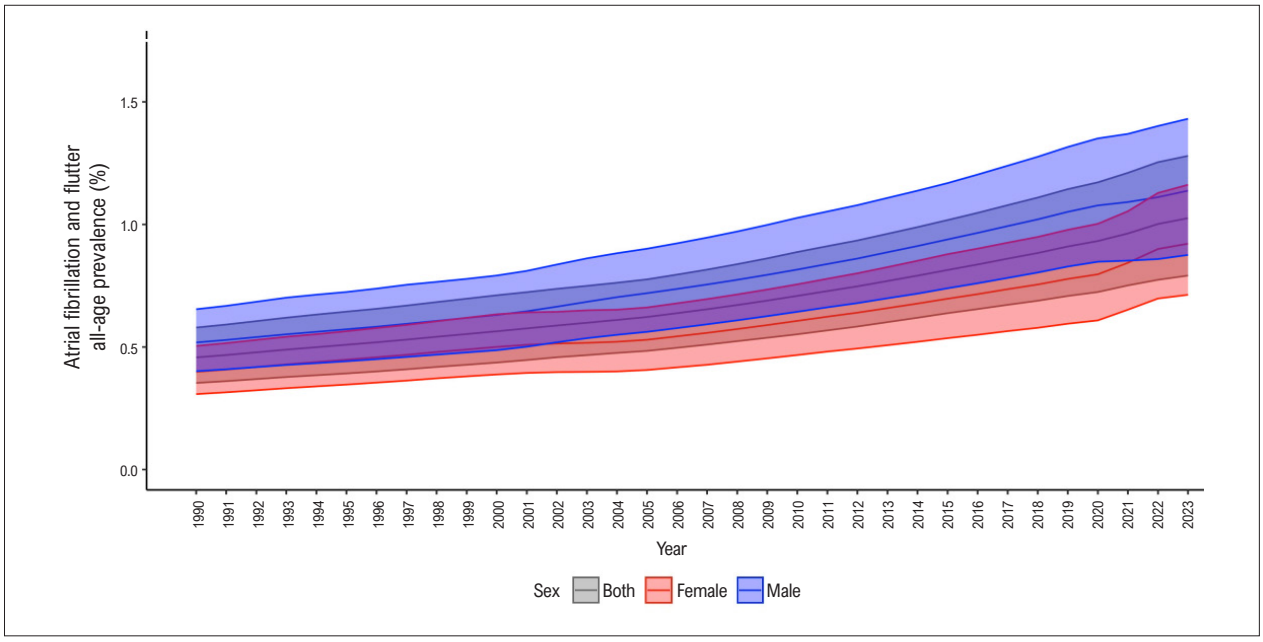

Chart 6.1 – *Crude prevalence rates of atrial fibrillation/flutter between 1990 and 2023, in Brazil. Data derived from Global Burden of Disease Study 2023 (GBD 2023). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

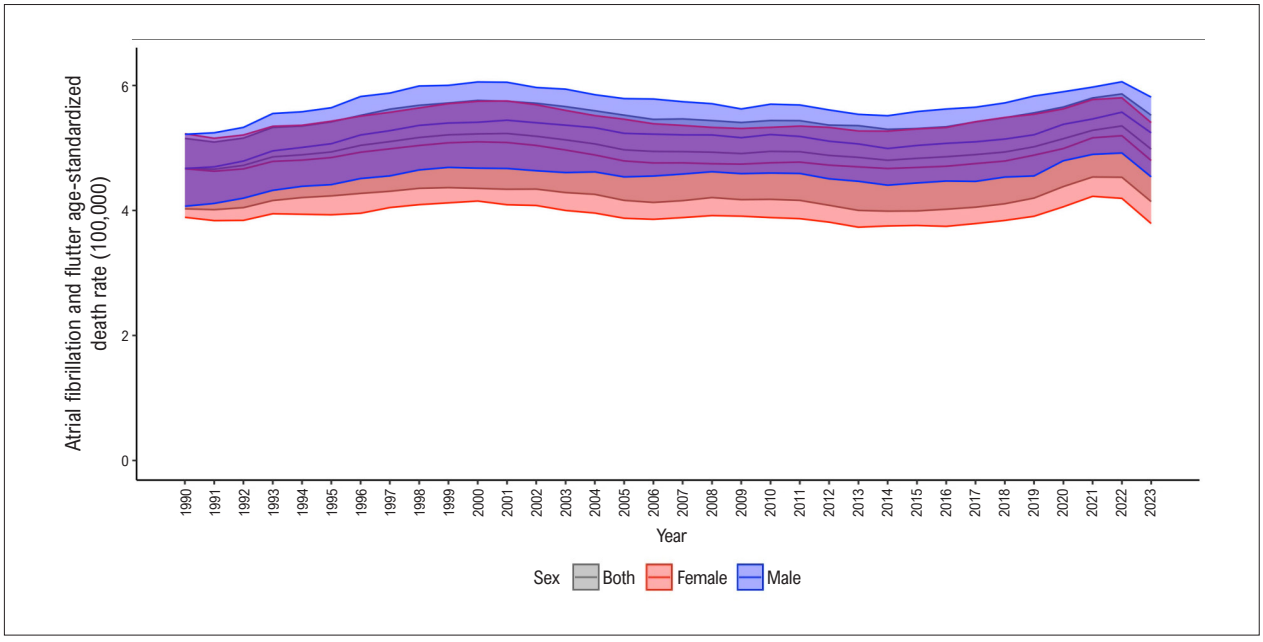

Chart 6.2 – *Age-standardized mortality rates of atrial fibrillation/flutter between 1990 and 2023, in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

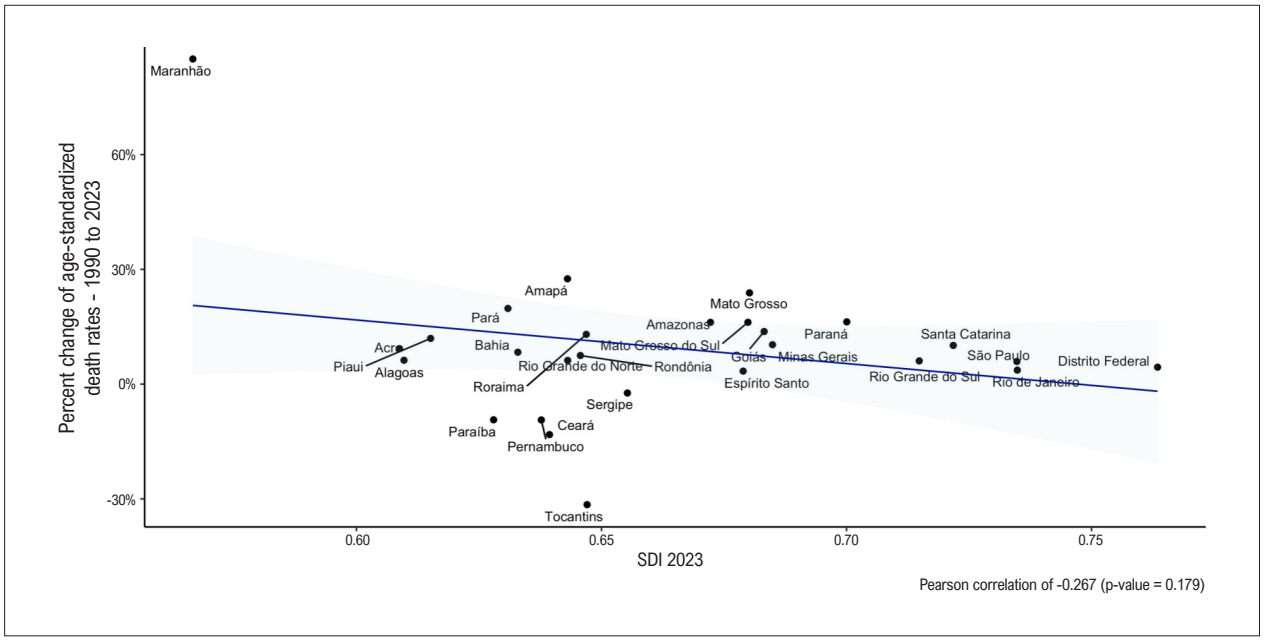

Chart 6.3 – *Correlation of the 2023 Sociodemographic Index (SDI) and the percent change of age-standardized mortality rates due to atrial fibrillation and flutter, per 100,000 inhabitants, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 7 – ARTERIAL HYPERTENSION

ICD 10 - I10.

See Tables 7.1 through 7.6 and Charts 7.1 through 7.5.

Abbreviations used in chapter 7

ABPM	Ambulatory Blood Pressure Monitoring
BMI	Body Mass Index
CI	Confidence Interval
COVID-19	Coronavirus disease 2019
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life Years
DATASUS	Department of Information and Data Processing of the Brazilian Unified Health System
FU	Federative Unit
GBD	Global Burden of Disease
HBPM	Home Blood Pressure Monitoring
IRR	Incidence Rate Ratio
OBPM	Office Blood Pressure Measurement
OR	Odds Ratio
PNS	National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
pp	percentage points
PR	Prevalence Ratio
PREDI Study	Predictors of Maternal and Infant Excess Body Weight
QALYs	Quality-Adjusted Life Years
QATSAH	Questionnaire of Adherence to the Treatment of Systemic Arterial Hypertension
SBP	Systolic Blood Pressure
SDI	Sociodemographic Index
UI	Uncertainty Interval
Vigitel	Telephone Survey for Surveillance of Noncommunicable Diseases (in Portuguese, *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*)

Overview and Definition

- Arterial hypertension is a multifactorial condition characterized by high and sustained systemic blood pressure levels,[232] recognized as the major modifiable risk factor for cardiovascular disease (CVD) and early death.[232,233]
- For epidemiological standardization purposes, hypertension is often defined in population surveys based on self-reported diagnosis or the use of antihypertensive drugs; however, it is worth noting that studies with direct measurement consider systolic blood pressure (SBP) levels ≥ 140 mm Hg and/or diastolic blood pressure levels ≥ 90 mm Hg.[234]
- When the GBD study is the source of data, the risk is attributable to high SBP, as described in previous publications.[235] To understand this chapter, it is worth distinguishing arterial hypertension, as a clinical risk factor, from hypertensive heart disease. While arterial hypertension acts as a precursor that increases the likelihood of cardiovascular events, hypertensive heart disease refers to the specific damage to target organs, such as left ventricular hypertrophy and heart failure, resulting from chronic blood pressure increase, whose burden of morbidity and mortality is studied separately in epidemiological studies. In this chapter, arterial hypertension is approached as a risk factor for CVD, except in the specific section for hypertensive heart disease.

Prevalence

- When considering criteria of pressure measurement and medication use, according to data from the National Health Survey (PNS) carried out in 2013, which continue to be the most recent representative data of the Brazilian population for measured blood pressure, the prevalence of hypertension in the Brazilian adult population was estimated as 32.3% (95% CI, 31.7–33.1).[233] It is worth noting that the prevalence based on measurement tends to reveal higher rates than the self-reported ones, evidencing gaps in diagnosis.[232,233]
- A temporal series analysis of self-reported data from the Vigitel survey, from 2006 to 2021, has shown that the prevalence of arterial hypertension remained stable between 2006 and 2019 at around 24%, but changed its trend during the COVID-19 pandemic, showing an increase in 2020-2021.[232,233,236] Data from the 2024 Vigitel survey, used to analyze the scenario in the Brazilian capitals and Distrito Federal, have shown that the frequency of adults reporting a medical diagnosis of hypertension in Brazil ranged from 30.1% in 2023 to 29.7% in 2024, while the 2006-2024 time series indicates an overall increasing trend (0.37 pp/year).[237]
- It is worth noting that when the assessment method is self-report, as in the Vigitel survey, the prevalence remains consistently higher in the female sex, suggesting greater awareness about the condition among women. In 2023, 31.9% of the women reported the diagnosis, and, in 2024, that proportion was 31.7%. Among men, that prevalence was 28.0% in 2023 and 27.4% in 2024. In the long run (2006-2024), the variation was slightly greater among men (7.9 pp) than among women (6.5 pp).[237]
- Regarding age group and according to the Vigitel survey, a direct gradient with aging was identified.[237] In 2024, the prevalence was only 6.4% among individuals aged 18-24 years, increasing to 48.2% among those aged 55-64 years, and reaching 60.2% in the age group of 65 years or older.[237] In addition, among those aged ≥80 years, the

prevalence can reach 72.6% (age group of 80-84 years), being independently associated with polypharmacy and overweight.[238]

- It is worth noting the inverse relationship between educational attainment and self-reported diagnosis of arterial hypertension. In 2024, individuals with no formal education or incomplete elementary education had a prevalence of 49.8%, while those with completed higher education had a prevalence of 22.7%, according to the Vigitel survey.[237] The coexistence of hypertension with obesity and/or diabetes reaches around 9.6% of the Brazilian adult population, being more frequent as age advances and among women with lower educational attainment.[239]

Children and Adolescents

- The prevalence of high blood pressure and its associated factors has been assessed among 15-year-old adolescents from the *2004 Coorte de Nascimentos de Pelotas*. The analysis included 1,417 adolescents with complete blood pressure measurements at the ages of 6, 11, and 15 years, considering arterial hypertension when blood pressure levels ≥ 95th percentile for sex, age, and height in all assessments. The prevalence of arterial hypertension was 3.2% (95% CI, 1.9–4.5) among girls and 4.3% (95% CI, 2.8–5.8) among boys. Among girls, the family history of arterial hypertension was associated with the presence of high blood pressure (OR = 3.1; 95% CI, 1.26–7.54). Among boys, maternal pregestational excess weight increased the chance by 2.3 times. In both sexes, excess weight in adolescence showed association with arterial hypertension (OR = 3.5 in girls and OR = 5.0 in boys), as well as higher fat and lean mass indices. In addition, among boys, there was an association between arterial hypertension and accelerated weight and height gain in specific growth periods.[240]
- In a cross-sectional study from the PREDI Study cohort, 142 children aged 9 years were assessed. High blood pressure was observed in 20.4% of them, and 69.0% were of the male sex. The frequency of high blood pressure was significantly higher among children with body mass index (BMI) > 85th percentile (34.2%) and among those with waist circumference > 85th percentile (50.0%) as compared to children without excessive adiposity ($p < 0.01$). In the adjusted model, high BMI and increased waist circumference were independently associated with greater chance of high blood pressure (OR = 3.91; 95% CI, 1.31–11.71; $p = 0.015$).[241]
- Studies have shown that arterial hypertension remains highly prevalent in the Brazilian population, with an increase in the absolute number of affected individuals in recent decades, driven by population aging. Despite the reduction in age-standardized rates over time, marked regional and sociodemographic inequalities persist, mainly among the elderly, women, individuals with lower educational attainment, and more vulnerable populations. In addition, a consistent association of arterial hypertension, obesity, and excess adiposity since childhood and adolescence has been observed, reinforcing the multifactorial and cumulative nature of the disease across the life course.

Incidence

- In the ELSA-Brazil study, the incidence of hypertension was assessed in 8,528 adult patients, according to sex and race, after two medical visits between 2010 and 2014. The estimated incidence of hypertension was 43.4/1000 people-year, ranging from 30.5/1000 among White women to 59.4/1000 among Black men. After adjusting for age and family history of hypertension, the incidence rate ratio (IRR) was greater among Black men (2.25; 95% CI, 1.65-3.08), Brown men (1.89; 95% CI, 1.59-2.25), Black women (1.85; 95% CI, 1.50-2.30), Brown women (1.47; 95% CI, 1.31-1.67), and White men (1.76; 95% CI, 1.49-2.08) than among White women.[242]
- Another study, assessing the elderly population in the city of São Paulo between 2010 and 2016 and aimed at estimating the cumulative incidence of arterial hypertension, has reported that 36.1% of normotensive individuals in 2010 had developed hypertension by 2016.[243]

All-cause mortality attributable to arterial hypertension

- According to GBD 2023 estimates, there were 220,160 (95% UI, 183,085 - 255,264) deaths from all causes attributable to high SBP in 2023, corresponding to a rate of 103.8 deaths per 100,000 inhabitants (95% UI, 86.3–120.4). However, the age-standardized mortality rate was 85 deaths per 100,000 inhabitants (95% UI, 70.6–120.4), reflecting a reduction of 52.9% (95% UI, −61.5; −38.7) from 1990 to 2023, following population aging (Table 7.1). The mortality numbers and rates from all causes attributable to high SBP are shown in Charts 7.1 and 7.2. The causes of death attributable to high SBP in Brazil in 1990 and 2023 are shown in Chart 7.3.
- Regarding sex, the age-standardized mortality rate attributable to high SBP in 2023 in Brazil was higher among men (104.9; 95% UI, 86.8 - 121.1) than among women (68.7; 95% UI, 56.0 - 80.3); however, the percent reduction was similar in both sexes (Table 7.1).
- Regarding the variation across the Federative Units (FUs) in 2023, the age-standardized mortality rate attributable to high SBP ranged from 119.7 per 100,000 (95% UI, 94.3 - 140.9) in Alagoas to 58.9 (95% UI, 46.7 - 71.2) in the Distrito Federal, evidencing national disparities (Table 7.2).
- Based on secondary data from the Hospital and Mortality Information systems from the Department of Information and Data Processing of the Brazilian Unified Health System (DATASUS), analyzing hospitalizations and deaths from diabetes mellitus and systemic arterial hypertension in the Bahia state, between 2010 and 2022, 127,080 admissions due to arterial hypertension were recorded, with predominance of women, individuals aged 60 years or older, and self-reported Brown individuals. The arterial hypertension mortality coefficient ranged from 24.8 per 100,000 inhabitants in 2010 to 43 per 100,000 inhabitants in 2022.[244]

Mortality from cardiovascular diseases attributable to arterial hypertension

- According to GBD 2023 estimates, there were 199,185 (95% UI, 163,888.4 - 233,372.8) deaths from all causes attributable to high SBP in 2023, corresponding to 90% of all deaths. All-ages mortality rates attributable to high SBP remained stable from 1990 to 2023. However, the age-standardized mortality rate was 76.8 deaths per 100,000 inhabitants (95% UI, 63.0 - 90.0), reflecting a reduction of 55.8% (95% UI, -63.6; -43.0).[245] The trends in all-ages and age-standardized mortality rates from CVD attributable to high SBP are shown in Chart 7.4.
- There was a higher reduction in age-standardized mortality rates attributable to high SBP from 1990 to 2023 in the FUs with higher sociodemographic index (SDI), with a significant negative correlation between the percent changes of those rates and the SDI in 2023 (Pearson correlation = -0.833, p<0.001) (Chart 7.5).

Morbidity and burden of disease attributable to arterial hypertension

- According to GBD 2023 estimates, there were 4,905,699 (95% UI, 4,021,042 - 5,639,940) DALYs due to all causes attributable to high SBP in 2023, corresponding to a rate of 2,313 (95% UI, 1,896 - 2,659) DALYs per 100,000 inhabitants. As compared to 1990, there was an increase of 3.1% (95% UI, −18; +42.3) in all age groups. The age-standardized DALY rates from all causes was 1,861.5 per 100,000 inhabitants (95% UI, 1,527 - 2,144) in 2023, corresponding to a reduction of 51% (95% UI, −60.5; −34), reflecting population aging (Table 7.3). The distribution across the FUs is similar to that of the mortality rates.
- Multimorbidity in the context of chronic non-communicable diseases in Brazil has been investigated using data from the 2013 PNS, which included 60,202 adults aged 18 years or older, and was defined as the simultaneous presence of two or more chronic conditions, specifically arterial hypertension, diabetes mellitus, and obesity. The overall prevalence of multimorbidity was 9.6%. There was a progressive increase in multimorbidity with age increase, reaching 16.3% (95% CI, 14.4 - 18.5) among men aged 60 years or older and 22.4% (95% CI, 20.8 - 24.2) among women of the same age group.[239]

Awareness, Treatment, and Control

- Based on a cross-sectional study derived from the 2013 PNS, arterial hypertension prevalence, diagnosis awareness, use of drug treatment, and blood pressure control in the Brazilian adult population were estimated. The analysis included 59,226 individuals aged 18 years or older. The arterial hypertension prevalence was 32.3% (95% CI, 31.7–33.1). Among hypertensive individuals, 60.8% (95% CI, 59.5–62.1) reported previous diagnosis awareness and, of those, 90.6% (95% CI, 89.5–91.6) reported being on drug treatment, 54.4% (95% CI, 52,6–56,2) of whom reported controlled blood pressure levels.[233]
- Based on a socioecological model, factors associated with diagnosis awareness and arterial hypertension control among the elderly living in Brazil and Colombia were assessed. The cross-sectional study used data from the *International Mobility in Aging Study*, collected in 2012, which included 803 adults aged 65-74 years, living in the cities of Natal (n=402) and Manizales (n=407). Arterial hypertension was present in 79% of the participants in Brazil and in 70% of those in Colombia, with diagnosis awareness of 85% and 82%, respectively. Awareness of arterial hypertension was associated with recent medication use (OR 18.86; 95% CI, 9.61–37.41), presence of diabetes (OR 4.19; 95% CI, 1.64–10.71), and perceived financial insufficiency (OR 1.85; 95% CI, 1.03–3.31).[15] Among individuals diagnosed with arterial hypertension, blood pressure control was observed in 30% of the Brazilian participants and in 51% of the Colombian ones. That control was associated with the female sex (OR 1.66; 95% CI, 1.12–2.46) and the habit of walking (OR 1.80; 95% CI, 1.09–3.00), with variations between the two countries.[246]
- According to the Vigitel survey, in 2023, 80.9% of hypertensive individuals reported being on drug treatment, with a slight change to 80.7% in 2024.[237] Women were more often being treated and, in 2024, 83.5% reported medication use as compared to 76.8% of men.[237] The frequency of treatment increased substantially with age advance. In 2024, only 21.1% of hypertensive individuals aged 18-24 years reported medication use, and that percentage reached 94.0% among those aged 65 years or older.[237]
- A systematic review with metanalysis including studies conducted in Brazil has estimated the prevalence of adherence to antihypertensive drug treatment in the country. Most were cross-sectional studies (79.8%), published between 2011 and 2021 (89.6%), with predominance of the Southeast (38.5%) and Northeast (33.7%) regions, and no study exclusive to the North region. The aggregated prevalence of treatment adherence was 44.4% (95% CI, 39.12–49.94), with high heterogeneity across the studies ($I^2 = 97.90\%$; $p < 0.001$). No statistically significant difference was observed between the 2001–2010 (42.09%; 95% CI, 28.76–56.69) and 2011–2021 (44.73%; 95% CI, 39.01–50.60) periods.[247]
- A study has assessed the influence of spirituality and religiosity on pharmacological and non-pharmacological treatment adherence of individuals with arterial hypertension using the Questionnaire of Adherence to the Treatment of Systemic Arterial Hypertension (QATSAH). High treatment adherence was observed in 46.8% of the participants. In the adjusted analysis, higher intrinsic religiosity ($\beta = 0.67$; 95% CI, 0.22–1.13; $p = 0.004$) and higher scores of forgiveness ($\beta = 0.66$; 95% CI, 0.13–1.19; $p = 0.015$) were positively associated with treatment adherence. However, the domain "values and beliefs" showed an inverse association with adherence ($\beta = -0.89$; 95% CI, -1.58; -0.20; $p = 0.012$), suggesting that certain individual beliefs can act as barriers against treatment adherence.[248]
- To measure access to medications prescribed to treat arterial hypertension, data from the 2019 PNS were used. The study included individuals who reported being prescribed antihypertensive drugs, considering the use in the 15 days

preceding the interview, as well as access to medication through the Brazilian popular drugstore program or the public health system. Medication use was reported by 91.5% (95% CI, 90.9–92.2) of the participants. Access to medication through the Brazilian popular drugstore program was reported by 45.2% (95% CI, 43.8–46.7) and through the Brazilian Unified Health System, by 41.0% (95% CI, 39.6–42.3). The major reasons for not using antihypertensive medications were the patient's perception that the disease was controlled (45.8%; 95% CI, 41.6–50.0) and the personal belief that treatment was unnecessary (38.3%; 95% CI, 34.0–42.8). In the adjusted model, access to medication through the public health system was greater among Black (PR 1.12; 95% CI, 1.03–1.22) and Brown (PR 1.10; 95% CI, 1.02–1.17) individuals, and lower among men (PR 0.93; 95% CI, 0.88–0.99).[249]

- In the context of CVD primary prevention, the proportion and prevalence of uncontrolled cardiovascular risk factors were assessed in individuals cared for at basic health units in São Paulo state, mainly due to arterial hypertension. The cross-sectional, community-based study included 7,724 participants assessed at 322 basic health units across 32 municipalities. Arterial hypertension was present in 96.2% of the sample. Blood pressure control was observed in 34.9% of the individuals according to the criterion <130/80 mm Hg and in 55.5% according to the criterion <140/90 mm Hg. Of the users of antihypertensive drugs, 33.5% had blood pressure <130/80 mm Hg. Among individuals aged 65 years or older, blood pressure control <130/80 mm Hg was identified in 24.3%, while among younger individuals, that proportion was 35.8%. Multivariate analyses showed a positive association with female sex, diagnosis of arterial hypertension, and obesity.[250]
- Studies have evidenced that, despite broad diagnostic coverage and high access to pharmacological treatment for hypertension in Brazil, adherence to treatment and blood pressure control remain suboptimal. Inequalities related to sex, race/ethnicity, educational attainment, income, and access to healthcare services significantly influence the quality of care and clinical outcomes. In addition, behavioral, cultural, and context factors, such as physical activity, individual beliefs, and social support, play a relevant role in treatment adherence. These findings reinforce the need for integrated strategies aimed at not only expanding access, but also at strengthening longitudinal care and improving sustained blood pressure control.

Inequality and Disadvantaged Populations

- Analyses of the 2013 and 2019 PNS have shown a reduction in the prevalence of high quality hypertension care from 41.7% to 35.4%, which is significantly less frequent among users of public healthcare services as compared to users of private healthcare services (PR = 0.64; 95% CI, 0.58–0.70). In the intersection analysis, low-income Black women had the lowest prevalence of high quality hypertension care (PR = 0.86; 95% CI, 0.73–1.02).[251]
- Users of the Unified Health System have shown lower blood pressure control as compared to those of private healthcare services, in addition to more frequent visits to emergency services and less frequent regular consultations with the cardiologist.[252] Moreover, worse rates of arterial hypertension control were observed in the public healthcare services, for both office (67.8% *versus* 47.6%) and home (60.4% *versus* 35.3%; p < 0.001) blood pressure measurements.[253]
- Racial inequalities have been consistently observed in different Brazilian studies. Data from the ELSA-Brazil have shown higher incidence of arterial hypertension among Brown (IRR = 1.27; 95% CI, 1.08–1.49) and Black (IRR = 1.62; 95% CI, 1.35–1.95) individuals as compared to White ones.[254] Higher prevalence of inadequate blood pressure control has been observed among Black men (35.6%; PR = 1.49; 95% CI, 1.26–1.75), Brown men (PR = 1.42; 95% CI, 1.18–1.72), and Black women (29.2%; PR = 1.36; 95% CI, 1.12–1.65), having White women as reference.[242] Supporting those findings, prevalence of uncontrolled arterial hypertension of 39.0% was observed among White individuals, 52.6% among Brown individuals, and 54.2% among Black ones, but these racial inequities were not totally explained by economic segregation.[255]
- According to the Vigitel survey, effective blood pressure control tends to be lower among males, individuals with low educational attainment, of Black/Brown race/ethnicity, residents of rural areas, and individuals without private health insurance, evidencing inequalities in arterial hypertension management.[237]
- In addition, important socioeconomic inequalities have been observed regarding receiving recommendations for lifestyle changes. Analysis of the 2019 PNS has shown that recommendations related to arterial hypertension management were more frequently provided to younger individuals, married ones, non-smokers, and those with higher educational attainment and income, evidencing an increasing gradient with educational attainment and income.[256]
- In addition, historically disadvantaged populations have a high burden of arterial hypertension. Review of studies conducted in Brazilian 'quilombola' communities identified mean prevalence of arterial hypertension of 32.1%, ranging from 13.8% to 52.5%, values greater than the national prevalence estimated by the PNS (23.9%).[257]
- Taken together, the studies cited have shown that men, Black and Brown individuals, populations of lower socioeconomic levels, users of the public health system, and socially disadvantaged communities have a higher incidence of arterial hypertension, worse blood pressure control rates, and lower access to high-quality healthcare, evidencing the central role of structural and social inequalities in the burden of arterial hypertension in Brazil.

Impact of COVID-19 Pandemic

- Aiming at assessing the mortality associated with arterial hypertension in Brazil between 2020 and 2022 and the impact of the COVID-19 pandemic, a national analysis has been conducted to compare the pandemic and pre-pandemic (2015–2019) periods. Data from 11,423,288

deaths recorded in the Brazilian Mortality Information System were analyzed, considering arterial hypertension identified using the codes ICD-10 I10–I15. Adjusted mortality ratios for arterial hypertension were 1.37 (95% CI, 1.36–1.37) in 2020, 1.54 (95% CI, 1.54–1.55) in 2021, and 1.14 (95% CI, 1.14–1.15) in 2022. After excluding deaths associated with COVID-19, the ratios remained higher than 1 and were 1.11 (95% CI, 1.19–1.18), 1.15 (95% CI, 1.15–1.15), and 1.09 (95% CI, 1.08–1.09), respectively.[258]

- Aiming at investigating the relationship between SARS-CoV-2 lineages and the clinical profiles of patients with COVID-19, a cross-sectional study was conducted in a Southern Brazil hospital between March 2020 and March 2021 and included 277 patients with RT-PCR-confirmed diagnosis, of whom 162 (58.5%) required hospitalization and 115 (41.5%) did not. The prevalence of arterial hypertension was 66.0% among hospitalized patients and 21.7% among non-hospitalized patients, totaling 47.7% of the sample. Regarding the predominant lineages, arterial hypertension was more prevalent among individuals infected with the P.1 lineage (66.7%; n=32), followed by the B.1.1.28 (52.3%; n=23) and B.1.1.33 (40.3%; n=50) lineages, with statistically significant differences across the groups (p=0.007).[259]
- After the third wave of the COVID-19 pandemic, changes in the prevalence of chronic non-communicable diseases and their risk and protective factors were assessed in the Brazilian adult population, with particular emphasis on self-reported arterial hypertension. The study used data from the Vigitel survey and compared estimates of prevalence between 2019 and 2021/2022, with stratification by sex. In the total population, the prevalence of arterial hypertension was 24.5% (95% CI, 23.8–25.3) in 2019 and 26.3% (95% CI, 25.1–27.6) in 2021/2022. Among men, that prevalence was 21.2% (95% CI, 20.1–22.4) and 25.4% (95% CI, 23.4–27.5), respectively, while among women, 27.3% (95% CI, 26.4–28.3) and 27.1% (95% CI, 25.6–28.8), respectively.[236]

Healthcare Utilization and Costs

- Analysis of the 2019 PNS has shown prevalence of self-reported arterial hypertension of 23.9% (95% CI, 23.5–24.4) in the Brazilian adult population, higher among women (26.4%) and individuals aged 60 years or older (55.0%). Among hypertensive individuals, 72.2% reported medical care in the preceding year and 57.8%, in the preceding six months. Most of the follow-up was carried out at the Unified Health System (66.1%), basic health units being responsible for 45.8% of the care provided. Most patients received guidance on self-care, including salt consumption reduction (87.8%), healthy diet (87.2%), regular follow-up (85.2%), appropriate weight maintenance (84.4%), and regular practice of physical activity (81.7%). In addition, 95.3% reported prescription of antihypertensive drugs and 91.1% reported regular use of all medications prescribed in the two weeks preceding the interview.[260]
- A study has assessed 306 patients with mean age of 54.3 years (interquartile interval: 53.4–55.3), 52.1% of whom were men, and 66.4% had arterial hypertension. Hypertensive and insufficiently active individuals, as compared to normotensive physically active ones, had higher adjusted costs with consultations (US$ 20.0; 95% CI, 9.9–30.2), medications (US$ 34.2; 95% CI, 18.9–49.5), and total primary health care (US$ 51.6; 95% CI, 30.2–72.9). Among hypertensives who adhered to antihypertensive treatment and were insufficiently physically active, even higher costs were observed with consultations (US$ 24.1; 95% CI, 1.90–46.3), medications (US$ 56.6; 95% CI, 1.65–111.5), and total primary health care (US$ 71.6; 95% CI, 19.2–123.9). In addition, patients with three or more diseases had higher expenditures in all domains assessed.[261]
- To assess the costs and health outcomes associated with different arterial hypertension diagnostic methods in primary health care in Brazil, a cost-utility analysis was performed comparing office blood pressure measurement (OBPM), home blood pressure monitoring (HBPM), and ambulatory blood pressure monitoring (ABPM). ABPM proved to be the most cost-effective strategy in all age groups over 35 years. Although it had costs higher than OBPM, ABPM provided greater gain in Quality-Adjusted Life Years (QALYs). In individuals over 35 years of age, ABPM had a cost of R$8,396.00 and gain of 9.46 QALYs, while HBPM had a cost of R$8,683.00 and gain of 9.44 QALYs, and OBPM had a cost of R$8,002.00 and gain of 9.33 QALYs. In addition, HBPM was considered cost-effective as compared to OBPM, with ratios below the threshold of R$35,000 per QALY gained.[262]
- The costs attributable to obesity, arterial hypertension, and diabetes in the Brazilian Unified Health System were estimated as R$ 3.45 billion (95% CI, R$ 3.15–3.75 billion) in 2018, corresponding to approximately US$ 890 million. Arterial hypertension accounted for 59% of the total costs, exceeding R$ 2 billion per year, while diabetes accounted for 30% and obesity, 11%. Expenditures were concentrated primarily on the provision of medications (58.8%), followed by hospitalizations (34.6%) and outpatient procedures (6,6%). Women corresponded to 56% of total costs, and more than 70% of the expenditure corresponded to individuals aged 30-69 years. When considered as a risk factor for arterial hypertension and diabetes, obesity increased its attributable costs to R$ 1.42 billion (95% CI, R$ 0.98–1.87), which corresponded to 41% of the total costs assessed.[263]
- The findings have shown that arterial hypertension imposes a substantial economic burden on the Brazilian healthcare system, especially due to costs associated with continuous use of medications, medical consultations, and hospitalizations. Physical inactivity and multimorbidity are associated with greater utilization of resources and increased healthcare expenditures. In addition, diagnostic methods based on out-of-office measurements, particularly ABPM, proved to be more cost-effective and associated with greater gain in quality of life. Taken together, these data reinforce the sustained financial burden of arterial hypertension on the Brazilian Unified Health System, as well as the importance of more effective strategies for disease prevention, diagnosis, and control.

Burden of disease attributable to hypertensive heart disease

- According to GBD study estimates, the prevalence of hypertensive heart disease in Brazil, per 100,000 inhabitants, passed from 148.8 (95% UI, 115.6 - 186.9) in 1990 to 164.3 (95% UI, 124.8 - 212.9) in 2023, an increase of 14.7% (95% UI, 4.7 - 24.4). Among men, that prevalence passed from 146.4 (112.7 - 187.0) to 168.0 (95% UI, 127.5 - 220.1), while among women it increased from 151.4 (95% UI, 119.6 - 188.1) to 162.4 (95% UI, 123.2 - 208.5) per 100,000 inhabitants in the same period (Table 7.4).
- Regarding the geographic regions, in 2023, the highest prevalence rates for both sexes were observed in the Northeast and North regions, 187.8 (95% UI, 146.0 - 240.2) and 180.8 (95% UI, 139.8 - 234.2) per 100,000 inhabitants, respectively. Similarly, analyzing the sexes separately, the highest rates were observed in the Northeast and North regions, with prevalence estimations among men of 198.4 (95% UI, 153.4 - 256.6) and 187.2 (95% UI, 141.7 - 240.1), and among women, 180.3 (95% UI, 140.9 - 227.3) and 175.4 (95% UI, 137.8 - 223.7), respectively (Table 7.4).
- Regarding mortality from hypertensive heart disease, age-standardized mortality rate decreased 45.3% (95% UI, -51.5; -39.3) from 1990 (22.3 per 100,000, 95% UI, 19.5 - 25.0) to 2023 (12.2 per 100,000; 95% UI, 10.6 -13.3). However, the number of deaths increased, due to population increase and aging, from 16,588 (95% UI, 14,767.9 - 18,495.5) deaths in 1990 to 31,239 deaths in 2023 (95% UI, 27,206.9 - 34,009.2) (Table 7.5). Data of DALYs due to hypertensive heart disease show similar trends (Table 7.6).

Future Directions

- Arterial hypertension remains an important problem of public health, requiring continuous strengthening of epidemiological surveillance to monitor its prevalence, cascade of care, and outcomes. Systematic analysis of the burden of disease is fundamental to guide health planning and efficient allocation of resources.
- Addressing arterial hypertension depends primarily on the implementation and strengthening of public health policies, with an emphasis on primary health care, expanded access to diagnosis and treatment, and promotion of healthy lifestyles. The persistence of social, racial, and regional inequalities reinforces the need for equitable and intersectoral strategies that extend beyond the health sector.
- Precision medicine and digital technologies have complementary potential from a forward-looking perspective. However, in the real-world setting, their impact on the population remains limited in the face of structural challenges. Thus, the advance in hypertension control is more directly related to the consolidation of robust surveillance systems and the efficacy of public health policies.
- Sustainable reduction in the burden of arterial hypertension requires an integrated approach, centered on surveillance, equity, and implementation of broadly accessible health interventions with population impact.

Table 7.1 – Number of deaths and all-cause mortality rate attributable to high systolic blood pressure, according to age group and sex, in Brazil, in 1990 and 2023, and percent change of rates in the period.

Sex	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)	Age group
Male	7,906.8 (4,484.6; 10,923.4)	20.9 (11.9; 28.9)	8,183.1 (6,387.4; 9,867.2)	15.1 (11.8; 18.3)	-27.6 (-48.2; 16.7)	15-49 years
Male	30,272.5 (21,951.4; 37,032.4)	400.9 (290.7; 490.4)	43,673.4 (35,917.4; 49,955.7)	213.7 (175.7; 244.4)	-46.7 (-57.0; -28.0)	50-69 years
Male	35,809.9 (27,694.4; 43,361.8)	1,878.5 (1,452.8; 2,274.7)	65,688.4 (54,006.8; 76,533.0)	1,022.9 (841.0; 1,191.7)	-45.5 (-54.8; -31.3)	70+ years
Male	73,989.2 (53,748.4; 91,388.1)	100.2 (72.8; 123.8)	117,544.9 (97,056.9; 135,706.2)	114.1 (94.2; 131.7)	13.8 (-6.7; 49.8)	All ages
Male		205.1 (152.5; 251.5)		104.9 (86.8; 121.1)	-48.9 (-57.6; -34.5)	Age-standardized
Female	4,416.0 (2,292.5; 6,654.0)	11.3 (5.9; 17.0)	4,429.4 (3,213.9; 5,672.3)	7.9 (5.8; 10.2)	-29.9 (-55.7; 35.6)	15-49 years
Female	19,244.3 (13,654.8; 24,244.2)	235.0 (166.7; 296.0)	25,067.8 (20,791.4; 28,971.2)	107.9 (89.5; 124.7)	-54.1 (-63.7; -37.2)	50-69 years
Female	39,984.8 (30,905.0; 49,092.2)	1,688.0 (1,304.7; 2,072.5)	73,118.0 (57,511.3; 86,507.6)	836.5 (658.0; 989.7)	-50.4 (-59.6; -36.9)	70+ years
Female	63,645.1 (46,437.5; 79,596.2)	84.3 (61.5; 105.4)	102,615.2 (83,244.7; 119,903.8)	94.1 (76.4; 110.0)	11.7 (-10.4; 49.6)	All ages
Female		158.4 (116.9; 196.8)		68.7 (56.0; 80.3)	-56.6 (-64.6; -43.2)	Age-standardized
Both	12,322.9 (6,777.1; 17,408.9)	16.0 (8.8; 22.7)	12,612.5 (9,639.5; 15,451.6)	11.5 (8.8; 14.1)	-28.4 (-50.1; 22.6)	15-49 years
Both	49,516.8 (35,428.5; 61,227.3)	314.6 (225.1; 389.0)	68,741.2 (57,434.3; 79,125.5)	157.4 (131.5; 181.2)	-50.0 (-59.8; -32.5)	50-69 years
Both	75,794.8 (58,815.2; 92,128.8)	1,773.0 (1,375.8; 2,155.0)	138,806.4 (112,392.4; 163,000.2)	915.4 (741.2; 1,075.0)	-48.4 (-57.0; -34.5)	70+ years
Both	137,634.4 (99,957.3; 169,696.1)	92.2 (66.9; 113.6)	220,160.0 (183,085.1; 255,263.6)	103.8 (86.3; 120.4)	12.6 (-8.5; 49.7)	All ages
Both		180.6 (134.7; 221.9)		85.0 (70.6; 98.6)	-52.9 (-61.5; -38.7)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 7.2 – Number of deaths and all-cause mortality rate attributable to high systolic blood pressure, according to age group and sex, in Brazil, its geographic regions, and Federative Units, in 1990 and 2023, and percent change of rates in the period

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
Brazil	137,634.4 (99,957.3; 169,696.1)	180.6 (134.7; 221.9)	220,160.0 (183,085.1; 255,263.6)	85.0 (70.6; 98.6)	-52.9 (-61.5; -38.7)
North region	4,834.2 (3,366.5; 6,134.6)	154.2 (109.8; 195.5)	12,682.7 (10,157.9; 15,228.6)	87.2 (69.4; 105.5)	-43.4 (-56.5; -22.1)
Acre	196.5 (138.1; 248.7)	146.1 (104.9; 184.5)	545.2 (419.0; 671.9)	84.9 (64.8; 104.2)	-41.9 (-57.3; -19.2)
Amapá	110.8 (76.6; 144.7)	127.9 (91.0; 164.5)	436.5 (336.5; 536.9)	84.4 (65.0; 104.6)	-34.0 (-50.7; -8.7)
Amazonas	849.6 (589.8; 1,099.1)	143.5 (102.5; 183.1)	2,452.2 (1,939.1; 2,964.6)	87.4 (69.0; 106.7)	-39.1 (-53.9; -17.2)
Pará	2,695.8 (1,871.7; 3,462.5)	156.7 (111.1; 200.3)	6,102.2 (4,778.2; 7,402.1)	85.6 (66.1; 104.3)	-45.4 (-58.7; -24.9)
Rondônia	532.1 (360.5; 697.5)	202.8 (146.0; 256.2)	1,454.1 (1,152.8; 1,718.0)	97.1 (77.8; 113.9)	-52.1 (-62.5; -35.6)
Roraima	66.3 (45.4; 87.7)	161.4 (116.3; 203.3)	349.7 (275.2; 418.4)	97.2 (75.8; 115.8)	-39.8 (-54.7; -17.7)
Tocantins	383.1 (257.9; 509.2)	161.8 (114.6; 208.4)	1,342.8 (992.1; 1,668.3)	86.1 (63.5; 107.0)	-46.8 (-60.8; -24.2)
Northeast region	32,763.0 (23,476.3; 41,086.2)	144.3 (104.7; 180.8)	59,585.9 (46,756.1; 71,440.5)	88.7 (69.7; 106.4)	-38.5 (-52.4; -16.4)
Alagoas	2,157.3 (1,529.6; 2,657.6)	178.9 (128.1; 220.3)	4,000.8 (3,149.6; 4,728.1)	119.7 (94.3; 140.9)	-33.1 (-48.5; -6.2)
Bahia	8,446.6 (6,305.8; 10,383.5)	138.0 (103.9; 171.3)	16,119.9 (12,598.3; 19,296.8)	86.8 (67.7; 103.9)	-37.1 (-50.5; -15.7)
Ceará	3,863.1 (2,676.5; 4,952.0)	109.2 (77.2; 140.5)	8,234.5 (6,374.7; 10,033.1)	73.5 (57.1; 89.0)	-32.7 (-48.7; -6.9)
Maranhão	3,111.8 (2,077.6; 3,965.6)	142.1 (96.7; 180.8)	7,308.5 (5,564.5; 8,763.4)	106.9 (80.9; 128.6)	-24.7 (-44.1; 7.3)
Paraíba	2,799.0 (2,008.9; 3,500.2)	134.4 (97.3; 168.2)	4,509.6 (3,586.3; 5,364.2)	85.7 (68.0; 101.8)	-36.2 (-49.9; -14.2)
Pernambuco	7,558.9 (5,454.1; 9,499.7)	186.5 (133.2; 233.2)	9,874.4 (7,707.6; 11,974.2)	89.8 (70.2; 109.0)	-51.9 (-63.5; -33.3)
Piaui	1,814.4 (1,307.5; 2,314.0)	144.2 (104.9; 182.1)	3,898.4 (2,965.9; 4,770.5)	93.5 (71.2; 114.4)	-35.1 (-51.0; -10.8)
Rio Grande do Norte	1,808.2 (1,275.3; 2,303.5)	122.0 (86.2; 155.5)	3,503.7 (2,768.3; 4,241.3)	81.0 (64.4; 98.1)	-33.6 (-50.3; -7.2)
Sergipe	1,203.7 (847.7; 1,502.6)	160.4 (113.7; 200.4)	2,136.2 (1,703.6; 2,515.7)	86.8 (69.0; 102.3)	-45.9 (-57.7; -26.4)
Southeast region	70,128.2 (51,580.4; 86,351.1)	201.2 (150.3; 244.9)	100,095.2 (81,549.0; 117,174.9)	84.0 (68.2; 98.5)	-58.2 (-66.2; -44.1)
Espírito Santo	2,341.5 (1,632.6; 2,975.0)	186.7 (132.6; 234.8)	4,180.3 (3,458.6; 4,879.4)	83.7 (68.6; 98.0)	-55.2 (-64.9; -38.4)
Minas Gerais	14,683.5 (11,413.6; 17,792.4)	174.9 (138.0; 211.2)	21,237.1 (16,448.0; 25,260.2)	71.6 (55.3; 85.1)	-59.1 (-66.3; -49.5)

Rio de Janeiro	19,480.6 (13,766.7; 24,607.4)	230.6 (164.7; 290.7)	22,446.0 (18,519.5; 25,959.2)	93.9 (77.7; 108.5)	-59.3 (-67.5; -43.6)
São Paulo	33,622.7 (24,597.5; 41,452.3)	201.4 (149.4; 244.4)	52,231.8 (41,354.8; 62,971.9)	86.4 (68.4; 104.2)	-57.1 (-66.0; -41.3)
South region	24,257.6 (18,250.0; 29,430.6)	206.5 (158.0; 248.0)	33,784.2 (28,211.0; 39,467.7)	83.2 (69.5; 97.5)	-59.7 (-66.6; -48.4)
Paraná	8,661.5 (6,122.3; 10,800.8)	213.4 (156.1; 263.7)	12,525.0 (10,176.5; 14,850.5)	85.0 (68.8; 101.0)	-60.2 (-68.4; -46.6)
Rio Grande do Sul	11,476.4 (9,002.7; 13,690.2)	206.3 (164.0; 244.5)	13,940.4 (10,839.2; 16,806.9)	82.3 (64.0; 99.2)	-60.1 (-68.5; -49.5)
Santa Catarina	4,119.7 (2,968.9; 5,164.6)	193.9 (140.9; 242.9)	7,318.7 (5,880.0; 8,697.9)	82.3 (65.6; 97.9)	-57.6 (-65.6; -43.6)
West-Central region	5,651.4 (3,873.5; 7,181.1)	160.2 (114.1; 202.8)	14,012.1 (11,101.7; 16,822.5)	81.4 (63.6; 98.3)	-49.1 (-60.6; -29.8)
Distrito Federal	748.3 (511.3; 956.3)	157.7 (111.7; 196.6)	1,700.4 (1,361.5; 2,054.6)	58.9 (46.7; 71.2)	-62.7 (-70.8; -49.3)
Goiás	2,639.9 (1,790.0; 3,404.2)	157.3 (109.8; 201.7)	6,277.4 (4,966.8; 7,678.4)	80.9 (63.6; 99.1)	-48.6 (-60.9; -28.7)
Mato Grosso	926.4 (642.0; 1,178.5)	149.6 (106.9; 187.8)	2,939.6 (2,325.4; 3,512.5)	87.8 (69.1; 105.6)	-41.3 (-55.3; -18.2)
Mato Grosso do Sul	1,336.8 (944.6; 1,681.4)	177.9 (128.7; 223.4)	3,094.7 (2,418.8; 3,721.1)	98.8 (77.0; 119.1)	-44.5 (-57.5; -24.2)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 7.3 – DALY numbers and rates due to all causes attributable to high systolic blood pressure, according to age group and sex, in Brazil, in 1990 and 2023, and percent change of the rates in the period

Sex	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)	Age group
Male	402,314.3 (224,480.7; 560,846.5)	1,064.2 (593.8; 1,483.6)	418,785.0 (326,051.7; 503,589.0)	774.7 (603.2; 931.6)	-27.2 (-48.2; 19.4)	15-49 years
Male	946,095.3 (678,115.5; 1,161,507.9)	12,529.5 (8,980.6; 15,382.3)	1,378,548.7 (1,127,197.7; 1,576,703.2)	6,745.3 (5,515.5; 7,714.9)	-46.2 (-56.5; -26.5)	50-69 years
Male	568,654.0 (432,791.7; 688,746.1)	29,830.5 (22,703.4; 36,130.3)	1,021,754.9 (835,070.1; 1,198,543.6)	15,910.3 (13,003.3; 18,663.1)	-46.7 (-55.9; -32.4)	70+ years
Male	1,917,063.6 (1,323,060.7; 2,415,734.2)	2,597.3 (1,792.5; 3,272.9)	2,819,088.6 (2,312,257.7; 3,224,468.4)	2,735.7 (2,243.9; 3,129.1)	5.3 (-15.4; 45.4)	All ages
Male		4,528.1 (3,230.2; 5,633.7)		2,377.2 (1,953.6; 2,724.8)	-47.5 (-57.3; -29.4)	Age-standardized
Female	230,127.6 (116,369.9; 353,326.1)	589.3 (298.0; 904.9)	236,984.3 (171,447.7; 302,944.0)	424.4 (307.1; 542.6)	-28.0 (-55.9; 43.8)	15-49 years
Female	607,102.8 (427,088.1; 770,113.0)	7,413.1 (5,215.0; 9,403.5)	809,603.2 (658,728.3; 939,127.6)	3,483.6 (2,834.4; 4,040.9)	-53.0 (-63.1; -34.3)	50-69 years
Female	595,410.3 (453,681.9; 730,742.9)	25,136.2 (19,152.9; 30,849.5)	1,040,022.7 (839,611.6; 1,224,130.4)	11,898.7 (9,605.8; 14,005.0)	-52.7 (-61.2; -39.4)	70+ years
Female	1,432,640.7 (1,001,682.3; 1,838,879.7)	1,897.0 (1,326.4; 2,434.9)	2,086,610.2 (1,718,442.3; 2,409,095.6)	1,913.8 (1,576.1; 2,209.6)	0.9 (-22.2; 41.6)	All ages
Female		3,134.3 (2,239.5; 3,966.2)		1,424.3 (1,168.1; 1,646.4)	-54.6 (-63.9; -37.5)	Age-standardized
Both	632,441.9 (340,850.6; 905,482.9)	822.9 (443.5; 1,178.2)	655,769.3 (496,948.1; 816,165.7)	596.8 (452.2; 742.7)	-27.5 (-50.6; 27.3)	15-49 years
Both	1,553,198.2 (1,093,630.2; 1,924,974.9)	9,867.5 (6,947.8; 12,229.4)	2,188,151.9 (1,801,735.0; 2,515,892.2)	5,009.8 (4,125.1; 5,760.1)	-49.2 (-59.4; -30.8)	50-69 years
Both	1,164,064.3 (894,981.2; 1,407,690.0)	27,229.4 (20,935.1; 32,928.2)	2,061,777.6 (1,721,614.8; 2,419,624.8)	13,597.7 (11,354.3; 15,957.8)	-50.1 (-58.4; -36.3)	70+ years
Both	3,349,704.3 (2,326,633.3; 4,219,742.4)	2,243.1 (1,558.0; 2,825.8)	4,905,698.9 (4,021,042.0; 5,639,940.4)	2,313.2 (1,896.0; 2,659.4)	3.1 (-18.0; 42.3)	All ages
Both		3,798.7 (2,716.4; 4.715.9)		1,861.5 (1,527.7; 2,144.0)	-51.0 (-60.5; -34.0)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 7.4 – Hypertensive heart disease: number of cases and prevalence rates, according to sex, in Brazil, its geographic regions and Federative Units, in 1990 and 2023, and percent change of rates in the period

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)	Sex
Brazil	53,010.4 (40,876.9; 67,729.1)	146.4 (112.7; 187.0)	184,678.4 (140,699.6; 240,009.0)	168.0 (127.5; 220.1)	14.7 (4.7; 24.4)	Male
North region	2,797.2 (2,178.4; 3,516.0)	159.1 (121.6; 206.5)	12,922.9 (9,680.5; 16,586.5)	187.2 (141.7; 240.1)	17.7 (6.7; 29.1)	Male
Acre	145.2 (112.7; 185.4)	176.3 (137.4; 226.7)	606.1 (463.8; 779.5)	195.4 (148.1; 253.6)	10.8 (-2.6; 24.2)	Male
Amapá	58.7 (46.7; 73.2)	144.7 (113.2; 183.4)	407.2 (307.1; 526.1)	169.7 (128.2; 222.1)	17.3 (3.4; 35.3)	Male
Amazonas	506.3 (391.5; 643.8)	150.4 (112.7; 191.8)	2,344.0 (1,785.9; 3,037.5)	178.9 (136.6; 234.5)	18.9 (4.2; 34.9)	Male
Pará	1,381.6 (1,063.6; 1,789.1)	152.3 (115.9; 200.3)	5,870.9 (4,315.6; 7,623.7)	175.8 (129.1; 227.2)	15.4 (0.1; 32.1)	Male
Rondônia	309.8 (244.2; 395.6)	171.9 (135.0; 221.5)	1,543.0 (1,192.6; 1,987.2)	205.7 (158.5; 266.9)	19.7 (2.7; 38.2)	Male
Roraima	44.9 (36.1; 57.1)	161.1 (121.8; 203.7)	353.0 (263.9; 459.8)	190.9 (143.4; 248.3)	18.5 (2.1; 35.8)	Male
Tocantins	350.8 (270.1; 441.3)	197.3 (155.4; 248.7)	1,798.6 (1,385.9; 2,329.4)	233.4 (181.3; 304.2)	18.3 (4.5; 34.0)	Male
Northeast region	19,307.7 (15.004.0; 24,422.0)	174.8 (137.0; 219.7)	56,763.5 (43,690.6; 72,979.6)	198.4 (153.4; 256.6)	13.5 (2.9; 24.3)	Male
Alagoas	1,087.2 (847.0; 1,371.7)	183.7 (141.3; 231.9)	2,847.4 (2,164.3; 3,746.0)	202.8 (154.2; 264.7)	10.4 (-5.6; 26.1)	Male
Bahia	5,695.2 (4,404.3; 7,194.2)	194.9 (151.1; 245.1)	16,929.8 (12,760.8; 22,003.3)	212.4 (159.1; 276.6)	8.9 (-7.4; 24.0)	Male
Ceará	2,348.6 (1,772.3; 3,061.8)	135.7 (103.9; 174.2)	8,133.9 (5,932.8; 10,671.0)	170.2 (124.7; 224.7)	25.4 (7.6; 47.3)	Male
Maranhão	1,849.8 (1,458.4; 2,337.1)	172.3 (133.8; 214.7)	6,569.4 (5,049.5; 8,389.4)	210.5 (162.0; 270.9)	22.2 (6.9; 40.7)	Male
Paraíba	1,687.8 (1,290.5; 2,163.7)	163.2 (124.2; 204.5)	4,069.9 (3,170.0; 5,292.7)	186.8 (146.0; 243.1)	14.5 (-2.2; 34.1)	Male
Pernambuco	3,292.3 (2,596.1; 4,275.5)	170.7 (134.9; 218.4)	7,886.1 (5,882.9; 10,145.8)	176.3 (132.3; 227.6)	3.3 (-8.6; 19.0)	Male
Piaui	1,495.5 (1,207.6; 1,872.9)	233.8 (187.7; 292.0)	4,771.5 (3,717.4; 6,064.1)	257.8 (201.1; 327.0)	10.2 (-4.3; 25.1)	Male
Rio Grande do Norte	1,325.5 (1,029.4; 1,690.2)	178.9 (137.5; 226.6)	3,794.5 (2,882.2; 4,882.6)	210.0 (159.5; 271.5)	17.4 (2.5; 35.5)	Male
Sergipe	525.8 (401.7; 662.8)	141.3 (106.1; 178.0)	1,761.0 (1,345.9; 2,308.7)	170.4 (128.5; 224.6)	20.6 (3.5; 40.2)	Male
Southeast region	21,542.3 (16,655.3; 27,315.0)	133.7 (103.6; 171.9)	75,114.1 (57,252.6; 98,393.6)	152.1 (116.5; 201.0)	13.8 (1.0; 25.9)	Male

Espírito Santo	1,030.6 (815.6; 1,288.2)	163.5 (129.5; 205.3)	4,475.3 (3,418.6; 5,708.6)	206.4 (157.7; 268.0)	26.2 (7.9; 43.8)	Male
Minas Gerais	6,187.6 (4,743.4; 7,818.6)	152.7 (117.5; 193.3)	21,912.7 (16,340.7; 28,380.7)	170.3 (128.7; 220.2)	11.5 (-4.6; 30.8)	Male
Rio de Janeiro	5,114.3 (3,964.8; 6,649.3)	143.6 (113.5; 184.8)	13,787.8 (10,117.0; 18,603.4)	147.1 (110.3; 197.2)	2.5 (-12.2; 21.8)	Male
São Paulo	9,209.8 (6,931.8; 11,916.5)	116.9 (88.4; 152.2)	34,938.3 (26,050.8; 46,551.2)	139.9 (104.8; 188.0)	19.7 (0.7; 38.0)	Male
South region	6,719.3 (5,136.1; 8,872.7)	118.9 (89.6; 153.2)	26,583.1 (19,756.2; 34,769.4)	152.9 (113.8; 200.3)	28.6 (13.6; 43.9)	Male
Paraná	2,774.1 (2,113.2; 3,558.2)	134.3 (103.3; 174.4)	10,406.5 (7,851.5; 13,815.5)	162.3 (123.3; 214.7)	20.8 (5.1; 38.2)	Male
Rio Grande do Sul	2,789.4 (2,131.8; 3,659.3)	109.8 (83.6; 144.1)	10,498.5 (7,655.5; 14,083.8)	148.6 (108.9; 198.0)	35.4 (15.7; 58.1)	Male
Santa Catarina	1,155.8 (865.3; 1,495.3)	110.4 (82.1; 142.9)	5,678.1 (4,078.0; 7,422.0)	145.6 (104.1; 191.7)	31.9 (11.5; 51.9)	Male
West-Central region	2,643.8 (2,024.4; 3,367.7)	142.4 (110.3; 180.4)	13,294.9 (10,170.0; 17,158.6)	171.8 (132.2; 225.2)	20.6 (8.3; 33.4)	Male
Distrito Federal	389.2 (308.5; 491.2)	169.1 (131.6; 215.6)	2,118.1 (1,584.8; 2,783.2)	172.3 (129.2; 225.9)	1.9 (-14.0; 18.7)	Male
Goiás	1,113.7 (831.0; 1,475.8)	128.9 (95.6; 163.6)	5,397.2 (4,017.6; 7,181.9)	155.4 (117.0; 208.5)	20.5 (1.8; 41.3)	Male
Mato Grosso	574.6 (448.5; 730.5)	158.7 (123.2; 203.8)	3,266.6 (2,469.1; 4,216.0)	200.2 (149.6; 259.5)	26.1 (7.3; 44.7)	Male
Mato Grosso do Sul	566.3 (434.9; 713.7)	143.1 (110.1; 181.4)	2,512.9 (1,889.0; 3,257.9)	179.0 (135.5; 230.5)	25.1 (6.7; 43.9)	Male
Brazil	66,672.9 (52,812.7; 82,661.1)	151.4 (119.6; 188.1)	238,779.3 (181,485.2; 307,443.9)	162.4 (123.2; 208.5)	7.2 (-2.6; 14.9)	Female
North region	2,939.0 (2,394.0; 3,591.1)	158.8 (126.6; 198.7)	13,642.1 (10,790.2; 17,177.5)	175.4 (137.8; 223.7)	10.5 (0.6; 19.0)	Female
Acre	121.2 (98.1; 148.4)	169.2 (137.3; 207.0)	618.9 (490.6; 774.0)	181.2 (142.3; 229.4)	7.1 (-5.3; 21.3)	Female
Amapá	77.5 (61.8; 96.5)	145.5 (114.4; 185.4)	439.8 (336.0; 559.2)	157.3 (117.0; 201.1)	8.1 (-6.4; 24.3)	Female
Amazonas	545.8 (438.0; 673.8)	150.1 (117.8; 188.9)	2,637.0 (2,091.8; 3,447.4)	168.7 (131.8; 218.4)	12.4 (-1.1; 26.2)	Female
Pará	1,557.8 (1,253.7; 1,950.8)	153.6 (121.0; 191.8)	6,363.2 (4,996.8; 8,023.0)	166.3 (129.1; 213.4)	8.3 (-3.8; 22.7)	Female
Rondônia	261.7 (214.7; 318.6)	176.7 (139.3; 217.2)	1,477.1 (1,170.1; 1,887.0)	189.1 (149.2; 243.9)	7.0 (-5.2; 21.2)	Female
Roraima	40.0 (32.5; 49.8)	171.7 (137.3; 212.9)	370.1 (289.8; 467.0)	190.3 (146.9; 239.9)	10.8 (-1.7; 24.0)	Female
Tocantins	335.0 (271.6; 419.0)	200.5 (163.2; 248.4)	1,736.1 (1,363.4; 2,175.4)	219.1 (171.8; 277.0)	9.3 (-3.4; 22.2)	Female

Northeast region	21,769.4 (17,612.5; 26,757.5)	170.2 (135.6; 208.8)	67,913.2 (53,257.5; 85,476.6)	180.3 (140.9; 227.3)	5.9 (-1.6; 13.6)	Female
Alagoas	1,126.8 (900.7; 1,411.2)	168.5 (136.6; 210.1)	3,541.5 (2,661.4; 4,441.0)	186.2 (141.4; 235.3)	10.5 (-2.1; 24.5)	Female
Bahia	6,716.9 (5,381.0; 8,259.3)	192.8 (153.3; 237.6)	20,152.5 (15,836.0; 25,621.9)	195.6 (153.3; 248.9)	1.5 (-11.1; 14.0)	Female
Ceará	2,643.7 (2,041.1; 3,320.1)	132.5 (101.9; 164.9)	9,441.2 (7,497.5; 12,389.0)	150.7 (118.8; 198.5)	13.8 (-0.3; 29.0)	Female
Maranhão	1,928.0 (1,527.7; 2,415.7)	160.0 (125.4; 199.8)	6,872.0 (5,479.5; 8,758.1)	185.7 (147.7; 238.9)	16.0 (2.7; 31.2)	Female
Paraíba	1,824.0 (1,456.5; 2,299.8)	159.9 (127.2; 198.2)	5,083.4 (3,824.6; 6,536.3)	167.9 (127.6; 216.1)	5.0 (-9.1; 18.0)	Female
Pernambuco	3,960.6 (3,166.4; 4,867.9)	168.7 (134.9; 207.8)	10,585.7 (8,156.6; 13,403.3)	166.2 (129.0; 210.6)	-1.5 (-13.7; 11.5)	Female
Piaui	1,534.3 (1,241.8; 1,853.0)	221.9 (180.6; 269.0)	5,269.9 (4,255.2; 6,654.2)	231.5 (186.5; 292.2)	4.3 (-7.6; 17.8)	Female
Rio Grande do Norte	1,404.8 (1,144.1; 1,748.2)	170.6 (138.6; 210.5)	4,615.7 (3,608.8; 5,832.1)	190.4 (149.1; 238.3)	11.6 (-0.7; 25.6)	Female
Sergipe	630.4 (500.4; 792.0)	147.8 (117.1; 185.8)	2,351.2 (1,787.3; 2,981.6)	167.2 (126.6; 213.5)	13.2 (-0.6; 29.1)	Female
Southeast region	29,373.0 (23,057.1; 36,910.7)	142.3 (111.6; 178.7)	103,836.7 (78,054.5; 135,707.0)	150.5 (113.1; 196.0)	5.8 (-5.7; 15.7)	Female
Espírito Santo	1,156.4 (932.5; 1,436.1)	163.7 (129.1; 203.2)	5,407.4 (4,144.6; 6,757.7)	192.9 (148.4; 240.8)	17.8 (4.0; 31.1)	Female
Minas Gerais	7,668.6 (6,030.0; 9,494.6)	156.9 (123.3; 194.0)	27,365.6 (21,192.1; 35,468.1)	165.0 (127.5; 213.4)	5.2 (-9.3; 19.0)	Female
Rio de Janeiro	7,772.9 (6,033.2; 9,702.4)	154.2 (119.8; 194.0)	21,639.1 (16,169.3; 28,105.0)	151.9 (114.4; 196.5)	-1.5 (-13.7; 12.3)	Female
São Paulo	12,775.2 (9,936.1; 16,604.4)	127.6 (99.4; 163.6)	49,424.6 (35,979.5; 65,662.7)	139.9 (101.6; 184.8)	9.6 (-6.2; 26.1)	Female
South region	9,805.3 (7,692.1; 12,215.0)	141.1 (109.0; 178.1)	37,838.9 (29,119.7; 48,560.7)	162.2 (125.6; 207.6)	14.9 (3.4; 26.3)	Female
Paraná	3,296.2 (2,608.4; 4,184.1)	144.8 (113.9; 183.9)	13,588.1 (10,181.5; 17,492.6)	163.1 (123.4; 210.9)	12.6 (-1.0; 27.8)	Female
Rio Grande do Sul	4,762.4 (3,723.0; 5,977.9)	139.5 (109.0; 174.4)	15,830.3 (12,068.5; 20,372.9)	160.6 (122.6; 205.4)	15.2 (-0.4; 31.3)	Female
Santa Catarina	1,746.7 (1,375.4; 2,205.9)	139.4 (107.4; 176.8)	8,420.5 (6,351.1; 10,758.8)	163.9 (122.7; 208.3)	17.6 (2.2; 32.8)	Female
West-Central region	2,786.1 (2,217.8; 3,422.9)	146.0 (116.8; 183.2)	15,548.4 (12,176.4; 19,725.1)	165.4 (129.7; 211.8)	13.3 (2.2; 24.5)	Female

Distrito Federal	501.9 (407.9; 610.8)	163.2 (131.1; 204.0)	2,817.4 (2,164.4; 3,677.6)	161.0 (123.1; 210.5)	-1.4 (-14.7; 13.9)	Female
Goiás	1,199.2 (933.9; 1,503.9)	136.3 (102.7; 173.3)	6,489.2 (5,038.9; 8,220.0)	154.6 (119.0; 196.8)	13.5 (-1.6; 30.5)	Female
Mato Grosso	512.5 (414.0; 631.9)	157.7 (124.5; 201.9)	3,352.3 (2,588.7; 4,169.7)	189.4 (144.8; 237.3)	20.1 (5.0; 36.7)	Female
Mato Grosso do Sul	572.5 (463.0; 712.1)	145.6 (116.6; 181.0)	2,889.5 (2,271.0; 3,703.9)	171.7 (134.9; 220.0)	17.9 (2.3; 33.1)	Female
Brazil	119,683.2 (93,286.3; 149,055.8)	148.8 (115.6; 186.9)	423,457.7 (320,542.7; 546,083.9)	164.3 (124.8; 212.9)	10.4 (0.3; 18.6)	Both
North region	5,736.2 (4,611.6; 7,096.5)	158.5 (123.6; 200.2)	26,565.0 (20,605.2; 33,833.1)	180.8 (139.8; 234.2)	14.1 (5.0; 23.0)	Both
Acre	266.4 (212.4; 334.5)	173.1 (138.5; 216.1)	1,225.0 (947.2; 1,545.8)	188.0 (144.7; 238.4)	8.6 (-3.4; 18.5)	Both
Amapá	136.2 (108.2; 169.3)	144.5 (114.2; 182.6)	847.0 (644.9; 1,080.5)	162.9 (124.0; 210.3)	12.7 (1.4; 26.6)	Both
Amazonas	1,052.1 (832.9; 1,314.4)	149.9 (116.7; 189.7)	4,981.0 (3,901.4; 6,429.5)	173.0 (135.0; 223.1)	15.4 (4.4; 27.6)	Both
Pará	2,939.4 (2,328.7; 3,678.3)	152.5 (119.0; 192.8)	12,234.1 (9,384.6; 15,681.1)	170.7 (128.5; 221.2)	11.9 (1.1; 23.6)	Both
Rondônia	571.5 (458.7; 709.5)	174.2 (134.1; 222.6)	3,020.1 (2,383.1; 3,816.9)	197.3 (157.4; 251.9)	13.3 (2.0; 25.0)	Both
Roraima	84.8 (69.4; 105.1)	165.4 (127.9; 204.4)	723.1 (555.1; 918.4)	190.6 (150.6; 240.7)	15.3 (3.7; 28.7)	Both
Tocantins	685.7 (540.1; 867.2)	199.1 (160.7; 249.0)	3,534.7 (2,779.4; 4,489.0)	226.2 (178.3; 287.8)	13.6 (3.0; 25.5)	Both
Northeast region	41,077.2 (32,397.3; 50,978.3)	172.3 (134.9; 213.3)	124,676.7 (97,034.2; 158,860.4)	187.8 (146.0; 240.2)	9.0 (0.7; 16.9)	Both
Alagoas	2,213.9 (1,760.1; 2,781.6)	175.7 (140.4; 220.0)	6,388.9 (4,861.2; 8,215.5)	192.8 (146.7; 248.1)	9.7 (-1.2; 20.6)	Both
Bahia	12,412.1 (9,805.5; 15,225.1)	193.4 (152.7; 237.7)	37,082.3 (28,864.0; 47,224.9)	202.7 (156.3; 259.4)	4.8 (-6.2; 15.0)	Both
Ceará	4,992.3 (3,749.2; 6,261.0)	133.9 (102.2; 166.5)	17,575.1 (13,244.4; 23,085.7)	158.8 (119.6; 208.8)	18.5 (6.1; 32.1)	Both
Maranhão	3,777.8 (3,004.9; 4,717.3)	165.6 (131.1; 205.6)	13,441.4 (10,605.0; 17,077.0)	196.9 (154.9; 251.5)	18.9 (7.8; 32.3)	Both
Paraíba	3,511.9 (2,749.1; 4,495.7)	161.6 (126.3; 205.3)	9,153.2 (7,137.0; 11,786.5)	175.3 (137.0; 225.8)	8.5 (-3.5; 21.2)	Both
Pernambuco	7,252.9 (5,720.6; 9,167.9)	169.6 (131.0; 211.7)	18,471.8 (14,028.5; 23,212.3)	169.8 (130.0; 212.8)	0.1 (-11.0; 11.2)	Both
Piaui	3,029.8 (2,503.9; 3,756.5)	227.8 (185.8; 282.1)	10,041.5 (8,014.1; 12,653.4)	243.0 (194.3; 306.1)	6.6 (-4.0; 17.6)	Both
Rio Grande do Norte	2,730.3 (2,155.8; 3,427.8)	174.6 (136.7; 217.3)	8,410.3 (6,450.2; 10,702.9)	198.3 (152.4; 252.1)	13.6 (2.2; 24.9)	Both

Sergipe	1,156.1 (903.8; 1,462.2)	144.7 (113.8; 183.2)	4,112.2 (3,181.4; 5,274.0)	168.3 (130.1; 217.9)	16.3 (4.9; 28.5)	Both
Southeast region	50,915.3 (39,159.3; 64,354.1)	138.2 (106.9; 174.9)	178,950.8 (133,288.2; 234,404.9)	150.8 (112.5; 197.2)	9.1 (-1.7; 18.0)	Both
Espírito Santo	2,187.0 (1,780.4; 2,752.9)	163.4 (132.5; 206.3)	9,882.7 (7,585.1; 12,507.1)	198.3 (151.8; 251.7)	21.4 (9.0; 33.4)	Both
Minas Gerais	13,856.1 (10,802.2; 17,500.8)	154.7 (120.2; 192.6)	49,278.3 (37,917.3; 63,115.5)	167.0 (128.2; 213.7)	8.0 (-4.7; 19.4)	Both
Rio de Janeiro	12,887.1 (9,953.8; 16,180.1)	149.4 (116.3; 188.3)	35,426.8 (26,681.2; 46,169.1)	149.2 (112.7; 194.7)	-0.1 (-11.0; 11.9)	Both
São Paulo	21,985.0 (16,932.9; 28,321.8)	122.6 (94.3; 155.8)	84,362.9 (61,973.5; 111,914.6)	139.5 (103.0; 185.4)	13.8 (-0.7; 27.9)	Both
South region	16,524.6 (12,783.6; 21,142.4)	130.9 (99.9; 167.9)	64,422.0 (49,045.7; 83,453.0)	157.9 (119.5; 203.7)	20.7 (8.8; 30.6)	Both
Paraná	6,070.3 (4,708.8; 7,668.5)	139.6 (106.6; 180.6)	23,994.6 (18,290.1; 31,185.5)	162.5 (125.5; 209.7)	16.4 (3.8; 29.2)	Both
Rio Grande do Sul	7,551.8 (5,853.0; 9,677.7)	126.6 (97.1; 160.5)	26,328.8 (19,889.5; 34,368.8)	155.4 (117.1; 201.3)	22.8 (8.1; 36.5)	Both
Santa Catarina	2,902.5 (2,270.9; 3,695.2)	126.0 (96.9; 160.7)	14,098.6 (10,389.0; 18,146.8)	155.6 (115.7; 199.8)	23.5 (9.1; 36.7)	Both
West-Central region	5,430.0 (4,227.2; 6,744.4)	144.1 (111.6; 183.4)	28,843.2 (22,219.7; 36,862.6)	168.0 (131.1; 216.2)	16.6 (5.9; 27.7)	Both
Distrito Federal	891.2 (717.5; 1,097.5)	165.1 (132.3; 207.2)	4,935.5 (3,771.4; 6,449.5)	165.3 (127.6; 217.2)	0.1 (-11.3; 11.5)	Both
Goiás	2,312.9 (1,765.0; 2,976.5)	132.6 (101.7; 171.0)	11,886.4 (8,935.8; 15,432.9)	154.8 (117.8; 201.0)	16.7 (3.7; 33.1)	Both
Mato Grosso	1,087.1 (866.7; 1,340.8)	158.1 (123.6; 203.5)	6,619.0 (5,130.3; 8,466.5)	194.4 (150.2; 247.8)	23.0 (8.2; 36.9)	Both
Mato Grosso do Sul	1,138.8 (902.2; 1,415.2)	144.2 (112.9; 180.8)	5,402.4 (4,156.4; 6,914.9)	174.7 (135.0; 225.0)	21.2 (7.4; 34.2)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 7.5 – Hypertensive heart disease: number of deaths and mortality rate according to sex, in Brazil, its geographic regions, and Federative Units, in 1990 and 2023, and percent change of rates in the period

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)	Sex
Brazil	7,546.4 (6,633.8; 8,656.0)	21.6 (18.7; 24.9)	14,228.9 (12,937.8; 15,601.6)	13.2 (11.8; 14.5)	-39.1 (-46.3; -30.4)	Male
North region	292.2 (254.1; 338.8)	19.2 (16.4; 22.3)	973.8 (853.4; 1,102.3)	14.8 (12.9; 16.8)	-23.3 (-34.7; -10.4)	Male
Acre	15.1 (12.1; 18.4)	21.0 (17.0; 25.3)	43.7 (35.7; 53.4)	14.6 (11.8; 17.9)	-30.3 (-46.6; -7.0)	Male
Amapá	6.0 (4.8; 7.2)	17.5 (13.9; 20.9)	27.1 (22.0; 33.0)	11.7 (9.5; 14.6)	-32.7 (-49.4; -11.5)	Male
Amazonas	47.5 (40.7; 55.9)	16.9 (14.2; 20.1)	184.3 (154.0; 216.9)	15.0 (12.4; 17.6)	-11.5 (-28.7; 8.7)	Male
Pará	141.4 (119.9; 168.4)	17.6 (14.7; 20.9)	411.4 (338.6; 491.8)	12.9 (10.6; 15.5)	-26.6 (-40.7; -7.3)	Male
Rondônia	43.3 (36.0; 50.9)	29.3 (24.4; 34.1)	125.2 (104.9; 151.7)	17.4 (14.4; 21.2)	-40.7 (-51.4; -23.7)	Male
Roraima	5.4 (4.2; 6.8)	24.6 (19.7; 30.7)	29.9 (23.9; 36.9)	17.8 (14.6; 21.7)	-27.7 (-46.4; -4.5)	Male
Tocantins	33.4 (26.8; 40.6)	31.4 (25.4; 38.4)	152.3 (126.3; 184.0)	20.3 (16.7; 24.5)	-35.5 (-50.4; -17.1)	Male
Northeast region	2,116.1 (1,711.4; 2,544.9)	20.3 (16.4; 24.3)	4,326.8 (3,654.3; 5,173.6)	15.1 (12.7; 18.1)	-25.5 (-39.4; -2.4)	Male
Alagoas	133.5 (106.5; 165.0)	23.6 (19.0; 29.1)	284.1 (238.0; 341.7)	20.3 (16.9; 24.3)	-14.1 (-33.8; 16.9)	Male
Bahia	588.7 (491.7; 690.5)	21.0 (17.6; 24.7)	1,078.4 (909.2; 1,280.0)	13.5 (11.3; 16.0)	-35.8 (-47.9; -18.7)	Male
Ceará	182.9 (145.7; 222.2)	11.7 (9.2; 14.1)	523.5 (442.9; 618.6)	10.8 (9.2; 12.7)	-7.2 (-25.9; 21.8)	Male
Maranhão	197.3 (144.1; 263.2)	19.6 (14.3; 26.2)	599.9 (497.3; 746.8)	20.1 (16.6; 24.9)	2.3 (-25.2; 49.5)	Male
Paraíba	183.9 (146.3; 228.4)	19.2 (15.3; 24.0)	357.4 (295.5; 425.5)	16.4 (13.6; 19.6)	-14.6 (-33.8; 13.7)	Male
Pernambuco	472.0 (387.2; 567.5)	25.7 (21.0; 30.6)	675.7 (575.3; 793.3)	15.2 (12.9; 17.9)	-40.9 (-52.5; -24.5)	Male
Piaui	186.2 (137.7; 236.1)	31.0 (23.1; 39.1)	381.1 (311.9; 475.9)	20.7 (16.9; 26.0)	-33.2 (-48.8; -4.6)	Male
Rio Grande do Norte	117.8 (90.9; 145.7)	17.4 (13.4; 21.6)	290.8 (243.3; 351.0)	15.8 (13.2; 19.2)	-8.9 (-30.0; 23.8)	Male
Sergipe	53.9 (43.3; 65.0)	15.5 (12.5; 18.7)	136.0 (110.3; 163.4)	13.3 (10.8; 15.9)	-14.6 (-33.1; 12.8)	Male
Southeast region	3,817.3 (3,355.3; 4,440.8)	23.9 (20.9; 28.0)	5,839.3 (5,163.0; 6,703.5)	12.0 (10.6; 13.7)	-49.9 (-59.0; -39.0)	Male
Espírito Santo	136.6 (117.3; 160.0)	22.9 (19.6; 26.9)	403.5 (348.7; 466.5)	19.0 (16.3; 21.9)	-17.3 (-32.5; 0.9)	Male
Minas Gerais	1,004.2 (880.3; 1,173.9)	24.5 (21.3; 29.0)	1,323.9 (1,155.7; 1,520.2)	10.4 (9.1; 12.0)	-57.6 (-66.1; -48.3)	Male

Rio de Janeiro	1,115.7 (977.1; 1,306.3)	30.9 (27.2; 36.4)	1,257.4 (1,100.1; 1,467.7)	13.4 (11.7; 15.6)	-56.6 (-64.8; -46.6)	Male
São Paulo	1,560.8 (1,359.7; 1,815.6)	20.7 (17.7; 24.0)	2,854.5 (2,520.1; 3,286.7)	11.7 (10.3; 13.3)	-43.6 (-53.4; -32.2)	Male
South region	977.2 (844.0; 1,138.6)	18.7 (16.0; 22.1)	2,066.8 (1,813.1; 2,363.9)	12.7 (11.0; 14.7)	-32.3 (-44.2; -16.5)	Male
Paraná	420.7 (362.1; 491.0)	21.9 (18.5; 25.7)	806.5 (701.8; 933.3)	13.3 (11.5; 15.4)	-39.5 (-50.4; -24.9)	Male
Rio Grande do Sul	403.4 (349.4; 470.7)	17.2 (14.8; 20.4)	839.8 (720.0; 959.2)	12.6 (10.8; 14.6)	-26.5 (-39.1; -9.4)	Male
Santa Catarina	153.2 (129.6; 180.9)	16.3 (13.7; 19.3)	420.5 (355.5; 495.5)	11.8 (9.8; 14.0)	-27.6 (-41.1; -9.5)	Male
West-Central region	343.5 (303.9; 403.8)	19.5 (17.0; 23.1)	1,022.2 (908.5; 1,149.0)	13.6 (12.0; 15.2)	-30.6 (-40.9; -19.0)	Male
Distrito Federal	60.4 (52.7; 70.7)	27.7 (24.1; 32.1)	112.5 (94.4; 134.1)	9.7 (8.1; 11.6)	-65.1 (-70.9; -56.7)	Male
Goiás	144.5 (124.7; 172.8)	17.4 (14.7; 20.9)	400.5 (343.5; 461.8)	11.8 (10.0; 13.6)	-32.3 (-46.7; -16.9)	Male
Mato Grosso	56.4 (46.4; 67.8)	17.1 (13.8; 20.6)	283.8 (241.2; 335.9)	18.1 (15.4; 21.7)	6.0 (-14.8; 35.4)	Male
Mato Grosso do Sul	82.1 (70.9; 96.3)	22.1 (19.0; 26.1)	225.4 (193.5; 263.9)	16.3 (13.9; 19.3)	-26.2 (-40.0; -9.1)	Male
Brazil	9,041.6 (7,713.4; 10,421.5)	22.6 (19.0; 26.1)	17,010.1 (13,956.7; 19,219.8)	11.3 (9.3; 12.7)	-50.0 (-56.9; -43.2)	Female
North region	307.9 (262.9; 357.4)	20.2 (17.0; 23.6)	879.9 (725.6; 1,010.0)	11.7 (9.6; 13.4)	-42.1 (-51.6; -32.8)	Female
Acre	11.6 (9.2; 14.0)	20.2 (15.8; 24.3)	40.7 (32.8; 49.0)	12.3 (9.8; 14.9)	-39.2 (-52.8; -20.8)	Female
Amapá	6.2 (4.9; 7.6)	13.0 (10.1; 15.9)	24.0 (18.8; 29.8)	8.8 (6.9; 11.0)	-32.0 (-49.6; -8.6)	Female
Amazonas	50.7 (42.4; 60.7)	17.9 (14.6; 21.5)	168.0 (134.8; 204.2)	11.4 (9.1; 13.8)	-36.2 (-48.0; -20.7)	Female
Pará	168.4 (139.9; 200.6)	19.2 (15.8; 22.8)	372.1 (288.3; 452.1)	9.9 (7.7; 11.9)	-48.6 (-59.9; -37.4)	Female
Rondônia	34.3 (28.0; 40.3)	35.3 (28.6; 41.5)	114.3 (93.4; 135.0)	16.0 (13.0; 19.0)	-54.8 (-62.7; -43.0)	Female
Roraima	4.3 (3.5; 5.3)	25.8 (20.8; 31.6)	24.3 (19.0; 29.7)	15.7 (12.5; 18.8)	-39.2 (-54.4; -21.9)	Female
Tocantins	32.4 (25.1; 40.9)	35.3 (27.0; 43.5)	136.5 (109.6; 163.8)	17.5 (13.9; 21.0)	-50.6 (-61.2; -35.3)	Female
Northeast region	2,406.6 (1,918.1; 2,869.8)	20.3 (16.1; 24.3)	4,910.8 (3,930.5; 5,838.0)	12.4 (10.1; 14.8)	-38.8 (-52.2; -21.8)	Female
Alagoas	140.5 (110.4; 170.9)	22.5 (17.7; 27.4)	333.8 (267.9; 395.6)	17.5 (13.9; 21.0)	-22.1 (-41.6; 1.7)	Female
Bahia	741.7 (598.5; 886.3)	22.4 (17.9; 26.9)	1,266.9 (1,018.4; 1,524.5)	11.5 (9.4; 13.7)	-48.7 (-58.7; -35.4)	Female
Ceará	215.4 (164.3; 266.1)	12.0 (9.0; 14.8)	652.0 (511.0; 774.6)	9.8 (7.9; 11.6)	-18.0 (-35.5; 8.3)	Female

Maranhão	128.0 (86.6; 170.3)	12.6 (8.6; 16.9)	586.4 (449.1; 714.3)	15.7 (12.0; 19.1)	24.6 (-12.9; 90.4)	Female
Paraíba	221.0 (165.3; 277.7)	21.3 (15.5; 26.7)	444.9 (352.5; 536.1)	13.8 (11.1; 16.5)	-35.2 (-51.8; -13.8)	Female
Pernambuco	608.1 (497.2; 721.8)	28.3 (23.0; 33.6)	779.5 (649.1; 920.5)	12.0 (10.0; 14.2)	-57.6 (-65.4; -47.7)	Female
Piaui	164.8 (121.3; 209.0)	26.6 (19.5; 33.7)	395.1 (297.4; 484.5)	16.5 (12.5; 20.1)	-38.0 (-55.0; -14.6)	Female
Rio Grande do Norte	117.7 (91.1; 144.9)	15.0 (11.6; 18.5)	299.5 (227.9; 375.0)	11.4 (8.8; 14.1)	-24.3 (-41.7; 2.5)	Female
Sergipe	69.4 (55.4; 83.5)	17.9 (14.2; 21.6)	152.7 (120.8; 186.6)	10.6 (8.4; 12.9)	-40.7 (-53.8; -25.0)	Female
Southeast region	4,628.5 (3,944.7; 5,456.0)	24.5 (20.9; 28.8)	7,265.5 (5,844.6; 8,576.6)	10.3 (8.3; 12.1)	-58.1 (-66.0; -49.5)	Female
Espírito Santo	138.1 (116.0; 163.2)	21.9 (18.0; 26.0)	438.9 (350.9; 517.2)	15.3 (12.3; 17.9)	-29.9 (-43.6; -12.8)	Female
Minas Gerais	1,118.2 (936.8; 1,321.7)	24.6 (20.5; 29.2)	1,643.2 (1,294.4; 1,977.0)	9.5 (7.5; 11.4)	-61.4 (-69.2; -52.9)	Female
Rio de Janeiro	1,390.1 (1,198.0; 1,626.0)	29.5 (25.1; 34.6)	1,562.7 (1,278.0; 1,827.7)	10.7 (8.8; 12.4)	-63.8 (-70.3; -55.3)	Female
São Paulo	1,982.1 (1,685.1; 2,343.4)	22.1 (18.7; 26.2)	3,620.7 (2,960.4; 4,274.4)	10.1 (8.3; 11.9)	-54.4 (-62.9; -45.3)	Female
South region	1,340.6 (1,140.9; 1,579.8)	21.9 (18.4; 25.9)	2,860.2 (2,266.8; 3,359.3)	12.2 (9.7; 14.3)	-44.5 (-55.7; -32.9)	Female
Paraná	507.1 (431.2; 596.9)	25.4 (21.2; 29.9)	972.3 (785.0; 1,144.8)	11.8 (9.5; 13.9)	-53.6 (-63.2; -43.6)	Female
Rio Grande do Sul	606.5 (514.8; 714.1)	19.9 (16.6; 23.4)	1,265.3 (989.8; 1,504.9)	12.3 (9.7; 14.6)	-38.2 (-50.4; -24.4)	Female
Santa Catarina	227.1 (191.4; 273.7)	21.4 (18.0; 25.9)	622.5 (488.6; 736.1)	12.5 (9.8; 14.8)	-41.5 (-53.7; -28.8)	Female
West-Central region	358.0 (303.2; 416.4)	21.7 (18.1; 25.4)	1,093.8 (919.4; 1,265.4)	12.0 (10.0; 13.9)	-44.6 (-53.9; -35.7)	Female
Distrito Federal	62.6 (53.1; 74.4)	23.8 (20.0; 28.2)	118.0 (92.8; 141.6)	7.2 (5.7; 8.7)	-69.7 (-75.9; -62.8)	Female
Goiás	166.3 (140.1; 199.7)	21.1 (17.4; 25.3)	470.0 (377.7; 557.9)	11.5 (9.2; 13.8)	-45.5 (-56.5; -32.2)	Female
Mato Grosso	52.7 (42.7; 63.1)	20.0 (16.1; 23.6)	262.4 (209.7; 310.4)	15.7 (12.5; 18.7)	-21.2 (-38.8; -2.2)	Female
Mato Grosso do Sul	76.4 (63.2; 91.6)	23.1 (19.0; 27.8)	243.4 (191.0; 287.8)	14.6 (11.4; 17.3)	-36.7 (-50.9; -22.4)	Female
Brazil	16,588.0 (14,767.9; 18,495.5)	22.3 (19.5; 25.0)	31,239.1 (27,206.9; 34,009.2)	12.2 (10.6; 13.3)	-45.3 (-51.5; -39.3)	Both
North region	600.2 (532.8; 667.3)	19.9 (17.3; 22.3)	1,853.7 (1,619.6; 2,060.4)	13.2 (11.4; 14.7)	-33.8 (-41.5; -25.0)	Both
Acre	26.7 (22.8; 31.0)	20.6 (17.4; 23.8)	84.3 (72.7; 97.4)	13.4 (11.5; 15.5)	-35.0 (-47.4; -21.1)	Both
Amapá	12.2 (10.3; 14.1)	14.6 (12.2; 17.0)	51.1 (43.4; 59.9)	10.2 (8.6; 12.0)	-30.2 (-43.4; -14.6)	Both

Amazonas	98.1 (85.1; 111.3)	17.5 (15.0; 20.0)	352.2 (306.2; 409.2)	13.0 (11.3; 15.4)	-25.3 (-36.3; -12.7)	Both
Pará	309.8 (268.8; 351.7)	18.6 (15.9; 21.2)	783.6 (657.4; 901.3)	11.3 (9.4; 13.0)	-39.4 (-49.5; -28.4)	Both
Rondônia	77.7 (67.6; 87.5)	32.5 (28.2; 37.1)	239.5 (204.2; 273.2)	16.6 (14.1; 19.1)	-48.8 (-56.2; -39.6)	Both
Roraima	9.8 (8.2; 11.8)	25.1 (21.3; 29.6)	54.2 (45.8; 63.0)	16.6 (14.2; 19.2)	-33.8 (-46.3; -20.9)	Both
Tocantins	65.8 (53.9; 75.8)	34.1 (28.5; 39.7)	288.8 (244.9; 330.8)	18.9 (15.9; 21.6)	-44.7 (-54.7; -33.3)	Both
Northeast region	4,522.7 (3,815.4; 5,170.7)	20.4 (17.1; 23.4)	9,237.6 (7,947.9; 10,533.1)	13.7 (11.8; 15.6)	-33.0 (-43.4; -20.0)	Both
Alagoas	274.0 (225.4; 317.3)	23.1 (18.9; 26.6)	617.9 (538.9; 702.4)	18.7 (16.2; 21.4)	-18.7 (-32.9; 1.3)	Both
Bahia	1,330.3 (1,115.1; 1,525.6)	21.9 (18.1; 25.1)	2,345.3 (1,971.3; 2,704.8)	12.4 (10.5; 14.3)	-43.2 (-51.9; -33.6)	Both
Ceará	398.4 (322.6; 465.2)	11.8 (9.6; 13.9)	1,175.5 (986.4; 1,343.5)	10.3 (8.8; 11.7)	-13.0 (-27.7; 6.4)	Both
Maranhão	325.2 (249.9; 397.4)	15.9 (12.1; 19.5)	1,186.3 (999.3; 1,371.7)	17.5 (14.7; 20.3)	9.9 (-13.2; 44.8)	Both
Paraíba	404.8 (319.8; 480.5)	20.3 (15.9; 24.2)	802.2 (678.1; 920.5)	15.0 (12.8; 17.2)	-26.0 (-39.5; -7.5)	Both
Pernambuco	1,080.1 (928.6; 1,228.4)	27.2 (23.4; 31.0)	1,455.1 (1,262.2; 1,648.5)	13.3 (11.5; 15.1)	-51.0 (-58.1; -41.9)	Both
Piaui	351.0 (277.2; 422.6)	28.8 (22.7; 34.7)	776.1 (641.8; 903.3)	18.5 (15.4; 21.5)	-35.9 (-49.0; -19.2)	Both
Rio Grande do Norte	235.5 (194.7; 277.0)	16.0 (13.1; 18.9)	590.3 (500.9; 696.6)	13.4 (11.4; 15.6)	-16.7 (-31.6; 3.1)	Both
Sergipe	123.3 (104.5; 141.3)	16.8 (14.2; 19.2)	288.7 (242.6; 333.0)	11.8 (9.9; 13.6)	-29.4 (-40.7; -15.6)	Both
Southeast region	8,445.8 (7,571.9; 9,413.3)	24.4 (21.5; 27.6)	13,104.8 (11,285.5; 14,639.5)	11.1 (9.6; 12.4)	-54.6 (-60.6; -48.2)	Both
Espírito Santo	274.7 (241.6; 310.8)	22.4 (19.5; 25.6)	842.4 (719.6; 949.3)	17.0 (14.4; 19.2)	-24.1 (-34.0; -10.5)	Both
Minas Gerais	2,122.4 (1,902.0; 2,376.9)	24.7 (21.8; 27.9)	2,967.0 (2,503.7; 3,382.5)	10.0 (8.4; 11.4)	-59.7 (-65.4; -52.8)	Both
Rio de Janeiro	2,505.8 (2,242.2; 2,782.6)	30.4 (26.7; 34.1)	2,820.1 (2,430.6; 3,187.3)	11.8 (10.2; 13.4)	-61.0 (-66.4; -55.3)	Both
São Paulo	3,542.9 (3,142.9; 3,962.8)	21.6 (18.7; 24.3)	6,475.3 (5,566.7; 7,266.4)	10.9 (9.3; 12.2)	-49.8 (-56.4; -42.0)	Both
South region	2,317.8 (2,041.4; 2,603.1)	20.6 (17.8; 23.4)	4,927.0 (4,181.7; 5,583.5)	12.5 (10.5; 14.2)	-39.2 (-48.2; -29.6)	Both
Paraná	927.7 (818.8; 1,040.8)	23.8 (20.6; 26.8)	1,778.8 (1,512.2; 2,010.3)	12.5 (10.6; 14.2)	-47.4 (-55.2; -38.1)	Both
Rio Grande do Sul	1,009.8 (877.5; 1,135.2)	19.0 (16.0; 21.5)	2,105.1 (1,766.4; 2,385.8)	12.6 (10.5; 14.3)	-33.3 (-42.6; -22.0)	Both
Santa Catarina	380.2 (334.8; 434.1)	19.2 (16.7; 22.0)	1,043.0 (887.5; 1,188.5)	12.4 (10.4; 14.2)	-35.6 (-45.5; -25.4)	Both

West-Central region	701.5 (628.3; 778.9)	20.6 (18.2; 23.2)	2,116.0 (1,852.3; 2,356.1)	12.8 (11.0; 14.3)	-38.2 (-45.4; -29.6)	Both
Distrito Federal	123.0 (108.6; 137.2)	25.3 (22.1; 28.4)	230.5 (193.6; 268.5)	8.3 (6.9; 9.7)	-67.4 (-72.2; -61.6)	Both
Goiás	310.8 (274.6; 349.0)	19.3 (16.7; 21.8)	870.6 (742.4; 982.4)	11.7 (9.9; 13.2)	-39.3 (-48.2; -29.0)	Both
Mato Grosso	109.2 (92.4; 125.0)	18.4 (15.5; 21.2)	546.2 (474.5; 621.6)	16.9 (14.5; 19.4)	-8.1 (-23.3; 10.1)	Both
Mato Grosso do Sul	158.6 (137.4; 179.0)	22.6 (19.4; 25.8)	468.8 (397.8; 536.0)	15.4 (13.0; 17.7)	-31.7 (-42.4; -20.2)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 7.6 – DALY numbers and rates attributable to hypertensive heart disease, according to sex, in Brazil, its geographic regions, and Federative Units, in 1990 and 2023, and percent change of rates in the period

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)	Sex
Brazil	185,232.9 (164,991.5; 209,242.8)	448.0 (396.7; 510.3)	299,984.4 (278,539.6; 322,546.4)	260.1 (240.5; 280.6)	-41.9 (-48.0; -34.7)	Male
North region	7,134.1 (6,273.4; 8,219.5)	368.5 (322.7; 426.9)	20,892.0 (18,509.1; 23,423.4)	282.1 (250.0; 316.9)	-23.5 (-34.0; -11.9)	Male
Acre	362.2 (293.4; 437.2)	406.9 (332.1; 490.5)	966.2 (799.9; 1,182.6)	289.2 (239.0; 352.5)	-28.9 (-43.8; -6.3)	Male
Amapá	141.1 (114.0; 166.4)	323.9 (262.9; 384.6)	624.4 (514.7; 765.7)	233.4 (193.4; 282.4)	-28.0 (-45.2; -5.7)	Male
Amazonas	1,154.0 (991.7; 1,347.7)	316.2 (271.4; 369.9)	4,007.7 (3,398.1; 4,742.2)	279.7 (237.0; 327.3)	-11.5 (-27.8; 7.0)	Male
Pará	3,327.0 (2,852.2; 3,893.0)	336.6 (285.7; 397.3)	8,769.9 (7,390.4; 10,214.1)	247.2 (209.4; 290.7)	-26.6 (-40.7; -9.3)	Male
Rondônia	1,161.1 (969.5; 1,358.8)	557.8 (466.0; 650.2)	2,665.7 (2,255.8; 3,203.0)	332.4 (281.6; 398.7)	-40.4 (-50.6; -25.3)	Male
Roraima	160.1 (124.1; 200.6)	468.9 (370.8; 581.7)	728.7 (588.2; 899.8)	342.2 (279.0; 420.3)	-27.0 (-46.4; -1.8)	Male
Tocantins	828.6 (660.7; 999.5)	502.4 (407.0; 602.5)	3,129.3 (2,610.5; 3,782.5)	391.7 (328.9; 473.9)	-22.0 (-39.9; 0.4)	Male
Northeast region	47,307.7 (38,522.5; 57,301.0)	406.9 (331.8; 492.8)	90,503.7 (78,011.7; 106,080.3)	304.7 (262.7; 357.7)	-25.1 (-38.5; -4.0)	Male
Alagoas	3,103.6 (2,460.1; 3,832.4)	488.3 (391.5; 602.2)	6,261.9 (5,315.4; 7,570.0)	411.6 (348.1; 496.8)	-15.7 (-34.8; 13.1)	Male
Bahia	13,647.6 (11,416.9; 16,134.5)	434.8 (364.8; 512.9)	22,329.5 (19,323.0; 26,291.9)	273.4 (236.5; 322.4)	-37.1 (-48.6; -21.3)	Male
Ceará	3,848.6 (3,103.2; 4,645.6)	217.1 (175.4; 260.7)	10,698.2 (9,186.9; 12,505.0)	218.7 (187.7; 255.2)	0.7 (-19.1; 30.2)	Male
Maranhão	4,566.7 (3,404.0; 6,117.8)	388.8 (289.6; 514.4)	12,213.7 (10,246.2; 14,974.6)	380.9 (317.8; 467.1)	-2.0 (-26.2; 38.5)	Male
Paraíba	3,591.5 (2,839.8; 4,456.6)	350.8 (279.1; 434.4)	7,385.9 (6,223.6; 8,576.4)	329.0 (277.5; 382.5)	-6.2 (-26.1; 23.4)	Male
Pernambuco	10,880.7 (9,015.4; 13,074.1)	529.1 (438.9; 632.0)	14,976.3 (12,842.2; 17,213.3)	314.3 (269.3; 361.9)	-40.6 (-51.5; -24.8)	Male
Piaui	4,087.5 (3,077.3; 5,154.2)	610.5 (459.5; 767.5)	7,635.2 (6,418.3; 9,328.9)	406.4 (342.1; 497.1)	-33.4 (-48.8; -6.8)	Male
Rio Grande do Norte	2,436.0 (1,934.7; 2,978.3)	332.4 (264.0; 404.6)	6,074.9 (5,186.4; 7,287.5)	323.7 (276.7; 388.7)	-2.6 (-24.7; 27.7)	Male

Sergipe	1,145.6 (920.7; 1,386.3)	301.5 (242.5; 364.7)	2,928.1 (2,400.3; 3,519.7)	265.5 (218.5; 317.8)	-11.9 (-31.0; 16.6)	Male
Southeast region	98,502.1 (87,253.8; 113,796.3)	514.3 (453.7; 595.3)	125,300.1 (111,707.6; 143,423.2)	241.6 (215.5; 276.2)	-53.0 (-60.5; -44.0)	Male
Espírito Santo	3,296.0 (2,860.2; 3,863.7)	466.3 (403.0; 544.4)	8,519.2 (7,524.9; 9,756.8)	372.7 (327.0; 426.5)	-20.1 (-33.4; -2.5)	Male
Minas Gerais	26,726.4 (23,673.6; 31,311.3)	557.4 (491.1; 650.2)	27,513.2 (24,267.5; 31,565.0)	208.5 (184.0; 239.1)	-62.6 (-69.5; -54.8)	Male
Rio de Janeiro	29,329.1 (25,968.0; 33,932.5)	678.6 (599.8; 789.8)	27,376.7 (24,054.7; 31,534.1)	274.6 (242.1; 314.4)	-59.5 (-66.6; -51.3)	Male
São Paulo	39,150.6 (34,427.1; 44,927.7)	424.6 (371.6; 492.3)	61,891.0 (55,077.7; 71,479.5)	234.3 (209.3; 269.9)	-44.8 (-53.2; -34.8)	Male
South region	23,241.0 (20,439.6; 26,697.6)	367.3 (319.3; 424.8)	41,319.6 (37,004.7; 46,673.6)	230.5 (204.5; 259.0)	-37.3 (-47.6; -24.5)	Male
Paraná	9,914.5 (8,608.9; 11,427.0)	428.3 (371.8; 495.7)	16,245.8 (14,477.3; 18,535.0)	244.4 (217.1; 277.1)	-42.9 (-52.3; -31.1)	Male
Rio Grande do Sul	9,732.6 (8,512.1; 11,152.4)	340.5 (296.5; 394.1)	16,420.3 (14,312.7; 18,616.0)	228.4 (199.6; 258.5)	-32.9 (-43.9; -19.2)	Male
Santa Catarina	3,593.9 (3,109.1; 4,238.6)	312.6 (264.9; 368.0)	8,653.5 (7,533.6; 9,943.4)	211.4 (182.6; 244.3)	-32.4 (-44.0; -17.6)	Male
West-Central region	9,048.0 (8,085.9; 10,441.2)	402.8 (358.3; 472.9)	21,969.0 (19,959.7; 24,143.0)	264.1 (239.4; 292.3)	-34.4 (-43.1; -24.8)	Male
Distrito Federal	1,764.9 (1,547.7; 2,063.5)	583.8 (509.4; 681.2)	2,522.3 (2,175.5; 2,947.9)	189.8 (163.2; 221.5)	-67.5 (-72.6; -60.7)	Male
Goiás	3,737.6 (3,266.0; 4,421.9)	360.3 (312.1; 427.5)	8,581.2 (7,460.4; 9,768.5)	230.2 (200.2; 262.3)	-36.1 (-48.4; -23.2)	Male
Mato Grosso	1,521.1 (1,247.0; 1,813.1)	344.8 (282.9; 411.1)	6,183.3 (5,313.2; 7,200.0)	348.8 (298.3; 405.6)	1.2 (-18.0; 27.8)	Male
Mato Grosso do Sul	2,024.4 (1,771.2; 2,360.1)	442.7 (385.5; 517.4)	4,682.2 (4,065.6; 5,371.1)	315.8 (272.8; 362.1)	-28.7 (-41.7; -14.1)	Male
Brazil	197,865.4 (172,080.3; 226,632.0)	432.7 (375.1; 497.2)	300,709.9 (260,819.5; 332,091.4)	204.3 (177.3; 225.4)	-52.8 (-58.7; -47.2)	Female
North region	6,692.9 (5,786.7; 7,712.0)	362.6 (312.1; 418.6)	17,056.5 (14,916.0; 19,072.4)	214.0 (185.4; 240.9)	-41.0 (-49.5; -32.7)	Female
Acre	270.7 (216.5; 322.9)	371.4 (295.4; 440.4)	832.9 (683.8; 1,006.3)	235.2 (192.6; 284.1)	-36.7 (-50.7; -19.3)	Female
Amapá	127.5 (104.8; 154.4)	236.7 (194.0; 286.7)	483.5 (388.7; 589.1)	166.4 (134.1; 199.8)	-29.7 (-47.3; -7.4)	Female

Amazonas	1,096.7 (929.4; 1,290.6)	310.7 (261.4; 367.4)	3,177.9 (2,644.5; 3,807.4)	200.2 (165.9; 238.0)	-35.6 (-47.1; -20.0)	Female
Pará	3,444.5 (2,946.9; 4,084.3)	341.9 (291.6; 406.1)	7,211.4 (5,997.3; 8,424.1)	184.4 (152.5; 216.6)	-46.1 (-56.7; -34.6)	Female
Rondônia	861.6 (711.7; 1,017.1)	605.2 (491.9; 704.2)	2,259.4 (1,846.6; 2,630.8)	283.5 (232.7; 332.1)	-53.1 (-61.4; -42.3)	Female
Roraima	117.3 (93.6; 144.1)	472.7 (383.1; 573.2)	565.9 (448.7; 704.6)	279.5 (225.5; 340.8)	-40.9 (-56.4; -22.4)	Female
Tocantins	774.6 (595.3; 977.9)	536.0 (422.5; 664.6)	2,525.6 (2,072.7; 3,000.6)	313.2 (257.9; 371.8)	-41.6 (-54.3; -23.6)	Female
Northeast region	49,898.6 (40,680.8; 58,891.1)	384.9 (312.6; 456.3)	87,614.0 (73,454.4; 102,122.0)	232.1 (195.9; 271.5)	-39.7 (-52.6; -23.9)	Female
Alagoas	3,124.5 (2,492.2; 3,818.6)	450.3 (359.7; 548.2)	6,460.6 (5,366.5; 7,554.6)	334.4 (277.5; 392.8)	-25.7 (-44.2; -2.9)	Female
Bahia	15,959.9 (13,264.1; 18,670.6)	447.8 (371.3; 524.8)	22,373.7 (18,727.3; 26,313.5)	217.8 (183.0; 256.1)	-51.4 (-61.3; -39.1)	Female
Ceará	4,265.7 (3,356.5; 5,223.1)	213.4 (169.1; 259.1)	11,129.3 (9,287.5; 12,969.9)	177.5 (148.8; 206.9)	-16.8 (-35.1; 8.5)	Female
Maranhão	2,587.2 (1,755.3; 3,414.5)	218.3 (148.3; 288.9)	10,554.5 (8,552.1; 12.784.9)	282.6 (229.0; 343.0)	29.5 (-6.3; 91.3)	Female
Paraíba	4,161.1 (3,173.7; 5,237.7)	367.7 (279.4; 459.2)	7,520.9 (6,169.7; 8,796.7)	250.2 (208.0; 291.7)	-31.9 (-48.6; -8.8)	Female
Pernambuco	12,647.6 (10,461.6; 14,976.6)	532.9 (440.3; 630.4)	14,936.3 (12,610.5; 17,408.2)	233.8 (197.4; 272.3)	-56.1 (-64.0; -45.6)	Female
Piaui	3,352.2 (2,493.2; 4,258.9)	480.8 (359.9; 609.6)	6,667.1 (5,312.9; 7,927.8)	291.0 (232.2; 347.1)	-39.5 (-55.6; -17.9)	Female
Rio Grande do Norte	2,408.0 (1,948.0; 2,911.8)	292.2 (235.5; 352.4)	5,181.3 (4,201.5; 6,360.0)	211.5 (173.6; 259.0)	-27.6 (-43.0; -4.9)	Female
Sergipe	1,392.5 (1,127.1; 1,657.3)	329.4 (268.0; 391.3)	2,790.4 (2,323.3; 3,376.9)	195.4 (162.8; 236.6)	-40.7 (-53.5; -24.6)	Female
Southeast region	103,574.5 (89,882.1; 121,577.3)	478.1 (411.0; 561.0)	128,884.3 (110,592.8; 148,248.9)	188.2 (161.8; 216.2)	-60.6 (-67.1; -52.2)	Female
Espírito Santo	3,071.2 (2,631.8; 3,623.4)	416.9 (356.0; 489.1)	7,954.3 (6,622.7; 9,205.5)	282.4 (235.0; 326.1)	-32.3 (-44.2; -17.6)	Female
Minas Gerais	26,104.1 (22,438.7; 30,599.5)	502.9 (428.3; 593.1)	28,589.5 (23,850.8; 33,256.1)	173.3 (144.8; 200.6)	-65.5 (-71.7; -58.5)	Female
Rio de Janeiro	31,257.6 (27,409.3; 36,546.8)	588.1 (513.8; 686.7)	28,866.6 (24,623.6; 33,005.9)	207.3 (177.2; 237.9)	-64.7 (-70.5; -56.9)	Female
São Paulo	43,141.6 (37,223.5; 50,581.5)	416.4 (357.4; 489.9)	63,474.0 (54,234.0; 72,500.9)	180.5 (154.3; 205.7)	-56.7 (-64.0; -47.7)	Female

South region	28,874.5 (24,767.8; 33,819.2)	406.3 (346.9; 475.4)	46,609.6 (38,796.1; 53,379.6)	200.0 (166.7; 228.7)	-50.8 (-59.7; -40.8)	Female
Paraná	11,502.7 (9,781.8; 13,476.6)	482.5 (409.1; 565.6)	16,465.8 (13,707.9; 18,914.0)	197.7 (164.1; 226.9)	-59.0 (-66.3; -50.1)	Female
Rio Grande do Sul	12,565.5 (10,722.7; 14,647.2)	364.0 (309.6; 425.1)	19,679.6 (16,400.4; 22,632.4)	199.6 (167.7; 228.8)	-45.2 (-54.8; -34.0)	Female
Santa Catarina	4,806.2 (4,127.5; 5,672.4)	382.7 (325.5; 457.3)	10,464.1 (8,701.5; 12,168.0)	204.2 (168.9; 237.4)	-46.7 (-57.2; -36.4)	Female
West-Central region	8,824.9 (7,566.0; 10,255.3)	424.4 (362.6; 494.1)	20,545.5 (17,877.9; 23,098.6)	214.8 (186.2; 242.5)	-49.4 (-57.2; -41.7)	Female
Distrito Federal	1,631.4 (1,389.2; 1,903.7)	484.1 (412.5; 570.1)	2,250.0 (1,848.0; 2,669.6)	128.8 (104.8; 151.8)	-73.4 (-78.8; -67.5)	Female
Goiás	4,076.4 (3,472.7; 4,853.7)	417.6 (352.9; 501.3)	8,658.1 (7,245.3; 10,129.6)	203.6 (170.3; 239.4)	-51.3 (-61.0; -40.3)	Female
Mato Grosso	1,331.0 (1,072.5; 1,588.9)	381.2 (308.2; 451.9)	5,085.0 (4,206.5; 5,835.7)	280.1 (230.9; 324.8)	-26.5 (-41.2; -9.7)	Female
Mato Grosso do Sul	1,786.1 (1,515.0; 2,131.7)	432.2 (362.3; 512.7)	4,552.4 (3,739.0; 5,308.7)	265.8 (218.4; 310.3)	-38.5 (-51.8; -25.8)	Female
Brazil	383,098.3 (348,622.3; 422,594.2)	441.5 (397.2; 489.5)	600,694.3 (546,105.7; 644,465.4)	230.2 (208.7; 247.2)	-47.8 (-52.9; -42.6)	Both
North region	13,827.0 (12,273.6; 15,342.4)	367.2 (326.7; 409.0)	37,948.5 (34,474.1; 41,436.6)	247.0 (222.8; 270.5)	-32.7 (-39.4; -25.4)	Both
Acre	632.9 (544.1; 728.1)	390.2 (333.0; 448.1)	1,799.0 (1,575.2; 2,079.1)	261.4 (228.2; 302.4)	-33.0 (-45.2; -19.1)	Both
Amapá	268.6 (233.4; 307.1)	273.0 (234.1; 314.0)	1,107.9 (950.8; 1,294.2)	198.6 (171.5; 229.2)	-27.2 (-41.0; -11.2)	Both
Amazonas	2,250.7 (1,989.3; 2,539.3)	314.6 (273.8; 355.4)	7,185.6 (6,311.1; 8,170.0)	238.0 (209.4; 269.3)	-24.4 (-35.0; -12.5)	Both
Pará	6,771.5 (6,021.4; 7,609.8)	341.4 (300.6; 385.6)	15,981.3 (13,827.5; 18,257.3)	214.4 (184.3; 245.0)	-37.2 (-46.8; -26.8)	Both
Rondônia	2,022.7 (1,775.3; 2,286.7)	583.5 (509.6; 654.9)	4,925.1 (4,260.6; 5,553.6)	307.8 (266.4; 347.4)	-47.3 (-54.6; -39.3)	Both
Roraima	277.4 (232.7; 334.0)	470.0 (399.3; 556.6)	1,294.6 (1,096.8; 1,496.2)	310.1 (268.0; 357.1)	-34.0 (-47.5; -18.8)	Both
Tocantins	1,603.2 (1,319.4; 1,849.5)	525.2 (445.5; 602.5)	5,654.9 (5,009.8; 6,494.2)	352.5 (311.8; 404.5)	-32.9 (-44.0; -20.1)	Both
Northeast region	97,206.3 (82,547.6; 110,973.8)	395.9 (334.5; 451.4)	178,117.7 (156,883.2; 201,904.7)	265.4 (234.2; 301.1)	-33.0 (-42.9; -20.3)	Both

Alagoas	6,228.1 (5,164.9; 7,200.3)	468.9 (388.8; 540.6)	12,722.4 (11,224.2; 14,383.6)	369.3 (325.1; 417.6)	-21.2 (-34.6; -4.0)	Both
Bahia	29,607.5 (25,782.1; 33,944.0)	442.7 (386.3; 506.6)	44,703.1 (39,478.2; 50,550.3)	243.8 (215.5; 275.7)	-44.9 (-53.1; -36.1)	Both
Ceará	8,114.3 (6,659.7; 9,344.5)	215.2 (177.1; 249.7)	21,827.5 (19,124.5; 24,628.1)	196.7 (173.0; 222.1)	-8.6 (-23.7; 10.3)	Both
Maranhão	7,153.9 (5,573.5; 8,744.8)	301.5 (233.6; 366.2)	22,768.1 (19,844.4; 26,260.0)	327.4 (284.8; 378.2)	8.6 (-12.4; 40.6)	Both
Paraíba	7,752.6 (6,194.2; 9,099.9)	359.4 (288.3; 421.8)	14,906.9 (12,963.7; 17,063.5)	286.3 (249.3; 327.2)	-20.3 (-34.7; -1.4)	Both
Pernambuco	23,528.3 (20,495.2; 26,639.7)	532.8 (463.5; 604.0)	29,912.5 (26,600.1; 33,640.7)	269.2 (239.4; 302.7)	-49.5 (-56.8; -40.5)	Both
Piaui	7,439.7 (5,977.6; 8,924.1)	543.9 (435.2; 650.9)	14,302.3 (12,334.9; 16,364.2)	345.1 (297.7; 394.7)	-36.5 (-49.3; -20.6)	Both
Rio Grande do Norte	4,844.0 (4,115.4; 5,616.6)	310.5 (263.0; 360.8)	11,256.2 (9,796.8; 13,101.7)	262.4 (228.8; 305.0)	-15.5 (-30.2; 2.1)	Both
Sergipe	2,538.0 (2,179.5; 2,886.1)	316.1 (270.3; 359.6)	5,718.5 (4,994.5; 6,529.2)	227.1 (197.8; 259.3)	-28.1 (-39.4; -13.4)	Both
Southeast region	202,076.6 (184,266.6; 223,816.1)	497.3 (449.4; 550.7)	254,184.4 (226,902.8; 280,635.1)	212.9 (190.0; 234.8)	-57.2 (-62.1; -51.6)	Both
Espírito Santo	6,367.2 (5,661.1; 7,122.0)	441.1 (391.0; 491.7)	16,473.5 (14,689.8; 18,324.3)	324.2 (289.1; 360.1)	-26.5 (-35.4; -13.9)	Both
Minas Gerais	52,830.5 (47,845.6; 58,420.4)	530.8 (480.6; 588.8)	56,102.7 (49,061.5; 62,577.9)	190.2 (167.0; 212.0)	-64.2 (-68.9; -58.4)	Both
Rio de Janeiro	60,586.7 (55,020.8; 66,741.1)	631.7 (568.8; 696.2)	56,243.2 (49,422.8; 62,350.5)	236.7 (208.2; 261.7)	-62.5 (-67.4; -57.4)	Both
São Paulo	82,292.2 (74,504.9; 91,152.0)	422.4 (378.4; 471.1)	125,365.0 (111,866.9; 138,838.9)	205.5 (183.2; 227.4)	-51.3 (-57.0; -44.4)	Both
South region	52,115.5 (46,676.9; 57,702.8)	390.0 (347.6; 435.5)	87,929.2 (77,180.6; 97,786.7)	215.3 (188.0; 239.7)	-44.8 (-51.7; -36.8)	Both
Paraná	21,417.3 (19,134.1; 23,882.4)	456.7 (404.5; 510.9)	32,711.6 (28,663.4; 36,415.1)	219.7 (191.9; 245.1)	-51.9 (-58.2; -44.7)	Both
Rio Grande do Sul	22,298.1 (19,904.1; 24,701.4)	356.5 (316.3; 397.6)	36,099.9 (31,605.0; 39,948.1)	214.6 (188.2; 238.1)	-39.8 (-47.5; -31.0)	Both

Santa Catarina	8,400.1 (7,481.6; 9,440.6)	352.0 (313.3; 399.8)	19,117.7 (16,946.9; 21,455.2)	209.5 (183.9; 235.4)	-40.5 (-49.0; -31.4)	Both
West-Central region	17,872.9 (16,086.0; 19,782.5)	413.9 (370.4; 459.3)	42,514.5 (38,504.3; 46,786.4)	238.3 (213.9; 262.3)	-42.4 (-48.7; -35.1)	Both
Distrito Federal	3,396.3 (3,028.4; 3,769.4)	527.6 (466.9; 589.9)	4,772.3 (4,155.8; 5,440.1)	155.3 (134.6; 177.0)	-70.6 (-74.4; -65.6)	Both
Goiás	7,814.0 (6,977.7; 8,663.4)	388.8 (345.4; 435.4)	17,239.2 (15,292.0; 19,306.0)	216.7 (191.0; 244.2)	-44.3 (-51.8; -35.3)	Both
Mato Grosso	2,852.1 (2,414.9; 3,252.1)	361.4 (306.7; 409.4)	11,268.3 (9,991.0; 12,700.4)	314.4 (278.0; 353.7)	-13.0 (-27.5; 4.3)	Both
Mato Grosso do Sul	3,810.5 (3,415.5; 4,256.4)	437.9 (383.8; 492.8)	9,234.7 (8,084.8; 10,445.5)	289.6 (252.1; 326.7)	-33.9 (-43.3; -23.3)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

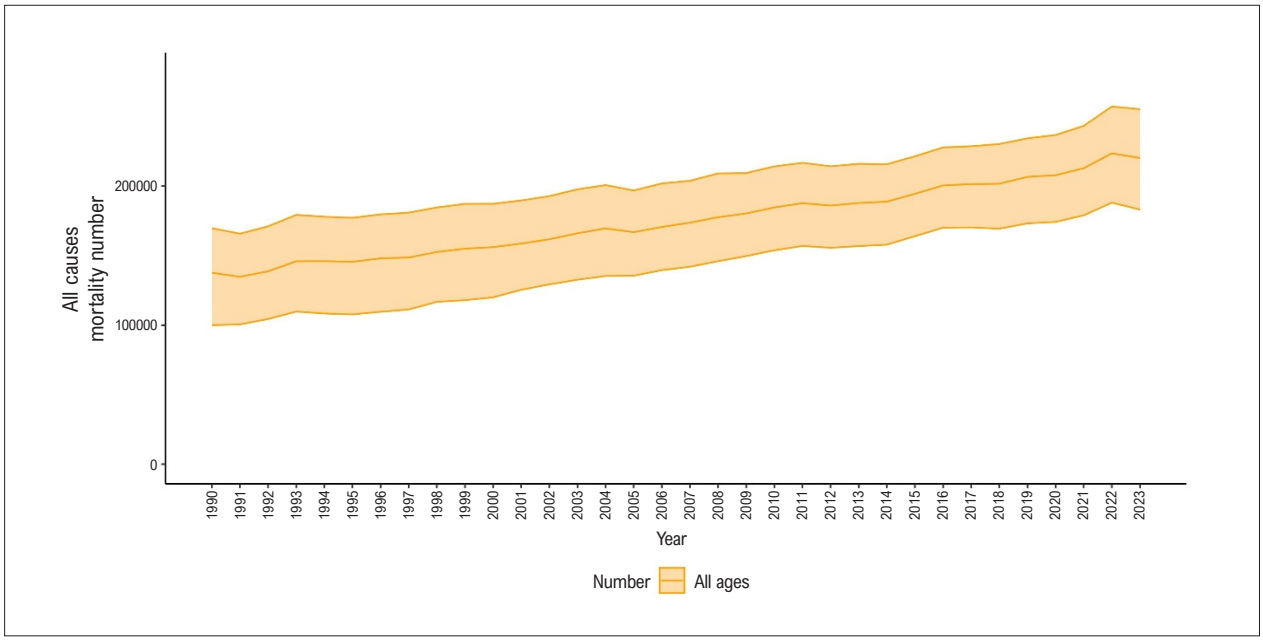

Chart 7.1 – *Number of deaths from all causes attributable to high systolic blood pressure in Brazil from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

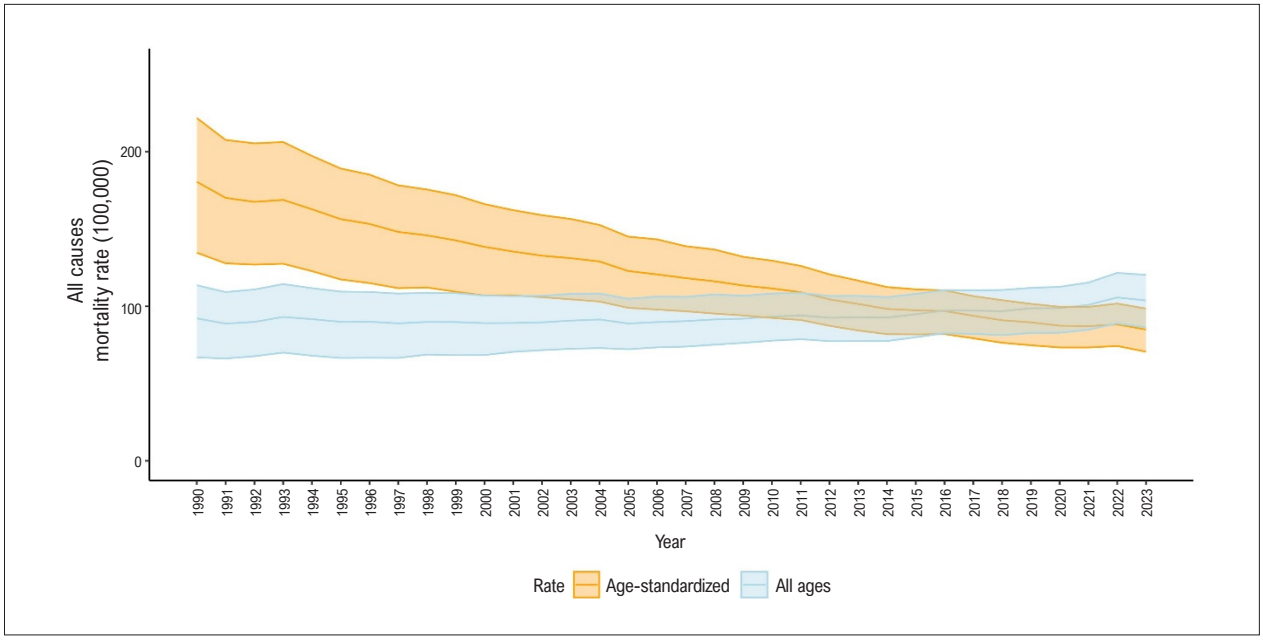

Chart 7.2 – *All-ages and age-standardized mortality rates from all causes, per 100,000 inhabitants, attributable to high systolic blood pressure in Brazil from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

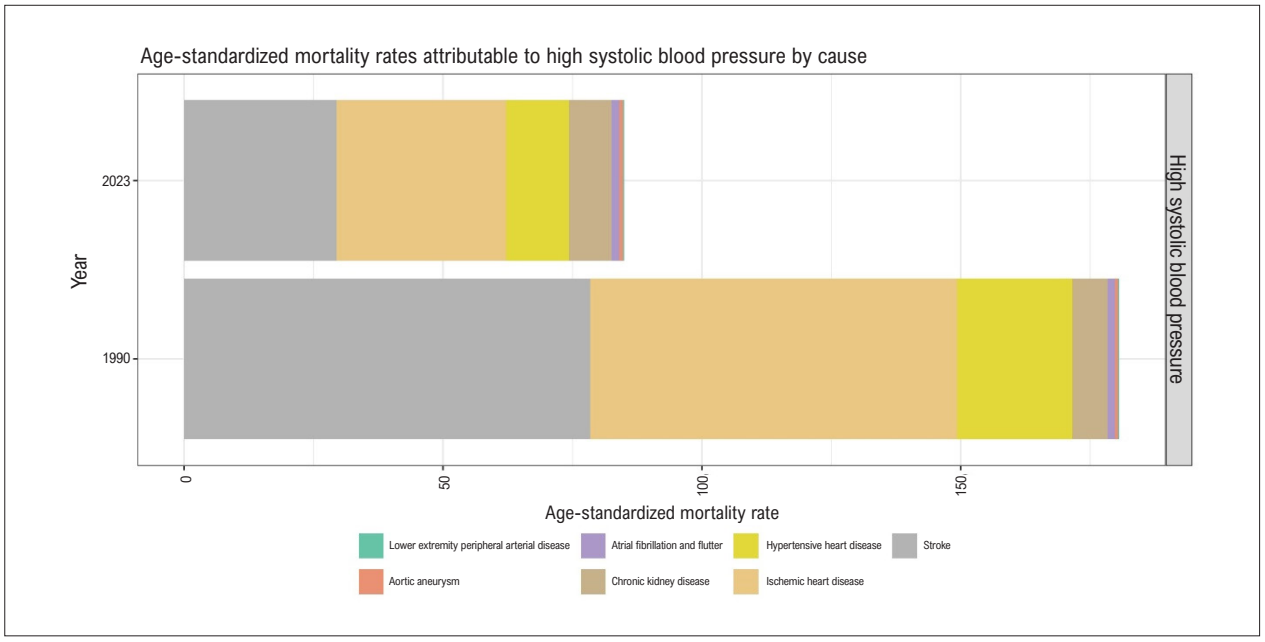

Chart 7.3 – *Age-standardized mortality rates stratified by causes attributable to high systolic blood pressure in Brazil, in 1990 and 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

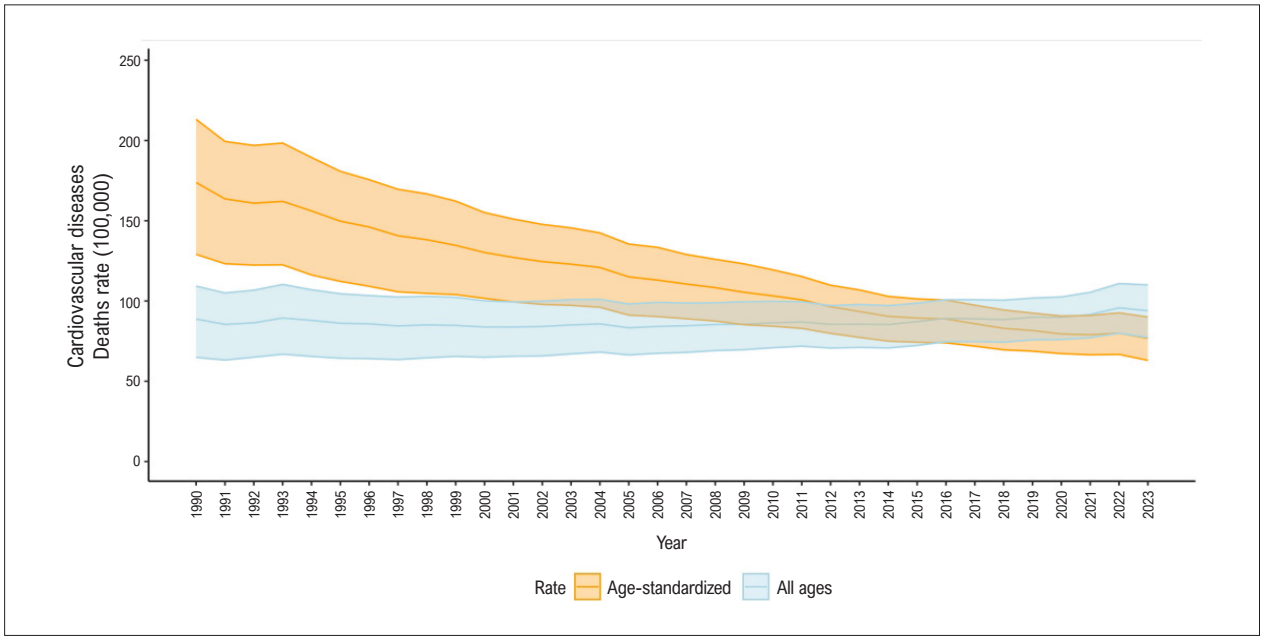

Chart 7.4 – *Trends in all-ages and age-standardized mortality rates from cardiovascular diseases attributable to high systolic blood pressure from 1990 to 2023 in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

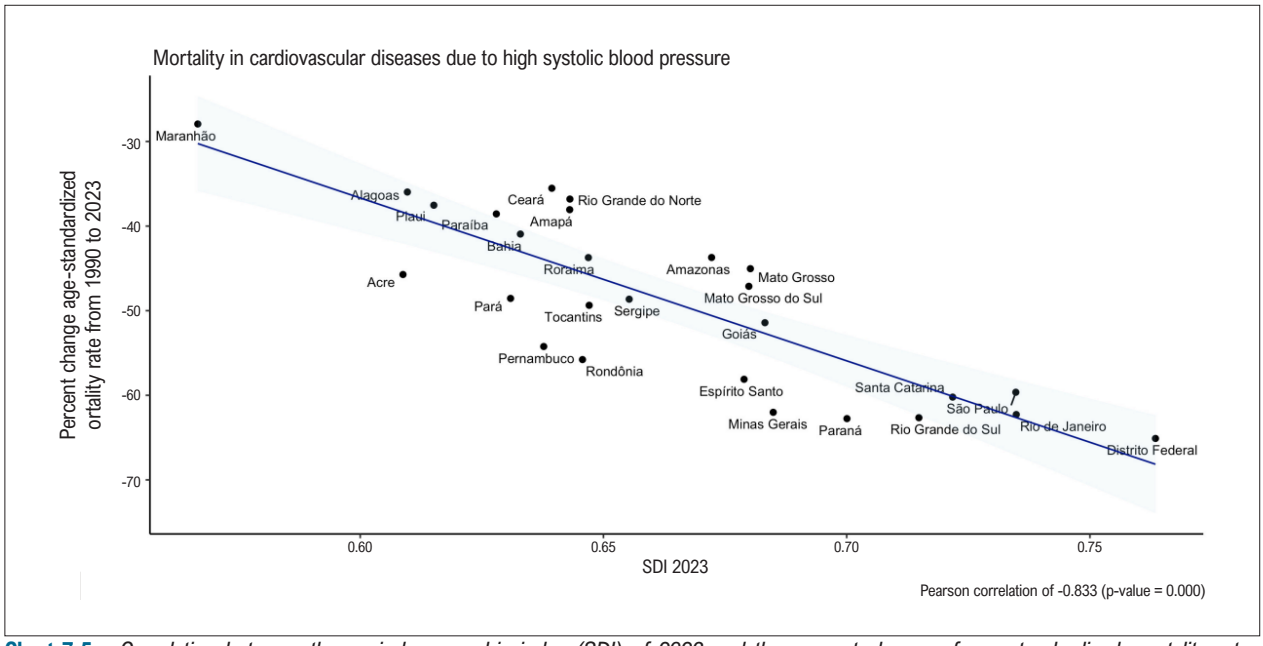

Chart 7.5 – *Correlation between the sociodemographic index (SDI) of 2023 and the percent change of age-standardized mortality rates attributable to high systolic blood pressure in Brazilian Federative Units from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 8 – DYSLIPIDEMIA

ICD-10 E78 (E78.0 – E78.9); ICD-10-CM E78 (E78.0 – E78.9).

See Tables 8.1 through 8.6 and Charts 8.1 through 8.5.

Abbreviations used in chapter 8

CI	Confidence Interval
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life-Year
ELSA-Brasil	Brazilian Longitudinal Study of Adult Health (in Portuguese, Estudo Longitudinal de Saúde do Adulto)
ERICA	Study of Cardiovascular Risks in Adolescents (in Portuguese, Estudo de Riscos Cardiovasculares em Adolescentes)
GBD	Global Burden of Diseases, Injuries, and Risk Factors Study
HDLc	High-Density Lipoprotein Cholesterol
LDLc	Low-Density Lipoprotein Cholesterol
NCEP-ATP-III	National Cholesterol Education Program - Adult Treatment Panel III
OR	Odds Ratio
PNAUM	Brazilian Survey on Medication Access, Use, and Promotion of Rational Use (in Portuguese, Pesquisa Nacional sobre Acesso, Utilização e Promoção do Uso Racional de Medicamentos no Brasil)
PNS	Brazilian Health Survey (in Portuguese, Pesquisa Nacional de Saúde)
PR	Prevalence Ratio
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, Sistema Único de Saúde)
TC	Total Cholesterol
TG	Triglyceride
UI	Uncertainty Interval
YLDs	Years Lived with Disability
YLLs	Years of Life Lost

Introduction

- Dyslipidemia is defined as the presence of abnormal serum levels of lipids, including total cholesterol (TC), its fractions and/or triglycerides (TG). It is a well-established risk factor for cardiovascular disease (CVD), whose causative role has been unequivocally demonstrated.[264] Even in the primary prevention context, randomized clinical trials have evidenced that the treatment of dyslipidemia results in the effective reduction of CVD.[264]
- Similarly to the Cardiovascular Statistics-Brazil published in 2023,[3] this document has the Brazilian National Health Survey (PNS) 2015 as its major source of data on mean cholesterol levels and dyslipidemia prevalence in adults. Similarly, the ERICA study continues to be the major reference for data on adolescents. In the past two years, we found no relevant publication specific to dyslipidemia prevalence that did not derive from the PNS. However, we could find new data on familial dyslipidemia assessment, treatment adequacy, and primary prevention practices. In addition, updated data from the GBD (*Global Burden of Disease*) study are an important addition to this document, in which, data from the previous edition of the Cardiovascular Statistics-Brazil (2023) were also used when more recent data were not available.
- This chapter presents data on TC, LDL-cholesterol (LDLc), HDL-cholesterol (HDLc), and TG. Defining dyslipidemia from a cut-off point perspective is a great challenge, because of the trend towards the reduction in the maximum TC and LDLc levels considered desirable.[265] This results in a constantly changing cut-off point. In addition, variations in the position of the different medical societies about this topic make a universal consensus difficult to achieve.[265-267] We adopted the definitions of dyslipidemia previously established by the two major studies that supported this document, which were as follows: 1) for adults: TC ≥ 200 mg/dL, LDLc ≥ 130 mg/dL, HDLc < 40 mg/dL, and TG ≥ 150 mg/dL;[268] 2) for children and adolescents: TC ≥ 170 mg/dL, LDLc ≥ 130 mg/dL, HDLc < 45 mg/dL, and TG ≥ 130 mg/dL.[269] In accordance with the Brazilian Society of Cardiology, we adopted the following definitions of desirable lipid levels for adults: TC < 190 mg/dL, HDLc > 40 mg/dL, and TG < 150 mg/dL. The target levels of LDLc vary according to the established cardiovascular risk as follows: below 130, 100, 70, and 50 mg/dL for individuals at low, intermediate, high, and very high risk, respectively.[265]

Prevalence

Young individuals

- As compared to the 2023 document,[3] data on dyslipidemia prevalence remain essentially unaltered. In the ERICA study, 38,069 students (female sex, 60%; age range, 12 to 17 years) of all Brazilian capitals and five sets of municipalities with more than 100 000 inhabitants were assessed.[269] The mean levels of the lipid parameters were as follows: TC, 148 mg/dL (95% CI 147–149 mg/dL); LDLc, 85 mg/dL (95% CI 84–86 mg/dL); HDLc, 47 mg/dL (95% CI 47–48 mg/dL); and TG, 78 mg/dL (95% CI 76–79 mg/dL). In that population, 20.1% (95% CI 19–21.3%) had high TC levels, 3.5% (95% CI 3.2–4%) had high LDLc, and 7.8% (95% CI 7.1–8.6%) had high TG. The prevalence of reduced HDLc was 47% (95% CI 45–49%). Data stratified by age group and sex are shown in Table 8.1.
- A similar profile of lipid changes was found in a study conducted in the Distrito Federal assessing 1,200 adolescents

(mean age, 14.8 years; female sex, 50.4%; White skin color, 35.6%; Brown skin color, 53.5%; and Black skin color, 6%), in which the most frequent change was low HDLc. The following prevalences were observed: TC ≥ 170 mg/dL, 30.6% (95% CI 27.6-33.7); LDLc ≥110 mg/dL, 21.3% (95% CI 19.0-23.7); HDLc ≤ 45 mg/dL, 41.8% (95% CI 38.1-45.4); and TG≥ 90 mg/dL, 30.5% (95% CI 27.4-33.8).[270]

- Other findings from smaller studies conducted in the capitals of different Brazilian regions reinforce that high rate of dyslipidemia in Brazilian children. In the city of Salvador, Bahia state, 1,131 children (age, 7 years to 15 years; male sex, 50.1%) have been assessed. Dyslipidemia was considered when TC ≥ 170 mg/dL and/or TG ≥ 130 mg/dL. The prevalence found was 25.5% (95% CI 22.7 – 28.3), with a positive association with weight excess (OR: 3.40; 95% CI 2.07-5.58) and inadequate dietary pattern (OR: 1.49; 95% CI 1.01-2.19).[271] A study conducted in the city of Vitória, Espírito Santo state, with 511 children (age, 6 to 9 years; male sex, 46.77%) has also reported dyslipidemia prevalence as follows: 32.7% had high TC levels, 9.2% had high LDLc levels, 4.1% had high TG levels, and 27% had low HDLc levels.[272] Finally, in the state of Santa Catarina, mean levels of cholesterol have been assessed in 1,011 students aged 6 to 14 years (52.4% girls). The following mean lipid levels were found in girls and boys, respectively: TC, 172 (±27) mg/dL and 170 (±28) mg/dL; LDLc, 104 (±24) mg/dL and 104 (±27) mg/dL; HDLc, 49 (±11) mg/dL and 49 (±11) mg/dL; and TG, 80 (24-459) mg/dL and 77 (14-752) mg/dL.[273]

Adults

- According to data from the PNS 2014-2015,[266] the prevalence of dyslipidemia in the adult Brazilian population was as follows: 32.7% for high TC levels; 18.6% for high LDLc levels; and 31.8% for reduced HDLc levels. The mean levels identified were as follows: TC, 185 mg/dL; HDLc, 46 mg/dL; and LDLc, 105 mg/dL. There was a higher prevalence of high TC among women, while low HDLc levels were more common among men. Tables 8.2 to 8.4 show these results, with an analysis stratified by sex, age group, educational level, skin color, and Brazilian geographic region. In general, higher educational level was associated with lower prevalence of increased TC and LDLc levels, as well as of reduced HDLc levels. More advanced age groups had higher prevalence of high TC and LDLc levels. Residing in the South and Southeast regions was associated with a lower frequency of low HDLc levels. Although the association of lipid profile and self-reported skin color was less consistent, it is worth noting that Black women had lower prevalence of reduced HDLc levels.[266]
- In the ELSA-Brasil study, the prevalences reported for women and men were, respectively: of hypertriglyceridemia, 23.2% and 40.7%; of reduced HDLc levels, 20.7% and 14.7%; and of high LDLc levels, 57.6% and 58.8%. In addition, that study showed small variations in the lipid profile according to skin color, although with apparently little clinical impact.[274,275]
- In a more recent investigation, Fonseca *et al*. have assessed cardiovascular risk factors in 7,724 individuals without previous diagnosis of CVD in the context of primary health care of 32 municipalities in São Paulo state. The prevalence of dyslipidemia, defined based on data from medical records, was 70.1%, being 68.6% among men and 71.2% among women.[250] These numbers differ significantly from those obtained from larger analyses, and might reflect the approach not based on direct measurement of cholesterol levels in addition to selection bias. Other determinants related to lipid profile changes include physical activity level[272] and seasonal variations.[273]

Relationship between lipids and lifestyle

- Changes in lifestyle can impact positively the lipid profile.[267] A subanalysis of the ERICA study with 36,952 adolescents has shown that those in the highest tertile of ultra-processed food consumption were at the highest risk of having high LDLc (PR 1.012; 95% CI 1.005 – 1.029) and low HDLc (PR 0.972; 95% CI 0.952 – 0.993).[274] Similarly, an analysis of 5,275 adults from the ELSA-Brasil study has shown that moderate and high consumption of ultra-processed food (as compared to the lowest consumption tertile) was also associated with a worse lipid profile in a four-year follow-up. The risk of isolated hypercholesterolemia was 12% higher (OR = 1.12; 95% CI 1.00 – 1.27) for moderate ultra-processed food consumption and 28% higher (OR = 1.28; 95% CI 1.12 – 1.47) for high ultra-processed food consumption. In addition, as compared to individuals with low ultra-processed food consumption, those with moderate and high ultra-processed food consumption had the following increases: in the risk for hypertriglyceridemia, 14% (OR: 1.14; 95% CI 1.03 – 1.26) and 30% (OR: 1.30; 95% CI 1.17 – 1.45), respectively; in the risk for mixed hypercholesterolemia, 21% (OR: 1.21; 95% CI 1.05 – 1.39) and 38% (OR: 1.38; 95% CI 1.18 – 1.62), respectively; and in the risk for low HDLc, 12% (OR: 1.12; 95% CI 1.00 – 1.24) and 18% (OR: 1.18; 95% CI 1.05 – 1.32), respectively.[275]
- In a cross-sectional study of 1,079 users of the Health Gym Program (*Programa Academia da Saúde*) of the MOTIVA-SUS study (93.2% women; 25.6% ≥ 60 years), the association of inadequate lifestyle (unhealthy diet, excessive alcohol consumption, tobacco use, and physical inactivity) with risk factors for CVD, such as dyslipidemia, has been assessed. That study identified that the simultaneous adoption of 1 and ≥ 2 inadequate lifestyle behaviors was associated with higher chances of hypercholesterolemia with OR 1.4 (95% CI 1.1 – 1.9) and OR 1.7 (95% CI 1.4 – 2.1), respectively.[276] The clear asymmetry of the studied population distribution (93.2% were women) evidences the significant risk of selection bias in that study.

Attributable Risk

Mortality

- Data on the risk attributable to high LDLc levels have been updated with the GBD Study 2023 publication. Regarding the absolute number of deaths and mortality rates in Brazil and its Federative Units, we report the results of the series between 1990 and 2023. The absolute number of deaths attributable to high LDLc levels in Brazil increased from 55,057 (95% UI 33,851

– 78,039) to 67,688 (95% UI 41,609 – 99,684) in the period. (Table 8.5) The cardiovascular mortality rate not adjusted for age, per 100 000, passed from 36.9 (95% UI 22.7 – 52.3) to 31.9 (95% UI 19.6 to 47.0), while the age-standardized cardiovascular mortality rate, per 100 000, decreased from 68.2 (95% UI 39.2 – 99.2) to 25.8 (95% UI 15.8 – 38.2) (Table 8.6). Regarding mortality attributable to high LDLc levels, the numbers of deaths from all causes coincide with those of cardiovascular mortality, because of the specificity of that risk factor for CVD. The temporal trend of the absolute numbers of deaths and mortality rates are shown in Chart 8.1. The increase in crude mortality rates, even with the reduction in age-standardized rates, can be attributed to population aging in the period studied, culminating in a higher absolute rate of events. Of the risk factors for CVD, that was the fourth most relevant for attributed mortality of men and the third for attributed mortality of women. Of the states, the greatest reduction in age-standardized mortality rate was observed in Paraná state [70.8% (95% UI -76.3 to -63.8)] and the smallest, in Rio Grande do Norte state [42.3% (95% UI -53.5 to -24.0)]. Of the Brazilian regions, the South had the greatest decrease [68.6% (95% UI -74.3 to -61.6)], while the Northeast region had the smallest decrease [49.3% (95% UI -59.3 to -34.6). The absolute numbers of deaths and percent changes of mortality rates in the country, per state and region, and stratified by sex are detailed in Table 8.5. In addition, the temporal trend of mortality rates attributable to high LDLc levels in the country and per its geographic regions is shown in Chart 8.2.

- Table 8.5 shows the distribution of cardiovascular mortality rates attributable to high LDLc levels according to sex. Among women, the cardiovascular mortality rates decreased from 56.2 (95% UI 31.2 – 84.1) in 1990 to 18.9 (95% UI 11.2 – 28.6) in 2023 per 100 000, a percent change of -66.4% (95% UI -72.8 to -58.3) in the period. The greatest advance was observed in Paraná state, a -75.3% percent change in mortality rate (95% UI -81.1 to -68.7), while the smallest percent change was observed in Piauí state, -44.2% (95% UI -57.7 to -19.4). Regarding men, that rate decreased from 81.0 (95% UI 48.3; 118.0) to 34 (95% UI 21.3 – 49.6), a percent change of -58% (95% UI -64.6 to -49.0). The greatest percent change among the Federative Units was observed in Minas Gerais state, -67.1% (95% UI -71.9 to -60.2). The smallest percent change was observed in Ceará state, -32.3% (95% UI -45.2 to -11.5).
- In the analysis of cardiovascular mortality attributable to high LDLc levels per age group shown in Table 8.6 and Chart 8.3, as expected, the absolute numbers and rates increase as age advances. The age group ≥ 70 years showed the greatest percent change in mortality (-62.5; 95% UI -69.9 to -52.9).
- The reduction in age-standardized mortality attributable to high LDLc levels was also significant when analyzing per specific causes. The mortality rate from ischemic heart disease decreased from 46 (95% UI 32 - 62) in 1990 to 19 (95% UI 13 - 26) in 2023, and the mortality rate from stroke decreased from 23 (95% UI 7 - 38) to 7 (95% UI 2 - 12) in that period. Chart 8.4 shows the changes described.
- The sociodemographic index (SDI) is a measure of sociodemographic development composed of indicators of per capita income, educational level, and fertility. The SDI enables comparisons between the Federative Units and countries based on their development level. Chart 8.5 shows the correlation between the SDI 2023 and the percent change of cardiovascular mortality rates between 1990 and 2023. The Federative Units with the highest SDI showed the greatest reductions in the rates (R= -0.791), which occurred in states of the South and Southeast regions and the Federal District.

Burden of Disease

- In addition to the fatal complications of CVD associated with dyslipidemia, non-fatal complications, such as non-fatal acute myocardial infarction and stroke, can be partially attributable to CVD. The magnitude of these impacts can be assessed by using DALYs (disability-adjusted life-years), which is the addition of YLLs (years of life lost) and YLDs (years of life lived with disability).
- Regarding DALYs, which follow the same trend of mortality, there was an increase in the absolute number, from 1,524,549.4 (95% UI 1,003,123.3 – 2,022,028.9) in 1990 to 1,775,660.0 (95% UI 1,198,252.7 – 2,458,582.3) in 2023. However, age-standardized DALY rates decreased in the same period, from 1,622.4 (95% UI 1,036.6 – 2,223.0) to 670.9 (95% UI 452.0 – 929.2), which represents a percent change of -58.6% (95% UI -65.2 to -50.8). These changes are shown in Table 8.6.
- In addition, Table 8.6 shows the DALY absolute numbers and rates attributable to high LDLc levels in 1990 and 2023 according to age group. Similarly to mortality, the highest rates were observed in the ≥ 70-year age group, whose DALY rates decreased from 8,618.7 (95% UI 4,261.4 – 13,797.4) in 1990 to 3,165.7 (95% UI 1,608.2 – 5,295.3) in 2023, a percent change of -63.3% (95% UI -70.6 to -53.9).

Familial Hypercholesterolemia

- The prevalence of familial hypercholesterolemia, according to the Dutch Lipid Clinic Network criteria, has been assessed in the ELSA-Brasil study, which reported a prevalence of 1 per 263 individuals, higher in individuals of Black race/skin color (1 per 156) and Brown race/skin color (1 per 204) than in those of White race/skin color (1 per 417).[277] Another study with data from the PNS, also using the Dutch Lipid Clinic Network criteria for familial hypercholesterolemia, has estimated the prevalence of possible familial hypercholesterolemia as 0.96%, with higher levels among women, individuals with diabetes, arterial hypertension, and several sociodemographic variables.[278] The difference in prevalence between the two studies can be explained by the fact that the latter used the definition of 'possible' familial hypercholesterolemia *versus* the definitions of 'probable' or 'confirmed' familial hypercholesterolemia.
- Despite the controversies in the use of cascade screening to identify relatives of individuals with familial hypercholesterolemia, a Brazilian study has shown that 59% of the relatives of individuals with mutations had those

same mutations, suggesting high prevalence of familial hypercholesterolemia in the selected subgroup.[279] However, in the study by Coutinho *et al.* including elderly individuals with hypercholesterolemia identified by cascade screening, the presence of previous CVD was a predictor of incident CVD, while the presence of a genetic variant associated with familial hypercholesterolemia was not, as compared to patients of similar ages and with similar cholesterol levels.[280]

Knowledge, Treatment, and Control

- An analysis of the ELSA-Brasil study has shown the prevalence of high LDLc levels in 45.5% of the participants, of whom, only 58.1% knew their diagnosis, 42.3% were on lipid-lowering drugs, and 58.3% met the goal defined by the NCEP-ATP-III.[281]
- In an analysis based on the PNAUM 2014-2015, in the context of primary health care of the Brazilian Unified Health System (SUS - *Sistema Único de Saúde*) in the five Brazilian geographic regions, the prevalence of statin use was 9.3%, and 81.4% of those users reported having dyslipidemia.[282]
- A study conducted in the public health system of the city of Curitiba included 7,066 patients hospitalized due to acute myocardial infarction between 2008 and 2015. Of them, 1,451 had at least one measurement of LDLc level, and mean LDLc level was 93.3 mg/dL. Only 7.4% had LDLc levels < 50, 21.5% had LDLc levels between 50 and 70, 35.2% between 70 and 100, and 35.5% > 100 mg/dL. Among those with LDLc measurements before and after the infarction, there was a reduction in LDLc levels, which fell short of the recommended values (from 128 to 92 mg/dL).[283]
- A study based on database from health insurance companies has reported that only 19% of the individuals diagnosed with CVD had LDLc levels below 70 mg/dL and only 4% had LDLc levels below 50 mg/dL.[107] In a study based on database of executive health screening tests with more than 55,000 participants, more than 2,000 individuals were identified with severe dyslipidemia (LDLc over 190 mg/dL or over 160 mg/dL on lipid-lowering drug use). Although two-thirds of those patients had reported dyslipidemia, only 19% were being treatment.[284]
- In a cross-sectional analysis of the Brazilian Study of Diabetes in the city of Campinas, 1,030 participants have been assessed regarding their lipid profile adequacy. Their mean LDLc levels were as follows: 105±38 in individuals at very high cardiovascular risk; 109±39 in those at high risk; and 110±37 mg/dL in those at moderate risk. Only 18.8% of the individuals had LDLc levels adequate to their risk category.[285]
- In a study with patients with stage 3 or higher chronic kidney disease, the prevalence of high TC levels was 28%. The prevalence of low HDL levels was 45% in those with stage 3 chronic kidney disease and 59% in those with stage 4 or 5 chronic kidney disease, while the prevalence of high TG levels was 45%. Almost half of the patients had no recent measurement of cholesterol levels and its fractions, and approximately 40% of the patients were not on lipid-lowering drugs despite their high cardiovascular risk.[286]
- In the already mentioned study by Fonseca *et al.* in the state of São Paulo, only 13,9% of the individuals considered to have dyslipidemia were on lipid-lowering drugs and could achieve target serum LDLc levels < 100mg/dL.[250]
- Regarding awareness about familial dyslipidemia and its treatment, Santos *et al*. have reported results from a database with 70,000 individuals undergoing routine and mandatory employer-sponsored health assessment at a private hospital in São Paulo.[282] Of those 70,000 individuals, 1,987 met the criteria for severe dyslipidemia (LDLc ≥ 190 mg/dL or LDLc ≥ 160 mg/dL on statin use). A sample of 200 individuals was selected to complete a questionnaire. Regarding those 200 individuals, their attending physician suspected familial dyslipidemia in only 29 (14.5%), although most of them (97%) knew their high serum levels of cholesterol. Only 18% were aware of their high risk for CVD, 30% knew their target LDLc levels, and 37% were not on lipid-lowering drugs.

Dyslipidemia and Subclinical Atherosclerosis

- Generoso *et al*.[287] have shown that HDLc was associated with coronary artery calcium even after adjusting for the traditional cardiovascular risk factors in a Brazilian population. However, that association was not significant after adjusting for TG. In addition, that same group has shown that HDLc and carotid intima-media thickness are associated and that such association is modified by the presence of diabetes.[288]
- Laurinavicius *et al*.[289] have studied carotid intima-media thickness according to HDLc level distribution. In that study, no association of carotid intima-media thickness and very high HDLc levels was shown.[289]
- In an analysis of the ELSA-Brasil study about TG-rich lipoproteins, Bittencourt *et al*.[290] have shown that those particles are associated with coronary artery calcification even after adjusting for significant risk factors.
- In a study with Brazilian octogenarians, the authors have shown that the association of coronary artery calcification with LDLc weakens as age advances, while the association with HDLc does not.[291]

Future Directions

- Current data on the epidemiology of dyslipidemia in the contemporary Brazilian population are scarce. Additional studies on the prevalence of dyslipidemia in the general population, as well as in specific groups at high risk, such as those of lower socioeconomic levels, are required.
- The frequency of cholesterol screening according to sex and age groups in Brazil needs to be investigated.
- Local Brazilian data on the impact of dyslipidemia on the health system, including costs, are yet to be assessed.

Table 8.1 – Mean serum levels of lipids, prevalences of borderline and high lipid levels, in addition to estimated population with abnormal lipid levels, according to sex and age group, in Brazil

Lipids	Mean		Borderline		High		Estimated population with abnormal lipid levels
	mg/dL	95% CI	%	95% CI	%	95% CI	
Total cholesterol							
General population	148.1	147.1-149.1	24.2	22.7-25.8	20.1	19.0-21.3	2,940,705
Men	143.6	142.4-144.8	22.7	20.4-25.2	15.3	13.9-16.9	1,256,102
Women	152.6	151.4-153.9	25.7	24.5-27.0	24.9	23.4-26.5	1,684,602
12-14 years	149.4	148.0-150.7	25.8	24.3-27.4	20.7	19.1-22.5	937,793
15-17 years	147.1	145.8-148.3	22.8	20.8-24.9	19.6	18.0-21.2	2,002,911
LDLc							
General population	85.3	84.5-86.1	19.5	18.5-20.5	3.5	3.2-4.0	1,526,733
Men	83.4	82.2-84.5	17.4	16.0-18.9	2.9	2.3-3.6	669,805
Women	87.2	86.3-88.1	21.5	20.2-22.9	4.3	3.7-4.9	856,928
12-14 years	86.2	85.1-87.3	20.6	19.0-22.4	3.7	3.1-4.4	467,877
15-17 years	84.5	83.5-85.5	18.4	17.2-19.7	3.4	2.9-4.1	1058,856
Triglycerides							
General population	77.8	76.5-79.2	12.0	11.0-13.0	7.8	7.1-8.6	1,312,329
Men	76.4	74.7-78.1	10.9	9.8-12.2	7.6	6.5-8.8	610,449
Women	79.3	77.8-80.7	13.0	11.8-14.2	8.1	7.3-9.0	701,880
12-14 years	78.9	76.7-81.0	12.7	11.0-14.6	8.3	7.2-9.5	434,638
15-17 years	76.9	75.8-78.1	11.3	10.2-12.4	7.4	6.6-8.4	877,690
HDLc	Mean			Low			
General population	47.3	46.7-47.9	46.8	44.8-48.9	-	-	3,104,161
Men	44.9	44.4-45.5	55.9	53.7-58.2	-	-	1,256,003
Women	49.6	48.9-50.3	37.8	35.4-40.2	-	-	1,848,158
12-14 years	47.4	46.7-48.1	45.0	42.3-47.8	-	-	819,980
15-17 years	47.2	46.4-48.0	48.4	45.9-50.8	-	-	2,284,181

Source: Modified from Faria Neto et al.[269] Change = borderline + highs levels; population estimates were obtained from processing microdata of the IBGE Demographic Census of 2000 and 2010.

Table 8.2 – Prevalence of total cholesterol ≥ 200 mg/dL according to sex, age group, educational level, skin color, and Brazilian geographic region, PNS 2014-2015

	Total			Men			Women		
	%	95% CI	p	%	95% CI	p	%	95% CI	p
Total	32.7	31.5 - 34.1		30.1	28.2 - 32.1		35.1	33.4 - 36.8	< 0.001
Age group (years)									
18 - 29	17.9	15.7 - 20.4		13.9	11.2 - 17.4		21.9	18.7 - 25.5	
30 - 44	31.0	28.7 - 33.4	< 0.001	34.9	31.2 - 38.8	< 0.001	27.6	24.9 - 30.5	< 0.001
45 - 59	43.4	40.8 - 46.0		39.4	35.7 - 43.4		47.0	43.5 - 50.5	
≥ 60	41.9	39.1 - 44.8		33.5	29.5 - 37.9		48.4	44.7 - 52.2	
Schooling (years)									
0 - 8	37.1	35.2 - 39.1		31.6	28.9 - 34.5		42.2	39.6 - 44.8	
9 - 11	28.6	25.5 - 32.0	< 0.001	26.6	22.2 - 31.6	0.237	30.6	26.4 - 35.2	< 0.001
≥ 12	30.4	28.4 - 32.5		30.0	26.9 - 33.3		30.8	28.3 - 33.4	
Skin color									
White	33.9	31.9 - 36.0		30.8	27.8 - 33.9		36.6	33.9 - 39.4	
Black	33.2	29.0 - 37.6	0.146	30.0	23.9 - 37.0	0.669	36.0	30.5 - 41.8	0.196
Brown	31.5	29.8 - 33.3		29.5	26.9 - 32.4		33.4	31.1 - 35.7	
Others	23.3	14.8 - 34.6		19.6	9.7 - 35.4		25.8	14.2 - 42.2	
Region									
North	32.5	30.4 - 34.6		31.0	27.9 - 34.3		33.9	31.2 - 36.7	
Northeast	34.0	32.3 - 35.8		30.2	27.7 - 33.0		37.4	35.1 - 39.8	
Southeast	31.5	29.1 - 34.1	0.195	28.7	25.1 - 32.6	0.376	34.1	30.9 - 37.4	0.291
South	34.7	31.7 - 37.8		33.4	28.9 - 38.3		35.8	32.0 - 39.8	
West-Central	31.7	28.7 - 34.8		30.1	25.7 - 34.9		33.0	29.1 - 37.2	

Source: Malta et al.[268]

Table 8.3 – Prevalence of low HDL-cholesterol levels (< 40 mg/dL) according to sex, age group, educational level, skin color, and Brazilian geographic region, PNS 2014-2015

	Total			Men			Women		
	%	95% CI	P	%	95% CI	p	%	95% CI	p
Total	31.8	30.5 - 33.1		42.8	40.6 - 45.0		22.0	20.6 - 23.5	< 0.001
Age group (years)									
18 - 29	29.1	26.2 - 32.2		39.7	34.9 - 44.7		18.7	15.9 - 21.9	
30 - 44	31.8	29.4 - 34.2	0.070	41.8	37.9 - 45.7	0.159	23.0	20.4 - 25.9	0.046
45 - 59	34.1	31.6 - 36.6		44.8	40.9 - 48.8		24.3	21.5 - 27.4	
≥ 60	32.4	29.8 - 35.2		46.5	42.1 - 51.1		21.5	18.7 - 24.6	
Schooling (years)									
0 - 8	33.7	31.8 - 35.7		43.3	40.2 - 46.4		24.9	22.8 - 27.2	
9 - 11	38.5	34.9 - 42.2	< 0.001	50.0	44.3 - 55.6	0.006	27.0	22.9 - 31.5	< 0.001
≥ 12	27.8	25.9 - 29.9		39.6	36.2 - 43.2		18.1	16.1 - 20.3	
Skin color									
White	31.0	29.0 - 33.1		43.0	39.7 - 46.5		20.6	18.4 - 23.0	
Black	28.5	24.3 - 33.2	0.072	41.8	34.5 - 49.4	0.586	16.6	12.6 - 21.6	0.006
Brown	33.5	31.7 - 35.4		43.0	40.0 - 46.1		24.8	22.8 - 27.0	
Others	24.7	15.8 - 36.5		27.7	15.1 - 45.2		22.7	11.6 - 39.5	
Region									
North	36.6	34.4 - 38.8		47.2	43.7 - 50.7		26.7	24.2 - 29.4	
Northeast	34.8	33.0 - 36.6		44.3	41.4 - 47.2		26.4	24.3 - 28.6	
Southeast	30.8	28.3 - 33.4	< 0.001	43.1	38.9 - 47.3	0.036	20.0	17.4 - 22.9	< 0.001
South	26.1	23.3 - 29.0		36.3	31.6 - 41.2		16.8	14.1 - 20.0	
West-Central	34.3	31.1 - 37.6		45.0	39.8 - 50.3		24.7	21.2 - 28.6	

Source: Malta et al.[268]

Table 8.4 – Prevalence of high LDL-cholesterol levels (> 130 mg/dL) according to sex, age group, educational level, skin color, and Brazilian geographic region, PNS 2014-2015

	Total			Men			Women		
	%	95% CI	p	%	95% CI	p	%	95% CI	p
Total	18.6	17.5 - 19.7		17.1	15.6 - 18.8		19.9	18.5 - 21.3	0,012
Age group (years)									
18 - 29	8.8	7.2 - 10.7		6.6	4.8 - 9.0		11.0	8.7 - 14.0	
30 - 44	17.5	15.7 - 19.5	< 0.001	20.2	17.3 - 23.6	< 0.001	15.2	13.0 - 17.6	< 0,001
45 - 59	25.6	23.3 - 27.9		23.2	20.0 - 26.7		27.7	24.7 - 30.9	
≥ 60	24.5	22.2 - 27.0		19.5	16.3 - 23.2		28.4	25.1 - 31.9	
Schooling (years)									
0 - 8	21.5	20.0 - 23.2		17.8	15.7 - 20.1		24.9	22.8 - 27.2	
9 - 11	16.8	14.3 - 19.7	< 0.001	15.2	11.8 - 19.3	0.525	18.5	15.0 - 22.6	< 0,001
≥ 12	16.7	15.1 - 18.4		17.2	14.8 - 20.0		16.2	14.2 - 18.4	
Skin color									
White	20.1	18.5 - 21.9		18.8	16.4 - 21.4		21.3	19.1 - 23.8	
Black	16.6	13.6 - 20.2	0.009	15.2	10.9 - 20.8	0.131	17.9	13.9 - 22.7	0,095
Brown	17.4	16.1 - 18.8		15.9	13.9 - 18.1		18.8	17.0 - 20.7	
Others	10.1	6.0 - 16.6		8.6	3.6 - 19.1		11.2	5.7 - 20.7	
Region									
North	16.2	14.7 - 17.9		15.5	13.2 - 18.1		17.0	14.9 - 19.2	
Northeast	19.8	18.4 - 21.3		17.5	15.5 - 19.8		21.9	19.9 - 23.9	
Southeast	17.9	16.0 - 19.9	0.136	16.1	13.4 - 19.3	0.355	19.4	16.8 - 22.2	0,195
South	20.0	17.6 - 22.6		19.8	16.2 - 24.0		20.1	17.1 - 23.5	
West-Central	17.8	15.4 - 20.4		17.8	14.3 - 21.9		17.8	14.8 - 21.3	

Source: Malta et al. 2019.[268]

Table 8.5 – Absolute numbers of deaths and age-standardized mortality rate due to cardiovascular diseases attributable to high LDLc levels, per 100 000 inhabitants, in 1990 and 2023, and percent change of the rates in the period, according to sex and location.

Sex and location	1990		2023		Percent change % (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	31,905.3 (20,265.3; 44,668.0)	81.0 (48.3; 118.0)	39,706.7 (25,226.0; 56,615.9)	34.0 (21.3; 49.6)	-58.0 (-64.6; -49.0)
Brazil (North)	1,125.6 (693.7; 1,586.7)	62.5 (34.1; 93.8)	2,449.0 (1,540.3; 3,501.5)	32.5 (19.7; 47.6)	-48.0 (-57.4; -34.7)
Acre	45.5 (28.0; 65.6)	55.0 (31.8; 81.9)	98.9 (63.1; 144.1)	29.1 (18.0; 43.3)	-47.0 (-57.9; -29.4)
Amapá	25.9 (15.9; 36.5)	62.5 (35.3; 93.7)	87.3 (54.4; 123.5)	32.3 (19.0; 47.8)	-48.4 (-60.2; -33.8)
Amazonas	191.4 (119.2; 276.2)	57.2 (31.2; 87.4)	434.8 (270.1; 640.5)	29.9 (17.7; 45.7)	-47.8 (-57.5; -35.3)
Pará	605.6 (352.1; 848.2)	64.7 (34.8; 96.0)	1,230.1 (764.2; 1,767.6)	34.0 (20.6; 49.9)	-47.4 (-57.5; -32.6)
Rondônia	145.3 (90.4; 197.7)	75.6 (43.4; 112.1)	263.4 (164.2; 369.8)	32.3 (19.3; 47.3)	-57.3 (-65.7; -46.9)
Roraima	19.5 (12.6; 27.1)	64.6 (36.7; 98.4)	74.7 (47.1; 105.1)	34.0 (20.6; 49.7)	-47.4 (-58.4; -30.2)
Tocantins	92.4 (57.1; 132.6)	61.5 (32.8; 93.8)	259.8 (165.0; 374.6)	32.2 (20.1; 46.8)	-47.7 (-59.0; -29.4)
Brazil (Northeast)	6,511.0 (3,891.0; 9,526.6)	58.1 (33.5; 85.9)	9,788.0 (6,266.1; 13,929.2)	32.8 (20.8; 47.1)	-43.6 (-54.1; -28.6)
Alagoas	385.1 (214.5; 567.6)	63.5 (33.8; 97.1)	635.9 (407.7; 895.5)	41.4 (25.9; 59.2)	-34.8 (-47.2; -14.0)
Bahia	1.542.1 (906.3; 2.215.2)	52.0 (29.9; 76.2)	2,349.3 (1,465.9; 3,366.3)	28.6 (17.7; 41.5)	-45.0 (-55.9; -30.0)
Ceará	763.3 (454.9; 1,128.6)	44.1 (25.2; 67.0)	1,466.9 (933.1; 2,070.9)	29.9 (18.9; 42.4)	-32.3 (-45.2; -11.5)
Maranhão	892.1 (556.2; 1,305.6)	74.4 (45.0; 110.6)	1,255.2 (797.6; 1,821.9)	38.8 (24.4; 57.2)	-47.8 (-59.1; -30.6)
Paraíba	514.4 (301.2; 775.2)	50.8 (29.5; 76.6)	742.6 (485.1; 1.048.3)	32.8 (21.2; 46.6)	-35.3 (-46.9; -14.3)
Pernambuco	1,450.5 (875.8; 2,127.7)	74.6 (43.5; 110.4)	1,738.5 (1,122.8; 2,398.0)	36.2 (22.9; 50.9)	-51.5 (-60.4; -36.3)
Piauí	372.8 (219.0; 542.9)	57.2 (32.2; 86.0)	634.0 (388.4; 936.9)	33.7 (20.5; 49.9)	-41.0 (-53.1; -23.4)
Rio Grande do Norte	381.3 (223.2; 560.4)	53.7 (30.8; 80.2)	647.1 (420.5; 908.4)	34.2 (21.9; 48.3)	-36.4 (-49.9; -15.0)
Sergipe	209.2 (115.8; 315.5)	57.2 (30.8; 87.6)	318.6 (197.7; 454.6)	28.8 (17.4; 41.8)	-49.6 (-59.9; -32.6)
Brazil (Southeast)	17,300.6 (11,144.7; 23,673.2)	96.7 (58.3; 140.1)	18,953.2 (12,261.9; 26,942.7)	36.3 (23.2; 52.3)	-62.5 (-68.8; -54.1)
Espírito Santo	530.4 (309.8; 777.5)	80.9 (44.0; 120.4)	727.1 (472.5; 1,051.4)	31.6 (20.2; 46.3)	-61.0 (-68.4; -51.9)
Minas Gerais	3,614.6 (2,264.6; 5,070.0)	84.4 (49.2; 121.4)	3,687.7 (2,381.4; 5,276.1)	27.8 (17.8; 40.1)	-67.1 (-71.9; -60.2)
Rio de Janeiro	4,549.7 (2,921.2; 6,273.5)	110.7 (67.0; 159.9)	3,946.8 (2,538.6; 5,676.7)	39.4 (25.2; 57.1)	-64.4 (-70.7; -56.5)
São Paulo	8,605.9 (5,581.1; 11,665.6)	97.7 (59.3; 140.7)	10,591.5 (6,827.2; 14,976.0)	39.7 (25.4; 57.0)	-59.4 (-66.6; -50.2)
Brazil (South)	5,524.2 (3,449.9; 7,805.9)	89.5 (51.8; 131.3)	5,744.2 (3,619.5; 8,356.1)	31.3 (19.5; 46.8)	-65.0 (-70.8; -58.0)

Paraná	2,097.3 (1,281.6; 2,941.3)	93.8 (52.3; 137.4)	2,156.6 (1,323.6; 3,140.5)	31.7 (19.2; 47.1)	-66.3 (-71.8; -59.2)
Rio Grande do Sul	2,473.9 (1,557.7; 3,453.5)	87.7 (51.8; 128.1)	2,287.7 (1,417.6; 3,354.3)	31.5 (19.5; 47.2)	-64.1 (-70.4; -57.2)
Santa Catarina	953.0 (592.0; 1,353.6)	85.9 (49.0; 128.0)	1,299.9 (850.7; 1,858.4)	30.5 (19.3; 44.9)	-64.5 (-70.7; -56.6)
Brazil (West-Central)	1,443.9 (913.9; 2,038.9)	69.7 (40.6; 103.3)	2,772.3 (1,806.3; 3,921.3)	32.6 (20.6; 47.6)	-53.3 (-60.8; -42.7)
Distrito Federal	186.9 (118.9; 253.0)	72.8 (42.4; 107.0)	329.3 (207.9; 465.8)	24.8 (15.1; 36.8)	-65.9 (-72.4; -58.3)
Goiás	654.4 (413.2; 930.3)	67.6 (39.0; 101.2)	1,257.5 (814.1; 1,801.9)	32.8 (21.0; 48.2)	-51.4 (-60.5; -38.9)
Mato Grosso	262.6 (165.6; 367.8)	65.3 (37.9; 97.2)	587.4 (377.8; 826.0)	32.3 (19.9; 46.8)	-50.5 (-60.1; -38.2)
Mato Grosso do Sul	339.9 (210.2; 471.8)	77.5 (45.5; 111.8)	598.0 (376.3; 849.8)	39.5 (24.5; 57.4)	-49.1 (-57.8; -34.9)
Female					
Brazil	23,151.7 (13,433.1; 33,702.3)	56.2 (31.2; 84.1)	27,980.9 (16,456.3; 42,545.4)	18.9 (11.2; 28.6)	-66.4 (-72.8; -58.3)
Brazil (North)	769.8 (431.5; 1,132.8)	48.3 (24.7; 73.8)	1,454.1 (846.9; 2,248.9)	18.5 (10.5; 29.0)	-61.8 (-69.6; -49.0)
Acre	27.5 (15.7; 40.6)	44.7 (23.7; 68.0)	60.5 (36.2; 87.6)	17.4 (10.2; 25.8)	-61.2 (-70.2; -44.6)
Amapá	18.1 (10.0; 27.6)	36.3 (19.3; 56.8)	50.1 (28.6; 77.7)	17.8 (9.9; 28.3)	-50.9 (-63.7; -35.4)
Amazonas	137.9 (75.5; 204.3)	45.9 (23.6; 71.3)	261.5 (149.4; 409.4)	16.7 (9.3; 26.8)	-63.5 (-72.3; -52.3)
Pará	449.4 (237.5; 675.8)	49.7 (25.0; 77.3)	745.9 (430.1; 1.167.8)	19.2 (10.8; 30.4)	-61.4 (-70.0; -46.7)
Rondônia	73.3 (43.7; 106.1)	62.7 (32.5; 96.4)	152.6 (91.6; 230.2)	19.5 (11.1; 30.5)	-68.9 (-76.0; -58.2)
Roraima	9.0 (5.2; 12.5)	47.5 (23.8; 71.0)	34.4 (21.6; 50.0)	18.1 (10.6; 27.5)	-61.9 (-71.1; -48.7)
Tocantins	54.6 (31.2; 78.8)	44.4 (22.6; 68.0)	149.0 (90.3; 225.2)	18.6 (11.1; 28.3)	-58.2 (-68.8; -42.0)
Brazil (Northeast)	5,205.2 (2,822.3; 7,749.7)	42.9 (22.6; 64.8)	7,344.3 (4,236.7; 11,232.3)	19.2 (11.3; 29.2)	-55.2 (-64.7; -39.7)
Alagoas	332.6 (174.1; 493.0)	52.0 (26.1; 79.0)	496.4 (299.7; 743.6)	25.6 (15.3; 38.6)	-50.8 (-62.4; -29.4)
Bahia	1,287.0 (696.7; 1,908.0)	38.8 (20.6; 58.2)	1,894.0 (1,073.5; 2,851.0)	18.1 (10.5; 27.1)	-53.2 (-63.7; -36.9)
Ceará	679.6 (364.8; 993.5)	35.9 (18.7; 53.4)	1,073.1 (619.4; 1,657.9)	16.8 (9.8; 25.8)	-53.2 (-63.6; -36.6)
Maranhão	412.3 (223.2; 609.4)	37.2 (18.8; 56.7)	853.7 (492.9; 1,351.7)	22.7 (13.0; 36.0)	-38.8 (-53.6; -16.0)
Paraíba	475.4 (255.0; 698.8)	43.6 (22.7; 65.3)	550.4 (324.4; 823.7)	18.3 (11.1; 26.9)	-58.1 (-68.4; -42.4)
Pernambuco	1,311.0 (712.8; 1,967.4)	59.3 (31.3; 90.7)	1,319.3 (804.7; 1,972.4)	20.5 (12.6; 30.6)	-65.4 (-72.3; -53.9)
Piauí	227.9 (119.2; 333.4)	34.9 (17.3; 52.5)	452.8 (254.8; 715.9)	19.5 (11.0; 30.7)	-44.2 (-57.7; -19.4)
Rio Grande do Norte	290.1 (163.4; 427.9)	36.7 (20.4; 54.6)	463.6 (286.9; 713.0)	18.7 (11.9; 28.4)	-49.0 (-60.6; -29.9)
Sergipe	189.3 (96.4; 282.7)	48.0 (23.7; 72.4)	241.0 (137.4; 366.8)	16.8 (9.6; 25.6)	-65.0 (-72.6; -49.8)
Brazil (Southeast)	12,166.4 (7,116.3; 17,677.9)	63.4 (36.2; 94.8)	13,243.3 (7,760.9; 20,192.1)	19.2 (11.4; 29.1)	-69.7 (-75.7; -62.5)
Espírito Santo	377.3 (207.1; 557.1)	58.2 (29.6; 89.2)	475.9 (280.3; 727.8)	16.8 (9.9; 25.6)	-71.2 (-77.9; -60.0)
Minas Gerais	2,681.3 (1,563.8; 3,806.2)	60.1 (32.9; 87.9)	2,690.3 (1,545.8; 4,150.5)	16.1 (9.3; 24.5)	-73.2 (-78.1; -67.2)

Rio de Janeiro	3,415.1 (1,953.4; 4,999.7)	70.4 (39.2; 105.2)	3,028.6 (1,774.4; 4,588.3)	21.4 (12.8; 32.1)	-69.5 (-76.3; -60.8)
São Paulo	5,692.8 (3,371.6; 8,290.5)	62.0 (35.4; 93.1)	7,048.6 (4,176.6; 10,605.5)	20.0 (12.0; 30.0)	-67.7 (-75.1; -58.5)
Brazil (South)	4,126.1 (2,365.3; 6,067.2)	64.7 (35.7; 98.3)	4,214.2 (2,364.5; 6,526.1)	18.0 (10.1; 27.7)	-72.2 (-77.9; -65.2)
Paraná	1,446.3 (835.6; 2,087.5)	69.5 (38.1; 104.3)	1,443.6 (815.1; 2,201.7)	17.2 (9.7; 26.2)	-75.3 (-81.1; -68.7)
Rio Grande do Sul	1,972.7 (1,131.0; 2,932.3)	62.2 (34.5; 95.1)	1,896.5 (1,054.1; 2,947.5)	19.1 (10.8; 29.4)	-69.3 (-75.6; -61.7)
Santa Catarina	707.1 (409.8; 1,029.9)	62.8 (33.8; 94.1)	874.2 (497.1; 1,347.2)	17.0 (9.6; 26.4)	-72.9 (-78.8; -64.8)
Brazil (West-Central)	884.2 (528.7; 1,254.8)	51.0 (27.9; 76.5)	1,725.1 (1,024.1; 2,576.5)	18.0 (10.5; 27.4)	-64.6 (-72.0; -54.9)
Distrito Federal	136.8 (80.6; 192.8)	51.4 (27.9; 76.0)	236.1 (131.9; 364.3)	13.8 (7.6; 21.6)	-73.1 (-79.4; -66.2)
Goiás	401.6 (234.4; 584.5)	49.2 (26.2; 75.9)	777.6 (470.4; 1,189.1)	18.2 (10.8; 28.3)	-63.1 (-71.0; -52.4)
Mato Grosso	141.3 (84.0; 198.4)	48.8 (27.5; 72.6)	328.6 (198.7; 487.1)	18.3 (10.7; 27.7)	-62.6 (-70.8; -48.9)
Mato Grosso do Sul	204.6 (122.5; 287.0)	56.9 (31.6; 83.8)	382.7 (229.9; 567.6)	22.2 (13.3; 33.1)	-61.0 (-69.7; -46.5)
Both sexes					
Brazil	55,057.0 (33,851.4; 78,039.2)	68.2 (39.2; 99.2)	67,687.6 (41,609.2; 99,683.7)	25.8 (15.8; 38.2)	-62.1 (-68.9; -53.5)
Brazil (North)	1,895.4 (1,103.4; 2,725.3)	56.0 (29.8; 83.1)	3,903.0 (2,388.5; 5,758.2)	25.3 (15.0; 37.9)	-54.8 (-62.9; -41.8)
Acre	73.1 (44.7; 105.4)	50.3 (28.1; 75.5)	159.4 (100.0; 233.3)	23.1 (14.2; 34.6)	-54.0 (-63.1; -39.5)
Amapá	44.0 (25.7; 63.8)	47.6 (26.2; 69.7)	137.4 (83.5; 201.1)	24.8 (14.5; 37.7)	-47.8 (-59.7; -33.2)
Amazonas	329.3 (195.6; 484.2)	51.8 (27.4; 79.4)	696.3 (414.7; 1.058.5)	23.0 (13.1; 36.2)	-55.6 (-63.9; -44.4)
Pará	1,055.0 (580.4; 1,524.0)	57.7 (30.3; 86.8)	1,976.1 (1,196.5; 2,918.7)	26.4 (15.6; 40.0)	-54.3 (-62.9; -40.1)
Rondônia	218.5 (135.5; 305.6)	70.6 (39.1; 104.1)	416.0 (257.3; 592.3)	25.8 (15.2; 37.6)	-63.4 (-70.5; -53.5)
Roraima	28.5 (17.8; 40.3)	57.1 (31.2; 87.4)	109.1 (69.4; 157.7)	25.9 (15.3; 38.5)	-54.6 (-63.9; -40.7)
Tocantins	147.0 (92.7; 207.1)	53.0 (28.1; 79.3)	408.8 (258.6; 603.6)	25.4 (15.9; 38.0)	-52.1 (-62.1; -35.8)
Brazil (Northeast)	11,716.1 (6,799.3; 16,954.1)	50.2 (28.5; 74.0)	17,132.3 (10,566.8; 25,178.4)	25.4 (15.7; 37.5)	-49.3 (-59.3; -34.6)
Alagoas	717.7 (390.6; 1,057.3)	57.6 (30.4; 86.7)	1,132.3 (709.8; 1,639.0)	32.7 (20.0; 48.1)	-43.2 (-54.3; -25.1)
Bahia	2,829.1 (1,602.3; 4,110.7)	45.2 (25.1; 67.1)	4,243.3 (2,549.7; 6,298.7)	23.0 (13.9; 34.2)	-49.1 (-59.2; -34.6)
Ceará	1,442.9 (842.7; 2,101.6)	39.8 (22.6; 59.1)	2,539.9 (1,554.3; 3,738.7)	22.8 (14.0; 33.5)	-42.8 (-54.5; -25.5)
Maranhão	1,304.4 (786.8; 1,864.2)	55.6 (32.3; 81.5)	2,108.9 (1,304.1; 3,179.9)	30.3 (18.4; 46.2)	-45.6 (-56.2; -29.1)
Paraíba	989.8 (576.1; 1,434.8)	46.8 (26.9; 69.0)	1,293.1 (809.0; 1,863.0)	24.8 (15.7; 35.6)	-47.0 (-58.0; -28.9)
Pernambuco	2,761.5 (1,628.1; 3,969.8)	66.5 (38.2; 97.7)	3,057.7 (1,926.5; 4,386.8)	27.5 (17.3; 39.6)	-58.7 (-66.2; -45.5)

Piauí	600.7 (342.2; 877.1)	45.7 (25.1; 67.4)	1,086.8 (657.9; 1,609.3)	26.2 (15.9; 38.8)	-42.7 (-54.1; -25.5)
Rio Grande do Norte	671.4 (392.2; 976.2)	44.7 (25.8; 66.0)	1,110.7 (701.5; 1,610.5)	25.8 (16.3; 37.2)	-42.3 (-53.5; -24.0)
Sergipe	398.6 (214.7; 601.3)	52.2 (27.4; 79.8)	559.6 (337.8; 826.7)	22.2 (13.2; 33.2)	-57.5 (-65.8; -43.0)
Brazil (Southeast)	29,467.0 (18,239.5; 41,070.8)	79.1 (46.2; 114.5)	32,196.5 (20,005.9; 47,105.3)	26.9 (16.7; 39.5)	-65.9 (-72.3; -58.5)
Espírito Santo	907.7 (512.2; 1,313.0)	69.3 (37.2; 104.2)	1,203.0 (737.9; 1,807.9)	23.6 (14.4; 35.6)	-66.0 (-72.6; -55.9)
Minas Gerais	6,295.9 (3,746.0; 8,821.3)	71.9 (40.2; 103.3)	6,378.0 (3,942.9; 9,371.5)	21.6 (13.4; 31.6)	-70.0 (-74.8; -63.8)
Rio de Janeiro	7,964.8 (4,875.8; 11,236.8)	88.9 (51.6; 129.7)	6,975.4 (4,342.2; 10,306.5)	29.4 (18.4; 43.3)	-66.9 (-73.6; -60.0)
São Paulo	14,298.6 (8,923.4; 19,956.2)	78.8 (46.4; 112.8)	17,640.1 (11,159.4; 25,748.5)	28.9 (18.2; 42.4)	-63.4 (-70.4; -54.5)
Brazil (South)	9,650.3 (5,839.2; 13,676.1)	76.8 (43.0; 112.3)	9,958.4 (5,898.4; 15,049.5)	24.1 (14.3; 36.6)	-68.6 (-74.3; -61.6)
Paraná	3,543.6 (2,101.8; 4,992.7)	81.7 (45.2; 120.3)	3,600.2 (2,121.2; 5,430.7)	23.8 (14.0; 36.2)	-70.8 (-76.3; -63.8)
Rio Grande do Sul	4,446.7 (2,722.4; 6,336.1)	74.6 (42.9; 109.6)	4,184.2 (2,459.9; 6,403.1)	24.8 (14.7; 37.7)	-66.7 (-73.1; -59.8)
Santa Catarina	1,660.0 (992.6; 2,355.1)	74.1 (41.5; 109.1)	2,174.1 (1,354.3; 3,222.2)	23.3 (14.2; 35.1)	-68.6 (-74.4; -60.1)
Brazil (West-Central)	2,328.2 (1,452.0; 3,308.6)	60.7 (34.8; 90.0)	4,497.4 (2,827.8; 6,496.2)	24.9 (15.2; 36.8)	-59.0 (-66.7; -49.5)
Distrito Federal	323.7 (203.9; 442.8)	60.9 (34.9; 89.5)	565.4 (341.9; 825.1)	18.6 (10.8; 27.8)	-69.5 (-75.4; -62.6)
Goiás	1,056.0 (655.2; 1,523.0)	58.6 (32.7; 88.9)	2,035.2 (1,320.2; 2,954.5)	25.1 (15.8; 37.2)	-57.2 (-64.9; -45.9)
Mato Grosso	403.9 (253.0; 566.1)	57.9 (33.6; 83.4)	916.1 (573.8; 1,321.0)	25.2 (15.2; 37.3)	-56.5 (-64.6; -45.2)
Mato Grosso do Sul	544.5 (333.9; 765.4)	67.7 (38.5; 98.0)	980.7 (625.0; 1.396.2)	30.4 (18.9; 43.7)	-55.2 (-63.4; -41.9)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 8.6 – Absolute numbers of deaths and of DALYs, age-standardized mortality rates and DALY rates due to cardiovascular diseases attributable to high LDLc levels, per 100 000 inhabitants, in 1990 and 2023, and percent change of the rates in the period, in Brazil, according to age group

Age group	1990		2023		Percent change % (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Deaths					
15-49 years	7,858.2 (5,890.0; 9,431.0)	10.2 (7.7; 12.3)	7,768.0 (5,943.0; 9,606.9)	7.1 (5.4; 8.7)	-30.9 (-40.4; -20.1)
50-69 years	23,057.9 (15,140.1; 30,286.3)	146.5 (96.2; 192.4)	27,837.2 (19,120.2; 37,248.4)	63.7 (43.8; 85.3)	-56.5 (-63.0; -48.9)
70+ years	24,140.8 (11,894.7; 39,255.2)	564.7 (278.2; 918.2)	32,082.4 (16,024.0; 52,938.4)	211.6 (105.7; 349.1)	-62.5 (-69.9; -52.9)
All ages	55,057.0 (33,851.4; 78,039.2)	36.9 (22.7; 52.3)	67,687.6 (41,609.2; 99,683.7)	31.9 (19.6; 47.0)	-13.4 (-28.1; 2.9)
Age-adjusted	NA	68.2 (39.2; 99.2)	NA	25.8 (15.8; 38.2)	-62.1 (-68.9; -53.5)
DALYs					
15-49 years	414,274.1 (305,876.0; 506,701.8)	539.1 (398.0; 659.3)	396,386.8 (300,060.0; 493,540.1)	360.7 (273.1; 449.1)	-33.1 (-42.4; -22.9)
50-69 years	741,824.8 (491,767.7; 964,923.5)	4,712.8 (3,124.2; 6,130.2)	899,272.9 (619,478.1; 1,207,765.1)	2,058.9 (1,418.3; 2,765.2)	-56.3 (-62.9; -49.2)
70+ years	368,450.5 (182,175.3; 589,841.5)	8,618.7 (4,261.4; 13,797.4)	480,000.3 (243,845.2; 802,900.7)	3,165.7 (1,608.2; 5,295.3)	-63.3 (-70.6; -53.9)
All ages	1,524,549.4 (1,003,123.3; 2,022,028.9)	1,020.9 (671.7; 1,354.1)	1,775,660.0 (1,198.252.7; 2,458,582.3)	837.3 (565.0; 1,159.3)	-18.0 (-31.3; -4.0)
Age-adjusted	NA	1,622.4 (1,036.6; 2,223.0)	NA	670.9 (452.0; 929.2)	-58.6 (-65.2; -50.8)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

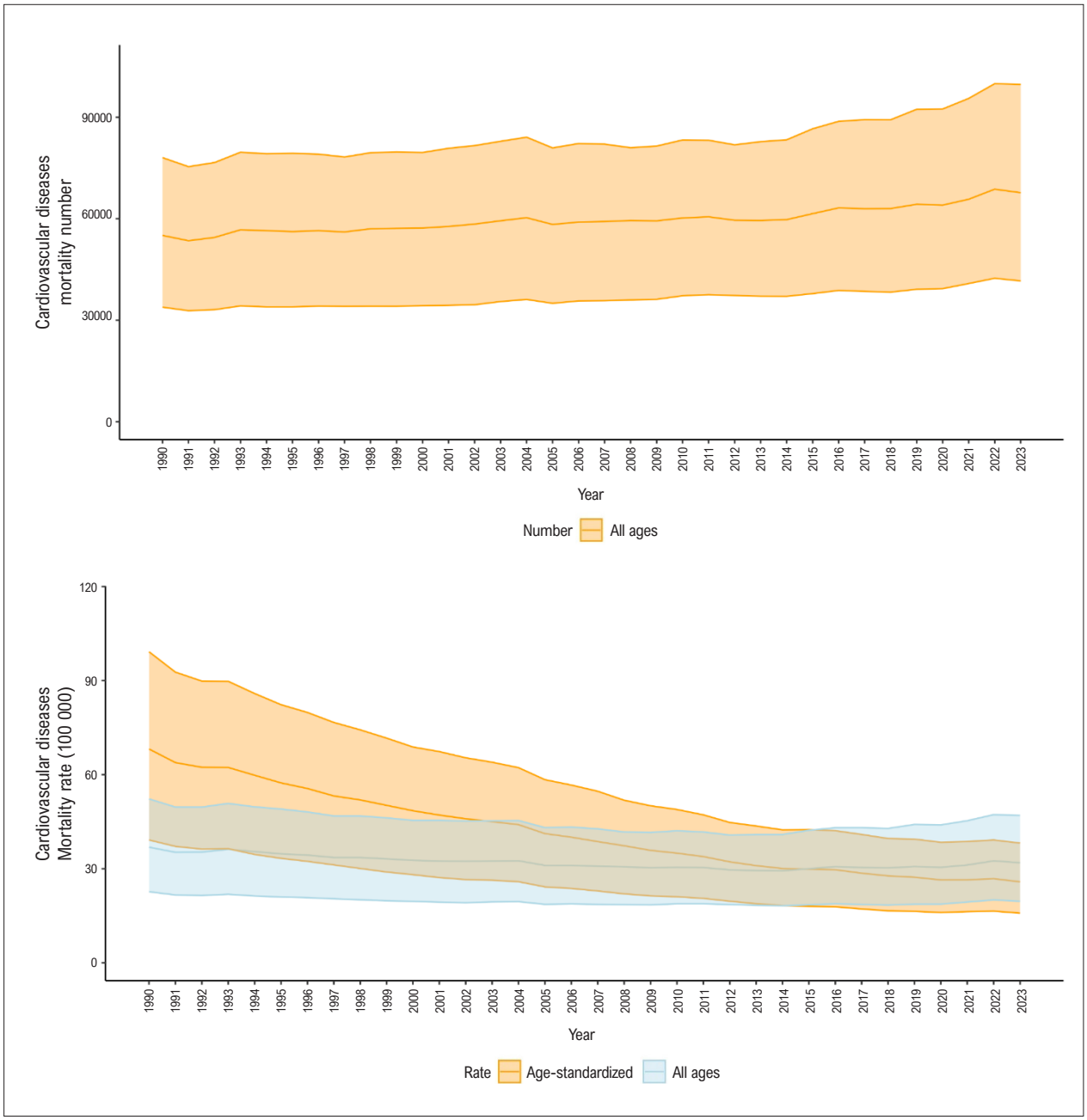

Chart 8.1 – *Absolute numbers of deaths and crude and age-standardized mortality rates from cardiovascular diseases attributable to high LDL-cholesterol levels in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

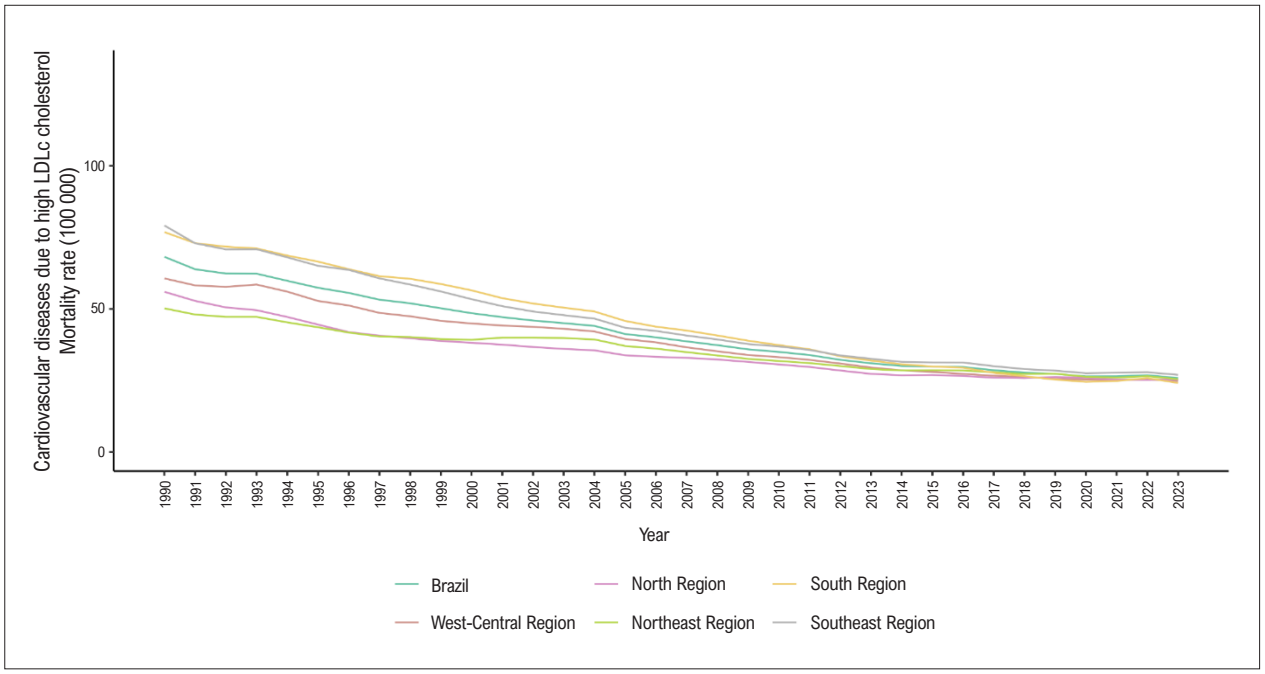

Chart 8.2 – *Age-standardized cardiovascular mortality rate (per 100 000) attributable to high LDL-cholesterol (LDLc) levels in Brazil and its geographic regions. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

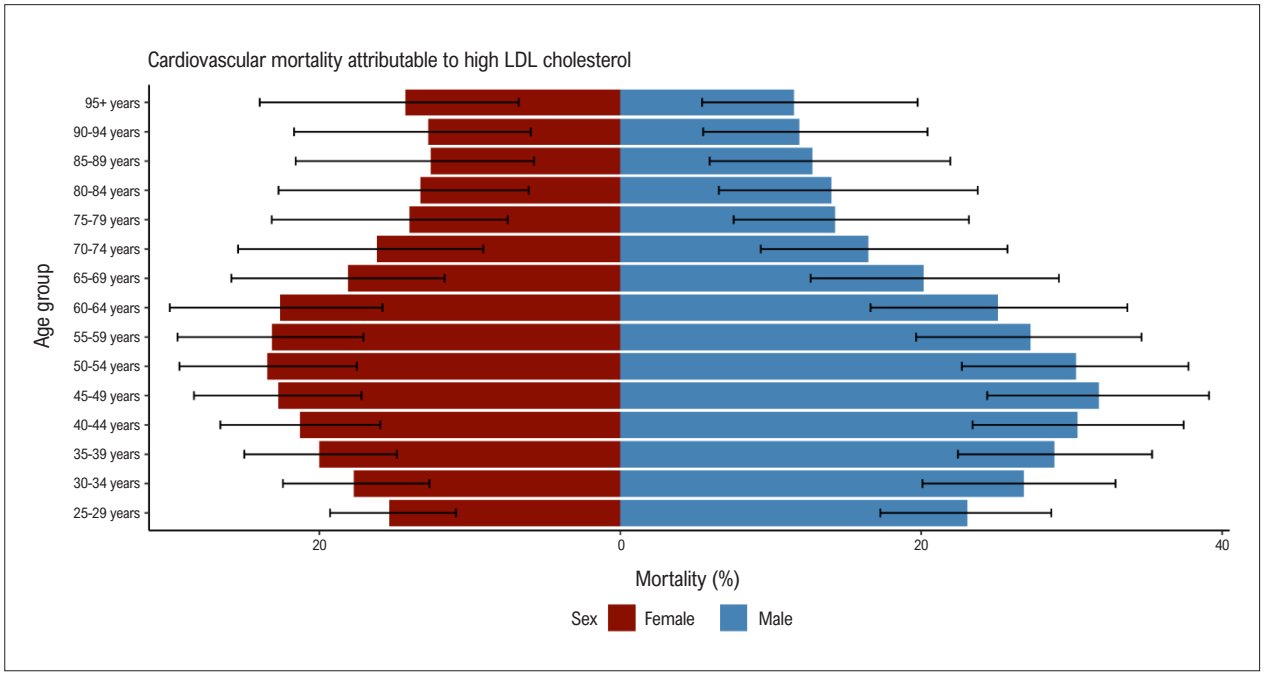

Chart 8.3 – *Proportional cardiovascular mortality attributable to high LDL-cholesterol levels according to age group in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

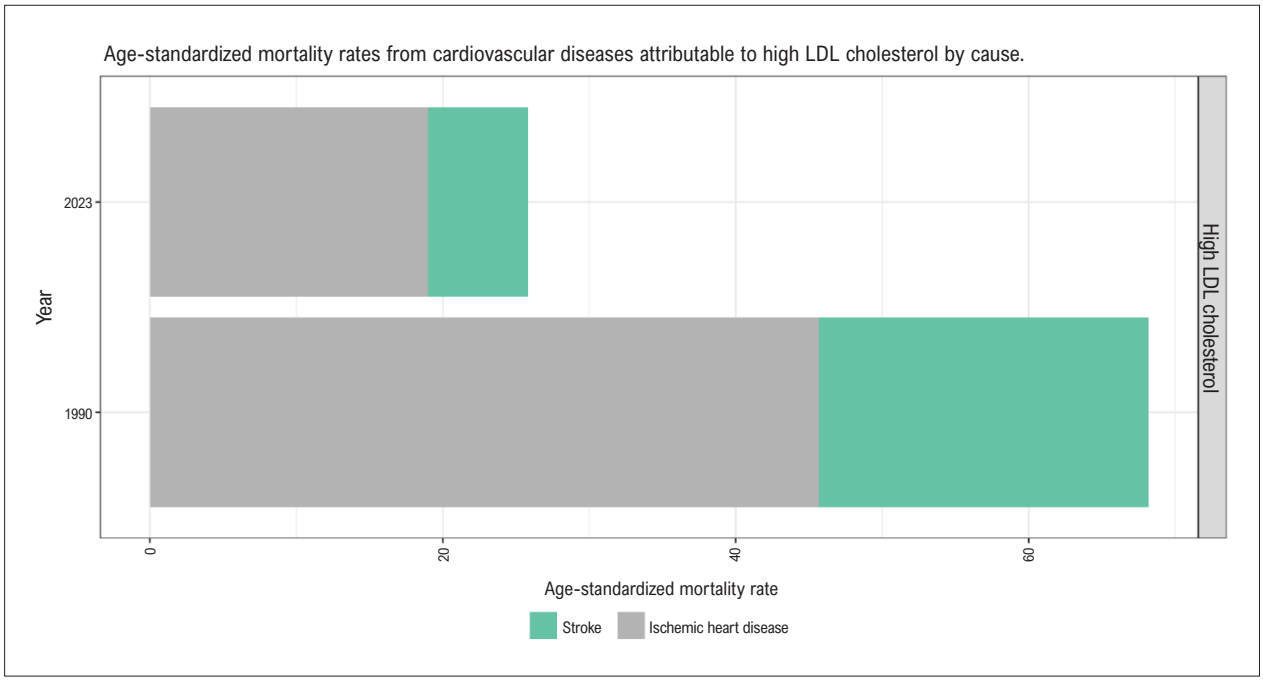

Chart 8.4 – *Change in age-standardized mortality rates from ischemic heart disease and stroke attributable to high LDL-cholesterol levels, from 1990 to 2023, in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

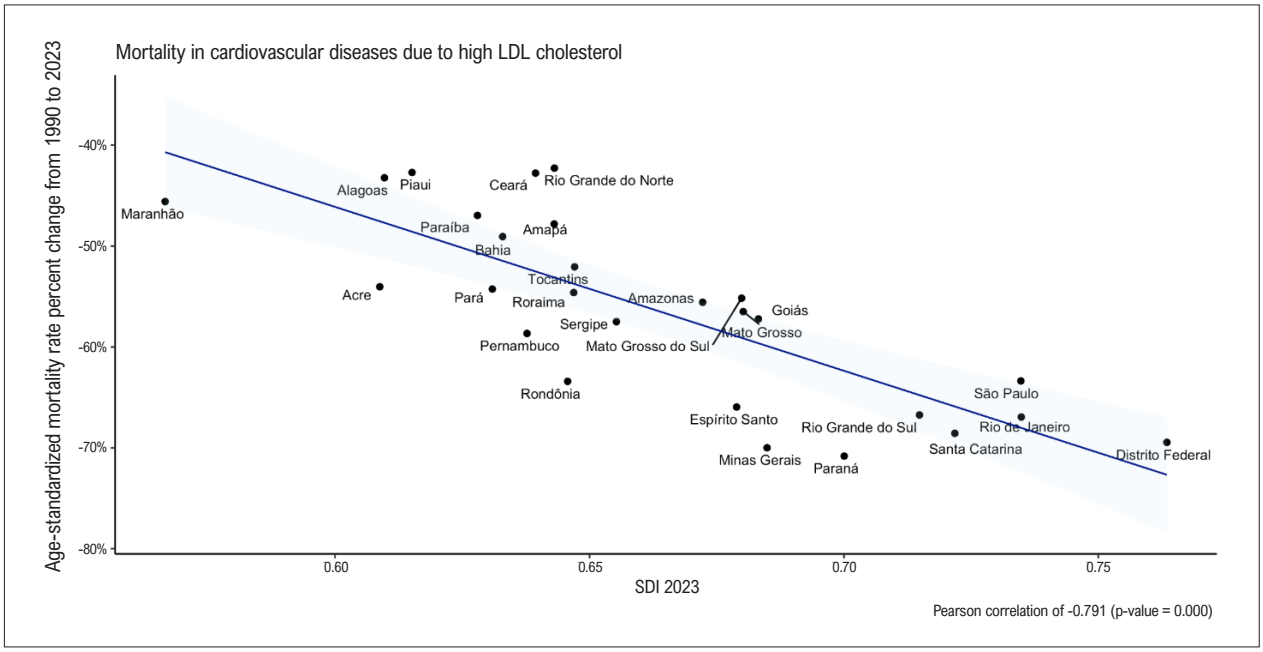

Chart 8.5 – *Correlation between the sociodemographic index (SDI) in 2023 and the percent change of age-standardized mortality rates from cardiovascular disease attributable to high LDL cholesterol, from 1990 to 2023, of the Brazilian Federative Units. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 9 – DIABETES MELLITUS

ICD-10 E10 to E14; ICD-10-CM E8 to E13.

See Tables 9.1 through 9.6 and Charts 9.1 through 9.5.

Abbreviations used in chapter 9

APC	Annual Percent Change
BMI	Body Mass Index
CI	Confidence Interval
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life-Years
DATASUS	Department of Information and Data Processing of the Brazilian Unified Health System
ELSA-Brasil	The Brazilian Longitudinal Study of Adult Health (in Portuguese, Estudo Longitudinal de Saúde do Adulto)
ERICA	Study of Cardiovascular Risks in Adolescents (in Portuguese, *Estudo de Riscos Cardiovasculares em Adolescentes*)
FU	Federative Unit
GBD	Global Burden of Disease
HbA1c	Hemoglobina glicada
HR	Hazard Ratio
IBGE	Brazilian Institute of Geography and Statistics
ICD	International Statistical Classification of Diseases and Related Health Problems
IDF	International Diabetes Federation
LDL	Low-Density Lipoprotein
OR	Odds Ratio
PMAQ	Program for Improvement of Access and Quality (in Portuguese, *Programa de Melhoria do Acesso e da Qualidade*)
PNAUM	National Survey on Access, Use and Promotion of the Rational Use of Medicines (in Portuguese, *Pesquisa Nacional sobre o Acesso, Utilização e Promoção do Uso Racional de Medicamentos no Brasil*)
PNS	Brazilian National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
PR	Prevalence ratio
PURE	Prospective Urban Rural Epidemiology
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
UI	Uncertainty Interval
Vigitel	Telephone Survey for Surveillance of Noncommunicable Diseases (in Portuguese, *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*)

Introduction

- Diabetes mellitus is a chronic and progressive disease, characterized by chronic hyperglycemia resulting from lower secretion of insulin and/or resistance to insulin, which in the long run can lead to microvascular (diabetic retinopathy, nephropathy, neuropathy) and macrovascular (coronary artery disease, cerebrovascular disease, and peripheral artery occlusive disease) complications. Prediabetes (reduced glucose tolerance and impaired fasting plasma glucose) is the condition in which there is hyperglycemia without meeting the diagnostic criteria for diabetes, leading to an increased risk for diabetes and cardiovascular disease (CVD).[292]
- In this chapter, diabetes mellitus is approached as a cardiovascular risk factor,[293] as it was in the previous version of this document,[2,3] because the presence of diabetes alone increases the risk of CVD by two to three times. In the GBD study, when diabetes is approached as a risk factor, the nomenclature used is "high fasting plasma glucose", and this definition is adopted in this chapter when citing GBD estimates.[294]
- The estimates from the International Diabetes Federation (IDF) Diabetes Atlas herein mentioned were based on national population surveys, published epidemiological studies, and other official sources available to that Atlas committee. Then, IDF applied regression models to generate age-standardized estimates and future projections.[295]

Prevalence

- The PURE/South America study has shown a 9% prevalence of diabetes (fasting plasma glucose >126 mg/dL or personal history of diabetes) at the study's baseline. Of 24,718 participants, 5,661 were from Brazil, from urban (65.1%) and rural areas of the São Paulo state; however, country-specific data for Brazil have not been reported.[296]
- According to the IDF,[295] Brazil ranks sixth worldwide regarding the number of adults (20-79 years of age) with diabetes (16.6 million), with an adjusted prevalence of 10.6%, and 31.9% of them are unaware of their disease. The number of unknown cases is similar to that previously reported in the previous edition of the IDF Diabetes Atlas.[297] The prevalence of reduced glucose tolerance is 11.3% and of impaired fasting plasma glucose is 9.7%, which may show a small variation as compared to previous data, depending on the method used for diagnosis (oral glucose tolerance test, fasting plasma glucose, HbA1c).[295,298]
- Brazil ranks fourth worldwide in number of cases of type 1 diabetes considering all ages (499,800 individuals) and the age group of up to 20 years (99,000 individuals).[295] The difference in prevalence among countries, especially across age groups, reflects younger populations and higher mortality in low-income countries (India, Sub-Saharan

African countries), which reduces the number of adults with type 1 diabetes.

- Malta *et al*.[299] have reported data from the National Health Survey (PNS) collected between 2014 and 2015, which are the Brazilian most recent data on diabetes prevalence in adults obtained using laboratory measurement (HbA1c). The prevalence of diabetes (HbA1c ≥ 6.5% or use of antidiabetic drugs) was 8.4% (95% CI, 7.6-9.1), lower in men (PR 0.75; 95% CI, 0.63-0.89) and at higher educational levels (PR 0.8; 95% CI, 0.6-0.9), and higher with age increase: 60 years or older (PR 12.6; 95% CI, 7.1-21.0).
- Reis *et al*.[300] have assessed data from the PNS and observed that the self-reported prevalence of diabetes increased 24% between 2013 and 2019, reaching 7.7% (95% CI, 7.4-8.0%) in 2019. The increase was greater among men (30%) as compared to women (20%), although prevalence remained higher among women (8.4% vs. 6.9%). Advanced age (≥65 years; PR=27.2) and obesity (PR=2.3) were strongly associated with diabetes, while individuals with complete higher education had a 40% lower prevalence of the disease (PR=0.60), evidencing important sociodemographic inequalities. It is worth noting that self-reported prevalences tend to be lower than those based on laboratory data.
- In 2024, Miranda *et al*.,[301] analyzing data from Vigitel 2020-2023 (n= 75,860 adults), identified prevalence of self-reported diabetes of 9.2% (95% CI, 8.8-9.6), very similar to previous data from the same survey. Prevalence was higher among the elderly (>65 years, 28.0%; 95% CI, 26.7-29.3). It is worth noting that these are self-reported data, and, thus, subject to bias.
- In the Cardiovascular Statistics 2023,[3] the reduction in the number of unknown cases of diabetes as compared to previous issues of the document was emphasized, which may have resulted from the high rate of screening, as observed in the PNS from the IBGE, because, in 2013, 11.6% (95% CI, 11.1-12.1) of the adults had never had their blood glucose levels measured, and that percentage was reduced to 6.2% in 2019 (95% CI, 5.9-6.5).[302] Higher access to diagnosis has been observed in women (PR=1.16; 1.15-1.17), elderly individuals (PR=1.25; 1.22-1.28), and those with higher educational level (PR=1.17; 1.15-1.18), obesity (PR=1.06; 1.05-1.08), and hypertension (PR=1.12; 1.11-1.13). However, lower access to diagnosis has been observed in self-reported Black individuals (PR=0.97; 0.95-0.99), in those living in rural areas (PR=0.89; 0.87-0.90), and in those without private health insurance coverage (PR=0.85; 0.84-0.86).[303]
- For the age group of 12-17 years, data from the ERICA study remain the most updated. It is a cross-sectional study conducted in a representative sample of Brazilian students (n=37,854), in which the prevalence of type 2 diabetes was 3.3% (95% CI, 2.9-3.7) and of prediabetes, 22.0% (95% CI, 20.6-23.4).[304]

Incidence

- The Brazilian multicenter ELSA-Brazil study has reported a cumulative incidence of diabetes of 2.0/100 person-year (95% CI, 1.8-2.1), higher among the elderly (2.8%; 95% CI, 2.3-3.4), and individuals with obesity (3.8%; 95% CI, 3.4-4.3) and with lower educational levels (3.0%; 95% CI, 2.6-3.6).[305]
- Bracco et al.[306] have calculated the risk of developing diabetes throughout life in Brazil based on data from diabetes incidence, all-cause mortality, and mortality from diabetes (data from the ELSA-Brazil study), using the illness-death state model. The results showed that a White adult aged 35 years has a 23.4% (95% CI, 22.5-25.5) risk throughout life of developing diabetes at the age of 80 years, while for a Black individual of the same age, that risk is 30.8% (95% CI, 29.6-33.2).
- The number of children and adolescents with type 1 diabetes has increased worldwide, approximately 3% per year, although with significant regional differences.[295,297,307,308]
- Recent data have shown that Brazil is not among the 10 countries with the highest number of new cases of diabetes in children and adolescents aged 0-15 years.[295]

Mortality

Overall mortality attributable to diabetes

- Data from the GBD study 2023 showed that, although age-standardized all-causes mortality rates attributable to high fasting plasma glucose have decreased substantially in recent years in Brazil, the total number of deaths from the disease increased. Diabetes, ischemic heart disease, stroke, chronic kidney disease, and Alzheimer's disease, in decreasing order, accounted for the highest age-standardized mortality rates attributable to high fasting plasma glucose in 1990 and 2023. There were 63,158 (95% UI, 49.095-81.878) and 150,483 (95% UI, 124,560-184,036) deaths from diabetes in Brazil in 1990 and 2023, respectively. The age-standardized mortality rate per 100,000 inhabitants was 80.6 (95% UI, 62.5-105.7) in 1990 and 58.1 (95% UI, 48.2-71.1) in 2023, a 27.9% (95% UI, -44.7; -4.1) decrease in the period (Chart 9.1 and Table 9.1).
- The reduction in age-standardized mortality rates from high fasting plasma glucose was not homogeneous across the Brazilian regions and Federative Units (FUs), being more pronounced in the FUs of the Southeast (-38.4%; 95% UI, -53.6; -16.5), South (-26.7%; 95% UI, -47.7; 5.8), and West-Central (-23.4%; 95% UI, -38.6; -1.7) regions, with not significant reductions in the FUs of the Northeast (-12.1%; 95% UI, -30.6; 14.1) and North (-7.2%; 95% UI, -29.0; 25.4) regions (Table 9.2). It is worth noting that a trend towards reduction occurred in all age groups, but with a more significant reduction in the following age groups: under the age of 5 years (-72.6%; 95% UI, -76.8; -67.0), 5-14 years (-41.0%; 95% UI, -50.5; -28.5), and 50-69 years (-32.1%; 95% UI, -48.1; -6.4). An intermediate reduction was observed in the age group of 70 years or older (-16.3%; 95% UI, -36.1; 9.7), and a less significant reduction was observed in the age group of 15-49 years (-9.8%; 95% UI, -33.1; 26.8) (Chart 9.1 and Table 9.1).
- According to the 11th edition of the IDF Diabetes Atlas published in 2025, Brazil is among countries with mortality

attributable to diabetes of 8-13% (n=111,393), an intermediate position as compared to other countries.[295]

- Flores-Ortiz *et al.*[309] have assessed the association between subsidized housing and diabetes mortality in Brazil. In a cohort of 9,961,271 low-income adults, observed from January 2010 to December 2015, with mean age of 40.3 years (±15.6 years) and most of them women (58.4%), there were 18,775 deaths with diabetes as the underlying or a contributory cause. Of those adults, 340,683 received subsidized housing (3.4%) and were at higher risk for mortality from diabetes as compared to non-subsidized housing residents (HR 1.17; 95% CI, 1.05-1.31). The magnitude of that association was more marked among those living in municipalities with lower Human Development Index (HR 1.30; 95% CI, 1.04-1.62).
- Garces *et al.*,[310] analyzing data from DATASUS between 2010 and 2020, have identified 601,521 deaths from diabetes in Brazil, corresponding to mean mortality of 29.5/100,000 inhabitants. The rates were higher among women (32.1/100,000), individuals aged ≥80 years (508.5/100,000), individuals who self-identified as mixed-race (pardo) (36.2/100,000), and those with lower educational level (59.5/100,000). Regarding regions, the highest mortality was observed in the Northeast (34.4/100,000). Indicators of social inequality, especially the Gini index (β=11.7), showed a strong association with mortality from diabetes, evidencing the impact of social determinants on the burden of disease in Brazil.
- Bracco *et al.*,[306] using data from the ELSA-Brasil, have calculated metrics for the Brazilian population aged 35-80 years estimating the years of life lost to diabetes, as well as the years lived with that condition. Those authors estimated that men diagnosed with diabetes at the age of 35 years would live 32.9 (95% CI, 32.4-33.2) years with diabetes and would lose 5.5 (95% CI, 5.1-6.1) years of life. Women of the same age, however, would live 38.8 (95% CI, 38.3-38.9) years with diabetes and would lose 2.1 (95% CI, 1.9-2.6) years of life. Considering sex and skin color, men showed higher mortality (Chart 9.2).

Cardiovascular mortality attributable to diabetes

- All-ages mortality from CVD attributable to high fasting plasma glucose in Brazil, according to GBD 2023, increased in absolute numbers from 24,789 deaths (95% UI, 15,365-39,630) in 1990 to 36,431 (95% UI, 25,121-54,377) in 2023. However, age-standardized CVD mortality rates per 100,000 inhabitants decreased from 32.8 (95% UI, 20.7-52.9) in 1990 to 14.1 (95% UI, 9.7-20.9) in 2023, a reduction of 57.1% (95% UI, -74.2; -24.5), reflecting the effect of population aging and growth (Table 9.3 and Chart 9.3).
- The trend towards reduction in age-standardized mortality rates was not uniform across the FUs, being more significant in the FUs of the Southeast (-64.5%; 95% UI, -78.9; -36.1) and South (-62.5%; 95% UI, -79.5; -31.5) regions, and more modest in the FUs of the West-Central (-51.2%; 95% UI, -66.7; -27.4), North (-47.7%; 95% UI, -68.3; -10.5), and Northeast (-40.9%; 95% UI, -64.6; 2.2) regions (Table 9.3). When comparing between sexes, women showed higher reductions in mortality rate (-59.2%; 95% UI, -75.4; -34.9) as compared to men (-54.5%; 95% UI, -73.9; -15.5). The reduction in CVD mortality rate attributable to high fasting plasma glucose was observed in all age groups: 15-49 years (-44.1%; 95% UI, -72.8; -32.0), 50-69 years (-58.4%; 95% UI, -76.6; -22.9) and 70 years or older (-50.7%; 95% UI, -69.7; -15,5) (Table 9.4).
- In 2023 and comparing by sex and age group (Chart 9.4), women had the highest proportional CVD mortality rates attributable to high fasting plasma glucose in almost all age groups described.[33]
- The sociodemographic index (SDI) is an estimate of the socioeconomic level of a certain location, and Chart 9.5 shows the correlation between the SDI of 2023 of each Brazilian FU and the percent change of the age-standardized mortality rates from CVD attributable to high fasting plasma glucose from 1990 to 2023 in those FUs. A correlation is observed between higher percent change of age-standardized mortality rates from 1990 to 2023 and higher SDI 2023, suggesting that the reduction in mortality from CVD accompanied the improvement in socioeconomic conditions. The FUs with the highest SDI had the highest percent reductions in deaths, such as São Paulo, Rio de Janeiro, and the Distrito Federal, while Maranhão, the lowest SDI across all FUs, had the smallest reduction.

Burden of Disease

Burden of disease attributable to high fasting plasma glucose

- The GBD 2023 estimated a reduction in the age-standardized all-causes DALY rates attributable to high fasting plasma glucose and diabetes, per 100,000 inhabitants, in Brazil of -20.3% (95% CI, -38.0; 1.7) between 1990 and 2023, despite the increase in the total number of DALYs from 2,055,686.6 (95% CI, 1,626,560.5 - 2,602,145.5) to 4,679,131.7 (3,824,059.6 - 5,710,474.4) in the period, similarly to what happened with mortality (Table 9.5).
- The reduction in DALY rates was observed in all age groups, except for the age group of 15-49 years (12.9%; 95% CI, -10.7; 41.2) (Table 9.5).

Burden of cardiovascular disease attributable to high fasting plasma glucose

- The GBD 2023 estimated a reduction in age-standardized DALY rates due to CVD attributable to high fasting plasma glucose, per 100,000 inhabitants, in Brazil of -57.4% (95% CI, -74.8; 22.7) between 1990 and 2023, despite the increase in the total number of DALYs from 577,708.7 (95% CI, 343,135.9 - 930,200.0) to 754,544.0 (95% CI, 513,071.8 to 1,166,760.4) in the period. This reduction in DALY rates was observed in all age groups: 15-49 years (-44.1%; 95% CI, -72.8; 32.0), 50-69 years (-58.4%; 95% CI, -76.6; -22.9) and 70 years and older (-50.7%; 95% CI, -69.7; -15.5) (Table 9.6).

Impact on cardiovascular health

- Mosenzon *et al.*,[311] in the CAPTURE study, have reported prevalence of established CVD, assessed using medical record data of adults with type 2 diabetes from primary and tertiary care centers in several countries (n=9,823), including Brazil. Of the 912 individuals assessed in Brazil, 43.9% (95% CI, 40.9-46.8) had CVD, a higher number than that estimated for the total sample of the 13 countries assessed [estimated weighted CVD prevalence of 34.8% (95% CI, 32.7-36.8)]. Heart failure was reported in 113 patients [12.4 (95% CI, 10.4-14.4)] and Brazil had the second highest prevalence of the 13 countries assessed.

Diabetes awareness, treatment, and control

- The treatment of diabetes is based on three pillars: diet, physical exercise, and drugs (oral antidiabetic drugs and insulin). Adherence to treatment is an important determinant of metabolic control. Meiners *et al.*,[312] based on data from PNAUM (n=2,624), have shown high access to medicines, but low treatment adherence (17.2%; 95% CI, 14.6-20.1). Better adherence to treatment was associated with the following: younger age, lower body mass index (BMI), presence of macrovascular complications, better occupational performance, and higher values in the emotional domain of the SF-36 quality of life questionnaire.[313]
- Data from the PNS have shown high use of medication for diabetes, with 95.2% of oral antidiabetic drug users and 70% of insulin users reporting recent use; the popular drugstore program (*Programa Farmácia Popular*) is the major source of access to those medications (53.6% for oral antidiabetic drugs and 42.7% for insulin), complemented by the Brazilian Unified Health System (SUS). Despite the expansion of treatment between 2013 and 2019 (medication use increased from 80.2% to 88.8%, and medical follow-up from 73.2% to 79.1%), the control of risk factors remains unsatisfactory: only 46% attained HbA1c <7%; 51.4% attained blood pressure <140 mm Hg; 40% attained LDL-cholesterol <100 mg/dL; and only 12.5% attained the three therapeutic goals simultaneously. In addition, essential indicators of care, such as retinopathy screening (36.7%) and foot assessment (31.7%), remain low, with worse results observed among men, young individuals, Black individuals, and those of lower socioeconomic level, evidencing important inequalities in diabetes management in Brazil.[302]
- In 2023 Dionato et al.[314] assessed data from the PNS carried out in 2013 regarding the adoption of healthy behaviors by 3,098 individuals with diabetes. Of them, 15.3% engaged in regular physical activity (95% CI, 13.3–18.1), 40.2% (95% CI, 37.2–43.1) maintained a healthy diet, 94.1% (95% CI, 92.9–95.3) did not engage in excessive alcohol consumption, 89.1% (95% CI, 87.5–90.7) were not smokers, and 55.6% (95% CI, 52.8–58.5) consumed sugar-containing foods less than once a week. Approximately half of the sample (49.3%; 95% CI, 46.4–52.1%) reported adopting two or fewer healthy behaviors, which was more common among those not using oral antidiabetic drugs [odds ratio (OR) 1,37; 95% CI, 1,02–1,85], not visiting the doctor regularly (OR 1.42; 95% CI, 1.08–1.87), without limitation in their daily activities (OR 1.39; 95% CI, 1.01–1.94), and those with good self-rated health (OR 1.47; 95% CI, 1.09–1.98).
- In 2024, Tomasi et al.[315] assessed data from the PMAQ (Program for Improvement of Access and Quality) between 2012 and 2018, which collected indicators of the quality of care provided to individuals with diabetes at Primary Health Care services in Brazil. A total of 8,118 and 1,7641 users with diabetes were interviewed at each time point, respectively. They reported the following in 2012 and 2018: good access to care [42.9% (95% CI, 41.9–44.1) and 52.7% (95% CI, 51.9–53.4), respectively]; availability of 8 supplies and equipment items [9.9% (95% CI, 9.3–10.6) and 23.3% (95% CI, 22.7–23.9), respectively]; availability of 4 medications (metformin, glibenclamide, NPH insulin, and regular insulin) [41.0% (95% CI, 39.8–42.2) and 50.4% (95% CI, 49.6–51.2), respectively]; and good organization and management of activities related to user care [12.6% (95% CI, 11.8–13.3) and 27.7% (95% CI, 27.0–28.4), respectively].
- Data from the ELSA-Brazil have shown important gaps and inequalities in the control of diabetes and its risk factors. Of the participants with diabetes, only 28.6% achieved simultaneously the HbA1c, blood pressure, and cholesterol targets. Proper glycemic control (HbA1c ≤7%) was associated with a 34% lower risk for all-cause mortality (RR=0.66; 95% CI, 0.50–0.88), while concomitant glycemia and blood pressure control reduced that risk by 46% (RR=0.54; 95% CI, 0.37–0.78). In addition, not smoking was strongly protective (RR=0.59; 95% CI, 0.42–0.82). Women, elderly individuals, and those with higher socioeconomic level had a higher probability of attaining the glycemic targets, while Black individuals and those with longer-lasting diabetes were less likely to achieve proper control, evidencing inequalities in disease management.[316]
- In 2023, Ramos et al.[317] conducted a systematic review with metanalysis of observational studies involving Brazilian adults with type 2 diabetes, and the outcome assessed was adherence to the proposed treatment. The analysis of 14 articles (2,962 individuals) showed 51% (95% CI, 0.268-0.754, p<0.001; I2= 99.25%, p<0.001) of poor adherence to diet, and that nonadherence to diet was higher in São Paulo (98%) and lower in Minas Gerais (9%). The combined proportion of adherence to physical activity was 36% (95% CI, 0.216-0.497, p<0.001; I2= 96.98%, p<0.01), which was higher in Minas Gerais (58.6%) and lower in Rio Grande do Sul (21%). Adherence to medication use was 88% (95% CI, 0.813-0.946, p<0.01; I2= 94.52%, p<0.001), higher in São Paulo (95.7%) and lower in Minas Gerais (84.4%).
- In 2023, Flores et al.[318] assessed data from the PNS carried out in 2013 and 2019 regarding the temporal evolution of advice on healthy habits provided by health professionals relative to several morbidities, such as diabetes. The samples comprised 3,182 patients with diabetes in 2013 and 6.317 in 2019. There were reductions in receiving advice for not smoking (APC, annual percentage change:

-1.13) and not drinking excessive alcoholic beverages (APC: -1.11), but no change regarding advice on healthy diet habits, regular physical activity, salt intake reduction, and healthy body weight maintenance. Regarding receiving advice on all types of healthy habits for diabetes management, there were reductions among women (APC: -0.94), elderly individuals (>60 years, APC: -0.77), white skin color individuals (APC: -1.07), and those in the fourth quintile of richness - Q4 (APC: -1.03).

- In 2023, Tonaco *et al*.[319] estimated the proportion of diabetes awareness, treatment, and control, according to sociodemographic characteristics, health condition, and access to health services, from a subsample of the 2014/2015 PNS, in which 8.6% had that condition. Most individuals with diabetes were of the female sex (60.7%), aged over 60 years (54.3%), had low educational level (67.2%), had a poor health perception (59.5%), and lived in the Southeast region (49.3%). Of those with diabetes, 68.2% (95% CI, 63.9–72.3) were aware of their diagnosis, 92.2% of whom (95% CI, 88.6–94.7) were on drug treatment. Of such individuals, 35.9% (95% CI, 30.5–41.6) had HbA1c <6.5%, while 48.1% (95% CI, 42.2–53.9) had HbA1c <7%.
- Natividade et al.[320] have assessed data from the Brazilian National Health Registry involving 203 million Brazilians and reported that, after the incorporation of dapagliflozin into the public health system in 2021, there was a progressive reduction in cardiovascular mortality as compared to 2017: 4.7% in 2022, 11.4% in 2023, and 19.1% in 2024. An interrupted time-series analysis showed a significant steeper reduction in cardiovascular mortality rates after the implementation of that public health intervention (slope of −0.74 vs. −0.16 before the intervention; p=0.039), suggesting populational benefit associated with the expansion of access to that therapy.

Risk factors and prevention

- A meta-analysis from 151 studies on overweight and obesity prevalence among Brazilian adolescents has shown an increase in overweight prevalence of 8.2% (95% CI, 7.7-8.7) up to 2000, of 18.9% (95% CI, 14.7-23.2) from 2000 to 2009, and of 25.1% (95% CI, 23.4-26.8) from 2010 onwards, a pattern similar to that of obesity prevalence. The Southeast and South regions had higher overweight and obesity prevalence.[321]
- Of the 37,892 adolescents of the ERICA Study, overweight was observed in 17.2%, obesity in 5.6%, and severe obesity in 1.3%, with an increased chance of adverse cardiometabolic outcomes according to higher BMI, such as higher fasting plasma glucose [PR 5.30 (95% CI, 1.94-14.50)] and HbA1c [2.04 (95% CI, 1.29-3.25)].[322]
- Data from the ELSA-Brasil study have shown that factors related to adiposity, diet pattern, physical activity, and metabolic health are associated with the risk of diabetes. Diabetes prevalence has increased from 11.7% among individuals with BMI ≤24.9 kg/m² to 18.9% among those with overweight and to 32.1% among obese individuals. Higher levels of leisure-time physical activity were associated with lower odds of diabetes (OR=0.76; 95% CI, 0.63–0.91), whereas diets with a higher inflammatory potential increased the risk of incident diabetes by 26% (HR=1.26; 95% CI, 1.04–1.52). After approximately 8 years of follow-up, higher consumption of ultra-processed foods was associated with a 24% increase in the risk of diabetes (RR=1.24; 95% CI, 1.10–1.39). In addition, the presence of nonalcoholic fatty liver disease and metabolic dysfunction-associated steatotic liver disease increased the risk of diabetes by 78% and 88%, respectively, and higher consumption of unprocessed red meat, processed meat, and poultry was associated with higher incidence of type 2 diabetes, with risk increases ranging from 9% to 24%.[323]
- Li *et al*.[324] have analyzed harmonized data from international cohorts to assess the association between meat consumption and the incidence of type 2 diabetes. In the ELSA-Brasil, which contributed 10,972 participants (57.3% women; median age, 50 years; median follow-up, 8 years), there were 1,695 incident cases of diabetes. Higher consumption of unprocessed red meat (RR=1.24; 95% CI, 1.13–1.36), processed meat (RR=1.18; 95% CI, 1.03–1.34), and poultry (RR=1.09; 95% CI, 1.02–1.17) was associated with higher risk of type 2 diabetes. Similar results were observed in the meta-analysis of individual data conducted by the authors, involving 1.97 million participants from different cohorts.
- Santos et al.,[303] analyzing data from the 2013 and 2019 PNS, have observed increases in the self-reported prevalence of diabetes (from 6.1% to 6.5%), in the coverage of medical consultations (from 85.6% to 89.2%), and in screening blood glucose testing (from 71.1% to 77.2%) among individuals with no previous diagnosis. Access to screening was higher among women, elderly individuals, those with higher educational level, obesity, and hypertension, but remained lower among individuals living in rural areas, those with no private health insurance, those in the North region, and of yellow race/skin color, evidencing that, despite the broad coverage provided by the SUS, inequalities in the access to diabetes diagnosis persist.
- Dias et al.[325] have assessed the association between consumption of sweetened beverages and the incidence of diabetes in the CUME project, in a 2-to-4-year follow-up. The incidence of diabetes was 2.78%, and the median calorie intake from daily sweetened beverage consumption was 47.7 kcal/day. Participants whose consumption of those beverages was higher had a 63% increased chance of developing diabetes (OR=1.63; 95% CI, 1.00–2.66), even after adjusting for sociodemographic factors, physical activity, and overweight.
- Miranda et al.,[301] analyzing 75,860 adults from 2020–2023 Vigitel surveys, have reported a 9.2% prevalence of self-reported diabetes. Individuals with diabetes had higher frequency and higher adjusted chance of engaging in insufficient physical activity (aOR=1.40; 95% CI, 1.25–1.55), excessive time watching television (aOR=1.22; 95% CI, 1.09–1.36), overweight (aOR=1.62; 95% CI, 1.44–1.82), and obesity (aOR=1.87; 95% CI, 1.67–2.10), reinforcing the importance of those behavioral and anthropometric factors for developing diabetes.

- Dumith et al.,[326] analyzing data from Vigitel surveys between 2006 and 2020, have reported that the consumption of artificially sweetened beverages remained stable (from 8.7% to 8.4%), while the prevalence of diabetes increased from 5.5% to 8.2%. Among individuals not consuming those beverages, no increase in diabetes prevalence was observed. However, among consumers of artificially sweetened beverages and juices, diabetes prevalence significantly increased (β=0.18; 95% CI, 0.10–0.25), with annual percent change of diabetes four times greater (β=0.71; 95% CI, 0.45–0.97).

Costs

- Ferrari *et al.*[327] have estimated the direct costs of healthcare related to noncommunicable chronic diseases attributable to obesity in Brazil in 2019 and have shown a total cost of diabetes of US$ 44.2 million (from a total of US$ 2967.6 million). Considering the attributable population fraction of 63.1% (40.3-86.4), the cost attributable to diabetes would be US$ 27.9 million (17.8-38.2).
- In 2022, Pereda *et al.*[328] used the cost-of-illness approach to calculate the total economic burden related to diabetes in Brazil in 2016, which was estimated at up to US$ 2.15 billion, of which US$ 1.52 billion (70.6%) were indirect costs related to premature deaths, absenteeism, and early retirement. The indirect costs related to premature deaths were US$ 1.18 billion (77.9% of indirect costs). The total direct costs related to diabetes were US$ 633 million, US$ 232.8 million with hospitalizations and US$ 86 million with outpatient expenses (95% covered by the SUS). The popular drugstore program represented US$ 304.2 million, while the out-of-pocket expenses were US$ 10.0 million. The total cost per patient diagnosed in Brazil, considering the prevalence of 6.4% (data from 2013), was US$ 223.54 (US$ 65.72 of direct costs and US$ 157.81 of indirect costs).
- In an ecological study, Costa *et al.*[329] have analyzed hospitalization expenditures for diabetes in Brazil from 2011 to 2019, which totaled R$ 844,795,917 (corrected value corresponding to US$ 420,692.23), with an increasing trend over the study period (from R$ 598.83 in 2011 to R$ 793.01 in 2019; p-value < 0.001).
- The 11th edition of the IDF Diabetes Atlas, published in 2025, reported that, in 2024, Brazil ranked third worldwide among countries with the highest healthcare expenditures for adults aged 20-79 years with diabetes (US$ 45.1 billion).[295]

Future Directions

- Brazilian studies on the prevalence of chronic complications of diabetes and its social and behavioral determinants are required.
- Considering the increase in overweight and obesity, mainly in more vulnerable populations, public policies on the prevention of obesity should be prioritized to reduce the new cases of diabetes and cardiovascular complications. Key strategies include food regulation, community-based prevention programs, early identification of individuals at risk, strengthening multidisciplinary teams through the participation of physical education professionals, and adding new anti-obesity medications to the list of medications approved by CONITEC for specific populations.
- Artificial intelligence has emerged as a promising tool for improving diabetes prevention and management, contributing to more individualized approaches and to reduce cardiovascular complications.
- Significant social, economic, demographic, gender, and racial inequalities persist in access to preventive, diagnostic, and therapeutic measures for diabetes in Brazil. Recent evidence indicates that expanding access to cardioprotective therapies, such as dapagliflozin, is associated with a reduction in cardiovascular events, reinforcing the importance of public policies aimed at promoting health equity and incorporating new anti-obesity medications into the SUS.

Table 9.1 – All causes deaths attributable to high fasting plasma glucose: numbers and rates in 1990 and 2023, and percent change of rates in the period in Brazil

Age group	Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
<5 years	Brazil	106.9 (94.2; 121.5)	0.6 (0.6; 0.7)	25.8 (22.4; 29.8)	0.2 (0.2; 0.2)	-72.6 (-76.8; -67.0)
5-14 years	Brazil	95.8 (86.0; 108.6)	0.3 (0.2; 0.3)	45.2 (39.0; 52.5)	0.2 (0.1; 0.2)	-41.0 (-50.5; -28.5)
15-49 years	Brazil	5,942.2 (4,607.0; 8,182.8)	7.7 (6.0; 10.6)	7,666.6 (6,279.0; 9,776.1)	7.0 (5.7; 8.9)	-9.8 (-33.1; 26.8)
50-69 years	Brazil	24,465.6 (18,732.2; 30,618.6)	155.4 (119.0; 194.5)	46,115.5 (37,361.4; 56,200.6)	105.6 (85.5; 128.7)	-32.1 (-48.1; -6.4)
70+ years	Brazil	32,547.2 (25,213.8; 43,345.6)	761.3 (589.8; 1,013.9)	96,630.3 (79,810.7; 119,453.1)	637.3 (526.4; 787.8)	-16.3 (-36.1; 9.7)
All ages	Brazil	63,157.8 (49,094.5; 81,877.5)	42.3 (32.9; 54.8)	150,483.4 (124,560.0; 184,036.4)	71.0 (58.7; 86.8)	67.8 (29.6; 125.1)
Age-standardized	Brazil	NA	80.6 (62.5; 105.7)	NA	58.1 (48.2; 71.1)	-27.9 (-44.7; -4.1)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 9.2 – All causes deaths attributable to high fasting plasma glucose in Brazil and geographic regions: numbers and rates in 1990 and 2023, and percent change of rates in the period

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	63,157.8 (49,094.5; 81,877.5)	80.6 (62.5; 105.7)	150,483.4 (124,560.0; 184,036.4)	58.1 (48.2; 71.1)	-27.9 (-44.7; -4.1)
North region	2,392.3 (1,749.8; 3,142.2)	72.3 (53.0; 97.2)	9,807.1 (8,021.1; 11,892.5)	67.1 (54.9; 81.3)	-7.2 (-29.0; 25.4)
Northeast region	16,829.5 (13,276.3; 21,618.7)	72.8 (57.3; 94.5)	42,913.0 (36,416.6; 52,652.6)	63.9 (54.3; 78.5)	-12.1 (-30.6; 14.1)
Southeast region	31,473.0 (24,864.6; 40,615.7)	87.1 (68.5; 113.6)	63,843.0 (52,019.5; 79,569.1)	53.6 (43.7; 66.9)	-38.4 (-53.6; -16.5)
South region	9.718,1 (7,029.8; 13,067.6)	79.9 (58.4; 109.3)	23,875.7 (19,003.1; 29,762.5)	58.6 (46.6; 73.3)	-26.7 (-47.7; 5.8)
West-Central region	2,744.9 (2.138.1; 3,403.0)	76.7 (59.6; 96.5)	10,044.5 (8,341.3; 11,995.4)	58.8 (48.7; 70.1)	-23.4 (-38.6; -1.7)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 9.3 – Cardiovascular diseases deaths attributable to high fasting plasma glucose in Brazil and geographic regions: numbers and rates in 1990 and 2023, and percent change of rates in the period

Location	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
Brazil	24,788.5 (15,365.4; 39,629.5)	32.8 (20.7; 52.9)	36,430.6 (25,120.6; 54,376.5)	14.1 (9.7; 20.9)	-57.1 (-74.2; -24.5)
North region	972.4 (543.2; 1,529.8)	31.3 (18.4; 50.5)	2,337.3 (1,539.2; 3,508.5)	16.4 (10.9; 24.4)	-47.7 (-68.3; -10.5)
Northeast region	5,787.0 (3,499.9; 9,476.9)	25.7 (15.9; 42.4)	10,221.8 (7,082.8; 15,244.4)	15.2 (10.5; 22.7)	-40.9 (-64.6; 2.2)
Southeast region	12,483.2 (7,968.7; 19,819.1)	36.1 (23.8; 57.1)	15,339.5 (10,554.9; 22,918.9)	12.8 (8.8; 19.1)	-64.5 (-78.9; -36.1)
South region	4,381.3 (2,463.0; 7,061.6)	37.2 (22.0; 60.5)	5,682.0 (3,654.3; 8,897.9)	13.9 (9.0; 21.9)	-62.5 (-79.5; -31.5)
West-Central region	1,164.6 (735.1; 1,683.8)	34.4 (22.8; 50.6)	2,850.0 (2,072.3; 3,892.0)	16.8 (12.3; 22.9)	-51.2 (-66.7; -27.4)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 9.4 – Cardiovascular diseases deaths attributable to high fasting plasma glucose in Brazil, according to sex and age group: numbers and rates in 1990 and 2023, and percent change of rates in the period

Sex	Age group	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
Male	15-49 years	861.4 (444.4; 1,668.7)	2.3 (1.2; 4.4)	702.2 (422.8; 1,290.1)	1.3 (0.8; 2.4)	-43.0 (-72.5; 30.4)
Male	50-69 years	5,472.1 (3,136.6; 8,988.3)	72.5 (41.5; 119.0)	6,340.0 (4,212.9; 10,601.5)	31.0 (20.6; 51.9)	-57.2 (-77.0; -15.9)
Male	70+ years	6,178.4 (3,988.7; 10,230.1)	324.1 (209.2; 536.6)	10,690.9 (7,393.5; 16,199.2)	166.5 (115.1; 252.2)	-48.6 (-69.6; -8.8)
Male	All ages	12,511.9 (7,573.2; 21,029.3)	17.0 (10.3; 28.5)	17,733.1 (12,105.8; 27,849.9)	17.2 (11.7; 27.0)	1.5 (-42.1; 90.5)
Male	Age-standardized	NA	35.1 (21.8; 58.4)	NA	16.0 (11.0; 24.9)	-54.5 (-73.9; -15.5)
Female	15-49 years	592.0 (294.8; 1,064.7)	1.5 (0.8; 2.7)	459.4 (261.2; 858.7)	0.8 (0.5; 1.5)	-45.7 (-74.3; 25.1)
Female	50-69 years	3,849.9 (2,247.4; 5,251.4)	47.0 (27.4; 64.1)	4,412.7 (2,743.3; 6,202.7)	19.0 (11.8; 26.7)	-59.6 (-75.8; -29.1)
Female	70+ years	7,834.7 (5,158.5; 12,484.9)	330.8 (217.8; 527.1)	13,825.5 (9,695.8; 19,746.9)	158.2 (110.9; 225.9)	-52.2 (-70.7; -22.7)
Female	All ages	12,276.6 (7,723.2; 18,646.6)	16.3 (10.2; 24.7)	18,697.5 (12,748.9; 26,719.9)	17.1 (11.7; 24.5)	5.5 (-37.3; 70.9)
Female	Age-standardized	NA	30.6 (19.6; 47.2)	NA	12.5 (8.5; 17.8)	-59.2 (-75.4; -34.9)
Both	15-49 years	1,453.4 (737.9; 2,732.4)	1.9 (1.0; 3.6)	1,161.6 (681.1; 2,141.2)	1.1 (0.6; 1.9)	-44.1 (-72.8; 32.0)
Both	50-69 years	9,322.0 (5,345.2; 14,201.1)	59.2 (34.0; 90.2)	10,752.7 (6,822.0; 16,701.1)	24.6 (15.6; 38.2)	-58.4 (-76.6; -22.9)
Both	70+ years	14,013.1 (9,212.9; 22,873.9)	327.8 (215.5; 535.1)	24,516.4 (17,261.1; 35,469.7)	161.7 (113.8; 233.9)	-50.7 (-69.7; -15.5)
Both	All ages	24,788.5 (15,365.4; 39,629.5)	16.6 (10.3; 26.5)	36,430.6 (25,120.6; 54,376.5)	17.2 (11.8; 25.6)	3.5 (-39.3; 83.3)
Both	Age-standardized	NA	32.8 (20.7; 52.9)	NA	14.1 (9.7; 20.9)	-57.1 (-74.2; -24.5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 9.5 – All-causes DALYs attributable to high fasting plasma glucose per age group, in Brazil: numbers and rates in 1990 and 2023, and percent change of rates in the period

Age group	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
<5 years	9,507.2 (8,382.5; 10,810.0)	56.3 (49.6; 64.0)	2,308.9 (2,001.2; 2,651.0)	15.5 (13.5; 17.8)	-72.4 (-76.7; -66.9)
5-14 years	8,691.4 (7,622.2; 10,036.4)	24.4 (21.4; 28.2)	4,549.3 (3,718.2; 5,960.7)	16.0 (13.1; 20.9)	-34.6 (-47.6; -11.8)
15-49 years	454,382.3 (361,644.2; 586,524.6)	591.2 (470.6; 763.2)	733,444.7 (580,850.2; 914,540.2)	667.4 (528.6; 832.2)	12.9 (-10.7; 41.2)
50-69 years	980,003.6 (764,062.1; 1,217,462.3)	6,226.0 (4,854.1; 7,734.6)	2,151,877.6 (1,740,606.0; 2,615,098.9)	4,926.7 (3,985.1; 5,987.3)	-20.9 (-36.8; 1.8)
70+ years	603,102.2 (468,743.0; 795,509.7)	14,107.6 (10,964.7; 18,608.3)	1,786,951.2 (1,487,906.8; 2,181,439.5)	11,785.2 (9,813.0; 14,386.9)	-16.5 (-35.3; 7.3)
All ages	2,055,686.6 (1,626,560.5; 2,602,145.5)	1,376.6 (1,089.2; 1,742.5)	4,679,131.7 (3,824,059.6; 5,710,474.4)	2,206.4 (1,803.2; 2,692.7)	60.3 (26.4; 104.6)
Age-standardized	NA	2,230.2 (1,766.1; 2,849.8)	NA	1,778.4 (1,457.4; 2,170.3)	-20.3 (-38.0; 1.7)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 9.6 – Cardiovascular diseases DALYs attributable to high fasting plasma glucose per age group, in Brazil: numbers and rates in 1990 and 2023, and percent change of rates in the period

Age group	1990 Number (95% UI)	1990 Rate (95% UI)	2023 Number (95% UI)	2023 Rate (95% UI)	Percent change of rates (95% UI)
15-49 years	72,991.2 (36,490.5; 136,329.9)	95.0 (47.5; 177.4)	57,679.2 (33,840.5; 106,655.0)	52.5 (30.8; 97.1)	-44.7 (-73.3; 31.0)
50-69 years	288,906.8 (164,813.3; 443,259.0)	1,835.4 (1,047.1; 2,816.0)	334,230.3 (215,147.1; 524,953.1)	765.2 (492.6; 1,201.9)	-58.3 (-76.5; -22.6)
70+ years	215,810.7 (139,486.0; 351,522.6)	5,048.2 (3,262.8; 8,222.7)	362,634.4 (256,518.9; 522,499.5)	2,391.6 (1,691.8; 3,446.0)	-52.6 (-71.0; -18.4)
All ages	577,708.7 (343,135.9; 930,200.0)	386.9 (229.8; 622.9)	754,544.0 (513,071.8; 1,166,760.4)	355.8 (241.9; 550.2)	-8.0 (-46.6; 67.7)
Age-standardized		670.9 (408.0; 1,077.4)		285.5 (194.2; 440.8)	-57.4 (-74.8; -22.7)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

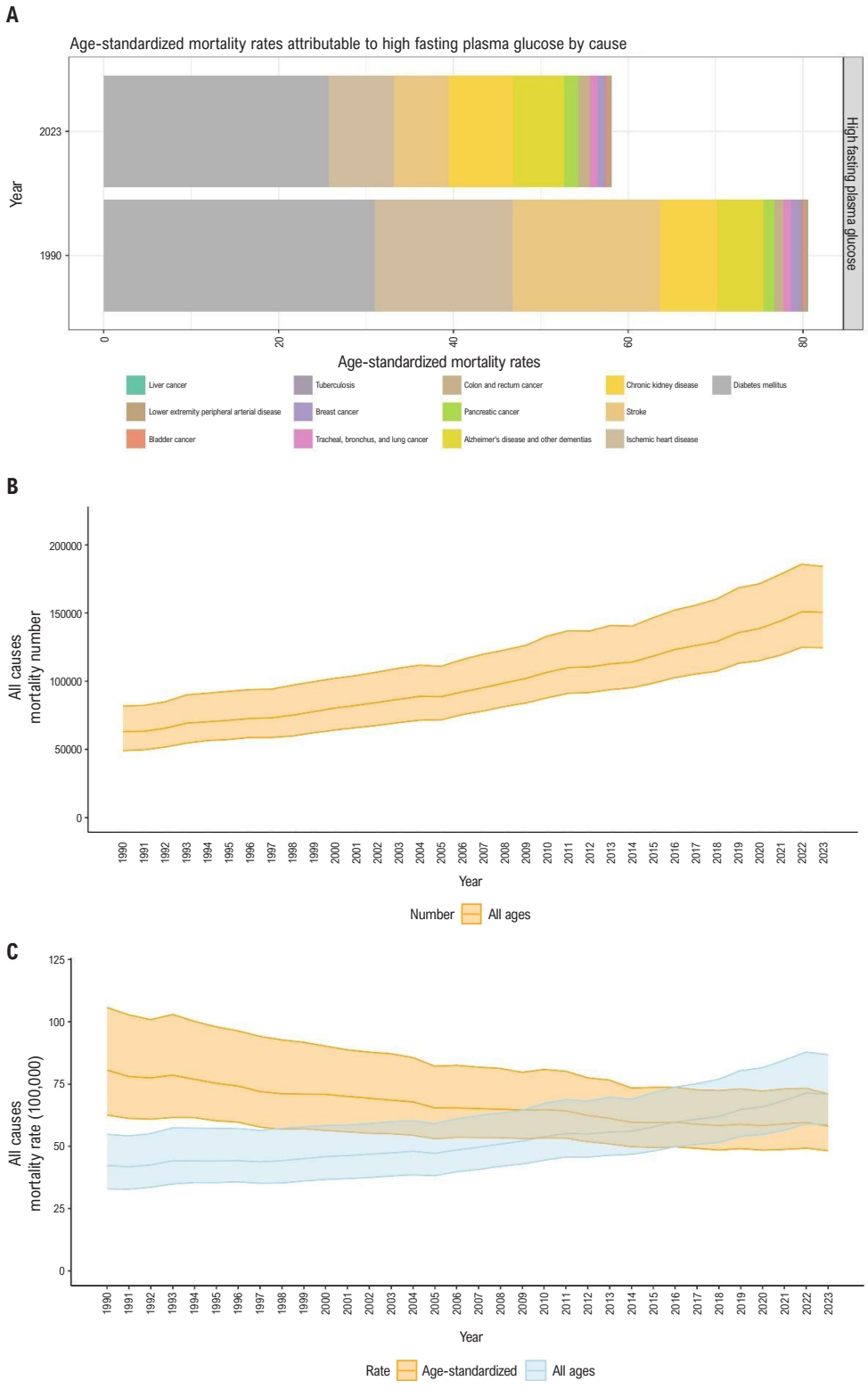

Chart 9.1 – *Mortality rate attributable to high fasting plasma glucose stratified by all causes - Brazil, 1990-2023 (A). Total number of deaths attributable to high fasting plasma glucose (B). All-age and age-standardized mortality rates attributable to high fasting plasma glucose (per 100,000) (C). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

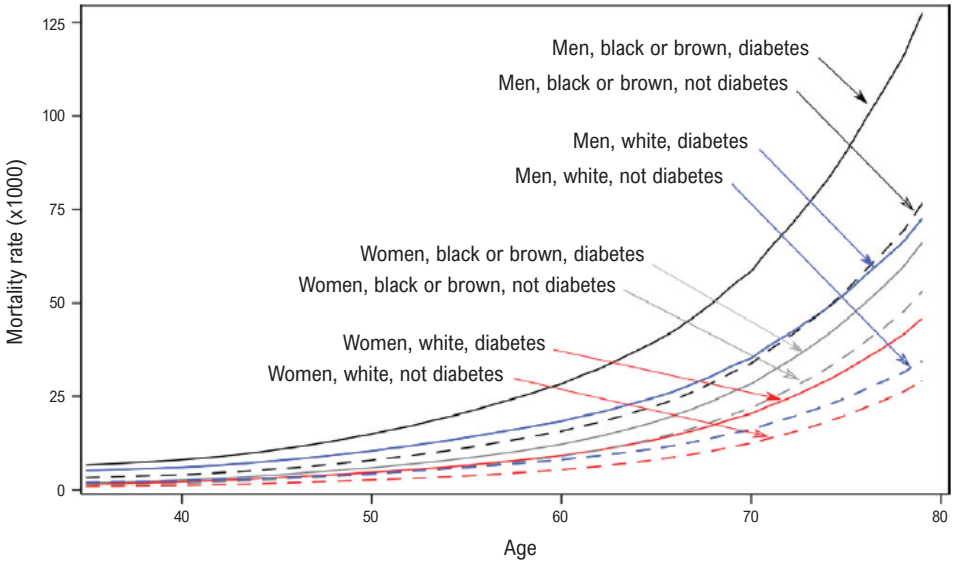

Chart 9.2 – *Mortality rate (per 1,000 people) of individuals aged 35-80 years with (continuous lines) and without (dashed lines) known diabetes. For men and women, self-declared White or Black/Brown. Source: Bracco et al.,[306] using data from the ELSA-Brasil Study.*

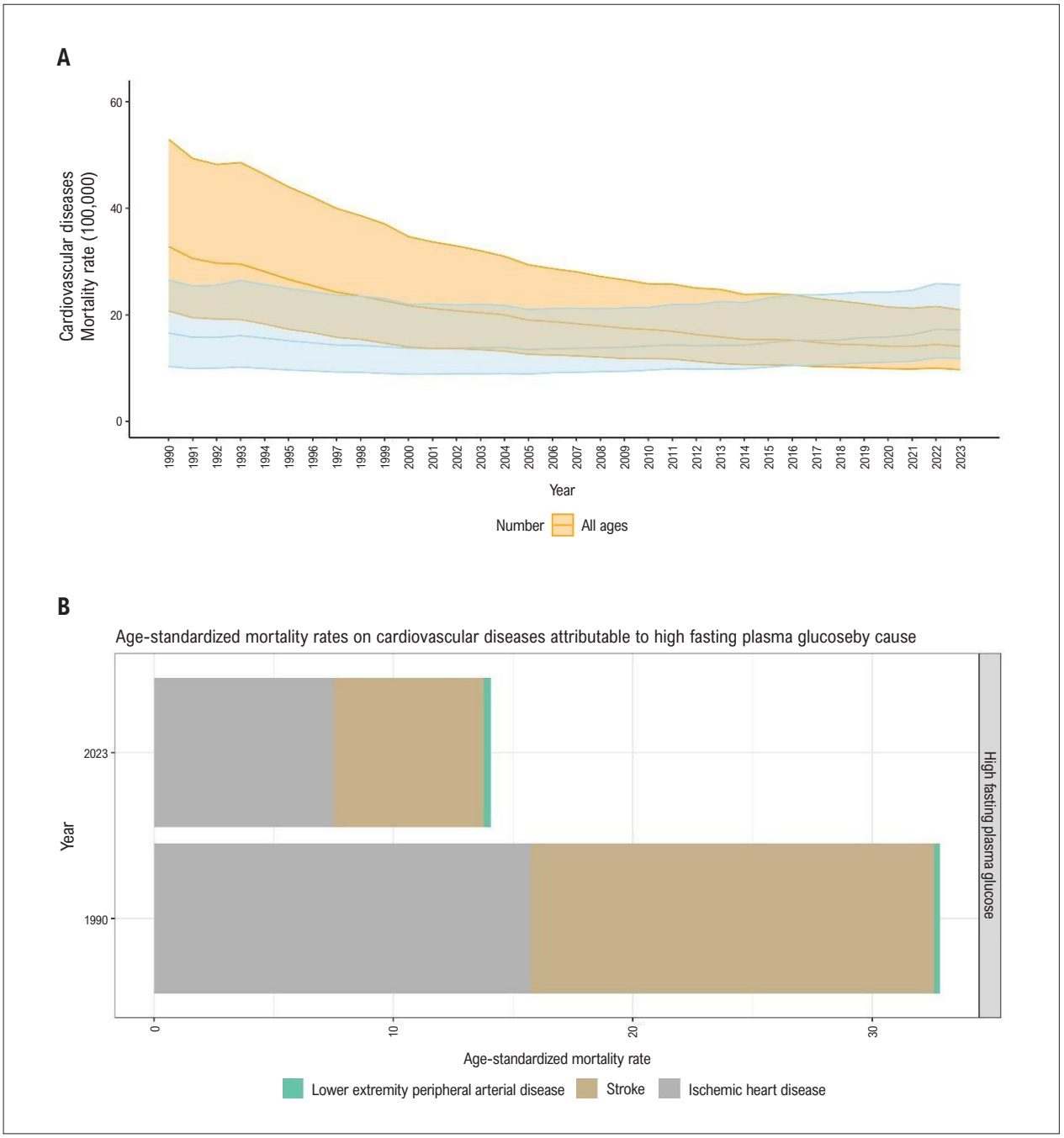

Chart 9.3 – *All-ages and age-standardized mortality rates from cardiovascular disease attributable to high fasting plasma glucose (per 100,000) (A). Deaths attributable to high fasting plasma glucose stratified by cardiovascular disease (B). Brazil, 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

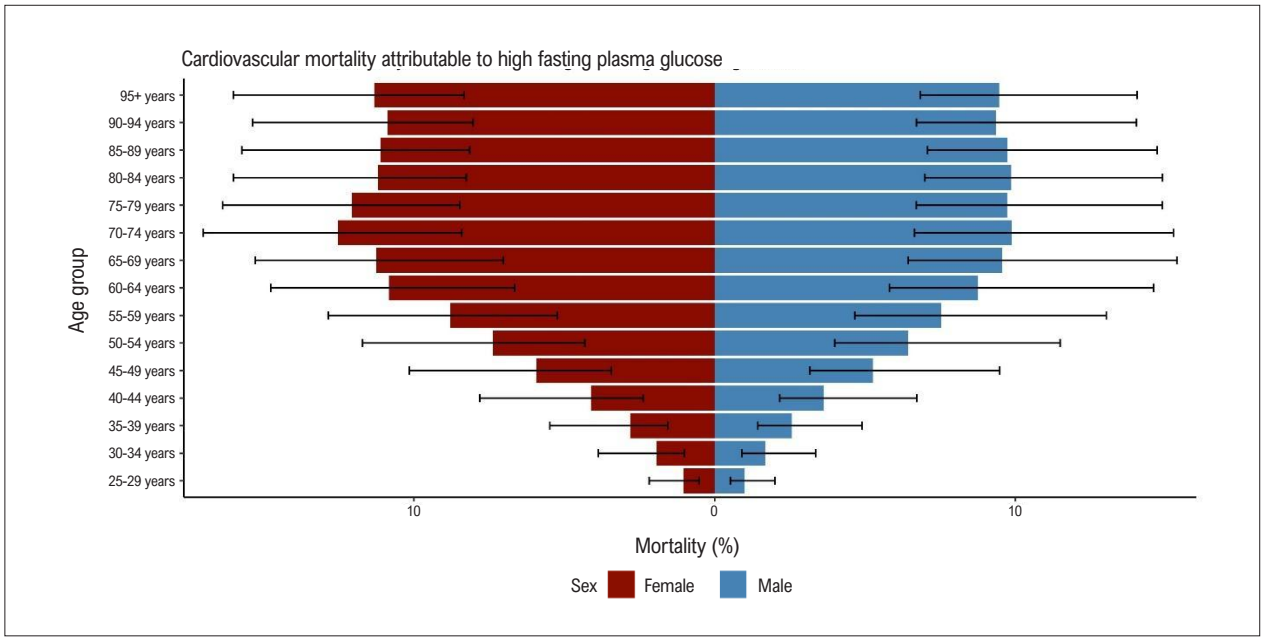

Chart 9.4 – *Proportional mortality from cardiovascular disease attributable to high fasting plasma glucose according to sex and age group. Brazil, 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

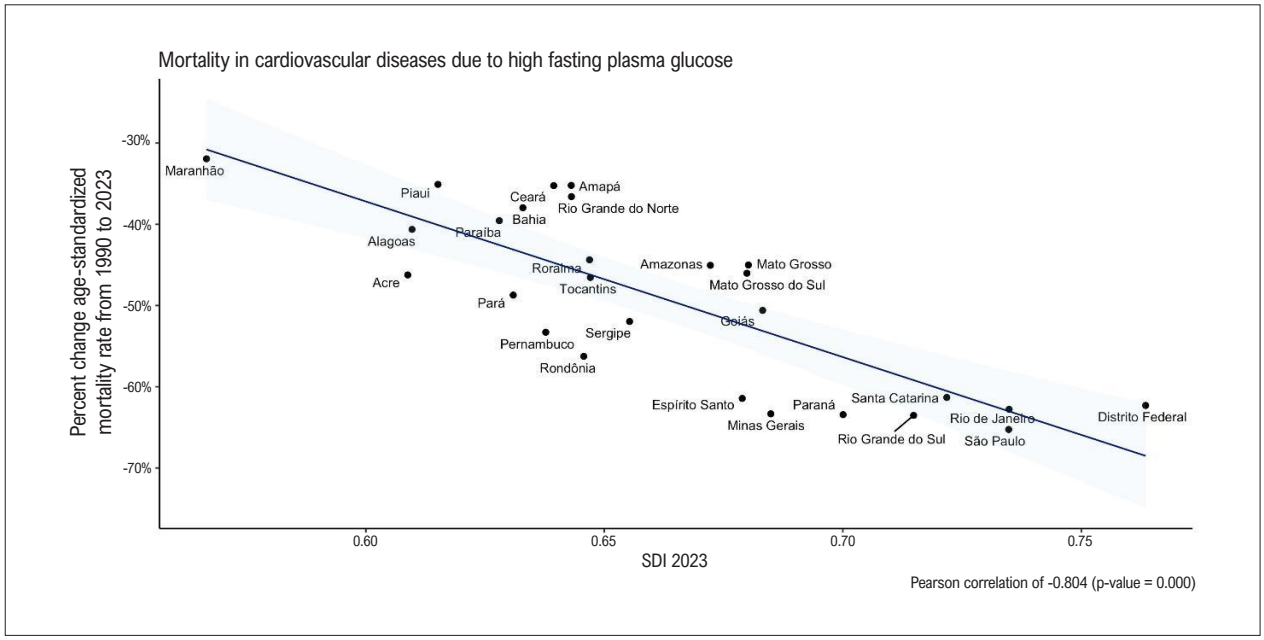

Chart 9.5 – *Correlation between the sociodemographic index (SDI) of 2023 and the percent change of the age-standardized mortality rates from cardiovascular diseases attributable to high fasting plasma glucose from 1990 to 2023 in Brazilian Federative Units. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 10 – SMOKING AND TOBACCO USE

Smoking and the Consequences for Cardiovascular Diseases, Brazil and Federative Units, 1990 to 2023

ICD-10: Z.72.0.

See Tables 10.1 through 10.8 and Charts 10.1 through 10.6.

Abbreviations used in chapter 10

Anvisa	Brazilian Health Surveillance Agency
CI	Confidence Interval
CVD	Cardiovascular Disease
DALYs	Disability-adjusted life-years
ENDS	Electronic Nicotine Delivery Systems
GBD	Global Burden of Disease
LENAD III	Third Brazilian Survey on Alcohol and Drugs (in Portuguese, III Levantamento Nacional de Álcool e Drogas)
PeNSE	Brazilian Survey of Schoolchildren Health (in Portuguese, Pesquisa Nacional de Saúde do Escolar)
RDC	Collegiate Board Resolution
SDI	Sociodemographic Index
UI	Uncertainty Interval
Vigitel	Brazilian Telephone Survey for Surveillance of Noncommunicable Diseases (in Portuguese, Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico)

Introduction

- Tobacco use continues to be one of the leading causes of preventable death in Brazil, remaining a central determinant of morbidity and mortality despite substantial progress in tobacco control over recent decades.[330] Cigarette smoking remains a major risk factor for cardiovascular disease (CVD), contributing to a broad spectrum of clinical manifestations, including coronary artery disease, stroke, heart failure, peripheral artery disease, and arrhythmias.[331] The health burden of tobacco arises not only from direct consumption—across smoked, inhaled, heated, and chewed products—but also from exposure to second-hand smoke, which remains a relevant public health concern.[332]
- In recent years, patterns of tobacco consumption in Brazil have undergone meaningful shifts. While traditional cigarette smoking continues to decline, the emergence and rapid uptake of electronic nicotine delivery systems (ENDS), such as electronic cigarettes, heated tobacco products, and hookah (waterpipe), among adolescents and young adults represent new challenges for surveillance and regulation.[333] These products have gained popularity despite regulatory restrictions and are increasingly associated with experimental and habitual use in younger populations.[333]
- This chapter provides an overview of tobacco use in Brazil and its implications for CVD, presenting updated prevalence estimates derived from the country's most recent and robust population surveys. For adults aged 18 years and older, we used data from the Global Burden of Disease (GBD) study 2023 and Vigitel (Brazilian Telephone Survey for Surveillance of Noncommunicable Diseases) 2023. The GBD data show mortality rates and the absolute number of deaths attributable to tobacco in Brazil and its 27 Federative Units, from 1990 to 2023, according to GBD estimates.[1-3] Vigitel is a continuous telephone surveillance system that monitors risk factors for chronic diseases in the capitals of Brazilian states.[334] Its time series allows us to assess recent trends in smoking, exposure to second-hand smoke, and experimentation with electronic cigarettes.[335] In addition, we included data from the Third Brazilian Survey on Alcohol and Drugs (LENAD III), which covers indicators related to smoking from the 2006, 2012, and 2023 editions, and inaugurates the investigation of the use of ENDS in a representative sample of the Brazilian population aged 14 years or older.[336] For adolescents, we used the PeNSE survey (Brazilian Survey of Schoolchildren Health) and the indicators: experimentation with tobacco, smoking in the last month, and use of alternative tobacco products. These data can be found in the previous edition of this document. We included the most recent and comprehensive sources available to estimate tobacco consumption by the Brazilian population.

Prevalence of smoking among adolescents

- It is estimated that nearly 200,000 adolescents aged 14-17 years are smokers in Brazil, corresponding to 1.7% of this population stratum.[336]
- According to LENAD III, 7.9% (95% CI 7.3–8.5) of the adolescents who reported smoking initiated tobacco use early in life, before the age of 14 years. In this age group, the age at experimentation ranges from 6 years to 17 years, with a mean of 13.7 and a median of 14.[336]
- Regarding tobacco experimentation, more than one-third of these adolescents (37.6%) reported early experimentation (before age 14), representing 2.8% (95% CI 2.16–3.73) of the overall adolescent population.[336]

Prevalence of smoking among adults

- According to Vigitel 2024, the prevalence of smoking among adults (≥ 18 years) was 11.5%, higher in males (13.9%) than in females (9.5%). That prevalence was higher among young adults (18-24 years of age)[335] (Table 10.1).
- The prevalence of smoking was lower at ages 35-44 years and 65 years and older, 10.5%, as compared to 13.2% at age 18-24 years and to 11.0% at age 25-34 years. It was also lower in populations with higher education, 7.8%, as compared to 10.2% among those with complete high school and incomplete higher education, 15.6% among those with complete elementary education and incomplete high school, and 16.6 among those with no schooling and incomplete elementary education.[335]

- The prevalence of smoking decreased between 2006 and 2024, declining from 15.7% in 2006 to 11.5% in 2024 (average reduction of −0.69 percentage points per year) (Chart 10.1). This decrease was observed in both sexes, with a greater reduction among men, from 19.5% in 2006 to 13.9% in 2024 (−0.38 percentage points per year) (Tables 10.2 and Chart 10.2).[337,338] However, analysis of the most recent period, 2021-2024, indicates stability, with an increase in the prevalence from 2021 (9.0%) to 2024 (11.5%) in both sexes.

Electronic Nicotine Delivery Systems

- According to LENAD III, the results indicate that 8.8% (95% CI 7.8–9.9) of the Brazilian population aged 14 years or older have experimented ENDS at least once in their lifetime, corresponding to more than 11 million individuals. Approximately 9 million Brazilians reported using ENDS in the past year (the year preceding the survey, referring to 2022), representing 5.6% (95% CI 4.9–6.5) of the population. Among those who reported use in the past year, about one quarter also used ENDS in the 30 days prior to the interview (25.8%; 95% CI 22.2–29.8), which corresponds to 2.2% (95% CI 1.8–2.8) of the Brazilian population, or approximately 3.5 million individuals.[336]
- More than half (63.6%) of experimenters (8.8% of the population) continued using ENDS after experimentation. Among adolescents, this proportion reached nearly 80%, with most experimenters becoming users. In other words, approximately three out of every four adolescents who have ever tried electronic cigarettes continue to use them[336] (Table 10.3).
- The use of ENDS was more prevalent among males, in terms of both lifetime use and past-year use. Lifetime prevalence was 11.5% (95% CI 9.9–13.3) among males, compared to 6.3% (95% CI 5.6–7.1) among females. Recent use, referring to consumption in the past year, was reported by 7.3% (95% CI 6.2–8.6) of males, compared to 4.1% (95% CI 3.5–4.8) of females[336] (Table 10.4).
- Prevalence estimates were relatively similar across racial groups, with only modest variations. Individuals who self-identified as indigenous had the highest prevalence of both lifetime use (10.9%; 95% CI 6.1–18.8) and past-year use (8.5%; 95% CI 4.3–16.0), although with wider confidence intervals. White, Black, Asian, and mixed-race individuals had comparable prevalence estimates[336] (Table 10.4).
- A trend toward higher prevalence was observed among individuals with complete or incomplete high-school education (11.9% lifetime; 7.7% in the past year) and among those with higher education or above (12.3% and 7.4%, respectively), suggesting an association between educational attainment and greater exposure or access to the product. Very low prevalence was observed among individuals with no formal education[336] (Table 10.4).
- Regarding marital status, single individuals reported the highest prevalence of ENDS use (13.4% lifetime; 9.0% in the past year), followed by married, divorced/separated, and widowed individuals, in that order[336] (Table 10.4).

Tobacco-attributable mortality

- GBD 2023 shows that the number of deaths attributable to tobacco from all causes remained high over the period analyzed, with annual estimates ranging from approximately 121,000 to 142,000 deaths. Throughout the time series, the total number of tobacco-attributable deaths showed moderate year-to-year fluctuations but no abrupt changes. Males consistently accounted for a higher number of tobacco-attributable deaths than females across all years, contributing most of the overall burden. Despite some recent stabilization, tobacco continued to account for a substantial number of deaths in the Brazilian population (Chart 10.3).
- According to GBD 2023, tobacco-attributable cardiovascular deaths accounted for approximately 21–22% of deaths among individuals aged 50–59 years, declining gradually at older ages to about 20% at 60–64 years, 16% at 65–69 years, 13% at 70–74 years, and 11% at 75–79 years. Across all age groups, the proportion was consistently higher among males than among females. At age 50–54 years, tobacco accounted for 24.4% of cardiovascular deaths in males as compared to 17.1% in females, and at age 75–79 years, the corresponding proportions were 14.3% in males and 7.6% in females (Chart 10.4).
- All-cause mortality rates attributable to tobacco declined substantially between 1990 and 2023, according to GBD 2023. Among both sexes combined, the age-standardized mortality rate decreased from 143.5 (95% UI 119.7–166.7) deaths per 100,000 population in 1990 to 53.9 (95% UI 43.9–63.9) per 100,000 in 2023, corresponding to an approximately 62% reduction over the period. Throughout the time series, tobacco-attributable mortality rates remained higher among males than among females, although declining trends were observed in both sexes (Chart 10.5).
- In Brazil, the number of cardiovascular deaths attributable to tobacco declined between 1990 and 2023. In 1990, tobacco accounted for an estimated 60,151 (95% UI 51,570–69,842) cardiovascular deaths. By 2023, this number had decreased to 50,160 (95% UI 42,336–59,251) deaths. This corresponds to an approximately 16.6% reduction in the number of tobacco-attributable cardiovascular deaths over the period. Despite this decline, tobacco continues to contribute to a substantial burden of cardiovascular mortality in the Brazilian population.
- According to GBD 2023, there was a significant reduction in tobacco-attributable mortality rates for ischemic heart disease and stroke in Brazil from 1990 to 2023. In 1990, the mortality rate attributable to tobacco for ischemic heart disease was 39 (95% CI 33.31-45.33) deaths per 100,000 population, declining to 12 (95% CI 10–14) per 100,000 in 2023. For stroke, the tobacco-attributable mortality rate decreased from 28 (95% CI 23-33) per 100,000 in 1990 to 6 (95% CI 5–7) per 100,000 in 2023 (Table 10.5).
- For all ages combined, tobacco-attributable mortality rates declined from 83.2 (95% UI 70.6-95.7) deaths per 100,000 in 1990 to 66.8 (95% UI 54.6-79.3) per 100,000 in 2023, while age-standardized mortality rates

decreased by more than 60%, indicating substantial long-term reductions in tobacco-related mortality despite the continued concentration of deaths among older adults (Table 10.6).

- Tobacco-attributable cardiovascular mortality declined across all sociodemographic index (SDI) groups between the early 1990s and 2023. Reductions were observed in low-, middle-, and high-SDI Federative Units, with estimated decreases of approximately 30–35%, 35–40%, and 40–45%, respectively. Throughout the period, low-SDI Federative Units consistently exhibited the highest tobacco-attributable cardiovascular mortality rates, followed by middle-SDI Federative Units, while high-SDI Federative Units showed the lowest rates. Despite substantial declines in all groups, clear gradients by SDI level persisted over time, with larger relative reductions occurring in higher-SDI Federative Units (Chart 10.6).
- In Brazil overall, tobacco-attributable cardiovascular deaths decreased from 60,151 (95% UI 51,570–69,842) in 1990 to 50,160 (95% UI 42,336–59,251) in 2023, a 16.6% reduction in the number of deaths. Over the same period, the mortality rate declined from 69.1 (95% UI 58.9–81.3) per 100,000 to 19.0 (95% UI 16.0–22.4) per 100,000, corresponding to a 72.5% reduction.
- Across the 27 Federative Units, cardiovascular death rate attributable to tobacco reductions ranged from −79.2% in Rio Grande do Sul (from 86.2 [95% UI 72.7–100.7] to 17.9 [95% UI 15.2–21.6] per 100,000) to −54.9% in Ceará (from 38.6 [95% UI 31.8–46.5] to 17.4 [95% UI 14.3–21.2] per 100,000). In absolute terms, some states experienced large decreases in the numbers of deaths (e.g., Rio Grande do Sul: from 5,491 [95% UI 4,680–6,323] to 3,061 [95% UI 2,585–3,683], −44.3%), whereas others increased despite rate declines, according to GBD 2023.

Tobacco-attributable burden of disease

- Age-standardized DALY rates attributable to tobacco for all causes declined markedly between 1990 and 2023 across all age groups and in both sexes. Among males, tobacco-attributable DALY rates decreased by 48.6% in children and adolescents aged 5–14 years (95% UI −58.2% to −38.5), by 56.1% in adults aged 15–49 years (95% UI −64.1% to −47.0), by 60.4% in those aged 50–69 years (95% UI −66.3% to −54.2), and by 55.9% among individuals aged 70 years or older (95% UI −61.3% to −50.2). The largest relative decline was observed in children under 5 years of age, with a reduction of approximately 91.0% (95% UI −93.1 to −88.6), due to a reduction in second-hand smoke exposure. Despite substantial reductions across all age groups, tobacco-attributable DALYs remained concentrated among adults aged 50 years and older in 2023, reflecting the persistent burden of tobacco-related disease later in life.
- Age-standardized DALY rates due to CVD attributable to tobacco declined substantially between 1990 and 2023 across all age groups. Among children aged <5 years, those DALY rates decreased by more than 90%, indicating a marked reduction in early-life cardiovascular burden related to tobacco exposure. In children and adolescents aged 5–14 years, these DALY rates declined by approximately 50–55% over the period, while among adults aged 15–49 years, tobacco-attributable cardiovascular DALY rates decreased by roughly 55–60%, reflecting sustained reductions in premature cardiovascular burden. In adults aged 50–69 years, tobacco-attributable cardiovascular DALYs showed a pronounced decline between 1990 and 2023, with DALY rates decreasing by approximately 60%, although this age group continued to account for a large share of the total burden in absolute terms. Among individuals aged 70 years and older, tobacco-attributable cardiovascular DALYs remained highest, despite an approximately 55–60% reduction in DALY rates over the study period. Overall, despite substantial relative reductions across all age groups, tobacco-attributable cardiovascular DALYs in 2023 remained predominantly concentrated among adults aged 50 years and older, underscoring the long-term cumulative effects of tobacco exposure on cardiovascular health (Table 10.7).

Second-hand smoke

- According to Vigitel 2023, the prevalence of second-hand smoke at home was 6.4% (95% CI 5.6-7.1) and higher among females (6.6%; 95% CI 5.7-7.4) than among males (6.2%; 95% CI 4.9-7.5) (Table 10.6).
- The prevalence of second-hand smoke at home in Brazil´s capitals varied from 2.6% (95% CI 1.4-3.7) in Campo Grande to 10.4% (95% CI, 6.7-14) in the Federal District. Among males and females, the highest prevalence was in the Federal District, 10.5% (95% CI 4.6-16.5) and 10.2% (95% CI 5.8-14.6), respectively. The prevalence of second-hand smoke at work was 7.0% (95% CI 6.2-7.9), higher in males, 10.2% (95% CI 8.8-11.6), than in females, 4.3% (95% CI 3.5-5.2).

Economic impact of tobacco

- The total economic burden attributable to tobacco in Brazil in 2020 was US$ 24.3 billion, representing 1.9% of the gross domestic product and 7.8% of the national health expenditure.[339]
- For every R$1.0 of profit earned by the tobacco industry, Brazil spends 2.3 times that amount on the direct costs of treating tobacco-related diseases and 5.1 times that amount on the total costs of these diseases.[340]

Public policies for tobacco control in Brazil

- Regulatory and field studies document persistent structural weaknesses in tobacco control enforcement. The continued sale of single cigarettes remains common in retail settings, facilitating smoking initiation and sustained consumption.[341]
- Between 2012 and 2023, a total of 1,112 new registrations of tobacco products with 'banned additives' were recorded.[341]

- The spread of hookah tobacco registrations started in 2014, and by 2023, the cumulative incidence of registrations containing 'banned additives' was 641. Both manufactured cigarettes and hookah products reached their peaks in new registrations in 2020.[341]
- Based on statistics from 2019, it was projected in 38.6% (95% CI 35.8- 41.5) the proportion of smuggled illicit cigarettes in Brazil. A quarter of illicit brand cigarettes were sold at or above the minimum legal price.[342,343] Economic analyses demonstrate that the expansion of the illicit cigarette market significantly reduces the effectiveness of tax policies by lowering price elasticity and maintaining affordability.[337]

Future Directions

- Policy-oriented evaluations conclude that Brazil's National Tobacco Control Policy has preserved significant achievements but faces increasing challenges related to fiscal constraints, regulatory disputes, illicit trade, and the diversification of nicotine products.[344] Additional evidence shows that brief smoking cessation counseling remains underutilized within health services, representing a missed opportunity to reduce smoking-related morbidity and healthcare costs.[341] Critical appraisals of national smoking cessation guidelines further highlight variability in methodological quality and partial adherence to international standards, reinforcing the need for guideline updating and harmonization.[344]
- Overall, the evidence indicates that while Brazil has sustained major gains in tobacco control, further progress will depend on strengthening enforcement mechanisms, expanding cessation services, updating clinical and regulatory frameworks, improving surveillance of new products, and countering illicit trade and industry interference.[344]
- In the specific case of electronic cigarettes and vapes, the industry in Brazil has used agents of legislative power to seek the approval of laws that would allow the sale of electronic cigarettes or the use of hookah in enclosed spaces. False arguments, in addition to economic pressure, are used to establish new behavioral parameters, including changes to local culture, values, and current legislation. On the other hand, the Collegiate Board Resolution (RDC) No. 855/2024, published by the Brazilian Health Surveillance Agency (Anvisa) on April 23, 2024, reinforces the prohibition in Brazil of ENDS, such as electronic cigarettes and vapes. This resolution expands the restrictions established by RDC No. 46/2009, covering not only the commercialization and importation of these products, but also their manufacture, distribution, storage, transportation, and advertising throughout the national territory. It becomes necessary to advance in the inspection and dissemination of educational campaigns on vaping harmful effects.[338]

Table 10.1 – Prevalence of adult smokers, by age and education level

Variables	Total (%)	Total (95% CI)	Male (%)	Male (95% CI)	Female (%)	Female (95% CI)
Age (years) 18–24	6.7	4.7 – 8.7	9.9	6.3 – 13.5	3.3	1.9 – 4.8
25–34	9.8	7.8 – 11.7	13.5	10.4 – 16.5	6.7	4.1 – 9.3
35–44	10.4	8.1 – 12.7	13.1	8.6 – 17.6	8.3	6.3 – 10.3
45–54	9.1	7.3 – 10.8	10.5	7.9 – 13.2	7.6	5.4 – 9.8
55–64	9.7	7.5 – 11.8	9.6	5.7 – 13.5	9.7	7.3 – 12.1
65 and older	9.1	7.1 – 11.2	12.4	8.0 – 16.7	6.8	5.3 – 8.3
Education (years) 0–8	12.2	10.3 – 14.1	14.6	11.5 – 17.8	10.1	8.0 – 12.2
9–11	8.9	7.6 – 10.3	11.7	9.5 – 13.9	6.4	4.8 – 8.0
12 or more	7.4	6.0 – 8.8	9.2	6.5 – 11.8	6.0	4.7 – 7.3
Total	9.3	8.4 – 10.1	11.7	10.2 – 13.2	7.2	6.3 – 8.2

Note: Weighted percentage adjusted to the sociodemographic distribution of the Vigitel sample to the projected adult population of each capital for 2023. CI: confidence interval. Source: Vigitel 2023.[334]

Table 10.2 – Temporal trend of smoking prevalence by sex, education level, and age group, Brazil, 2006–2023

Variable	Year																	AAPC	p value
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023		
Total	15.7	15.6	14.8	14.3	14.1	13.4	12.1	11.3	10.8	10.4	10.2	10.1	9.3	9.8	9.5	9.1	9.3	-3.3	<0.001
Sex																			
Female	12.4	12.3	12.0	11.5	11.7	10.7	9.2	8.6	9.0	8.3	8.0	7.5	6.9	7.7	7.6	6.7	7.2	-3.5	<0.001
Male	19.5	19.5	18.0	17.5	16.8	16.5	15.5	14.4	12.8	12.8	12.7	13.2	12.1	12.3	11.7	11.8	11.7	-3.1	<0.001
Education (years)																			
0 - 8	19.3	18.7	18.9	18.1	18.1	18.2	16.3	15.0	14.1	14.4	14.3	13.2	13.0	13.8	12.4	12.9	12.2	-2.5	<0.001
9 - 11	13.8	13.6	12.0	11.9	12.2	10.7	10.0	10.3	10.3	9.0	9.4	9.9	8.8	9.5	9.2	8.1	8.9	-2.5	<0.001
≥ 12	10.8	12.2	10.8	10.8	10.0	9.7	9.1	7.4	6.8	7.2	6.9	7.4	6.2	6.7	7.5	7.2	7.4	-2.8	<0.001
Age (years)																			
18 - 24	12.1	13.5	11.4	10.9	10.9	8.8	8.5	7.1	7.8	7.2	7.4	8.5	6.7	7.9	7.1	6.4	6.7	-3.9	<0.001
25 - 34	14.0	14.6	13.8	14.5	14.2	13.2	11.7	12.1	11.9	10.5	9.7	9.6	9.4	9.2	10.6	7.3	9.8	-3.4	<0.001
35 - 44	18.7	17.4	16.5	14.8	15.1	13.9	12.9	11.2	9.9	10.4	10.0	11.7	9.1	9.7	9.6	11.6	10.4	-3.5	<0.001
45 - 54	22.8	21.5	19.6	18.9	18.0	18.6	16.0	15.1	13.2	12.7	12.6	11.2	11.1	10.9	10.0	10.1	9.1	-5.4	<0.001
55 - 64	15.0	15.8	17.2	16.7	16.7	15.9	15.0	13.6	12.5	12.8	13.5	11.6	12.3	13.6	12.2	11.5	9.7	-2.5	<0.001
≥ 65	9.6	8.4	9.3	8.4	8.1	9.0	7.6	6.9	8.1	8.2	7.7	7.3	6.1	7.8	5.9	7.4	9.1	-0.1	0.737

AAPC = Average Annual Percent Change. Source: Malta et al.[338]

Table 10.3 – Conversion from experimentation to current use of electronic nicotine delivery systems in the population and by age group

Group	experimented	currently use	conversion rate
Total population	8.8%	5.6%	63.6%
Adults	8.6%	5.4%	62.8%
Adolescents	11.4%	8.7%	76.3%

Table 10.4 – Distribution of the use of electronic nicotine delivery systems in the total population, stratified by sociodemographic variables

Sex				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
Male	11.5	9.9 – 13.3	7.3	6.2 – 8.6
Female	6.3	5.6 – 7.1	4.1	3.5 – 4.8
Age group (years)				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
14–17	11.4	10.0 – 13.0	8.7	7.4 – 10.2
18–24	25.0	21.8 – 28.7	16.7	13.8 – 20.0
25–49	9.6	8.3 – 11.1	5.9	5.0 – 7.0
50–64	1.2	0.8 – 1.8	0.5	0.3 – 0.9
65 or older	0.2	0.1 – 0.5	0.1	0.0 – 0.4
Race/Ethnicity				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
White	9.3	7.7 – 11.3	6.1	5.0 – 7.4
Black	8.5	7.1 – 10.1	5.5	4.1 – 7.2
Asian	9.0	5.4 – 14.5	6.4	4.0 – 10.0
Mixed (Pardo)	8.7	7.8 – 9.8	5.4	4.6 – 6.2
Indigenous	10.9	6.1 – 18.8	8.5	4.3 – 16.0
Educational level				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
Illiterate / No formal education	0.3	0.0 – 1.8	0.3	0.0 – 1.8
Complete elementary school	4.4	3.7 – 5.2	3.0	2.4 – 3.7
High school (complete or incomplete)	11.9	10.5 – 13.5	7.7	6.6 – 9.0
Higher education or above	12.3	10.6 – 14.3	7.4	6.1 – 8.8
Marital status				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
Single	13.4	11.9 – 15.1	9.0	8.0 – 10.3
Married	5.5	4.5 – 6.6	2.9	2.2 – 3.7
Widowed	1.1	0.5 – 2.2	0.5	0.1 – 1.5
Divorced/Separated	4.4	2.5 – 7.8	3.6	1.8 – 7.2
Monthly household income				
Category	**Lifetime use (%)**	**95% CI**	**Use in the past year (%)**	**95% CI**
Up to R$1,212.00 (1 MW)	5.4	4.5 – 6.5	3.6	2.9 – 4.4
R$1,212.01 – R$2,424.00 (1–2 MW)	7.9	6.7 – 9.2	4.8	3.9 – 5.9
R$2,424.01 – R$3,636.00 (2–3 MW)	10.2	8.7 – 11.9	6.6	5.5 – 7.9
> R$3,636.01 (>3 MW)	12.4	10.6 – 14.6	8.0	6.6 – 9.6

Notes: MW: minimum wage; CI: confidence interval. Prevalence estimates are weighted percentages. 95% CI calculated using Taylor linearization. Unweighted sample size (n) = 16,546. Source: LENAD III.[336]

Table 10.5 – Tobacco-attributable cardiovascular mortality rates by diagnosis, Brazil (1990 vs 2023)

Diagnosis	1990 Rate	1990 Lower 95% UI	1990 Upper 95% UI	2023 Rate	2023 Lower 95% UI	2023 Upper 95% UI
Aortic aneurysm	1.57	1.30	1.84	1.27	1.05	1.56
Atrial fibrillation and flutter	0.18	0.10	0.29	0.11	0.06	0.18
Lower extremity peripheral arterial disease	0.46	0.33	0.61	0.28	0.19	0.38
Ischemic heart disease	39.43	33.31	45.33	11.54	9.78	13.56
Stroke	27.50	22.92	33.41	5.76	4.79	6.90

CI: confidence interval; rates per 100,000 inhabitants with 95% CI. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 10.6 – All-cause deaths attributable to tobacco by sex and age group, in 1990 and 2023.

All causes Deaths attributable to Tobacco Number, Rate and porcent change 95% UI)						
Sex and age group	Location	1990		2023		Percent change or rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
<5 years	Brazil	2.281,0 (1.610,9; 2.963,5)	26,6 (18,8; 34,6)	159,4 (104,9; 223,6)	2,1 (1,4; 2,9)	-92,1 (-92,1; -94; -90,0)
5-14 years	Brazil	109,6 (76,3; 142,5)	0,6 (0,4; 0,8)	39,1 (26,4; 50,1)	0,3 (0,2; 0,3)	- 56,0 (-63,8; -44,3)
15-49 years	Brazil	12.100,6 (10.284,9; 13.866,9)	32.0 (27,2; 36,7)	7.141,5 (5.661,8; 8.800,2)	13,2 (10,5; 16,3)	-58,7 (-66,6; -50,5)
50-69 years	Brazil	39.148,6 (33.547, 9; 43.995,8)	518,5 (444,3; 582,7)	41.001,5 (33.741,9; 49.218,6	200,6 (165,1; 240,8)	-61,3 (-66,8; -55,4)
70+ years	Brazil	29.385,1 (24.444,0; 34.704,6)	1.541,5 (1.282,3; 1.820,5)	44.312,0 (36.833,0; 53.152,8)	690,0 (573,5; 827,7)	-55,2 (-60,7; -49,6)
All ages	Brazil	83.024,8 (70,830,1; 94.499,0)	112,5 (96,0; 128,0)	92.653,5 (76.275,7; 108.707,7)	89,9 (74.0; 105,5)	-20,1(-29,3; -10,7)
Age standadized	Brazil	NA	204,4 (172,1; 234,0)	NA	80,3 (66,5; 94,4)	-60,7 (-65,1; -56,3)
Female						
<5 years	Brazil	1.817,3 (1.275,6; 2.495,1)	21.9 (15,3; 30,0)	105,4 (70,3; 145,0)	1,4 (1.0; 2.0)	-93,4 (-95,1; -92)
5-14 years	Brazil	98,8 (71,0; 132,5)	0,6 (0,4; 0,8)	30,4 (20,0; 41,1)	0,2 (0,1; 0,3)	-61,1 (-70,2; -45,9)
15-49 years	Brazil	6.108,8 (5.065,2; 7.351,8)	15,6 (13,0; 18,8)	3.479,1 (2.570,4; 4.452,9)	6,2 (4,6; 8,0)	-60,2 (-69,5; -49,4)
50-69 years	Brazil	15.035,7 (12.210,4; 17.989,0)	183,6 (149,1; 219,7)	19,921,1 (16.550,9; 24.406,1)	85,7 (71,2; 105,0)	-53,3 (-61,4; -43,7)
70+ years	Brazil	18.143,8 (13.957,7; 22.714,3)	766,0 (589,2; 958,9)	25.547,7 (19.317,4; 33.256,5)	292,3 (221,0; 380,5)	-61,8 (-70,4; -52,5)
All ages	Brazil	41.204,5 (33.187,5; 49.381,8)	54,6 (43,9; 65,4)	49.083,8 (39.737,3; 61.320,7)	45,0 (36,4; 56,2)	-17,5 (-31,2; -3,6)
Age standadized	Brazil	NA	91,0 (72,8; 110,6)	NA	33,2 (26,9; 41,4)	-63,5 (-69; -57,3)
Both						
<5 years	Brazil	4.098,3 (2.884,8; 5.473,7)	24,3 (17,1; 32,4)	264,8 (181,7; 349,6)	1,8 (1,2; 2,4)	-92,7 (-94,0; -90,9)
5-14 years	Brazil	208,4 (148,6; 262,6)	0,6 (0,4; 0,7)	69,5 (49,1; 89,5)	0,2 (0,2; 0,3)	-58,4 (-65,3, -49,1)
15-49 years	Brazil	18.209,3 (15.485,8; 20.884,9)	23,7 (20,2; 27,2)	10.620,5 (8.663,8; 12,458,6)	9,7 (7,9, 11,3)	-59,2 (-64,0; -52,6)
50-69 years	Brazil	54.184,3 (46.925,0; 61.396,0)	344,2 (298,1; 390,0)	60.922,7 (50.541,3; 71.645,8)	139,5 (115,7; 164,0)	-59,5 (-63,9; -54,5)
70+ years	Brazil	47.528,9 (38.591,4; 56.876,6)	1.111,8 (902,7; 1.330,4)	69.859,8 (56.004,8; 84.687,7)	460,7 (369,4; 558,5)	-58,6 (-64,3; -52,3)
All ages	Brazil	124.299,3 (105.407,7; 142.844,4)	83,2 (70,6; 95,7)	141.737,7 (115.777,6; 168.152,7)	66,8 (54,6; 79,3)	−19,7 (−28,3; −10,1)
Age standadized	Brazil	Na	143.5 (119,7; 166,7)	NA	53,9 (43,9; 63,9)	-62,4 (-66,8; -57,9)

UI: uncertainty interval; NA: not applicable. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 10.7 – Tobacco-attributable DALYs due to cardiovascular diseases by age group, Brazil (1990 vs 2023)

Age group	1990 (Number) (95% UI)	1990 (Rate) (95% UI)	2023 (Number) (95% UI)	2023 (Rate) (95% UI)
5-14 years	61.6 (19.5-128.1)	0.2 (0.1-0.4)	44.9 (14.8-103.3)	0.2 (0.1- 0.4)
15-49 years	548,288.9 (479,631.6- 627,663.7)	713.4 (624.1- 816.7)	275,525.3 (227,044.9- 323,036.0)	250.7 (206.6- 294.0)
50-69 years	891,971.1 (769,642.5- 1,013,657.4)	5,666.7 (4,889.6- 6,439.8)	755,914.1 (635,516.0- 883,143.5)	1,730.7 (1,455.0- 2,022.0)
70+ years	348,735.3 (279,580.5- 420,648.4)	8,157.5 (6,539.9- 9,839.7)	333,347.1 (271,066.1- 409,290.9)	2,198.5 (1,787.7- 2,699.3)
All ages	1,789,057.0 (1,531,849.0- 2,041,229.7)	1,198.0 (1,025.8- 1,366.9)	1,364,831.5 (1,148,925.9- 1,596,315.5)	643.6 (541.8- 752.7)
Age-standardized	NA	1,828.3 (1,567.3- 2,098.3)	NA	511.6 (430.8- 597.6)

UI: uncertainty interval; numbers and rates per 100,000 inhabitants with 95% UI; NA: not applicable. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 10.8 – Prevalence of adults (≥18 years) exposed to second-hand smoke at home among the adult population of the state capitals of Brazil and the Federal District, by sex, age group, and years of schooling

Variables	Total (%)	Total (95% CI)	Male (%)	Male (95% CI)	Female (%)	Female (95% CI)
Age (years) 18–24	9.9	7.2–12.6	8.0	4.6–11.4	11.9	7.7–16.1
Age (years) 25–34	7.0	5.2–8.8	7.2	4.2–10.3	6.8	4.7–8.8
Age (years) 35–44	5.6	4.2–7.0	4.7	2.4–7.1	6.3	4.6–8.0
Age (years) 45–54	5.3	3.7–6.9	5.6	2.8–8.5	5.0	3.3–6.6
Age (years) 55–64	5.5	3.6–7.4	6.2	2.3–10.1	5.0	3.4–6.5
Age (years) 65+	5.3	4.1–6.6	4.8	2.7–7.0	5.7	4.2–7.1
Schooling 0–8 years	6.1	4.8–7.4	5.1	3.4–6.8	7.0	5.1–8.8
Schooling 9–11 years	7.0	5.7–8.3	6.7	4.5–9.0	7.3	5.8–8.7
Schooling 12+ years	5.9	4.6–7.1	6.4	4.2–8.6	5.4	4.0–6.8
Total	6.4	5.6–7.1	6.2	4.9–7.5	6.6	5.7–7.4

CI: confidence interval. Source: Vigitel, 2023.[334]

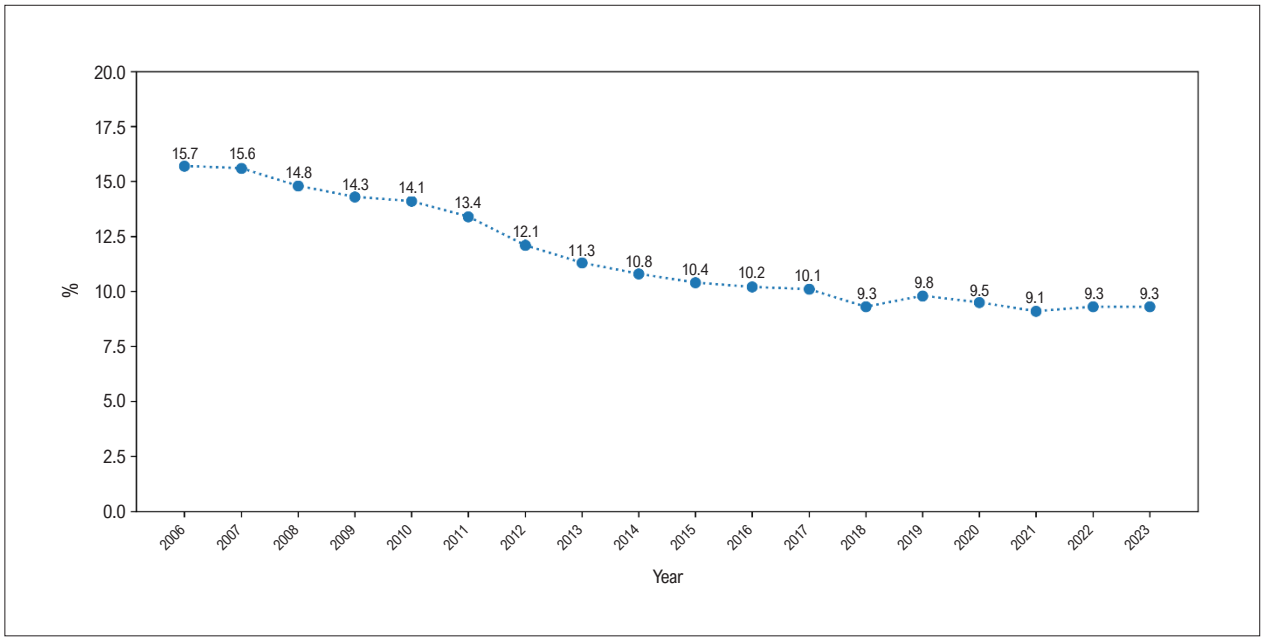

Chart 10.1 – *Prevalence trend of adult smokers (≥ 18 years) in Brazilian capitals and the Federal District. Source: Vigitel, 2006-2023.*[335]

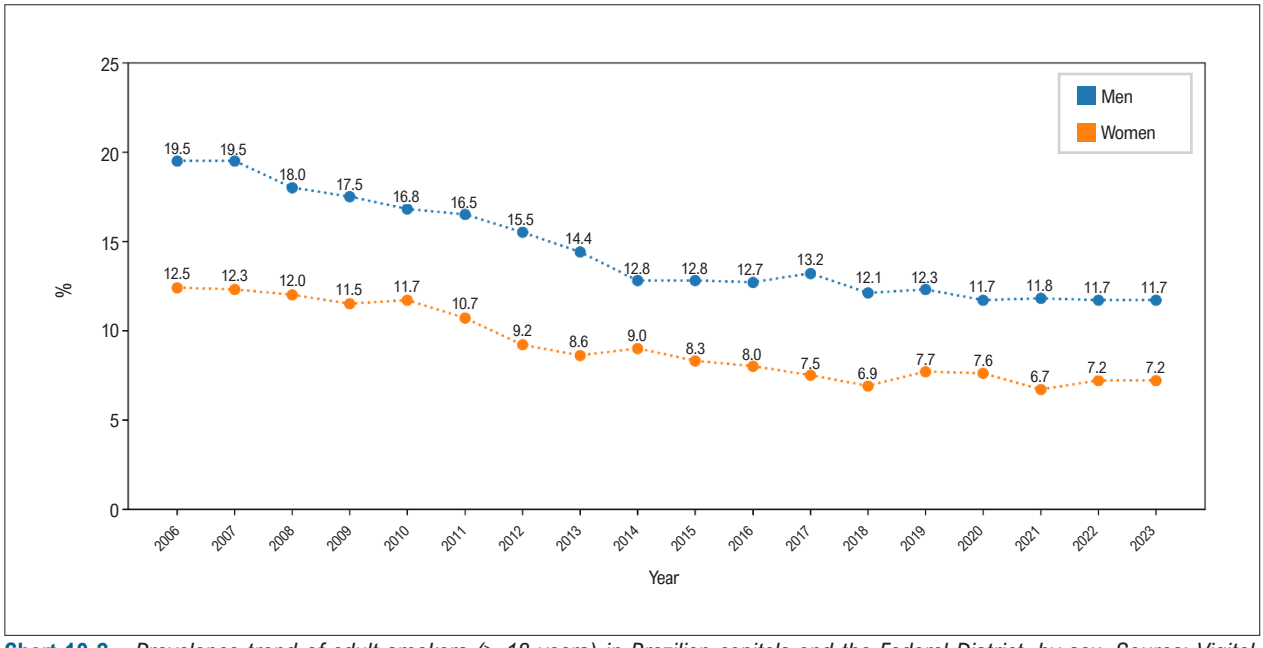

Chart 10.2 – *Prevalence trend of adult smokers (≥ 18 years) in Brazilian capitals and the Federal District, by sex. Source: Vigitel, 2006-2023.*[335]

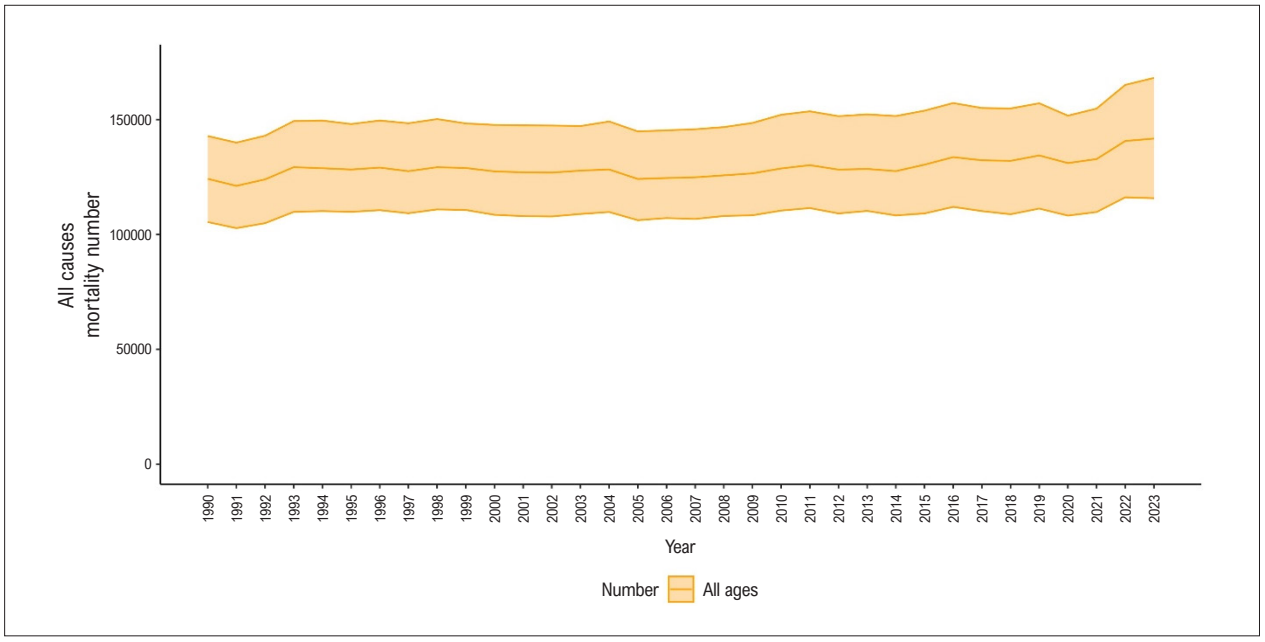

Chart 10.3 – *Numbers of deaths from all causes attributable to tobacco, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

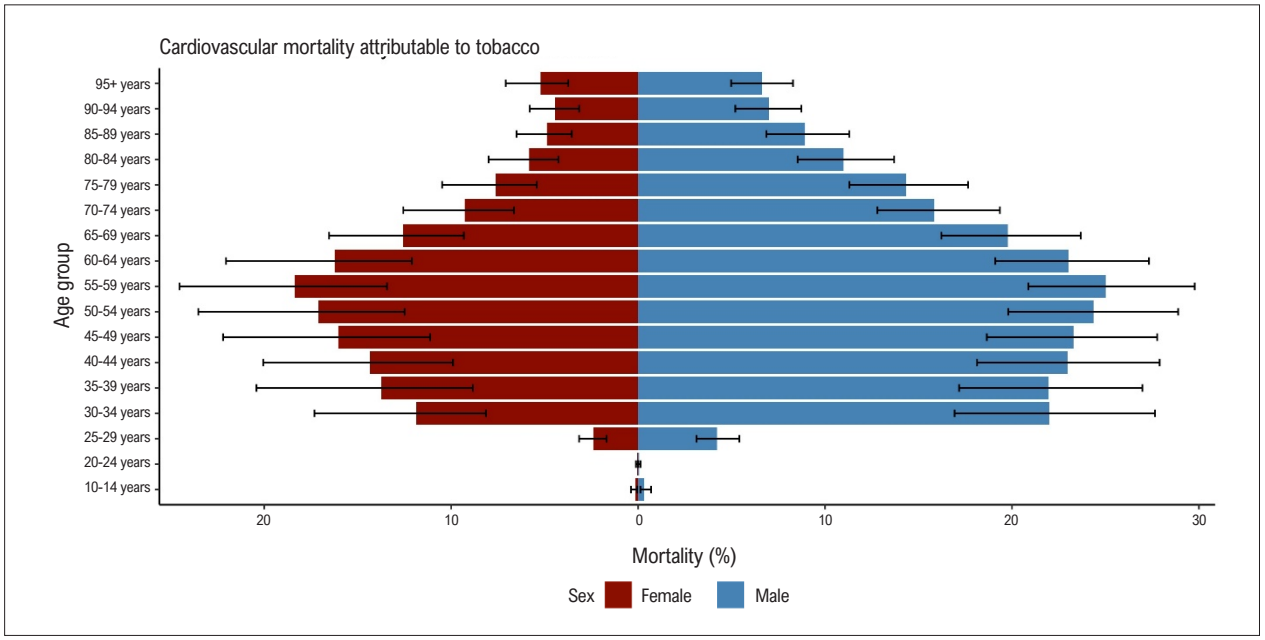

Chart 10.4 – *Cardiovascular mortality attributable to tobacco by age group and sex. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

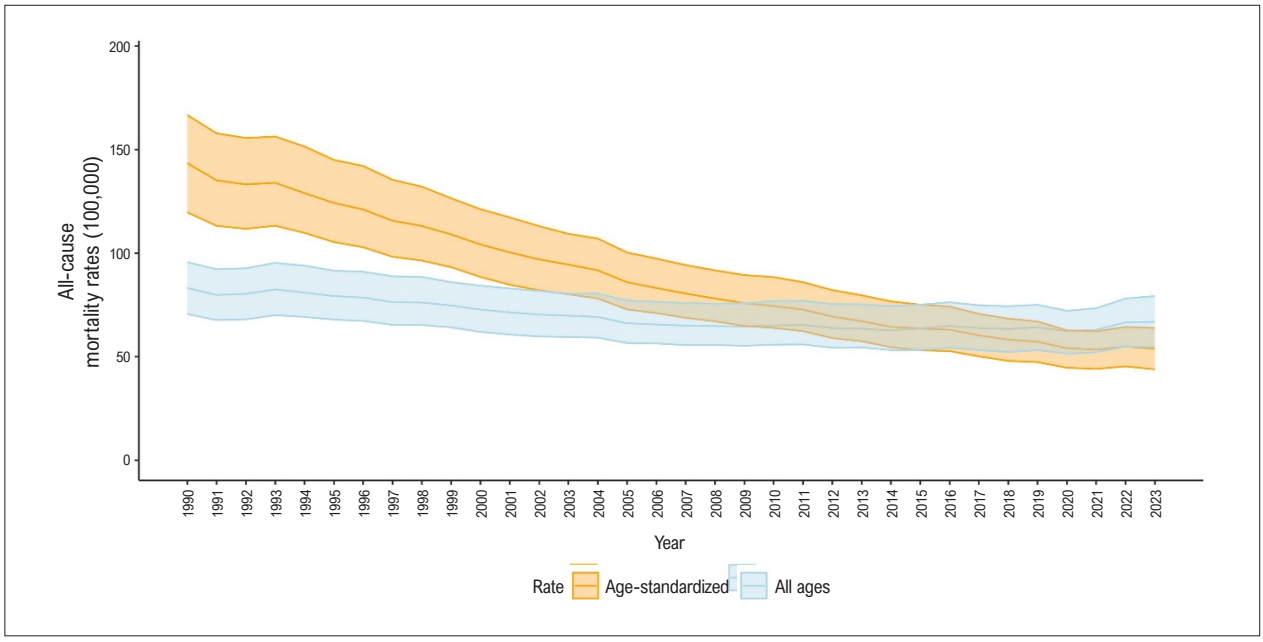

Chart 10.5 – *All-cause mortality rates attributable to tobacco, by sex, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

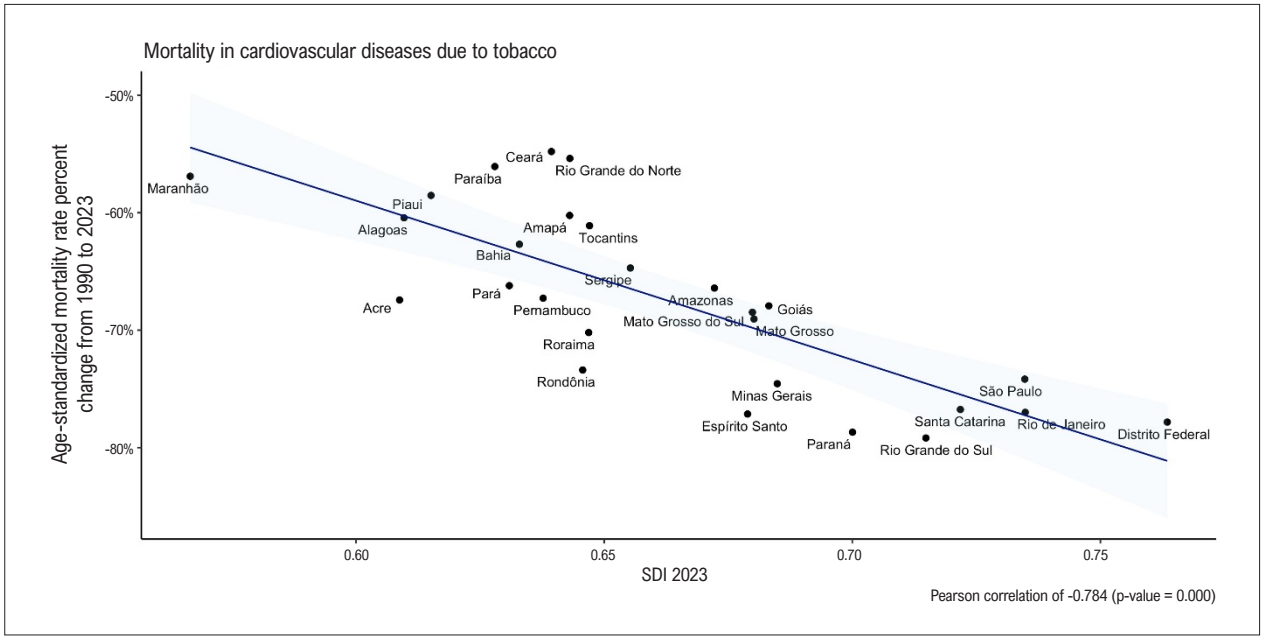

Chart 10.6 – *Correlation between the 2023 sociodemographic index (SDI) and the percent changes of age-standardized mortality rates due to cardiovascular diseases attributable to tobacco in the Brazilian Federative Units, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 11 - OBESITY

See Tables 11.1 through 11.4 and Charts 11.1 through 11.6.

Abbreviations used in chapter 11

AEPS	Annual Directory of Brazilian Social Security Statistics (in Portuguese, *Anuário Estatístico da Previdência Social*)
BMI	Body Mass Index
CI	Confidence Interval
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life-Year
ELSA-Brasil	The Brazilian Longitudinal Study of Adult Health (in Portuguese, *Estudo Longitudinal de Saúde do Adulto*)
EWGSOP2	European Working Group on Sarcopenia in Older People
FU	Federative Unit
GBD	Global Burden of Diseases, Injuries, and Risk Factors Study
ICD	International Statistical Classification of Diseases and Related Health Problems
ICU	Intensive Care Unit
MS	Metabolic Syndrome
NCD	Noncommunicable Disease
NCEP-ATP UII	National Cholesterol Education Program's Adult Treatment Panel UII
OECD	Organization for Economic Cooperation and Development
OR	Odds Ratio
pp	percentage point
SABE Survey	Brazilian Survey on Health, Well-being, and Aging (in Portuguese, *Inquérito SABE - Saúde, Bem-Estar e Envelhecimento*)
SDI	Sociodemographic Index
SIH/SUS	Inpatient Information System of the Brazilian Unified Health System (in Portuguese, *Sistema de Informação Hospitalar do SUS*)
SISVAN	Brazilian Food and Nutrition Monitoring System (in Portuguese, *Sistema de Vigilância Alimentar e Nutricional*)
SIVEP-Gripe	Brazilian Information System on Influenza Epidemiological Surveillance
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
UI	Uncertainty Interval
Vigitel	Telephone Survey for Surveillance of Noncommunicable Diseases (in Portuguese, *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*)

Overview

- Obesity is a widespread problem. A large study was published in 2025 on the progression of the prevalence of overweight and obesity in adults, from 1990 to 2021, with detailed projections up to 2050. The study used the structure of the *2021 Global Burden of Diseases, Injuries, and Risk Factors Study* (GBD) to estimate the prevalence of overweight and obesity in adults aged 25 years and older in 204 countries. Data were extracted from 1350 sources, including national research and literature, and 2.11 billion adults (around 45.1% of the global adult population) were estimated to live with overweight or obesity in 2021. China, India, and the United States of America had the highest absolute numbers of individuals affected, and Brazil was ranked fourth in the world. The highest age-adjusted prevalence rates were found in Oceania, Northern Africa and Middle East, exceeding 80% in several countries. Between 1990 and 2021, the global prevalence of obesity increased in a worrying way: 155.1% among men and 104.9% among women. If this trend continues, it is estimated that 3.80 billion adults will be overweight or obese in 2050, representing more than half of the world adult population.[345]
- The progression of population overweight and obesity in member countries of the Organization for Economic Cooperation and Development (OECD) and in Brazil has been analyzed by use of data on overweight and obesity prevalence made available by the OECD for its member countries and the Vigitel system (Telephone Survey for Surveillance of Non-Communicable Diseases) for Brazil. The study has shown a mean prevalence around 50% and a trend towards increase. In Brazil, the overweight and obesity prevalence increased significantly in the period analyzed: from around 45% in 2010 to 53.5% in 2020.[346]

Obesity and Multimorbidity

- The prevalence of multimorbidity (presence of at least two chronic diseases) and complex multimorbidity (presence of at least three chronic diseases or two chronic diseases of different organic systems) is extremely high in Brazilians with severe obesity, even at young ages and adults. A study on the prevalence of multimorbidity and complex multimorbidity in Brazilians aged 18-65 years and with body mass index (BMI) >35 kg/m^2, the frequencies of multimorbidity and of complex multimorbidity were 90.7% and 72.0%, respectively.[347]
- A population-based survey was conducted on the prevalence of self-reported noncommunicable diseases (NCDs) according to sex and age range, with 3119 residents of the Manguinhos slum complex (Rio de Janeiro city), where 37% were cisgender men and 63% were cisgender

women, and most participants (36.4%) were aged 45-64 years. Obesity was the second most frequently reported condition (men: 19%, women: 25.6%), after arterial hypertension (men: 29.7%, women: 36.3%). Obesity prevalence was higher among individuals aged 25-44 years, suggesting a transition from malnutrition to obesity, associated with changes in dietary patterns, increased access to ultra-processed foods, and sedentary lifestyle. Multimorbidity was more common among those self-identified as Brown or Black and the elderly, evidencing association of multimorbidity in an urban population exposed to precarious life conditions and socioeconomic vulnerability.[348]

Prevalence

- The prevalence data presented in this chapter were derived from the Vigitel 2024 survey for the adult population of the 26 Brazilian state and Distrito Federal capitals, which considered obesity as BMI ≥30 kg/m^2, calculated from weight in kilograms divided by height in meters squared, both self-reported according to the answers to the following questions: "Do you know your weight (even an approximate value)?" and "Do you know your height?".[237,334]
- Chart 11.1 shows the prevalence of obesity among individuals aged 18 years or older, by sex, in Brazilian capitals, from 2006 to 2024, according to Vigitel data. The percentage of adults (age ≥18 years) with obesity in 2024 was 25.7% (95% CI, 23.1% - 25.7%), a mean increase of 0.71 pp (percentage points)/year (observations weighted to adjust for the sociodemographic distribution of the sample), being 24.4% (95% CI, 21.8% - 24.4%) for men and 26.7% (95% CI, 23.2% - 26.7%) for women. A progressive increase of obesity has been observed from the beginning of the historical series, with an almost 100% increase from 2006 to 2023 for men and women.[237,334]
- The frequency of adults with obesity, between 2006 and 2023, ranged from 17.7% in Goiânia (95% CI, 14.3% - 21.0%) to 30.4% (95% CI, 26.0% - 34.9%) in Macapá. The highest frequencies of obesity were observed, among men, in Macapá (33.4%; 95% CI, 26.6% - 40.3%), Campo Grande (27.9%; 95% CI, 19.7% - 36.2%), and Porto Alegre (26.8%; 95% CI, 23.4% - 33.3%), and, among women, in Fortaleza (29.8%; 95% CI, 24.2% - 35.3%), Cuiabá (29.7%; 95% CI, 23.7% - 35.8%), and Porto Alegre (29.6%; 95% CI, 22.6% - 36.5%). The lowest frequencies of obesity were found, among men, in the Distrito Federal (16.9%; 95% CI, 11.4% - 22.4%), São Luís (17.3%; 95% CI, 11.3% - 23.3%), and Vitória (18.6%; 95% CI, 13.7% - 23.5%), and, among women, in Goiânia (15.9%; 95% CI, 12.0% - 19.9%), Palmas (17.3%; 95% CI, 13.0% - 21.5%), and Maceió (19.3%; 95% CI, 14.6% - 24.0%).[334]
- An increase in the percentage of obesity was found with age increase between 2006 and 2024 at all age ranges and education levels. Between 2006 and 2023, that percentage ranged from 14.4% among men (95% CI, 10.5% - 18.9%) and 11.8% (95% CI, 6.8% - 16.7%) among women in the age group of 18-24 years to 32.6% (95% CI, 27.4% - 37.8%) among men and 27.9% among women (95% CI, 24.0% - 31.0%) in the age group of 45-54 years. In the age group of 60+ years, there was a mild reduction in the prevalence of obesity, 18.2% (95% CI, 14.0% - 22.5%) among men and 25.5% (95% CI, 22.9% - 28.2%) among women. In the total population (22.7%; 95% CI, 20.5% - 24.8%) and women (20.4%; 95% CI, 17.9% - 22.8%), the frequency of obesity decreased with the increase in schooling. (Table 11.1) The highest increase was observed among adults aged 35-44 years, ranging from 12.8% in 2006 to 30.1% in 2024 (0.82 pp/year). Regarding the education level, the highest increase was observed among individuals with complete secondary education and incomplete higher education, ranging from 10.9% in 2006 to 25.9% in 2024 (0.87 pp/year).[237,334]
- The prevalence of obesity differs in different geographic contexts (urban and rural). In a cross-sectional study performed with 1162 individuals, obesity was more prevalent in urban areas (27.7%) as compared to rural ones (20.9%). Obesity was associated with worse quality of life measured using the WHOQOL-Bref questionnaire (assessing four domains: physical health, psychological health, social relationships, and environment). In addition, the rural area participants achieved higher quality of life scores in the physical health and environment domains as compared to the urban area participants.[349]
- A systematic review with meta-analysis of Brazilian representative cross-sectional studies published between 2006 and 2023 has shown obesity prevalence in Brazilian adults of 20.6% (95% CI, 19.0 - 22.3%). That prevalence was higher among women (23.0%) as compared to men (18.1%). Gender was associated with obesity, with a 47%-higher risk for obesity in women as compared to men (OR: 1.47; 95% CI, 1.38 - 1.58).[350]
- In addition, association with age was observed, indicating that the increase in age increases the risk for obesity (OR: 1.02; 95% CI, 1.02 - 1.02). Individuals with lower education level have a 32%-higher risk of obesity (OR: 1.32; 95% CI, 1.22 - 1.42). Sedentary lifestyle and low level of physical activity confer an 18%-higher risk for obesity (OR: 1.18; 95% CI, 1.09 - 1.29).[350]
- The consumption of sweetened beverages was associated with a 30%-higher risk of developing obesity (OR: 1.30; 95% CI, 1.17 - 1.45). Individuals with obesity had a 2.75-fold higher probability of having arterial hypertension (OR: 2.75; 95% CI, 2.49 - 3.03) and a 2.74-fold higher probability of having diabetes (OR: 2.74; 95% CI, 2.36 - 3.17).[350]
- A longitudinal cohort study with individuals aged 60 years or older living in the São Paulo municipality, followed up in three waves (2000, 2006, and 2010) and in a final wave in 2015, has assessed the progression of excess weight in Brazilian elderly over 15 years (2000 to 2015), using data from the SABE Survey (Health, Well-being, and Aging). Nutritional status was assessed using BMI to classify the individuals as 'with overweight/obesity' if BMI >27 kg/m^2, according to the cut-off point for the elderly. The overweight prevalence was persistently high among

the elderly, reaching over 60% in all years analyzed, and increased significantly over time (from 60.4% in 2000 to 64.6% in 2015). Overweigh was more prevalent in women than in men (in 2015, 68.1% vs 59.5%).[351]

- A cross-sectional study conducted with 191 elderly living in the state of São Paulo has assessed the prevalence of sarcopenia (muscle mass and strength loss), obesity, sarcopenic obesity, and the association of such conditions with metabolic syndrome (MS). Sarcopenia was diagnosed according to the European Working Group on Sarcopenia in Older People (EWGSOP2) criteria, while MS was diagnosed according to the National Cholesterol Education Program's Adult Treatment Panel UII (NCEP-ATP UII) criteria. Sarcopenia was found in 20.4%, obesity in 33.0%, sarcopenic obesity in 8.4%, and MS in 52.9%. Sarcopenic obesity showed the highest prevalence of MS, with which it was significantly associated (OR: 4.77; 95% CI, 1.51 - 15.08). In addition, obesity alone was significantly associated with MS (OR: 4.14; 95% CI, 2.05 - 8.36), while sarcopenia alone was not significantly associated with MS (OR: 1.41; 95% CI, 0.44 - 4.53). These findings suggest that the combination of excessive body fat and muscle mass loss significantly potentiates the metabolic risk in the elderly, requiring specialized attention and interventions that simultaneously approach body composition and metabolism.[352]

Incidence

- A remarkable influence of diet has been observed in the incidence of obesity. The consumption of traditional and healthy foods, such as beans and vegetables, has been associated with smaller weight gain and lower risk of obesity, while the consumption of ultra-processed foods, such as sweetened beverages and salty snacks, is associated with increased risk.[353] A dietary survey, using data from the food consumption modules from the 2008-2009 (n=21,003 adults) and 2017-2018 (n=28,153 adults) Brazilian Household Budget Survey, has assessed the changes in food consumption and nutritional status of adults in Brazil in the period from 2008-2009 to 2017-2018. That survey has observed that the overweight prevalence increased in both sexes in that period: among men, from 38.4% to 42.2%, and, among women, from 29.5% to 35.2%. Fast food consumption increased significantly among men and women in that period, while the consumption of traditional foods, such as rice, beans, and fruits, decreased. The study reinforces the need to encourage healthy dietary patterns that revive the country's food culture.[354]
- A Brazilian cohort study has used microdata from the Brazilian Food and Nutrition Monitoring System (SISVAN) to assess the association of dietary and sociodemographic factors with obesity in 30,354 adult women (20-59 years) followed up between 2015 and 2019. The study has reported an increase in those women's BMI in the period. The mean increase in BMI was smaller in women who consumed beans, vegetables, and/or pulses. Obesity incidence within 4 years was 11% higher in the group consuming sweetened beverages and 9% higher in the group consuming instant noodles, packaged snacks or savory biscuits. The risk of obesity was 20% higher in the age group of 40-49 years as compared to that of 20-29 years.[355]
- A study by Abbade *et al.* (2024) has reported, based on data from the Vigitel (2010-2019), an annual 0.09-kg/m^2 increase in mean BMI in Brazil, in addition to an increase in overweight and obesity rates of approximately 0.9% and 0.45% per year, respectively.[356]

Mortality Attributable to High BMI

- From 2010 to 2024, obesity accounted for 45,310 deaths in Brazil, a 75.3% increase in the period according to the 2024 Brazilian Health Ministry Epidemiological Bulletin. The year with the highest number of deaths was 2021, with 4,561 deaths registered. Projections indicate that overweight and obesity can account for over 1.2 million deaths and 10.9 million cases of chronic diseases in the next 20 years.[357]
- Chart 11.2 shows the age-standardized mortality rates, per 100,000 inhabitants, attributable to high BMI in Brazil in 2023. Diabetes mellitus (13.62, 95% UI, 5.94; 19.89), ischemic heart disease (9.53, 95% UI, 4.22; 14.83), chronic renal disease (7.39, 95% UI, 4.46; 10.3), hypertensive heart disease (6.70, 95% UI, 4.17; 8.89) and stroke (3.27, 95% UI, 0.37; 6.47) were the major causes of death associated with high BMI in 2023.[33]
- Chart 11.3 shows the proportional cardiovascular mortality attributable to high BMI in Brazil, stratified by sex and age range, in 2023. The highest proportional cardiovascular mortalities were observed among men aged 35-39 years, 40-44 years, and 24-49 years, around 21%, followed by women aged 40-44 years and 45-49 years, around 20%. The lowest proportional cardiovascular mortalities were observed in men aged 90-94 years and 95+ years, around 9%, followed by women aged 20-24 years and men aged 80-84 years, around 10%.[33]
- Chart 11.4 shows the trend of crude and age-standardized mortality rates due to cardiovascular disease (CVD) attributable to high BMI, from 1990 to 2023, in Brazil. There was an increase in the crude mortality rates per 100,000 inhabitants over the period, with higher rates registered in 2023 (25.6; 95% UI, 14.3; 36.9) as compared to 1990 (14.5; 95% UI, 7.8; 21.9). Conversely, the age-standardized mortality rates showed a reduction trend in the period, -18.1 (95% UI, -34.6; +0.4), with rates of 25.4 (95% UI, 13.9; 37.8) in 1990 and 20.8 (95% UI, 11.7; 29.9) in 2023, more marked from 2010 on.[33]
- Table 11.2 shows the numbers of deaths and age-standardized mortality rates due to CVD attributable to high BMI, per 100,000 inhabitants, in Brazil and Federative Units (FUs), in 1990 and 2023, stratified by sex, in addition to the percent change of the rates in the period. Regarding obesity in men, most FUs had a positive percent change in the rates of death from CVD attributable to high BMI, which ranged from +3.6% (95% UI, - 8.3; + 31.5) in Rondônia to +80.9% (95% UI, +39.7; +132.9) in Ceará, while the FUs with the highest negative percent changes were Distrito Federal and Rio de Janeiro [-34.2% (95% UI, -48.4; -20.8) and -29.2% (95% UI, -45.1; -12.2), respectively]. However,

among women, obesity had a different behavior, with most FUs showing a negative percent change of the mortality rates from CVD attributable to obesity, varying from -3.3% (95% UI, -27.1; +29.7) in Mato Grosso to -55.1% (95% UI, -66.2; -41.2) in Distrito Federal. The FUs with the highest positive percent changes among women were Maranhão and Ceará [74.7% (95% UI, +24.5; +148.6) and 12.2% (95% UI, -17.3; +48.7), respectively]. It is worth noting that, in Brazil, from 1990 to 2023, there was a reduction in the cardiovascular mortality rates attributable to obesity in both sexes, more marked in women [-31.9% (95% UI, -47.0%; -15.0%)] as compared to men [-1.1% (95% UI, -18.7%; +20.5%)].[33]

- Chart 11.5 shows the significant correlation of the sociodemographic index (SDI) in 2023 and the percent change of age-standardized mortality rates due to CVD attributable to high BMI, between 1990 and 2023, in all ages and both sexes. It is worth noting that the decrease in mortality from CVD attributable to high BMI correlated with the improvement in the socioeconomic conditions of the FUs observed in Distrito Federal, São Paulo, and Rio de Janeiro, which occupy the highest SDI strata in Brazil.[33]

Burden of Diseases Attributable to Obesity

- Chart 11.6 shows the trends of the rates of DALYs (Disability-Adjusted Life-Years) due to CVD attributable to high BMI, per 100,000 inhabitants, in both sexes, from 1990 to 2023, in Brazil. There is a trend towards increase in the crude DALY rates, while the age-standardized DALY rates show a decline trend in the period, and the two curves cross in the year 2013.[33]
- Table 11.3 shows the number of DALYs, the crude and age-standardized DALY rates, per 100,000 inhabitants, due to CVD attributable to high BMI in Brazil, in 1990 and 2023, stratified by age group and sex, and the percent change of the rates in the period, according to the 2023 GBD. Considering all ages, there was an increase in the number of DALYs due to CVD attributable to obesity of 79.3% (95% UI, +42.6%; +123.5%) in men and of 37.9% (95% UI, +5.9%; +76.7%) in women, especially in the age range of 15-49 years (+22.3; 95% UI, -7.4; +59.4), in the period studied. Regarding age-standardized rates, there was a reduction for both sexes of -17.8 (95% UI, -34.2; +0.3) in the period, being -31.9 (95% UI, -47.1; -14.3) for women and -2.7 (95% UI, -22.5; +19.8) for men.[33]
- Table 11.4 shows the numbers of DALYs, the age-standardized DALY rates, per 100,000 inhabitants, due to CVD attributable to high BMI in Brazil, in 1990 and 2023, stratified by geographic region and sex, in addition to the percent change of the rates in the period. There was a percent reduction in the burden of CVD attributable to obesity in all geographic regions, for both sexes, except for men in the Northeast and North regions, who showed a percent increase of 39.0% (95%UI, 12.1; 75.2) and 28.0% (95%UI, 0.5; 53.9), respectively. The highest percent reductions were observed among women in the Southeast and South regions [-41.1% (95%UI, -55.5; -26.0) and -40.7% (95%UI, -56.5; -23.7), respectively] followed by men in the same regions [-16.1% (95%UI, -35.5; 5.3) and -16.0% (95%UI, -36.2; 5.4), respectively], suggesting a higher negative gradient in regions of smaller socioeconomic vulnerability.[33]

Impact of the COVID-19 Pandemic

- The clinical and epidemiological characteristics of patients hospitalized with COVID-19 in addition to their frequency of intensive care unit (ICU) admission, use of invasive mechanical ventilation, and in-hospital mortality rates of individuals with and without obesity were analyzed in a cross-sectional study based on secondary data publicly available from the Brazilian Information System on Influenza Epidemiological Surveillance (SIVEP-Gripe). The study included 329,206 adults hospitalized with COVID-19, 26.3% of whom (n=86,444) were classified as having obesity.
- High rates of ICU admission, higher dependence on invasive mechanical ventilation, and increased in-hospital mortality were found among individuals with obesity in all age groups: 53.2% of patients with obesity required ICU admission as compared to 39.9% of those without obesity ($p<0.001$). The use of invasive mechanical ventilation was 34.8% for patients with obesity and 24.2% for those without obesity ($p<0.001$). The 28-day survival rate was 58.1% for patients with obesity and 59.8% for those without obesity in general ($p<0.001$), and, according to the age groups, as follows: 68.1% x 77.8% (<50 years), 57.1% x 69.4% (50-59 years), 47.9% x 59% (60-69 years), and 39.8% x 45.2% (≥70 years), respectively, all with $p<0.001$. Obesity was an independent risk factor for adverse outcomes in cases of COVID-19.[358]

Obesity-Associated Costs

- Obesity imposes significant direct and indirect costs on the government and represents a challenge to the sustainability of the health and social security systems. A study has assessed the prevalence of overweight/obesity in Brazil and their direct and indirect costs associated with obesity-related NCDs. The time series analysis used data from the Vigitel (2010–2019) to calculate the BMI of adults in the Brazilian capitals. For the costs, data on hospital admissions from the Inpatient Information System of the Brazilian Unified Health System (in Portuguese, *Sistema de Informação Hospitalar do SUS* - SIH/SUS) and on disability retirement and ill-health benefits from the AEPS Infologo systems were used, focusing on 23 diagnoses of NCDs highly correlated to BMI [chapters C, E, I, and K from the International Statistical Classification of Diseases and Related Health Problems (ICD)]. The regression analysis estimated the additional annual economic cost due to increase of obesity, using as metric the 1-point increase in average BMI or the 1% increase in obesity prevalence. For the 1-point increase in average BMI, Brazil would incur in additional: 81,772 new hospital admissions, costing R$ 237.51 million; 5,541 new disability retirement benefits, costing R$ 18.8 million; and 42,360 new ill-health benefits, costing R$ 131 million. With a 1% increase in

obesity prevalence, the impact would be 16,973 new hospital admissions (R$ 48.8 million), 1,202 new disability retirement benefits (R$ 3.97 million), and 8,686 new ill-health benefits (R$ 26.8 million).[359]

- A retrospective analysis of a time series (2011 to 2020) has assessed the evolution of the direct costs of hospital admissions due to obesity (and not to its comorbidities; ICD-10: E66 – Obesity) in the Brazilian Unified Health System (SUS) over 10 years. Data from the SIH/SUS were used, showing that, between 2011 and 2020, the total cost of admissions to the SUS directly attributable to obesity summed to over R$ 380 million, with a mean annual cost of R$ 38,077,587.41, that is over 7 million dollars. In that period, 333,649 admissions were registered. The mean total cost per admission increased from R$ 1,096.44 in 2011 to R$ 1,236.10 in 2020. The study confirmed the high direct cost of obesity for the SUS, reinforcing the need for increasing investment in obesity prevention and management programs to reduce the pressure on the hospital system.[359]
- Another study has projected the economic burden of NCDs attributable to overweight in Brazil from 2021 to 2030, based on overweigh prevalence in the Brazilian adult population (55.4% in 2019). The study considered 11 NCDs, including CVD, diabetes, and several types of cancer, in addition to direct costs (outpatient and in-hospital expenses in the SUS) and indirect costs (years of productive life lost due to premature mortality attributable to overweight). It was estimated that around 1.8 billion international dollars would be spent with the direct treatment of NCDs attributable to overweight, and CVDs (cerebrovascular and coronary artery diseases) would have the highest attributable direct costs, followed by cancer and chronic renal disease. The indirect costs, due to years of productive life lost, would be approximately 20.1 billion international dollars in the same period. The study calculated the total cost reduction (direct and indirect) up to 2030 in three scenarios of intervention: reduction by half in the annual BMI increase: reduction of 20.2 million international dollars; maintaining obesity prevalence constant at 2019 level: reduction of 40.8 million international dollars; a 6.7% reduction in obesity prevalence (gradual reduction up to 6.7% by 2030): reduction of 74.1 million international dollars. The results showed that interventions to reduce BMI/overweight can contribute to substantial savings in health and social security costs.[360]

Obesity and Lifestyle

- A cross-sectional study with 150 women of a certain Brazilian region has assessed the association of food consumption, physical activity, and abdominal obesity. Over half of the women (63.3%) had abdominal obesity and most (72.7%) had a high percentage of body fat, independently of their BMI. The intake of carbohydrates was above the recommended amount, the intake of proteins and lipids was below, and most women (78%) were classified as insufficiently active or sedentary.[361]
- A cross-sectional study, using data from the first follow-up (2012-2014) of the ELSA-Brasil cohort, has assessed leisure-time physical activity, categorized as 'sufficiently active' or 'insufficiently active', and sedentary behavior according to the time spent sitting and with screen-based activities, categorized as 'little time' or 'long time'. The combination of 'being sufficiently active' and 'little time spent with sedentary behavior' proved to contribute the most to prevent abdominal obesity in both sexes.[362]

Future Directions

- Obesity is a complex chronic disease with multiple impacts on health, in addition to severe economic consequences. The urgent need for multisectoral interventions, especially before 2030, to reverse the projection of the increases in obesity prevalence and obesity-related costs is emphasized worldwide.[345,363]
- In Brazil, the projected obesity epidemic reinforces the importance of primary prevention, with measures concerning the entire population, surveillance systems, and public health strategies. Obesity affects mainly the socioeconomically disadvantaged groups, which tend to have less access to health and worse health outcomes. Public health policies aimed at reducing social inequities might decrease the burden of disease for future generations, change the predicted trend, and protect vulnerable individuals.

Table 11.1 – Percentage* of adults (≥18 years) with obesity (BMI ≥30 kg/m²) in the adult population of the capitals of the Brazilian states and Distrito Federal, by sex, according to age groups and years of schooling

VARIABLES	SEX					
	Total		Male		Female	
	%	95% CI	%	95% CI	%	95% CI
Age (years)						
18 - 24	13.3	10.0 - 16.5	14.7	10.5 - 18.9	11.8	6.8 - 16.7
25 - 34	23.9	20.8 - 26.9	22.3	17.6 - 27.0	25.1	21.2 - 29.1
35 - 44	27.0	24.3 - 29.7	26.5	22.3 - 30.8	27.4	23.9 - 30.8
45 - 54	30.0	26.9 - 33.1	32.6	27.4 - 37.8	27.5	24.0 - 31.0
55 - 64	26.1	22.9 - 29.3	24.0	18.8 - 29.1	27.7	23.7 - 31.7
≥65	22.4	20.1 - 24.8	18.2	14.0 - 22.5	25.5	22.9 - 28.2
Years of schooling						
0 - 8	26.9	24.3 - 29.6	24.7	20.4 - 28.9	28.9	25.6 - 32.2
9 - 11	24.1	22.1 - 26.0	21.9	19.0 - 24.7	26.1	23.4 - 28.7
≥12	22.7	20.5 - 24.8	25.6	22.0 - 29.3	20.4	17.9 - 22.8
Total	24.3	23.1 - 25.6	23.8	21.8 - 25.8	24.8	23.2 - 26.4

**Percentage weighted to adjust the sociodemographic distribution of the Vigitel sample for the distribution of the adult population of each city projected to 2023. CI = Confidence Interval. Source: Vigitel 2023.[334] Data not available for 2022.*

Table 11.2 – Number of deaths, age-standardized mortality rates from cardiovascular diseases attributable to high body mass index (BMI), per 100,000 inhabitants, and percent change of the rates in the period, in Brazil and Federative Units, in 1990 and 2023, stratified by sex.

Sex and Location	Mortality from cardiovascular diseases attributable to high BMI Number, rate, and percent change (95% UI)				
	1990		2023		
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	Percent change of rates (95% UI)
Male					
Brazil	10.473,4 (5.749,4; 16.130,7)	25,3 (13,7; 38,1)	29.037,5 (15.393,9; 42.172,3)	25,0 (13,2; 36,2)	-1,1 (-18,7; 20,5)
North Region	382,1 (206,8; 585,6)	19,5 (10,9; 28,6)	1.861,4 (972,6; 2.762,3)	24,8 (13,3; 36,1)	27,3 (2,0; 53,8)
Acre	15,6 (9,4; 23,1)	17,5 (10,2; 26,0)	78,5 (42,6; 118,8)	23,2 (12,8; 35,1)	32,7 (-1,0; 69,1)
Amapá	8,9 (4,7; 13,8)	19,6 (10,7; 29,8)	66,6 (33,4; 103,1)	24,6 (12,2; 37,5)	25,6 (-6,0; 58,1)
Amazonas	68,2 (35,5; 105,4)	18,6 (9,9; 27,8)	365,7 (191,2; 547,6)	25,2 (13,8; 38,0)	35,3 (4,2; 67,7)
Pará	195,3 (102,1; 300,9)	19,3 (10,5; 29,3)	855,1 (459,3; 1.263,5)	23,7 (12,8; 35,0)	22,6 (-3,0; 53,1)
Rondônia	54,6 (30,6; 79,9)	25,9 (14,6; 36,8)	217,3 (117,2; 317,7)	26,9 (14,6; 39,1)	3,6 (-18,3; 31,5)
Roraima	6,9 (3,9; 10,2)	20,5 (12,0; 29,5)	60,2 (31,9; 85,9)	28,1 (15,9; 40,7)	37,2 (2,9; 74,9)
Tocantins	32,7 (18,8; 46,0)	19,0 (11,3; 29,2)	217,9 (123,0; 313,4)	27,1 (15,8; 39,2)	42,6 (6,4; 83,8)
Northeast Region	2.070,2 (1.212,5; 3.062,9)	17,8 (10,2; 26,0)	7.364,9 (4.059,4; 10.638,7)	24,7 (13,6; 35,8)	39,1 (11,7; 72,8)
Alagoas	127,8 (71,3; 187,2)	20,0 (11,3; 29,4)	493,1 (276,1; 716,5)	32,1 (18,3; 47,0)	60,5 (22,3; 102,3)
Bahia	493,1 (298,3; 696,9)	15,9 (9,6; 22,6)	1.688,8 (943,4; 2.453,5)	20,6 (11,5; 30,0)	29,7 (0,0; 66,0)
Ceará	213,8 (117,1; 329,1)	11,8 (6,5; 18,0)	1.049,0 (545,1; 1.517,2)	21,4 (11,1; 31,1)	80,9 (39,7; 132,9)
Maranhão	246,2 (132,7; 367,0)	19,9 (11,0; 29,6)	927,6 (517,7; 1.333,9)	28,7 (16,1; 41,1)	44,5 (9,4; 95,1)
Paraíba	171,7 (97,6; 257,9)	16,6 (9,6; 24,5)	606,0 (338,2; 871,8)	26,9 (15,1; 38,7)	61,9 (26,6; 109,2)
Pernambuco	497,6 (284,0; 756,7)	24,3 (13,9; 36,3)	1.327,6 (706,5; 1.928,0)	27,7 (15,0; 40,1)	14,2 (-7,3; 40,4)
Piauí	133,2 (79,2; 187,7)	19,8 (12,1; 27,5)	499,2 (241,4; 716,1)	26,5 (15,4; 38,0)	34,3 (0,8; 75,5)
Rio Grande do Norte	124,9 (69,3; 188,4)	17,1 (9,5; 26,2)	524,7 (293,4; 742,4)	27,9 (15,7; 39,6)	63,3 (25,3; 108,6)
Sergipe	61,8 (33,0; 94,2)	16,4 (8,7; 25,0)	248,9 (131,4; 362,3)	22,5 (12,0; 32,6)	37,6 (6,6; 81,8)
Southeast Region	5.713,5 (3.172,8; 8.812,6)	30,2 (16,2; 45,6)	13.195,5 (7.141,4; 19.534,9)	25,3 (13,5; 37,4)	-16,1 (-33,6; 4,6)
Espírito Santo	160,8 (84,1; 238,6)	22,7 (12,4; 33,4)	592,0 (361,1; 801,3)	26,0 (15,9; 35,3)	14,5 (-10,0; 55,2)
Minas Gerais	1.073,6 (619,0; 1.593,7)	23,1 (13,3; 33,6)	2.533,3 (1.373,9; 3.807,8)	19,1 (10,4; 28,5)	-17,4 (-34,6; 6,0)
Rio de Janeiro	1.741,2 (947,3; 2.647,3)	41,1 (21,6; 62,9)	2.904,8 (1.576,2; 4.279,9)	29,1 (15,4; 42,6)	-29,2 (-45,1; -12,2)
São Paulo	2.738,0 (1.472,6; 4.278,1)	29,4 (15,5; 44,1)	7.165,4 (3.868,4; 10.662,5)	26,9 (14,3; 40,1)	-8,5 (-26,9; 14,2)
South Region	1.828,9 (920,2; 2.899,1)	28,5 (14,3; 44,9)	4.508,9 (2.404,4; 6.635,7)	24,9 (13,4; 35,7)	-12,5 (-33,1; 11,6)
Paraná	664,5 (350,0; 1.036,6)	28,6 (14,7; 44,0)	1.719,9 (944,5; 2.513,1)	25,7 (14,1; 37,2)	-10,2 (-31,1; 14,7)
Rio Grande do Sul	877,2 (421,2; 1.391,0)	30,0 (14,7; 48,6)	1.793,4 (937,0; 2.574,6)	24,8 (12,9; 35,6)	-17,3 (-36,8; 5,8)
Santa Catarina	287,6 (143,6; 444,3)	24,7 (12,3; 37,7)	995,6 (535,9; 1.452,2)	23,9 (12,9; 34,8)	-3,2 (-25,4; 28,1)
West-Central Region	478,6 (261,4; 723,6)	21,4 (11,7; 31,5)	2.106,8 (1.140,1; 3.109,1)	25,1 (13,7; 36,9)	17,3 (-6,0; 42,2)
Distrito Federal	76,4 (45,6; 111,4)	27,2 (16,0; 38,8)	237,4 (132,2; 345,7)	17,9 (10,0; 26,1)	-34,2 (-48,4; -20,8)
Goiás	195,5 (103,5; 294,3)	18,7 (10,0; 27,9)	899,2 (487,0; 1.330,5)	23,8 (12,8; 35,3)	27,5 (0,8; 60,7)
Mato Grosso	86,5 (46,4; 132,5)	19,8 (10,9; 29,4)	505,3 (292,5; 728,2)	28,4 (16,3; 41,6)	43,6 (11,4; 83,1)
Mato Grosso do Sul	120,1 (64,4; 187,2)	25,8 (14,0; 38,9)	464,9 (251,2; 678,5)	31,0 (17,2; 45,2)	19,9 (-8,9; 48,5)

Sex and Location	Mortality from cardiovascular diseases attributable to high BMI Number, rate, and percent change (95% UI)				
	1990		2023		
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	Percent change of rates (95% UI)
Female					
Brazil	11.106,7 (5.980,7; 16.559,9)	25,1 (14,0; 38,0)	25.299,2 (14.761,7; 35.312,2)	17,1 (10,0; 23,9)	-31,9 (-47,0; -15,0)
North Region	355,8 (185,8; 544,4)	20,0 (11,0; 29,4)	1.338,9 (757,3; 1.929,0)	16,9 (9,9; 24,3)	-15,2 (-32,0; 7,0)
Acre	14,9 (7,9; 22,8)	21,2 (11,5; 32,1)	63,6 (36,4; 93,0)	18,3 (10,6; 26,7)	-14,0 (-34,2; 10,2)
Amapá	8,3 (4,1; 13,0)	15,8 (8,1; 24,7)	45,9 (24,0; 69,8)	16,1 (8,5; 24,2)	2,0 (-22,7; 31,0)
Amazonas	67,4 (33,2; 105,1)	19,6 (10,5; 29,6)	258,8 (143,8; 379,5)	16,4 (9,3; 24,1)	-16,2 (-36,9; 5,8)
Pará	188,0 (98,4; 287,5)	19,2 (10,2; 28,8)	612,7 (325,8; 922,8)	15,7 (8,5; 23,7)	-18,0 (-36,7; 8,9)
Rondônia	41,6 (22,7; 63,0)	20,2 (17,0; 45,1)	159,4 (93,7; 222,2)	20,4 (12,6; 29,1)	-32,4 (-47,8; -11,6)
Roraima	5,2 (3,0; 8,0)	23,6 (13,8; 34,4)	38,0 (21,4; 55,2)	20,0 (12,0; 28,9)	-15,5 (-35,9; 13,1)
Tocantins	30,5 (19,0; 44,3)	21,6 (12,5; 32,9)	160,6 (97,5; 227,1)	20,1 (12,1; 28,6)	-7,0 (-34,4; 21,9)
Northeast Region	2.394,7 (1.346,3; 3.530,7)	18,7 (10,7; 27,8)	6.843,2 (3.894,5; 9.788,2)	18,0 (10,3; 26,0)	-3,9 (-26,7; 25,1)
Alagoas	156,8 (83,8; 240,6)	23,0 (12,5; 34,9)	474,2 (272,9; 686,5)	24,6 (14,1; 35,6)	6,8 (-21,6; 42,6)
Bahia	640,4 (388,2; 917,3)	18,4 (11,2; 26,2)	1.737,8 (987,1; 2.511,0)	16,8 (9,2; 24,1)	-8,3 (-30,3; 21,5)
Ceará	268,9 (139,0; 413,3)	13,5 (7,0; 20,7)	954,9 (549,6; 1.421,3)	15,1 (8,8; 22,7)	12,2 (-17,3; 48,7)
Maranhão	141,0 (70,4; 215,4)	11,8 (6,2; 18,4)	774,2 (433,7; 1.119,2)	20,7 (11,5; 29,9)	74,2 (24,5; 148,6)
Paraíba	229,0 (125,5; 338,4)	20,3 (11,0; 30,1)	576,6 (325,7; 840,8)	18,9 (10,9; 27,7)	-5,5 (-31,1; 27,7)
Pernambuco	628,3 (353,5; 930,4)	26,8 (15,1; 39,8)	1.239,6 (713,7; 1.852,8)	19,3 (11,0; 28,9)	-28,0 (-47,3; -6,5)
Piauí	125,9 (74,1; 186,2)	18,4 (10,6; 27,4)	445,8 (244,7; 637,9)	19,2 (10,6; 27,6)	4,6 (-26,5; 41,6)
Rio Grande do Norte	121,9 (68,5; 191,3)	15,0 (8,5; 23,2)	406,0 (227,6; 592,6)	16,5 (9,4; 24,2)	10,3 (-16,8; 49,8)
Sergipe	82,5 (43,5; 129,2)	19,9 (10,7; 31,2)	234,1 (125,5; 332,3)	16,3 (8,7; 23,2)	-17,8 (-39,6; 7,2)
Southeast Region	6.079,0 (3.255,5; 9.286,3)	29,3 (16,0; 44,7)	11.630,1 (6.809,9; 16.510,4)	16,9 (9,7; 24,1)	-42,4 (-56,7; -26,8)
Espírito Santo	157,5 (84,1; 240,4)	22,3 (12,2; 33,6)	511,7 (310,1; 704,0)	18,0 (11,0; 24,9)	-19,2 (-41,9; 9,3)
Minas Gerais	1.144,7 (662,6; 1.675,5)	23,0 (13,3; 32,2)	2.306,9 (1.349,9; 3.345,8)	13,9 (8,0; 20,3)	-39,5 (-51,1; -22,0)
Rio de Janeiro	1.790,4 (952,6; 2.747,4)	34,5 (18,8; 52,6)	2.600,8 (1.456,2; 3.848,5)	18,5 (10,2; 27,4)	-46,3 (-59,2; -31,1)
São Paulo	2.986,3 (1.559,8; 4.578,7)	30,4 (16,5; 46,9)	6.210,7 (3.644,7; 8.943,1)	17,6 (10,3; 25,4)	-42,1 (-56,0; -27,9)
South Region	1.831,0 (939,7; 2.808,7)	26,5 (14,0; 40,7)	3.854,4 (2.218,7; 5.361,2)	16,4 (9,5; 22,9)	-38,0 (-54,4; -19,1)
Paraná	656,0 (346,8; 999,0)	28,6 (15,5; 44,1)	1.355,7 (778,3; 1.900,8)	16,2 (9,2; 22,7)	-43,3 (-58,0; -27,2)
Rio Grande do Sul	876,4 (441,9; 1.345,4)	25,8 (13,4; 39,8)	1.628,5 (924,0; 2.303,2)	16,4 (9,4; 23,5)	-36,3 (-54,1; -16,4)
Santa Catarina	298,5 (159,1; 480,4)	24,7 (13,6; 38,9)	870,3 (500,2; 1.227,1)	17,1 (9,7; 24,2)	-31,0 (-50,1; -6,9)
West-Central Region	446,3 (236,4; 672,3)	22,6 (12,5; 33,5)	1.692,5 (994,8; 2.330,1)	17,1 (10,3; 24,6)	-24,4 (-42,4; -3,7)
Distrito Federal	78,8 (44,1; 119,8)	25,9 (14,9; 38,7)	200,8 (112,5; 299,4)	11,7 (6,4; 17,3)	-55,1 (-66,2; -41,2)
Goiás	193,5 (102,0; 298,2)	20,7 (11,4; 31,1)	692,3 (401,0; 1.007,0)	16,2 (9,5; 23,5)	-21,5 (-41,4; 0,7)
Mato Grosso	68,2 (36,8; 107,4)	20,6 (11,6; 31,1)	355,7 (213,5; 504,2)	19,9 (11,7; 28,5)	-3,3 (-27,1; 29,7)
Mato Grosso do Sul	105,7 (54,4; 158,9)	26,5 (14,5; 39,0)	383,7 (227,3; 556,7)	22,4 (13,3; 32,5)	-15,4 (-35,7; 10,3)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 11.3 – Numbers of DALYs (Disability-Adjusted Life Years), crude and age-standardized DALY rates due to cardiovascular diseases attributable to high body mass index (BMI) in Brazil, in 1990 and 2023, stratified by age group and sex, and percent change of the rates in the period.

			DALYs due to cardiovascular diseases attributable to high BMI Number, rate, and percent change (95% UI)				
			1990		2023		
Sex	Age group	Location	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	Percent change of rates (95% UI)
Male							
	15-49 years	Brazil	102.077,9 (51.305,9; 159.564,3)	270,0 (135,7; 422,1)	193.470,6 (94.267,7; 280.067,4)	357,9 (174,4; 518,1)	32,5 (0,5; 68,1)
	50-69 years	Brazil	164.433,9 (86.663,2; 249.610,9)	2.177,7 (1.147,7; 3.305,7)	411.818,9 (214.736,2; 604.493,0)	2.015,1 (1.050,7; 2.957,8)	-7,5 (-26,5; 13,2)
	70+ years	Brazil	54.949,6 (32.651,8; 80.112,8)	2.882,5 (1.712,8; 4.202,6)	199.330,1 (119.401,7; 283.845,4)	3.103,9 (1.859,3; 4.419,9)	7,7 (-14,0; 34,4)
	All ages	Brazil	321.461,4 (173.710,0; 503.461,4)	435,5 (235,3; 682,1)	804.619,7 (425.017,6; 1.172.918,7)	780,8 (412,4; 1.138,2)	79,3 (42,6; 123,5)
	Age-standardized	Brazil	NA	682,8 (369,4; 1.062,2)	NA	664,2 (352,9; 966,2)	-2,7 (-22,5; 19,8)
Female							
	15-49 years	Brazil	71.560,0 (31.915,1; 118.162,3)	183,3 (81,7; 302,6)	110.168,1 (50.233,2; 165.272,9)	197,3 (90,0; 296,0)	7,7 (-21,0; 56,0)
	50-69 years	Brazil	143.537,7 (74.533,3; 222.075,3)	1.752,7 (910,1; 2.711,7)	257.394,9 (133.689,3; 377.689,1)	1.107,5 (575,2; 1.625,1)	-36,8 (-52,3; -21,2)
	70+ years	Brazil	83.206,4 (46.529,6; 123.790,9)	3.512,7 (1.964,3; 5.226,0)	226.390,0 (132.685,1; 321.715,9)	2.590,1 (1.518,0; 3.680,7)	-26,3 (-43,2; -6,4)
	All ages	Brazil	298.304,1 (155.973,1; 456.788,8)	395,0 (206,5; 604,9)	593.952,9 (319.256,6; 865.865,9)	544,8 (292,8; 794,2)	37,9 (5,9; 76,7)
	Age-standardized	Brazil	NA	603,3 (313,9; 924,7)	NA	411,1 (219,9; 600,8)	-31,9 (-47,1; -14,3)
Both							
	15-49 years	Brazil	173.637,8 (83.329,8; 275.483,6)	225,9 (108,4; 358,5)	303.638,7 (145.428,3; 444.710,5)	276,3 (132,3; 404,7)	22,3 (-7,4; 59,4)
	50-69 years	Brazil	307.971,6 (159.668,9; 476.765,5)	1.956,5 (1.014,4; 3.028,9)	669.213,8 (352.840,1; 972.807,7)	1.532,2 (807,8; 2.227,2)	-21,7 (-37,5; -5,6)
	70+ years	Brazil	138.156,0 (77.392,9; 203.492,6)	3.231,7 (1.810,4; 4.760,0)	425.720,1 (256.447,6; 597.430,4)	2.807,7 (1.691,3; 3.940,1)	-13,1 (-30,8; 7,7)
	All ages	Brazil	619.765,4 (331.240,3; 946.237,4)	415,0 (221,8; 633,7)	1.398.572,6 (746.675,2; 2.003.920,5)	659,5 (352,1; 944,9)	58,9 (27,2; 96,3)
	Age-standardized	Brazil	NA	644,3 (342,1; 981,3)	NA	529,8 (281,3; 760,0)	-17,8 (-34,2; 0,3)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 11.4 – Number of DALYs (Disability-Adjusted Life Years), age-standardized DALY rates due to cardiovascular diseases attributable to high body mass index (BMI) in Brazil, in 1990 and 2023, stratified by geographic region and sex, and percent change of the rates in the period.

	DALYs due to cardiovascular diseases attributable to high BMI Number, rate, and percent change (95% UI)				
	1990		2023		
Sex and Location	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	Percent change of rates (95% UI)
Male					
Brazil	321.461,4 (173.710,0; 503.461,4)	682,8 (369,4; 1.062,2)	804.619,7 (425.017,6; 1.172.918,7)	664,2 (352,9; 966,2)	-2,7 (-22,5; 19,8)
North Region	11.900,3 (6.257,3; 18.645,7)	498,6 (267,1; 769,0)	52.989,5 (28.024,6; 78.019,3)	638,2 (338,5; 943,4)	28,0 (0,5; 53,9)
Northeast Region	60.115,3 (33.830,6; 91.063,2)	477,0 (266,5; 720,2)	203.751,4 (108.224,2; 293.266,5)	662,9 (353,5; 952,7)	39,0 (12,1; 75,2)
Southeast Region	178.962,8 (96.128,2; 277.761,6)	821,1 (450,7; 1.274,0)	370.131,6 (192.595,7; 549.698,5)	688,6 (359,6; 1.020,7)	-16,1 (-35,5; 5,3)
South Region	54.842,0 (27.254,5; 87.108,1)	736,9 (365,6; 1.164,6)	118.437,2 (61.717,3; 173.317,7)	618,9 (323,7; 908,1)	-16,0 (-36,2; 5,4)
West-Central Region	15.641,1 (8.494,4; 23.905,6)	578,0 (311,4; 875,9)	59.310,0 (31.857,5; 87.108,4)	651,8 (353,9; 954,8)	12,8 (-10,3; 39,2)
Female					
Brazil	298.304,1 (155.973,1; 456.788,8)	603,3 (313,9; 924,7)	593.952,9 (319.256,6; 865.865,9)	411,1 (219,9; 600,8)	-31,9 (-47,1; -14,3)
North Region	9.806,9 (5.134,5; 15.561,8)	464,0 (236,6; 721,6)	34.173,1 (17.774,5; 51.228,2)	403,4 (214,0; 599,3)	-13,0 (-31,6; 8,7)
Northeast Region	63.686,9 (34.096,6; 96.206,8)	463,1 (250,1; 695,8)	162.899,4 (88.460,7; 242.491,4)	443,2 (243,3; 661,0)	-4,3 (-28,0; 24,6)
Southeast Region	162.627,1 (83.049,8; 252.930,7)	697,8 (361,4; 1.080,0)	271.739,5 (146.342,9; 388.570,5)	410,9 (218,0; 589,1)	-41,1 (-55,5; -26,0)
South Region	48.694,5 (24.343,0; 77.260,7)	623,1 (315,7; 979,3)	84.763,7 (46.638,3; 123.203,1)	369,4 (200,6; 537,9)	-40,7 (-56,5; -23,7)
West-Central Region	13.488,6 (6.918,5; 20.911,9)	562,7 (294,3; 863,2)	40.377,2 (21.862,5; 58.673,9)	403,1 (220,8; 585,7)	-28,4 (-44,9; -8,4)
Both					
Brazil	619.765,4 (331.240,3; 946.237,4)	644,3 (342,1; 981,3)	1.398.572,6 (746.675,2; 2.003.920,5)	529,8 (281,3; 760,0)	-17,8 (-34,2; 0,3)
North Region	21.707,2 (11.345,3; 33.701,1)	484,4 (254,2; 728,3)	87.162,5 (46.422,2; 127.643,3)	519,1 (276,3; 757,5)	7,2 (-16,1; 28,0)
Northeast Region	123.802,2 (68.660,3; 185.569,1)	470,3 (261,5; 701,7)	366.650,8 (196.673,0; 532.189,7)	545,9 (292,3; 792,8)	16,1 (-7,6; 42,2)
Southeast Region	341.589,8 (179.061,9; 523.671,6)	761,2 (404,5; 1.164,3)	641.871,1 (341.849,8; 915.949,9)	540,4 (286,3; 769,7)	-29,0 (-44,7; -13,1)
South Region	103.536,5 (51.993,5; 162.238,8)	680,7 (340,5; 1.073,1)	203.200,9 (108.448,4; 296.290,3)	486,4 (254,8; 709,4)	-28,6 (-45,2; -12,2)
West-Central Region	29.129,7 (15.712,8; 44.417,8)	571,2 (306,9; 861,9)	99.687,2 (53.926,6; 141.736,3)	521,6 (280,7; 742,6)	-8,7 (-27,9; 13,2)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

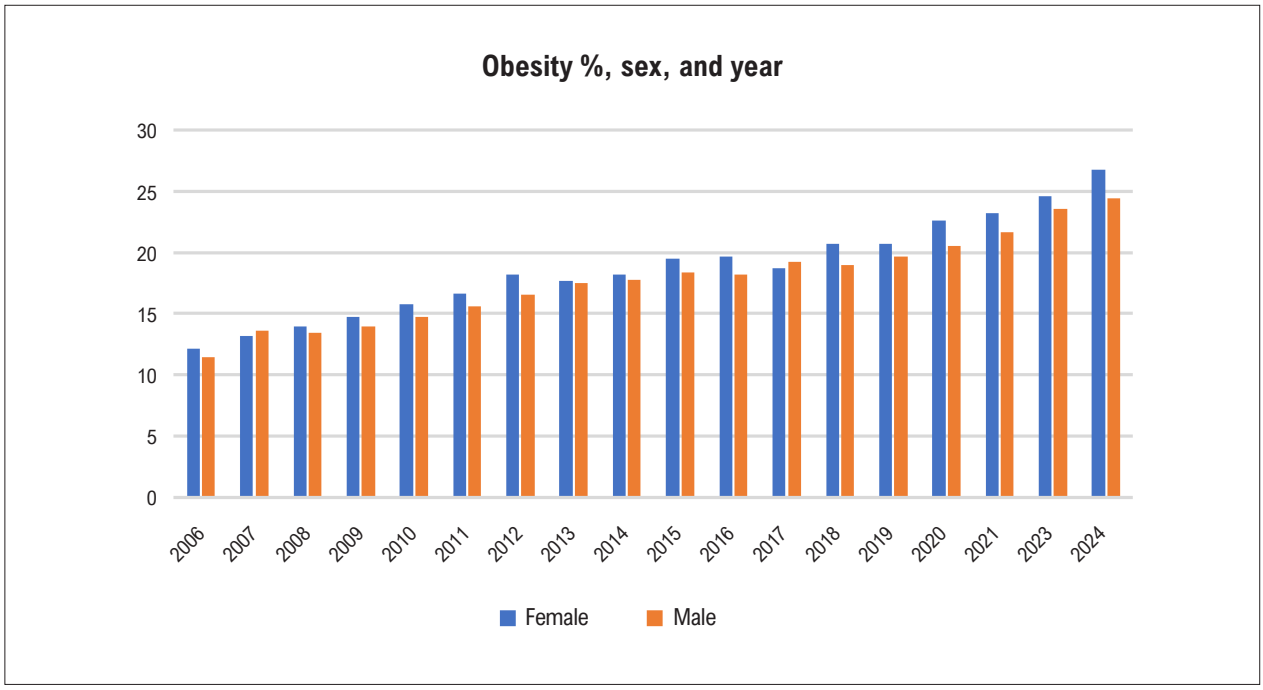

Chart 11.1 – *Percentage* of adults (≥18 years) with obesity (BMI ≥30 kg/m2), by sex, in the capitals of the Brazilian states and Distrito Federal. Source: Vigitel, 2024.[237] Data not available for 2022.*

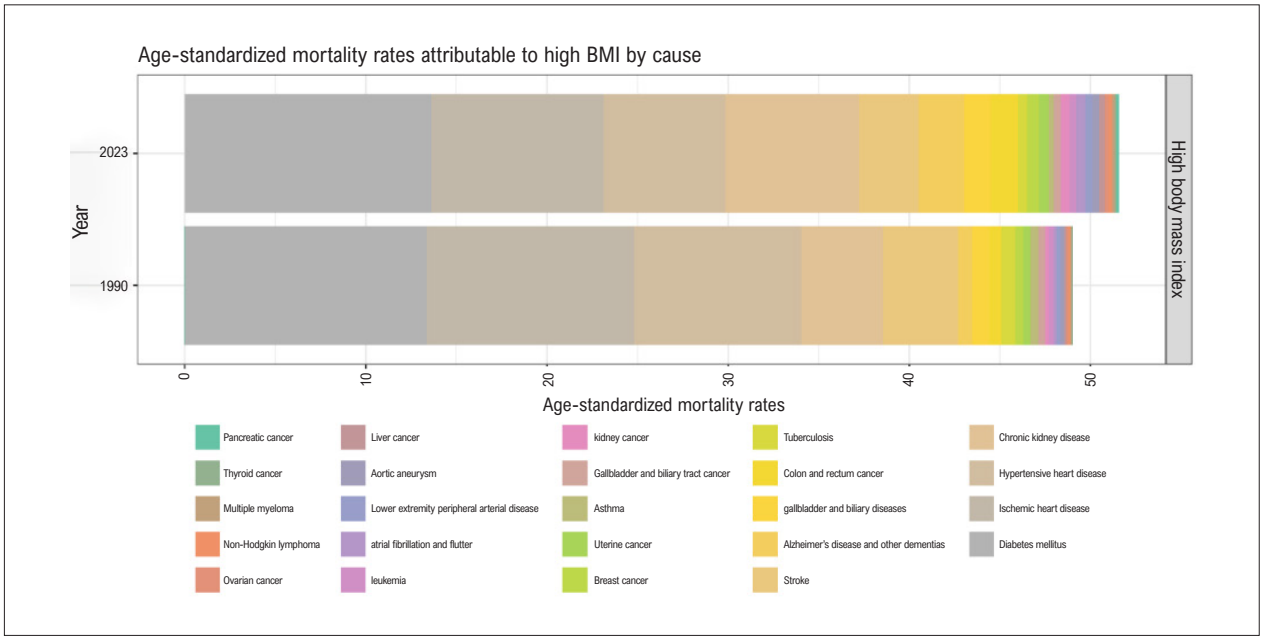

Chart 11.2 – *Age-standardized mortality rates attributable to high body mass index (BMI) in Brazil, according to their causes, in 1990 and 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]*

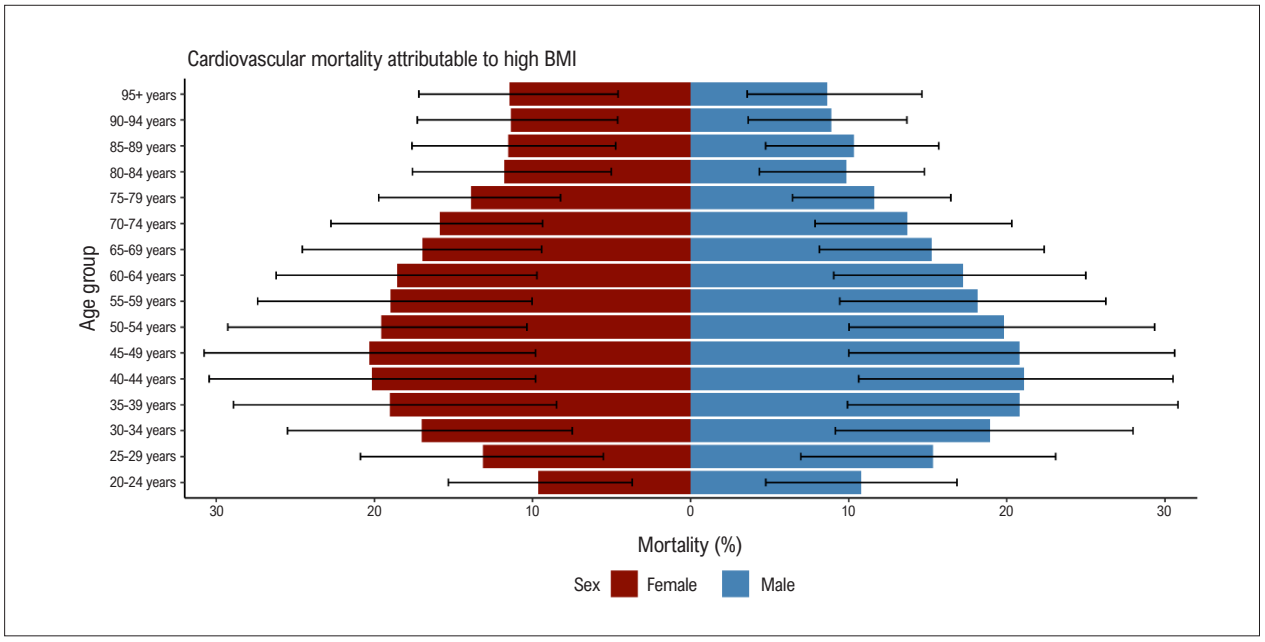

Chart 11.3 – *Proportional cardiovascular mortality attributable to high body mass index (BMI), stratified by sex and age group, in 2023, in Brazil. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

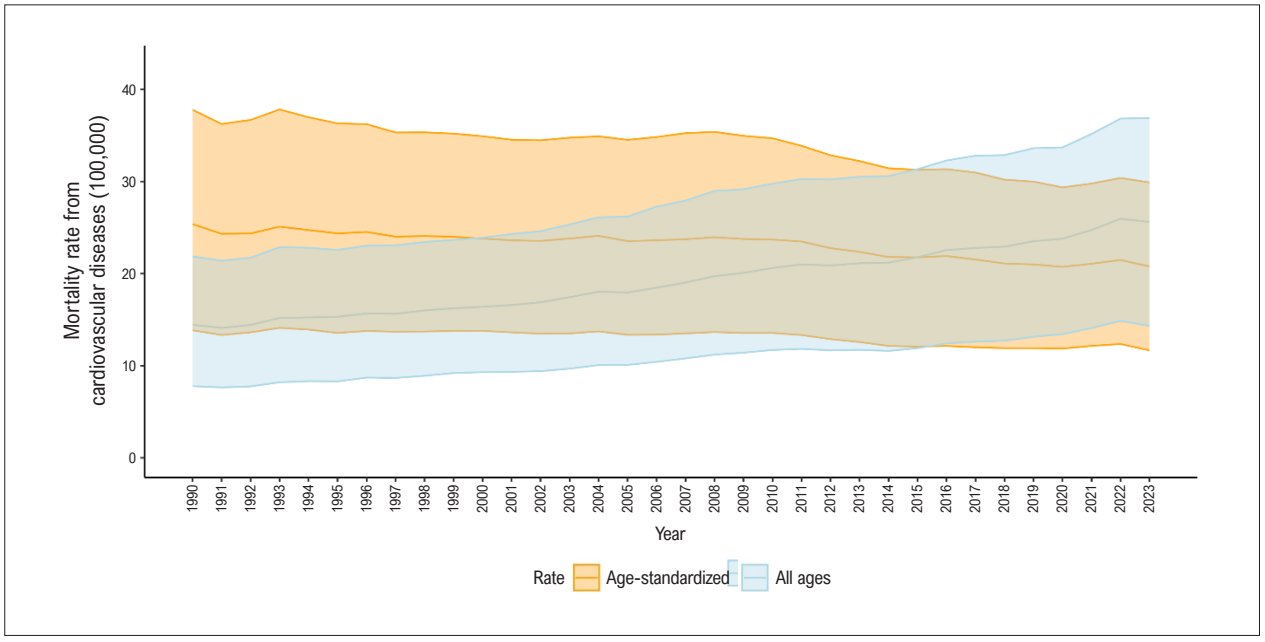

Chart 11.4 – *Time series of the crude and age-standardized mortality rates from cardiovascular diseases attributable to high body mass index (BMI), per 100,000 inhabitants, from 1990 to 2023, in Brazil. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

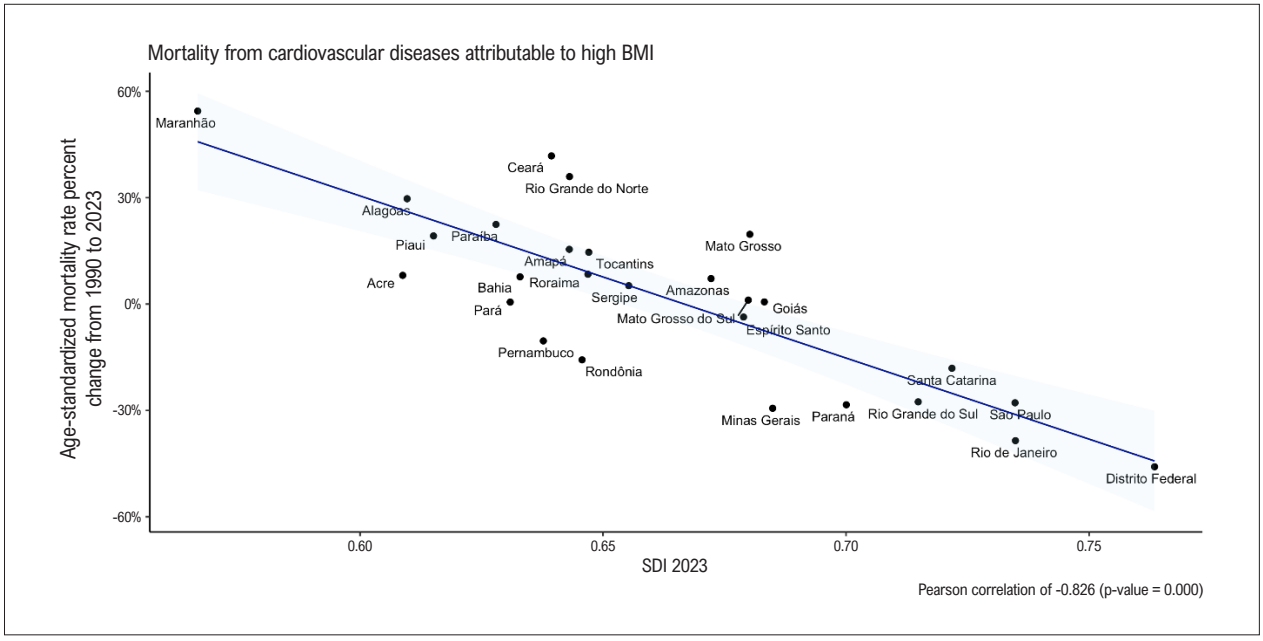

Chart 11.5 – *Correlation between the sociodemographic index (SDI) in 2023 and the percent change of the age-standardized mortality rates from cardiovascular disease attributable to high body mass index (BMI), from 1990 to 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

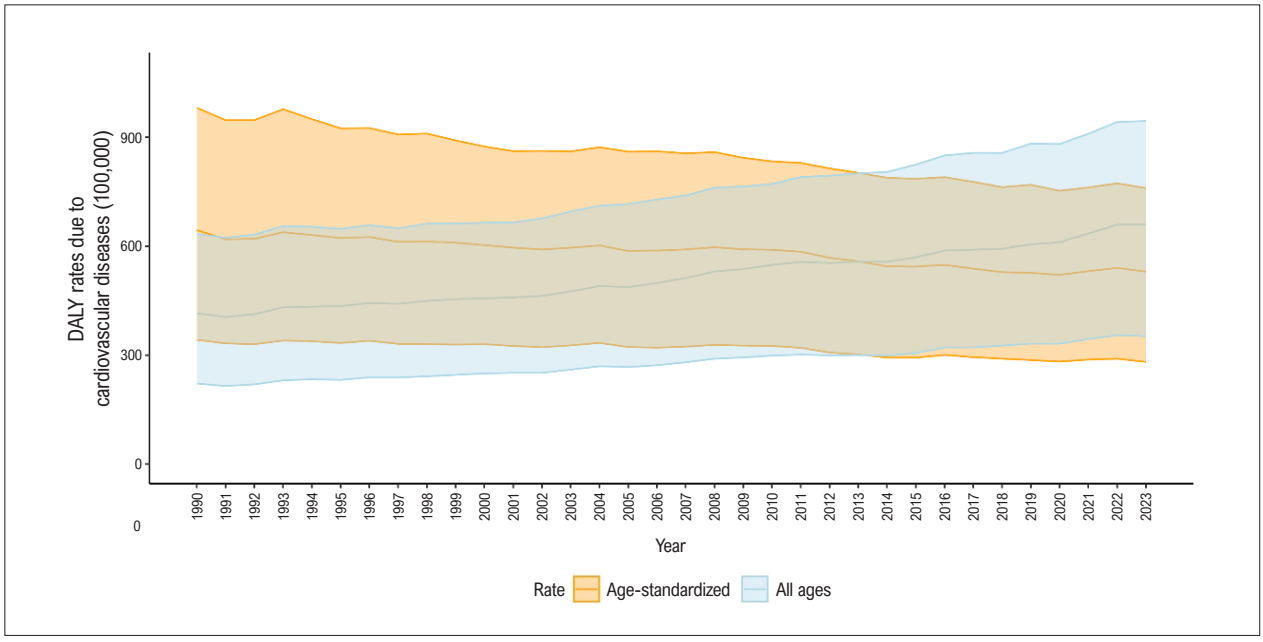

Chart 11.6 – *Time series of the rates of DALYs (Disability-Adjusted Life Years) due to cardiovascular diseases attributable to high body mass index (BMI), per 100,000 inhabitants, in both sexes, from 1990 to 2023, in Brazil. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 12 – PHYSICAL ACTIVITY

See Tables 12.1 through 12.4 and Charts 12.1 through 12.6.

Abbreviations used in chapter 12

CI	Confidence Interval
COVID-19	New Coronavirus Disease 2019
Covitel	Telephone Survey of Risk Factors for Chronic Noncommunicable Diseases During the Pandemic (in Portuguese, *Inquérito Telefônico de Fatores de Risco para Doenças Crônicas não Transmissíveis em Tempos de Pandemia*)
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life Years
ELSA-Brasil	Longitudinal Study of Adult Health - Brazil
GBD	Global Burden of Disease
MET	Metabolic Equivalent of Task
PeNSE	National Survey on the Health of Schoolchildren (in Portuguese, *Pesquisa Nacional de Saúde do Escolar*)
PNS	National Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
SDI	Sociodemographic Index
SUS	Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*)
UI	Uncertainty Interval
Vigitel	Surveillance System of Risk and Protection Factors for Chronic Diseases by Telephone Survey (in Portuguese, *Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*)

Introduction

- "Physical activity" and "physical exercise" have different meanings. Physical activity is defined as any bodily movement produced by skeletal muscle contraction resulting in an increase in energy expenditure as compared to the state of rest.[364,365] Physical activity comprises recreational or occupational activities spontaneously performed, and some examples are as follows: walking to work, house cleaning, lawn mowing, and climbing up and down stairs.
- Physical exercise is a planned and structured physical activity aimed at improving components of physical fitness, such as strength, power, resistance, and balance.[366,367]
- The terms "sedentary behavior" and "physical inactivity" have different definitions.[368] Sedentary behavior can be defined as engaging in activities that involve very low energy expenditure, of 1.5 MET (metabolic equivalent of task) or less,[369] such as spending long hours watching television or using electronic devices. Physical inactivity refers to performing a smaller volume of physical activity per week than the minimum recommended by current guidelines, which is 150 min/week of moderate-intensity physical activity or 75 min/week of vigorous-intensity physical activity, which corresponds to 450 MET-min/week.[370] Other definitions of physical inactivity can be found in the literature, such as "insufficient physical activity practice", used in Vigitel Brazil.[334]
- One MET is equivalent to the estimated oxygen uptake at rest, which approximates 3.5 $mL.kg^{-1}.min^{-1}$. Classifications related to the intensity of physical activity consider: (a) ≤1.5 MET = sedentary behavior; (b) >1.5 and <3 METs = light-intensity physical activity; (c) ≥3 and <6 METs = moderate-intensity physical activity; (d) ≥6 METs = vigorous-intensity physical activity.
- The recommendation of physical activity for adults (150 to 300 min/week of moderate-intensity exercise) is equivalent to approximately 7.5 to 29.5 MET-hour/week or 450 to 1770 MET-min/week.[370,371] The guidelines emphasize that more than 300 min/week of moderate-intensity physical activity provide additional health benefits.[371]
- The first guide of physical activity for the Brazilian population, published by the Brazilian Ministry of Health in 2021,[372] reinforces those recommendations (Table 12.1). In addition, the guide highlights the importance of including activities for muscle and bone strengthening at least 2 days/week and provides specific recommendations for the different age groups. Old individuals (>65 years of age) should engage in light/moderate-intensity physical activity at least 3 days/week, focusing on activities to reduce the risk of falls and improve muscle function.[370,371] Children and adolescents (6-17 years of age) should engage in at least 1 hour of physical activity per day, and at least 3 days/week should be intended for muscle and bone strengthening.[372]
- Despite those recommendations and the widespread awareness of the important role of physical activity in health promotion and disease prevention, a significant part of the Brazilian population does not meet the minimum physical activity levels recommended. Data from Vigitel 2023 have shown that approximately 37% of the Brazilian adults are physically inactive, with more concerning figures among women (43%), old individuals (63.6%), and those with lower educational levels (47.7%).[334] It is worth noting, however, that although those figures remain high, there was a favorable trend toward reduction in physical inactivity over the last decade, reinforcing the potential impact of public policies aimed at physical activity promotion.
- Regarding screen time, the American Academy of Pediatrics[373] recommends that children under 18 months should not spend any time watching screens, and those aged 18 months to 5 years should limit it to a maximum of 1 hour/day. For children aged 6 years or more, there is no maximum time defined, as long as screen time interferes with neither sleep nor physical activity levels.

Prevalence

- According to data from Vigitel 2023,[334] approximately 37% of Brazilian adults do not meet the recommended physical activity level, and that percentage is higher among women (43%) as compared to men (30%). The physical inactivity level varied in the Brazilian capitals, being the highest in Fortaleza (41.3%) and the smallest in Boa Vista (27.7%).
- Age showed a direct association with the frequency of physical inactivity. In the age group of 18-24 years, that frequency was 27.8%, while, in individuals aged 65 years and older, it was 63.6%.[334]
- An inverse relationship was observed between educational level and physical inactivity. Among individuals with lower educational level (0-8 years of schooling), the prevalence of physical inactivity was 47.7%, while among those with at least 12 years of schooling, that prevalence was 32.4%.[334]
- Data from the ELSA-Brazil study obtained between 2008 and 2010 from 15,105 men and women (civil servants), aged 35-74 years, have shown that less than half that population was engaged in physical activity. The study showed that only 44.1% of men and 33.8% of women were engaged in leisure-time physical activity. Those percentages were even smaller among 51-59-year-old men (40.2%) and 34-50-year-old women (31.4%).[374]
- A systematic review conducted to update the *Report Card Brazil* about the physical activity level of Brazilian children and adolescents (age of 0-18 years) has shown that, in almost half (48.9%) of the 47 articles included (published between 2018 and 2019), the prevalence of physically active children/adolescents was below 50%, an alarming percentage, considering the age range and the recent behavior changes of children/adolescents.[375]
- Regarding the adoption of sedentary behaviors, in 2023, 23.2% of the adults reported spending at least 3 hours of their leisure time watching television, and the frequency was similar for men and women, but higher among individuals aged 65 years and older (39.4%) and those with 0 to 8 years of schooling (28.2%).[334]
- When considering the combined use of other electronic devices, the prevalence of sedentary behavior almost tripled and there was an inversion in the association of age and educational level.[376] Of the adults from the capitals of the 26 Brazilian states and Distrito Federal, in 2023, 67% reported spending at least 3 hours/day of their leisure time watching screens (television, computer, tablet, or cellular phone), and that frequency was similar among men (67.9%) and women (66.3%). When combined use was considered, the highest percentages were observed among adults aged 18-24 years (82.0%) and those with at least 12 years of schooling (73.9%).[334] The lowest percentages, however, were observed among adults aged 65 years or older (53.9%), and adults with 0 to 8 years of schooling (52.5%).
- For children/adolescents, the *Report Card Brazil* update has shown that, in almost 70% of the articles included in the systematic review, more than 50% of the individuals spent at least 2 hours per day engaged in non-sedentary behaviors.[377]
- In addition to age, sex, and years of schooling, other factors associated with an increase in the prevalence of leisure-time sedentary behavior, due to either television watching or combined use of electronic devices, are physical inactivity, consumption of ultra-processed food, excessive consumption of alcohol, smoking, arterial hypertension, and living without a partner.[376]
- Data from different Brazilian population surveys have shown a general trend towards physical inactivity reduction among adults in recent decades, although important inequities regarding sex, age, educational level, and geographic location persist. Data from the GBD Study have consistently shown that, between 1990 and 2023, there was an important reduction in cardiovascular mortality attributable to low physical activity level in all Brazilian regions, as detailed in the following sections.

Trends

- According to the time series of Vigitel,[334] the frequency of physically inactive adults (≥18 years) decreased from 48.3% in 2013 to 37.0% in 2023, resulting in a mean annual variation measured in percent points per year (pp/year) of -0.66 (95% CI, -1.28; -0.05). This reduction was observed among women (-0.81 pp/year; 95% CI, -1.51; -0.10), but not among men (-0.50 pp/year; 95% CI, -1.09; 0.09).
- Regarding the different age groups, there was a reduction in the prevalence of physical inactivity between 2013 and 2023 among adults aged 35-44 years (-0.95 pp/year; 95% CI, -1.71; -0.19), 45-54 years (-1.27 pp/year; 95% CI, -1.80; -0.73), 55-64 years (-0.59 pp/year; 95% CI, -1.15; -0.02), and 65 years or older (-0.58 pp/year; 95% CI, -1.10; -0.06). However, in younger age groups, prevalence stability was observed. In the age groups 18-24 years and 25-34 years, the mean annual changes were -0.46 (95% CI, -1.01; 0.08) and -0.62 (95% CI, -1.46; 0.22) pp/year, respectively.[334]
- Regarding educational level, the prevalence of physical inactivity was stable in all levels between 2013 and 2023.[334] Among adults with 0 to 8 years, 9 to 11 years, and at least 12 years of schooling, the mean annual changes were -0.41 (95% CI, -1.07; 0.25), -0.56 (95% CI, -1.23; 0.10), and -0.48 (95% CI, -1.10; 0.15) pp/year, respectively.[334]
- The variation in the percentage of physically inactive adults aged ≥18 years according to Brazilian data from 2013 to 2023 made available by Vigitel is shown in Chart 12.1.[334]
- The variation in the percentage of physically inactive adults aged ≥18 years according to the Brazilian capitals and the Distrito Federal based on data from 2013 and 2023 made available by the Vigitel is shown in Chart 12.2.[334]
- Similarly, data from the Brazilian National Health Survey (PNS) have shown a relative increase of over 30% in the proportion of Brazilian adults reporting engaging in moderate to vigorous physical activity for at least 150 min/week from 2013 to 2019, increasing from 22.7% in 2013 to 30.1% in 2019.[378] In both years, that proportion was higher among men (27.3% and 34.2%, respectively), young individuals aged 18-24 years (35.6% and 41.0%,

respectively), white individuals (23.9% and 31.6%, respectively), and those with high educational level (38.8% and 49.1%, respectively).

- However, data from the National Survey on the Health of Schoolchildren (PeNSE) have shown a reduction in the prevalence of physically active Brazilian students aged 13-17 years between 2009 and 2019.[379] In Brazilian state capitals, the prevalence of physically active schoolchildren declined from 43.1% (95% CI, 42.2; 43.9) in 2009 to 18.2% (95% CI, 17.5; 19.0) in 2019, paralleling the trend observed in inland municipalities, where the prevalence of physically active schoolchildren decreased from 30.4% (95% CI, 29.2; 31.6) in 2012 to 17.9% (95% CI, 17.3; 18.6) in 2019. The prevalence of physically active schoolchildren declined from 2012 to 2019 for both girls (22.6% and 9.3%, respectively) and boys (40.6% and 26.7%).
- Regarding the adoption of sedentary behaviors, according to Vigitel data,[334] between 2010 and 2023, there was a reduction in the frequency of adults spending at least 3 hours/day of their leisure time watching television, from 27.3% in 2010 to 23.2% in 2023 (-0.24 pp/year; 95% CI, -0.49; -0.00). When stratifying by sex, age, and educational level, that reduction was observed among men (-0.36 pp/year; 95% CI, -0.62; -0.10), in the age groups of 18-24 years (-1.30 pp/year; 95% CI, -1.58; -1.02) and 25-34 years (-0.62; 95% CI, -0.99; -0.24), and those with 9 to 11 years of schooling (-0.37 pp/year; 95% CI, -0.57; -0.16). Stability was observed among women, adults older than 34 years, and those with 0-8 years and 12 and more years of schooling.
- When the use of other electronic devices (computer, tablet, cell phone) in association with television is considered, there is an increase in the prevalence of sedentary behaviors. While, in 2016, 61.7% of the adults reported spending 3 hours or more of their leisure time watching television or using a computer, tablet, or cell phone, in 2023 that percentage increased to 67.0%. This increase was more pronounced among women (1.21 pp/year; 95% CI, 0.57; 1.84), in the age group of 45-54 years (2.09 pp/year; 95% CI, 1.62; 2.55), and among those with 0-8 years of schooling (1.58 pp/year; 95% CI, 1.31; 1.85).[334]
- The percent change of adults aged ≥18 years spending at least 3 hours per day of their leisure time watching television or using a computer, tablet, or cell phone, according to Brazilian data from 2010 to 2023 made available by Vigitel can be seen in Chart 12.3.[334]
- According to data from PeNSE, while there was a reduction in the frequency of schoolchildren watching television for more than 2 hours per day between 2009 and 2019 (79.8% and 46%, respectively), the frequency of the habit of sitting for more than 3 hours increased from 50.1% in 2009 to 54% in 2019.[379]
- In the global scenario, it is estimated that 27.5% of adults and more than 81% of adolescents do not meet the international recommendations for the practice of aerobic physical activity.[370] This suggests that more than 1.4 billion adults are at risk of developing or aggravating diseases related to insufficient physical activity.[380]

Cardiovascular Disease Mortality Attributable to Low Physical Activity

- According to GBD 2023 data from Brazil,[33] in the assessment of CVD mortality rates attributable to selected risk factors, low physical activity ranked 15th among the most important risk factors in 1990 and 14th in 2023 (Chart 12.4). However, there was a reduction in age-standardized CVD mortality rates attributable to low physical activity, which passed from 8.02 (95% UI, 1.98; 14.91) per 100,000 inhabitants in 1990 to 3.29 (95% UI, 0.90; 5.94) per 100,000 inhabitants in 2023 (Chart 12.5).
- Regarding percent changes in the mortality rates in Brazil from 1990 to 2023, there was a reduction of 59.1% (95% UI, -71.9; -36.0). Considering the Brazilian macroregions, from 1990 to 2023, the highest reductions occurred in the South (-64.8%; 95% UI, -78.2; -44.4) and Southeast (-64.4%; 95% UI, -76.7; -42.7) regions, while the lowest reductions were found in the Northeast (-46.1%; 95% UI, -64.2; -10.3) and North (-51.6%; 95% UI, -67.5; -21.4) regions. In the West-Central region, the reduction was intermediate (-56.5%; 95% UI, -72.2; -31.7).
- When comparing the different Federative Units, the reductions varied from 30.5% (95% UI, -60.9; -20.2) in Maranhão to 66.8% (95% UI, -81.4; -44.5) in Paraná (Table 12.2).
- It is worth noting the inverse association between the sociodemographic index (SDI) in 2023 and the percent change of the age-standardized cardiovascular mortality rates attributable to low physical activity level from 1990 to 2023 ($r = -0.789$; $p < 0.001$) (Chart 12.6). The Brazilian Federative Units with the highest SDI had more significant reductions in those mortality rates from 1990 to 2023, suggesting influence of socioeconomic factors on the magnitude of those changes in recent decades.
- When comparing between sexes, the age-standardized cardiovascular mortality rate in 2023 was similar for men [3.32 (95% UI, 0.73; 6.59) per 100,000 inhabitants] and women [3.22 (95% UI, 0.9; 5.99) per 100,000 inhabitants], as was the percent reduction between 1990 and 2023 for men and women [-54.4% (95% UI, -75.4; -14.8 and -62.2% (95% UI, -76.5; -31.2), respectively] (Table 12.2).
- When comparing the age groups, however, an increase in the mortality rates attributable to low physical activity level was observed with age advance in both 1990 and 2023. In 2023, while CVD mortality rate in the age group of 15-49 years was 0.2 (95% UI, 0.1; 0.4) per 100,000 inhabitants, in the age group of 70 years or older, that rate was 40,1 (95% UI, 8,3; 75,8). In addition, while the percent reduction between 1990 and 2023 was similar in the age groups of 50-69 years [-54.1% (95% UI, -70.1; -29.7)] and 70 years or older [-55.0% (95% UI, -71.7; -25.9)], in the age group of 15-49 years no significant percent reduction [-23.8% (95% UI, -60.1; 55.5) was observed (Table 12.3). These data suggest that the importance of physical activity is directly related to age, and this relation is even more important as age advances, despite the general benefit in all other age groups.

- In addition, according to data from the GBD, globally the CVD mortality rate attributable to low physical activity level has decreased over the years, reaching 3.98 (95% UI, 1.23; 6.97) per 100,000 inhabitants in 2023, similarly to that observed in Brazil.

Attributable Burden of Disease

- According to GBD 2023 data, age-standardized CVD DALY (disability-adjusted life year) rates attributable to low physical activity were 149.4 (95% CI, 48.5; 250.1) per 100,000 inhabitants in 1990 and 65.7 (95% CI, 21.8; 109.2) per 100,000 inhabitants in 2023, representing a percent change of the rates of -56.0% (95% CI, -67.6; -40.2) (Table 12.3).
- As observed for CVD mortality rates, CVD DALY rates (per 100,000 inhabitants) in 2023 also varied across Brazilian macroregions and Federative Units, sex, and age groups. When comparing the Brazilian macroregions, in 2023, the lowest rate was observed in the South region (59.2; 95% UI, 18.0; 103.9) and the highest, in the North region (74.7; 95% UI, 23.4; 130.4). Between 1990 and 2023, the highest reductions in DALY rates were observed in the South (-62.6%; 95% UI, -73.9; -47.7) and Southeast (-60.4%; 95% UI, -71.2; -43.4) regions, while the lowest were observed in the Northeast (-44.1%; 95% UI, -59.2; -23.1) and North (-48.3%; 95% UI, -61.7; -28.9) regions. When comparing Brazilian Federative Units, the highest DALY rates (per 100,000 inhabitants) in 2023 were observed in Alagoas (100.8; 95% UI, 35.0; 169.0), and Maranhão (92.9; 95% UI, 28.7; 159.9), while the lowest were observed in the Distrito Federal (41.8; 95% UI, 10.7; 79.0), and Minas Gerais (44.7; 95% UI, 12.9; 78.1). Regarding the reduction in DALY rates between 1990 and 2023, the values ranged from -27.4% (95% UI, -54.0; 14.8) in Maranhão to -65.0% (95% UI, -77.5; -47.0) in Minas Gerais, evidencing important regional heterogeneity, as observed for cardiovascular mortality attributable to low physical activity level (Table 12.4).
- Regarding sexes, a reduction in CVD DALY rates (per 100,000 inhabitants) attributable to low physical activity level was observed for both men and women between 1990 and 2023, and that reduction was more significant for women (-58.8%; 95% UI, -71.1; -37.8) than for men (-52.2%; 95% UI, -70.3; -23.9). In 2023, DALY rates (per 100,000 inhabitants) for men and women were 68.0 (95% UI, 21.4; 117.9) and 63.4 (95% UI, 22.1; 105.5), respectively (Table 12.3).
- When comparing across age groups, the highest CVD DALY rate (per 100,000 inhabitants) was observed in the age group of 70 years or older [592.0 (95% UI, 133.5; 1107.1)], while the lowest CVD DALY rate was observed in the age group of 15-49 years [13.0 (95% UI, 6.3; 22.5)]. Between 1990 and 2023, there was a percent reduction of DALY rates in the age groups of 50-69 years [-52.5 (95% UI, -68.8; -28.6)] and 70 years or older [-56.2 (95% UI, -72.1; -31.4)], and not significant in the age group of 15-49 years [-20.4 (95% UI, -55.7; 56.8)] (Table 12.3).
- Globally, in 2023, the age-standardized CVD DALY rate (per 100,000 inhabitants) attributable to low physical activity level was 78.76 (95% CI, 31.469; 128.96).[381]

Healthcare Utilization and Cost

- Physical inactivity has an important economic impact on health systems. Bielemann *et al*.[382] have carried out a study on the costs of the hospitalizations at the Brazilian Unified Health System (SUS) attributable to physical inactivity due to malignant breast and colon neoplasms, cerebrovascular diseases, ischemic heart disease, hypertension, diabetes, and osteoporosis of individuals aged ≥40 years, in 2013. Of the total of 974,641 hospitalizations due to the chronic diseases assessed, 15.0% were attributed to physical inactivity. Regarding ischemic heart diseases, the attributable fraction of physical inactivity varied, among men, from 11.3% in the South region to 12.6% in the North and Northeast regions, and, among women, from 16.1% in the South region to 18.4% in the North region. Regarding cerebrovascular diseases, the attributable fraction of physical inactivity varied, among men, from 20.7% in the South region to 22.8% in the North and Northeast regions, and, among women, from 7.6% in the South region to 8.8% in the North region.[383]
- Regarding costs to the SUS in 2013, of the total of 1.8 billion *reais*, more than 275 million *reais* were estimated to be due to hospitalizations attributable to physical inactivity from the already mentioned diseases.[382] Across all regions assessed and in both sexes, ischemic heart diseases accounted for the largest share of total costs and costs attributable to physical inactivity. Of the total cost with hospitalizations of 781 million *reais* for ischemic heart disease and almost 155 million *reais* for cerebrovascular disease, 12% and 22%, respectively, were attributable to physical inactivity among men. Among women, of the total cost with hospitalization of almost 500 million *reais* for ischemic heart disease and 161 million *reais* for cerebrovascular disease, 17% and 8%, respectively, were attributable to physical inactivity.[382]
- In 2023, a study by Prodel *et al*.[381] aimed to update data on the economic cost of physical inactivity to the public health system in Brazil. Considering individuals aged ≥40 years living in Brazilian state capitals and Distrito Federal in 2017, the same seven chronic diseases cited in the previous paragraphs accounted for 154,017 hospitalizations (6.5% of all hospitalizations), corresponding to a cost of US$ 112,524,914.47 (10.6% of the total cost of the SUS).
- Considering the group of leisure-time physically inactive individuals, 17.4% of the cost estimated of those same diseases was attributed to physical inactivity. Nationwide, it is estimated that noncommunicable chronic diseases accounted for approximately 740,000 hospitalizations in 2017, at a cost to SUS of US$ 482 million. Of that total cost, US$ 83.9 million (17.4%) were attributed to physical inactivity. However, in 2019, malignant breast and colon neoplasms, cerebrovascular diseases, ischemic heart disease, hypertension, diabetes, and osteoporosis

accounted for 786,000 hospitalizations, at a cost of US$ 526 million, US$ 91.4 million of which attributed to leisure-time physical inactivity.[381]

- Feter *et al*.[384] have assessed the economic impact of leisure-time physical inactivity on hospitalizations involving dementia in Brazil. In 2013, 3,724 individuals were hospitalized for dementia (61.2% aged <70 years and 61.5% in the Southeast region), at a cost to SUS of over US$ 7.6 million. Of such admissions, approximately 37% were attributed to physical inactivity, at an estimated cost of almost US$ 3 million.[384]
- A retrospective study by Araújo *et al*.[383] has assessed the direct costs with health and the indirect costs due to productivity loss of 278 residents of the Presidente Prudente city (São Paulo) with CVD and their association with the usual pattern of physical activity practice measured with the Baecke questionnaire. Individuals who reported work absenteeism incurred US$ 187 higher healthcare costs over one year than those who did not miss work for health-related reasons. In addition, it was estimated that US$ 53 could be saved annually for each one-unit increase in the physical activity pattern score measured with the questionnaire.

Impact of COVID-19 pandemic on physical activity

- COVID-19 pandemic had a significant impact on the increase of the sedentary behavior time in Brazil, considerably affecting the practice of physical activity in the entire country and its major geographic regions. According to a study by Silva *et al*.[385] performed between April/24/2020 and May/24/2020, high prevalence and incidence of physical inactivity and excessive screen time were observed in the Brazilian population. Approximately 40,000 adults filled in an online questionnaire, evidencing 26%, 266%, and 38% increases in the prevalence of physical inactivity, prolonged time of television watching and computer/tablet use, respectively.[386]
- Assessing a longer period, the Vigitel analysis comparing the pre-pandemic period (2019) with the end of the third wave of COVID-19 (2021) has evidenced a shift in the downward trend of physical inactivity prevalence in Brazil.[236] While, in 2019, 44.8% of the adults were considered physically inactive, in 2021, that proportion reached 48.2%, a prevalence similar to that observed in 2014 (48.7%).
- In addition, comparing the pre-pandemic period with the years 2022 and 2023, according to data from the Covitel 2023,[387] the prevalence of adults engaged in leisure-time moderate- or vigorous-intensity physical activity for 150 minutes or more per week decreased from 38.6% (95% CI, 36.3; 40.9) in the pre-pandemic period to 30.3% (95% CI, 28.1; 32.6%) in the first trimester of 2022 and to 31.5% (95% CI, 29.7; 33.2) in the first trimester of 2023. Moreover, while, in the pre-pandemic period, 13.1% (95% CI, 11.7; 14.7%) of adults engaged in no physical activity across the leisure-time, transportation, occupational, and household domains, that prevalence increased to 18.4% and 17.6% in 2022 and 2023, respectively.
- An online health survey on the lifestyle and mental health of Brazilian adolescents during the COVID-19 pandemic, *ConVid Adolescentes – Pesquisa de Comportamentos,* collected data between June and September/2020 using a questionnaire completed by 2,695 individuals, aged 12-17 years. Its analysis has shown that the physical inactivity prevalence among Brazilian adolescents increased from 71.3% to 84.3% during the COVID-19 pandemic.[388]
- Regarding the adoption of sedentary behaviors and according to data from the Covitel 2023, the prevalence of excessive use of screen (3 or more hours per day) increased from 56.3% (95% CI, 54.4; 58.2) in the pre-pandemic period to 58.2% (95% CI, 56.5; 59.9) in the first trimester of 2022 and to 59.9% (95% CI, 57.0; 62.7) in the first trimester of 2023.[387]
- According to the *ConVid Adolescentes – Pesquisa de Comportamentos*, among Brazilian adolescents, the prevalence of sedentary behaviors, such as watching television, playing video games, and using mobile devices, for 3 hours or more per day, increased from 44.6% to 70.2%.[389]
- According to Schuch *et al*.,[390] Brazilians on self-isolation during the COVID-19 pandemic reduced the time engaged in moderate and vigorous physical activity by 65 min/day as compared to the prepandemic period. However, the time spent in sedentary behaviors increased by 42%, corresponding to an increase of 152 min/day.

Perspectives (Future directions)

- Physical inactivity is one of the major modifiable risk factors for noncommunicable diseases, such as stroke, arterial hypertension, type 2 diabetes, coronary artery disease, several types of cancer, dementia, and depression, as well as for all-cause mortality.[391] The adoption of a physically active lifestyle has significant benefits for both primary and secondary prevention of CVD.[392,393] The linear relationship between physical activity volumes and cardiovascular protection suggests that, by simply quitting sedentary behavior and adopting a physically active lifestyle, a significant reduction in cardiovascular risk is obtained.
- In addition to the Brazilian population surveys (Vigitel, PNS, and PeNSE), initiatives, such as the City Gym Program, and public policies for health promotion have contributed to foster physical activity and improve urban spaces intended for its practice.[394]
- However, despite the trend to reduce physical inactivity among Brazilians in recent years, its prevalence remains high, and that was compounded by the COVID-19 pandemic. Thus, it is necessary to continuously encourage national policies that promote healthy life habits, such as the increase in regular physical activity time, aiming to reduce the deleterious socioeconomic consequences of physical inactivity and sedentary lifestyle in Brazil.

- Finaly, adopting an integrated approach of "movement behaviors", which includes physical activity, sedentary behavior, and sleep,[395,396] in addition to respecting individual preferences and sociocultural contexts, is fundamental to ensure greater adhesion to the sustainability of interventions in the long-term.

Conclusion

- Physical activity is one of the fundamental pillars of prevention and treatment of cardiovascular diseases. Although Brazil has experienced important advances in recent decades, with physical inactivity reduction and expressive decrease in cardiovascular mortality attributable to low levels of physical activity, the prevalence of physically inactive individuals remains high, especially among women, old individuals, and more socioeconomically disadvantaged groups.
- The persistence of regional and sociodemographic inequities, associated with the negative impact of the COVID-19 pandemic on the patterns of physical activity and sedentary behavior, reinforces the need for permanent public policies that promote physically active lifestyles across all age groups, contributing to reduce the burden of cardiovascular diseases and their costs to the health system.

Table 12.1 – Recommendations for physical activity practice according to the Guide of Physical Activity for the Brazilian Population.

Physical activity	Young individuals (6-17 years of age)	Adults	Old individuals
If moderate intensity	≥60 min/day*	≥150 min/week	≥150 min/week
If vigorous intensity	NM	≥75 min/week	≥75 min/week
Muscle strengthening	To be included into the 60 min/day	≥2 days/week	2-3 times/week
Balance	NM	NM	2-3 times/week

**Can be divided into blocks; NM: Not mentioned. Source: Brazil.*[372]

Table 12.2 – Deaths from cardiovascular diseases attributable to low levels of physical activity: numbers and age-standardized rates, by sex, in Brazil, its geographic regions, and Federative Units, in 1990 and 2023, and percent change of the rates in the period

Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	2.437,1 (750,3; 4.318,1)	7,3 (1,7; 13,8)	3.657,8 (869,1; 6.944,3)	3,3 (0,7; 6,6)	-54,4 (-75,4; -14,8)	Male
North region	108,6 (32,1; 187,6)	7,2 (1,4; 13,7)	264,3 (65,1; 498,0)	4,0 (0,9; 7,7)	-45,3 (-72,9; 1,6)	Male
Acre	5,6 (1,5; 10,2)	7,7 (1,6; 15,3)	12,0 (3,4; 22,9)	4,0 (1,0; 8,0)	-47,7 (-78,1; 16,7)	Male
Amapá	3,0 (0,8; 5,8)	8,4 (1,4; 18,0)	9,1 (2,2; 17,0)	4,0 (0,8; 8,1)	-52,3 (-77,2; 21,6)	Male
Amazonas	19,7 (6,0; 39,0)	7,1 (1,3; 15,0)	52,7 (13,3; 100,0)	4,2 (0,8; 8,6)	-40,2 (-73,3; 33,6)	Male
Pará	56,3 (15,6; 104,1)	7,2 (1,2; 14,3)	127,5 (28,2; 249,2)	4,0 (0,7; 8,2)	-44,3 (-76,5; 21,6)	Male
Rondônia	14,6 (4,4; 25,9)	9,2 (1,9; 17,9)	30,0 (7,7; 59,8)	4,0 (0,9; 8,3)	-56,0 (-79,9; -3,6)	Male
Roraima	1,9 (0,8; 3,3)	8,1 (2,1; 15,8)	7,5 (2,3; 14,0)	4,0 (1,0; 8,2)	-51,0 (-78,5; 4,3)	Male
Tocantins	7,5 (2,2; 13,9)	6,5 (0,9; 14,1)	25,6 (6,8; 51,3)	3,3 (0,8; 7,0)	-48,3 (-79,3; 46,3)	Male
Northeast region	655,9 (164,7; 1.268,5)	6,3 (1,3; 12,8)	1.062,2 (252,0; 2.007,7)	3,7 (0,8; 7,2)	-41,1 (-69,1; 14,0)	Male
Alagoas	44,7 (11,0; 80,6)	7,9 (1,6; 15,0)	70,1 (17,8; 150,4)	5,0 (1,2; 10,9)	-37,0 (-69,6; 24,5)	Male
Bahia	148,1 (42,6; 299,6)	5,3 (1,2; 11,6)	239,8 (43,9; 477,7)	3,0 (0,5; 6,1)	-43,6 (-75,6; 16,8)	Male
Ceará	87,4 (18,8; 170,1)	5,4 (0,9; 11,0)	178,5 (42,1; 366,3)	3,7 (0,9; 7,8)	-31,5 (-68,9; 46,2)	Male
Maranhão	74,5 (18,9; 141,4)	7,3 (1,4; 14,7)	153,5 (31,4; 330,2)	5,1 (1,0; 11,3)	-31,0 (-66,1; 68,5)	Male
Paraíba	53,8 (12,6; 109,9)	5,4 (1,2; 11,4)	78,6 (21,1; 161,0)	3,6 (1,0; 7,6)	-33,0 (-72,2; 74,6)	Male
Pernambuco	146,3 (35,1; 304,7)	8,3 (1,5; 18,2)	175,3 (43,2; 373,0)	4,0 (0,9; 8,6)	-52,6 (-78,8; -0,2)	Male
Piaui	38,6 (8,6; 73,1)	6,3 (1,2; 12,3)	71,5 (16,1; 154,7)	3,9 (0,8; 8,6)	-38,7 (-71,9; 43,1)	Male
Rio Grande do Norte	40,1 (9,2; 81,7)	5,8 (1,1; 12,6)	61,8 (15,8; 124,3)	3,4 (0,9; 6,9)	-41,7 (-75,0; 37,8)	Male
Sergipe	22,5 (5,2; 43,5)	6,4 (1,1; 12,7)	33,2 (8,4; 68,2)	3,2 (0,7; 6,9)	-49,2 (-76,4; 35,3)	Male
Southeast region	1.161,8 (387,7; 2.045,3)	7,9 (1,9; 15,2)	1.555,2 (424,0; 2.864,3)	3,1 (0,7; 6,1)	-60,8 (-79,4; -25,5)	Male
Espírito Santo	42,4 (10,5; 84,6)	7,3 (1,3; 15,9)	62,3 (13,0; 124,5)	2,9 (0,6; 6,1)	-60,2 (-82,1; -2,6)	Male
Minas Gerais	232,9 (68,3; 461,7)	6,3 (1,3; 13,7)	301,7 (66,6; 664,8)	2,3 (0,5; 5,3)	-62,9 (-83,1; -17,4)	Male
Rio de Janeiro	345,9 (129,5; 669,4)	10,3 (2,7; 22,1)	347,1 (97,4; 661,9)	3,6 (0,9; 7,3)	-64,6 (-85,7; -15,1)	Male
São Paulo	540,6 (162,6; 984,7)	7,8 (1,7; 16,7)	844,1 (224,1; 1.591,1)	3,3 (0,8; 6,8)	-57,4 (-80,3; -6,8)	Male
South region	402,8 (120,9; 713,1)	7,9 (1,6; 15,4)	541,1 (139,1; 1.057,5)	3,1 (0,7; 6,5)	-60,1 (-81,0; -12,5)	Male
Paraná	160,0 (45,7; 297,0)	8,4 (1,8; 17,2)	203,8 (48,0; 422,3)	3,2 (0,6; 6,7)	-62,4 (-85,7; -11,7)	Male
Rio Grande do Sul	177,5 (52,6; 320,3)	7,7 (1,5; 15,4)	230,0 (64,2; 475,6)	3,3 (0,7; 7,0)	-57,7 (-82,4; 2,8)	Male
Santa Catarina	65,4 (16,5; 126,9)	7,2 (1,5; 14,8)	107,3 (23,0; 213,6)	2,9 (0,6; 6,4)	-59,1 (-84,8; -8,4)	Male
West-Central region	107,9 (33,1; 187,1)	6,5 (1,3; 12,8)	235,0 (52,4; 470,5)	3,1 (0,7; 6,5)	-52,1 (-77,1; -4,4)	Male
Distrito Federal	9,6 (2,7; 16,8)	5,6 (0,5; 11,3)	27,5 (5,5; 59,6)	2,4 (0,4; 5,4)	-57,2 (-82,0; 4,5)	Male
Goiás	52,8 (15,5; 97,4)	6,5 (1,3; 12,9)	101,9 (25,6; 212,2)	2,9 (0,6; 6,6)	-54,4 (-81,3; 2,9)	Male

Mato Grosso	23,9 (7,4; 44,6)	7,2 (1,7; 14,7)	57,3 (15,5; 113,3)	3,6 (0,9; 7,6)	-50,1 (-77,5; 10,0)	Male
Mato Grosso do Sul	21,7 (5,3; 41,0)	6,3 (1,2; 13,2)	48,4 (10,5; 99,4)	3,5 (0,7; 7,5)	-44,3 (-76,5; 24,4)	Male
Brazil	3.290,7 (913,8; 6.209,6)	8,5 (2,3; 17,2)	4.819,8 (1.336,5; 8.995,5)	3,2 (0,9; 6,0)	-62,2 (-76,5; -31,2)	Female
North region	123,6 (33,8; 241,8)	8,3 (1,5; 18,3)	273,7 (76,4; 500,2)	3,6 (1,0; 6,8)	-55,9 (-74,0; -14,4)	Female
Acre	5,2 (1,4; 9,2)	8,9 (2,1; 17,1)	11,8 (3,6; 22,5)	3,6 (1,0; 6,9)	-59,7 (-76,0; -20,6)	Female
Amapá	3,3 (0,9; 6,8)	7,0 (1,8; 14,5)	10,4 (2,4; 20,4)	4,0 (0,8; 7,9)	-43,6 (-68,3; -4,0)	Female
Amazonas	24,7 (6,8; 48,2)	8,8 (2,0; 18,6)	53,2 (13,0; 104,4)	3,6 (0,8; 7,2)	-59,2 (-79,4; -25,6)	Female
Pará	70,8 (13,6; 150,3)	8,2 (1,0; 19,1)	141,9 (37,5; 270,5)	3,8 (1,0; 7,3)	-53,8 (-76,3; 8,8)	Female
Rondônia	11,8 (4,5; 21,0)	11,6 (2,7; 22,6)	28,7 (9,0; 51,0)	3,9 (1,0; 7,2)	-66,3 (-82,4; -41,4)	Female
Roraima	1,4 (0,5; 2,5)	8,9 (1,9; 18,9)	6,3 (1,9; 11,3)	3,9 (1,0; 7,5)	-56,3 (-75,7; -20,4)	Female
Tocantins	6,3 (2,0; 10,9)	5,6 (0,5; 12,4)	21,4 (5,5; 43,6)	2,7 (0,7; 5,6)	-51,3 (-78,3; 20,1)	Female
Northeast region	839,8 (229,1; 1.600,5)	7,1 (1,5; 13,9)	1.378,7 (359,8; 2.584,0)	3,6 (1,0; 6,6)	-49,9 (-69,8; -13,0)	Female
Alagoas	60,0 (15,3; 121,7)	9,6 (1,8; 20,4)	92,8 (25,3; 170,9)	4,9 (1,3; 9,0)	-48,9 (-71,9; 4,3)	Female
Bahia	228,4 (61,8; 429,6)	7,0 (1,4; 13,4)	361,6 (84,1; 678,2)	3,4 (0,9; 6,3)	-51,4 (-71,6; -8,7)	Female
Ceará	99,2 (24,5; 214,1)	5,4 (1,2; 12,4)	195,6 (45,6; 393,2)	3,0 (0,7; 5,9)	-44,5 (-71,5; 14,3)	Female
Maranhão	65,7 (13,5; 131,5)	6,4 (0,9; 13,5)	170,2 (37,3; 325,5)	4,6 (1,0; 8,8)	-28,1 (-61,8; 72,8)	Female
Paraíba	71,6 (17,5; 143,0)	6,7 (1,4; 13,7)	99,2 (26,4; 181,1)	3,2 (0,9; 5,8)	-52,5 (-77,2; 8,2)	Female
Pernambuco	201,4 (54,2; 365,0)	9,4 (2,0; 18,0)	244,5 (69,1; 451,5)	3,8 (1,1; 6,9)	-59,9 (-78,6; -20,3)	Female
Piaui	39,1 (9,8; 75,0)	6,2 (1,2; 12,5)	90,3 (18,9; 186,1)	3,8 (0,9; 7,8)	-38,6 (-70,0; 24,3)	Female
Rio Grande do Norte	43,0 (9,2; 88,0)	5,5 (1,1; 11,3)	81,6 (23,3; 154,3)	3,2 (1,0; 6,0)	-42,0 (-72,4; 25,1)	Female
Sergipe	31,3 (5,5; 69,8)	8,1 (0,9; 18,7)	42,7 (9,3; 84,1)	3,0 (0,7; 5,9)	-62,5 (-81,0; -6,1)	Female
Southeast region	1.673,0 (462,8; 3.227,6)	9,4 (2,5; 19,3)	2.203,4 (639,1; 3.987,9)	3,1 (0,9; 5,6)	-66,9 (-79,3; -38,4)	Female
Espírito Santo	44,9 (8,7; 87,8)	7,4 (0,6; 15,3)	72,9 (19,6; 136,5)	2,6 (0,7; 4,8)	-65,3 (-83,5; -10,6)	Female
Minas Gerais	300,8 (81,7; 614,2)	7,1 (1,7; 15,7)	381,4 (98,3; 757,4)	2,2 (0,6; 4,4)	-68,8 (-84,3; -37,7)	Female
Rio de Janeiro	496,1 (153,4; 899,8)	10,8 (2,7; 21,0)	525,5 (151,0; 950,5)	3,6 (1,0; 6,4)	-66,8 (-80,5; -33,1)	Female
São Paulo	831,2 (233,2; 1.568,3)	10,1 (2,5; 20,0)	1.223,7 (378,2; 2.287,9)	3,4 (1,1; 6,4)	-66,1 (-81,2; -31,5)	Female
South region	538,3 (152,1; 1.043,7)	9,1 (2,0; 18,6)	688,5 (149,9; 1.305,9)	2,9 (0,6; 5,5)	-67,9 (-83,2; -44,6)	Female
Paraná	181,7 (52,4; 344,8)	9,5 (2,1; 19,9)	236,9 (55,5; 450,0)	2,8 (0,6; 5,4)	-70,2 (-84,2; -38,8)	Female
Rio Grande do Sul	272,4 (72,6; 538,5)	9,1 (1,8; 20,2)	319,2 (71,2; 621,4)	3,1 (0,7; 6,0)	-65,7 (-82,5; -31,0)	Female
Santa Catarina	84,2 (20,0; 179,8)	8,2 (1,5; 18,5)	132,4 (27,5; 265,5)	2,6 (0,5; 5,3)	-67,7 (-86,4; -24,7)	Female
West-Central region	116,0 (34,5; 213,0)	7,5 (1,9; 15,0)	275,4 (72,3; 480,3)	3,0 (0,7; 5,4)	-60,1 (-77,5; -32,3)	Female
Distrito Federal	13,8 (3,7; 26,8)	6,2 (1,6; 13,2)	34,5 (6,6; 70,7)	2,1 (0,3; 4,4)	-66,3 (-86,2; -30,2)	Female
Goiás	58,3 (16,7; 108,3)	7,9 (1,9; 15,4)	127,3 (32,4; 233,8)	3,1 (0,7; 5,7)	-60,9 (-80,3; -25,9)	Female

Mato Grosso	20,2 (6,7; 37,2)	7,9 (1,8; 16,0)	58,3 (16,0; 107,6)	3,5 (0,8; 6,6)	-56,1 (-76,8; -17,9)	Female
Mato Grosso do Sul	23,7 (6,9; 43,9)	7,4 (1,7; 14,7)	55,3 (14,6; 105,2)	3,3 (0,8; 6,4)	-55,7 (-79,2; 0,1)	Female
Brazil	5.727,8 (1.563,9; 9.955,9)	8,0 (2,0; 14,9)	8.477,6 (2.373,1; 15.139,5)	3,3 (0,9; 5,9)	-59,1 (-71,9; -36,0)	Both
North region	232,2 (61,4; 416,6)	7,8 (1,7; 15,5)	538,0 (149,2; 1.015,3)	3,8 (1,0; 7,3)	-51,6 (-67,5; -21,4)	Both
Acre	10,8 (3,1; 18,8)	8,2 (2,0; 15,3)	23,8 (6,8; 40,5)	3,8 (1,0; 6,7)	-54,1 (-70,0; -18,4)	Both
Amapá	6,3 (1,6; 11,3)	7,5 (2,0; 14,1)	19,5 (5,4; 37,1)	4,0 (1,0; 8,1)	-46,9 (-65,1; -16,4)	Both
Amazonas	44,3 (12,5; 82,4)	8,0 (1,5; 15,8)	105,9 (27,7; 192,0)	3,9 (0,9; 7,4)	-51,5 (-69,8; -17,5)	Both
Pará	127,1 (32,6; 242,5)	7,8 (1,4; 16,1)	269,4 (70,6; 510,7)	3,9 (1,0; 7,6)	-50,2 (-68,6; -2,8)	Both
Rondônia	26,4 (9,6; 42,7)	10,4 (2,3; 19,5)	58,7 (16,4; 103,0)	4,0 (1,0; 7,5)	-61,7 (-76,3; -37,3)	Both
Roraima	3,4 (1,3; 5,4)	8,6 (1,9; 16,0)	13,7 (4,2; 23,2)	3,9 (1,1; 7,3)	-54,2 (-71,9; -27,7)	Both
Tocantins	13,8 (4,3; 23,2)	6,0 (0,8; 11,9)	47,0 (12,8; 88,9)	3,0 (0,8; 5,8)	-49,5 (-71,6; 35,4)	Both
Northeast region	1.495,7 (380,2; 2.664,0)	6,8 (1,6; 12,7)	2.440,9 (655,9; 4.409,7)	3,6 (1,0; 6,6)	-46,1 (-64,2; -10,3)	Both
Alagoas	104,7 (28,7; 195,5)	8,8 (1,7; 17,6)	162,9 (44,9; 304,4)	4,9 (1,3; 9,5)	-43,9 (-65,8; -0,5)	Both
Bahia	376,4 (108,6; 704,0)	6,3 (1,5; 12,3)	601,5 (144,4; 1.102,9)	3,2 (0,8; 6,0)	-48,3 (-68,0; -16,9)	Both
Ceará	186,6 (43,0; 351,6)	5,4 (1,2; 10,5)	374,1 (85,3; 706,4)	3,3 (0,8; 6,2)	-38,7 (-63,2; 19,4)	Both
Maranhão	140,2 (36,1; 252,3)	6,9 (1,3; 13,2)	323,7 (79,0; 605,7)	4,8 (1,1; 9,0)	-30,5 (-60,9; 20,2)	Both
Paraíba	125,4 (31,8; 231,9)	6,0 (1,4; 11,5)	177,9 (49,2; 328,2)	3,4 (0,9; 6,2)	-44,4 (-67,8; 14,9)	Both
Pernambuco	347,7 (96,5; 635,5)	8,9 (2,0; 17,6)	419,8 (115,1; 773,1)	3,9 (1,1; 7,1)	-56,8 (-72,3; -24,8)	Both
Piaui	77,7 (20,0; 139,2)	6,3 (1,3; 11,9)	161,8 (40,4; 320,7)	3,9 (1,0; 7,7)	-38,4 (-62,3; 9,2)	Both
Rio Grande do Norte	83,2 (19,8; 158,2)	5,7 (1,4; 11,0)	143,4 (40,1; 262,7)	3,3 (0,9; 6,0)	-41,7 (-69,0; 14,8)	Both
Sergipe	53,8 (10,6; 107,2)	7,3 (1,0; 15,1)	75,9 (19,0; 144,6)	3,1 (0,8; 6,1)	-56,9 (-73,5; -19,3)	Both
Southeast region	2.834,8 (835,6; 4.945,5)	8,9 (2,3; 17,0)	3.758,6 (1.095,5; 6.665,2)	3,2 (0,9; 5,6)	-64,4 (-76,7; -42,7)	Both
Espírito Santo	87,3 (20,4; 158,3)	7,4 (1,1; 14,4)	135,2 (35,1; 246,3)	2,7 (0,7; 5,0)	-63,1 (-78,9; -15,8)	Both
Minas Gerais	533,7 (151,9; 1.028,4)	6,8 (1,5; 14,4)	683,1 (165,6; 1.229,1)	2,3 (0,6; 4,2)	-66,4 (-81,1; -42,9)	Both
Rio de Janeiro	842,0 (281,1; 1.477,7)	10,7 (2,8; 20,2)	872,5 (266,5; 1.510,4)	3,6 (1,1; 6,4)	-65,9 (-78,2; -42,8)	Both
São Paulo	1.371,8 (387,7; 2.452,2)	9,2 (2,4; 18,1)	2.067,7 (601,9; 3.801,1)	3,4 (1,0; 6,3)	-62,6 (-76,6; -33,7)	Both
South region	941,1 (263,4; 1.599,0)	8,6 (2,1; 16,4)	1.229,6 (315,9; 2.278,2)	3,0 (0,7; 5,7)	-64,8 (-78,2; -44,4)	Both
Paraná	341,7 (100,2; 594,7)	9,0 (2,1; 16,9)	440,7 (98,2; 861,2)	3,0 (0,6; 5,9)	-66,8 (-81,4; -44,5)	Both
Rio Grande do Sul	449,9 (119,0; 807,9)	8,6 (1,7; 17,0)	549,2 (131,1; 1.023,4)	3,2 (0,8; 6,0)	-62,7 (-78,1; -31,7)	Both
Santa Catarina	149,6 (38,3; 264,8)	7,8 (1,7; 15,5)	239,7 (61,5; 450,7)	2,8 (0,6; 5,4)	-64,3 (-79,1; -37,6)	Both

West-Central region	223,9 (73,5; 379,1)	7,0 (1,6; 12,9)	510,4 (139,6; 911,1)	3,1 (0,8; 5,5)	-56,5 (-72,2; -31,7)	Both
Distrito Federal	23,4 (6,9; 41,9)	5,9 (1,1; 11,8)	62,0 (12,6; 125,5)	2,2 (0,4; 4,7)	-62,5 (-79,8; -28,7)	Both
Goiás	111,1 (36,3; 190,2)	7,2 (1,6; 13,9)	229,2 (58,1; 409,7)	3,0 (0,7; 5,7)	-57,8 (-75,0; -28,0)	Both
Mato Grosso	44,1 (14,8; 75,7)	7,6 (2,0; 13,4)	115,6 (33,3; 204,1)	3,5 (0,8; 6,6)	-53,2 (-70,4; -24,4)	Both
Mato Grosso do Sul	45,4 (13,1; 85,4)	6,9 (1,6; 13,6)	103,6 (25,0; 189,2)	3,4 (0,8; 6,3)	-50,5 (-73,6; -7,9)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 12.3 – Deaths and DALYs due to cardiovascular diseases attributable to low levels of physical activity: numbers and rates (all-ages and age-standardized), according to age group, in Brazil, in 1990 and 2023, and percent change of the rates in the period

Measure	Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)	Age
Deaths	Brazil	231,8 (111,4; 402,1)	0,3 (0,1; 0,5)	252,5 (115,6; 452,6)	0,2 (0,1; 0,4)	-23,8 (-60,1; 55,5)	15-49 years
Deaths	Brazil	1.683,6 (689,8; 2.791,3)	10,7 (4,4; 17,7)	2.144,3 (710,4; 3.410,8)	4,9 (1,6; 7,8)	-54,1 (-70,1; -29,7)	50-69 years
Deaths	Brazil	3.812,4 (714,2; 7.508,3)	89,2 (16,7; 175,6)	6.080,8 (1.256,9; 11.493,2)	40,1 (8,3; 75,8)	-55,0 (-71,7; -25,9)	70+ years
Deaths	Brazil	5.727,8 (1.563,9; 9.955,9)	3,8 (1,0; 6,7)	8.477,6 (2.373,1; 15.139,5)	4,0 (1,1; 7,1)	4,2 (-28,0; 47,5)	All-ages
Deaths	Brazil		8,0 (2,0; 14,9)		3,3 (0,9; 5,9)	-59,1 (-71,9; -36,0)	Age-standardized
DALYs	Brazil	12.565,1 (6.303,0; 20.895,1)	16,3 (8,2; 27,2)	14.297,3 (6.875,0; 24.703,8)	13,0 (6,3; 22,5)	-20,4 (-55,7; 56,8)	15-49 years
DALYs	Brazil	52.190,5 (22.355,1; 86.653,4)	331,6 (142,0; 550,5)	68.772,2 (23.236,8; 108.910,9)	157,5 (53,2; 249,4)	-52,5 (-68,8; -28,6)	50-69 years
DALYs	Brazil	57.795,0 (14.237,0; 108.194,5)	1.351,9 (333,0; 2.530,9)	89.769,6 (20.245,8; 167.871,1)	592,0 (133,5; 1.107,1)	-56,2 (-72,1; -31,4)	70+ years
DALYs	Brazil	122.550,6 (49.390,5; 195.903,4)	82,1 (33,1; 131,2)	172.839,2 (57.565,9; 281.866,5)	81,5 (27,1; 132,9)	-0,7 (-26,4; 27,6)	All-ages
DALYs	Brazil		149,4 (48,5; 250,1)		65,7 (21,8; 109,2)	-56,0 (-67,6; -40,2)	Age-standardized

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 12.4 – DALYs due to cardiovascular diseases attributable to low levels of physical activity: numbers and age-standardized rates, by sex, in Brazil, its geographic regions, and Federative Units, in 1990 and 2023, and percent change of the rates in the period

Location	1990_Number (95% UI)	1990_Rate (95% UI)	2023_Number (95% UI)	2023_Rate (95% UI)	Percent change (95% UI)	Sex
Brazil	55.309,7 (20.747,2; 90.406,7)	142,3 (49,0; 244,7)	79.478,0 (25.722,2; 138.502,3)	68,0 (21,4; 117,9)	-52,2 (-70,3; -23,9)	Male
North region	2.531,5 (954,5; 4.159,9)	138,2 (42,6; 235,8)	5.682,4 (1.735,2; 9.566,2)	77,3 (21,1; 133,7)	-44,1 (-66,6; -4,0)	Male
Acre	132,3 (46,6; 226,1)	152,7 (44,8; 275,6)	266,8 (78,7; 473,3)	81,0 (21,8; 147,9)	-46,9 (-74,8; 1,1)	Male
Amapá	69,1 (24,9; 123,9)	164,5 (51,1; 308,8)	205,6 (66,1; 380,5)	80,0 (23,2; 144,1)	-51,4 (-72,5; 2,6)	Male
Amazonas	441,7 (160,1; 765,4)	129,9 (37,9; 256,2)	1.151,5 (364,7; 2.064,4)	81,7 (23,3; 150,1)	-37,1 (-67,0; 23,6)	Male
Pará	1.262,6 (469,4; 2.232,3)	135,3 (42,8; 245,5)	2.648,3 (741,3; 4.656,0)	75,6 (18,5; 136,3)	-44,1 (-71,4; 4,5)	Male
Rondônia	387,4 (151,1; 672,4)	186,3 (54,2; 344,4)	664,2 (207,5; 1.163,7)	81,6 (24,1; 148,0)	-56,2 (-75,7; -18,3)	Male
Roraima	54,7 (23,5; 92,7)	168,4 (54,1; 292,5)	185,2 (63,1; 323,0)	84,0 (26,6; 153,7)	-50,1 (-74,8; -2,4)	Male
Tocantins	183,8 (64,6; 325,4)	109,1 (25,6; 215,2)	560,7 (187,5; 1.003,3)	69,6 (22,5; 126,5)	-36,2 (-66,1; 37,0)	Male
Northeast region	14.159,2 (4.803,0; 24.484,8)	124,3 (37,8; 224,5)	22.190,1 (7.099,5; 39.748,0)	74,9 (23,4; 134,9)	-39,7 (-65,5; -4,3)	Male
Alagoas	1.044,5 (354,9; 1.821,9)	167,4 (48,0; 297,1)	1.568,3 (464,0; 2.931,7)	102,9 (28,4; 200,3)	-38,5 (-65,8; 15,6)	Male
Bahia	3.384,4 (1.089,9; 6.014,0)	110,2 (33,2; 201,5)	5.113,2 (1.470,0; 9.367,9)	62,4 (17,1; 114,9)	-43,4 (-71,9; 4,4)	Male
Ceará	1.792,4 (547,7; 3.125,0)	101,6 (26,7; 180,4)	3.581,7 (1.003,9; 6.690,7)	73,6 (20,0; 140,3)	-27,5 (-63,1; 31,4)	Male
Maranhão	1.631,6 (507,6; 3.005,2)	142,6 (40,3; 260,9)	3.101,4 (911,2; 5.945,0)	97,0 (27,2; 186,3)	-32,0 (-66,7; 47,6)	Male
Paraíba	1.086,0 (353,4; 2.005,3)	103,5 (30,7; 197,1)	1.640,0 (582,1; 3.020,3)	73,0 (24,6; 135,1)	-29,5 (-61,8; 44,1)	Male
Pernambuco	3.102,9 (970,2; 5.681,3)	157,8 (47,3; 312,5)	3.721,3 (1.223,3; 7.042,4)	79,0 (23,8; 152,8)	-50,0 (-73,1; -4,4)	Male
Piaui	899,3 (269,9; 1.639,9)	133,9 (39,1; 244,7)	1.470,7 (482,9; 2.877,4)	78,0 (24,9; 155,0)	-41,8 (-69,3; 16,2)	Male
Rio Grande do Norte	763,4 (222,6; 1.455,8)	104,6 (29,0; 200,5)	1.287,4 (409,4; 2.304,3)	69,0 (21,1; 125,3)	-34,1 (-68,4; 31,6)	Male
Sergipe	454,5 (129,3; 807,0)	122,5 (31,8; 222,3)	706,0 (222,4; 1.247,6)	64,8 (18,8; 120,7)	-47,1 (-72,8; -8,5)	Male
Southeast region	26.750,8 (10.668,2; 43.261,8)	153,8 (52,5; 266,7)	34.945,6 (11.210,7; 57.164,8)	66,1 (21,1; 112,2)	-57,0 (-76,2; -26,6)	Male
Espírito Santo	935,2 (284,5; 1.676,4)	141,8 (40,5; 273,3)	1.326,7 (378,6; 2.464,5)	57,9 (14,6; 109,7)	-59,2 (-79,5; -15,2)	Male
Minas Gerais	5.338,6 (1.764,5; 9.002,4)	124,8 (39,6; 235,7)	6.174,0 (1.681,9; 11.648,4)	46,3 (12,9; 89,8)	-62,9 (-80,9; -31,8)	Male

Rio de Janeiro	8.321,4 (3.417,6; 16.301,4)	207,4 (81,3; 401,3)	7.710,6 (2.300,5; 13.417,2)	76,1 (23,3; 133,9)	-63,3 (-83,6; -27,8)	Male
São Paulo	12.155,6 (4.439,0; 20.387,7)	145,3 (44,9; 265,6)	19.734,3 (6.136,5; 34.036,5)	72,6 (23,0; 124,4)	-50,0 (-73,1; -9,7)	Male
South region	9.216,0 (3.384,0; 15.757,8)	151,6 (46,9; 267,6)	11.587,2 (3.487,5; 19.799,2)	62,2 (18,0; 113,2)	-59,0 (-76,3; -21,5)	Male
Paraná	3.699,4 (1.397,8; 6.496,2)	164,4 (50,2; 302,5)	4.379,1 (1.146,2; 8.088,1)	63,6 (16,9; 122,6)	-61,3 (-81,5; -24,3)	Male
Rio Grande do Sul	4.054,7 (1.414,4; 7.304,0)	148,5 (45,5; 267,5)	4.962,9 (1.675,9; 8.946,7)	66,2 (21,1; 124,4)	-55,4 (-76,3; -5,7)	Male
Santa Catarina	1.461,9 (505,5; 2.549,5)	134,2 (34,8; 257,5)	2.245,2 (564,0; 3.990,3)	54,1 (12,8; 106,1)	-59,6 (-79,4; -21,8)	Male
West-Central region	2.652,1 (1.007,0; 4.482,0)	129,1 (40,0; 222,7)	5.072,8 (1.482,2; 9.430,9)	61,3 (17,3; 116,8)	-52,6 (-71,7; -21,4)	Male
Distrito Federal	239,2 (74,8; 408,9)	103,2 (27,6; 186,4)	588,9 (159,6; 1.097,4)	45,9 (11,1; 90,2)	-55,5 (-78,8; -10,2)	Male
Goiás	1.324,4 (491,2; 2.295,7)	133,8 (43,8; 240,6)	2.231,7 (635,4; 4.134,1)	59,6 (16,2; 114,9)	-55,5 (-78,0; -13,3)	Male
Mato Grosso	613,1 (237,3; 1.093,4)	148,8 (46,6; 278,0)	1.285,5 (403,9; 2.196,1)	72,0 (20,6; 130,3)	-51,6 (-74,1; -6,1)	Male
Mato Grosso do Sul	475,4 (144,6; 859,2)	116,8 (28,5; 215,8)	966,6 (279,7; 1.849,5)	66,1 (16,6; 130,3)	-43,4 (-71,9; 15,1)	Male
Brazil	67.241,0 (25.199,8; 116.547,6)	153,9 (47,0; 273,9)	93.361,1 (32.228,5; 156.420,4)	63,4 (22,1; 105,5)	-58,8 (-71,1; -37,8)	Female
North region	2.637,3 (984,8; 4.507,6)	148,9 (41,8; 274,8)	5.744,0 (2.117,1; 9.533,8)	72,2 (24,8; 122,1)	-51,5 (-66,6; -27,8)	Female
Acre	121,2 (43,3; 203,5)	169,0 (50,2; 294,2)	259,8 (90,8; 442,5)	73,9 (25,2; 130,5)	-56,3 (-72,0; -27,3)	Female
Amapá	71,6 (28,2; 126,4)	138,4 (50,7; 254,6)	214,7 (73,2; 378,0)	76,8 (25,1; 140,2)	-44,5 (-65,9; -17,3)	Female
Amazonas	513,0 (186,9; 910,1)	152,2 (45,1; 286,1)	1.114,4 (334,2; 1.905,8)	69,9 (20,8; 123,6)	-54,1 (-73,7; -25,1)	Female
Pará	1.434,4 (437,0; 2.582,1)	147,0 (41,0; 279,7)	2.940,1 (1.118,2; 4.901,5)	75,5 (26,7; 128,0)	-48,6 (-67,6; -8,3)	Female
Rondônia	305,1 (117,5; 509,4)	215,4 (72,4; 388,1)	618,0 (244,4; 1.034,3)	76,2 (25,6; 129,2)	-64,6 (-78,8; -45,3)	Female
Roraima	37,7 (16,8; 60,6)	164,9 (53,9; 299,7)	148,9 (59,5; 252,9)	73,5 (22,8; 131,3)	-55,4 (-72,1; -29,5)	Female
Tocantins	154,4 (60,1; 267,9)	98,0 (26,1; 179,1)	448,2 (154,8; 794,4)	55,6 (18,2; 100,5)	-43,2 (-68,8; 6,4)	Female
Northeast region	17.258,1 (5.981,7; 29.577,1)	134,7 (40,9; 238,7)	26.389,1 (8.842,3; 44.098,6)	70,5 (24,5; 118,1)	-47,6 (-64,5; -20,1)	Female
Alagoas	1.335,9 (474,7; 2.344,7)	194,9 (57,1; 363,2)	1.907,6 (665,3; 3.203,2)	98,9 (33,9; 167,4)	-49,3 (-68,1; -15,4)	Female
Bahia	4.785,2 (1.666,8; 8.206,7)	136,8 (42,5; 241,7)	6.893,4 (2.172,6; 11.938,6)	68,2 (21,8; 119,1)	-50,2 (-67,9; -22,5)	Female
Ceará	2.077,9 (685,5; 3.718,4)	103,5 (29,9; 195,4)	3.671,3 (1.166,0; 6.648,2)	59,2 (19,3; 105,3)	-42,8 (-67,0; -4,4)	Female

Maranhão	1.325,7 (506,2; 2.375,1)	112,9 (33,8; 210,2)	3.330,0 (1.071,9; 5.714,6)	89,6 (28,5; 155,1)	-20,6 (-52,1; 47,2)	Female
Paraíba	1.406,1 (476,9; 2.582,2)	121,9 (38,1; 228,3)	1.860,0 (667,6; 3.210,4)	62,9 (22,6; 107,4)	-48,4 (-69,3; -9,8)	Female
Pernambuco	4.077,9 (1.623,6; 6.909,2)	174,2 (59,9; 299,0)	4.733,8 (1.695,6; 8.119,1)	74,0 (26,7; 126,6)	-57,5 (-74,6; -27,6)	Female
Piaui	835,6 (279,8; 1.407,1)	119,1 (33,5; 206,4)	1.603,7 (520,6; 2.871,0)	70,2 (23,1; 124,5)	-41,1 (-67,9; 1,5)	Female
Rio Grande do Norte	818,3 (279,6; 1.511,0)	100,9 (32,8; 185,9)	1.529,6 (510,5; 2.669,7)	63,5 (21,5; 109,1)	-37,0 (-62,6; 18,7)	Female
Sergipe	595,6 (169,2; 1.157,9)	142,9 (38,3; 292,0)	859,8 (261,2; 1.544,6)	60,7 (18,6; 109,3)	-57,5 (-75,5; -25,0)	Female
Southeast region	33.564,8 (12.561,5; 57.629,3)	165,7 (53,9; 303,7)	42.325,9 (15.252,8; 70.929,9)	61,7 (22,7; 103,2)	-62,8 (-73,7; -40,5)	Female
Espírito Santo	929,4 (333,6; 1.671,9)	133,8 (40,1; 251,2)	1.490,3 (477,2; 2.590,7)	52,8 (16,9; 92,0)	-60,5 (-77,8; -28,4)	Female
Minas Gerais	6.190,7 (2.066,0; 10.867,7)	128,9 (40,7; 247,4)	7.166,5 (2.190,3; 12.906,8)	43,2 (13,5; 77,3)	-66,5 (-80,5; -42,1)	Female
Rio de Janeiro	10.495,5 (3.778,2; 17.764,9)	203,9 (73,9; 357,6)	10.239,6 (3.418,1; 17.347,8)	72,6 (24,9; 122,2)	-64,4 (-76,5; -41,8)	Female
São Paulo	15.949,2 (5.842,9; 28.409,5)	167,6 (50,7; 303,7)	23.429,4 (8.640,3; 40.490,6)	66,7 (25,0; 114,7)	-60,2 (-74,7; -30,4)	Female
South region	11.092,9 (4.184,0; 19.034,0)	162,3 (50,1; 299,4)	13.283,2 (4.045,3; 22.452,0)	56,5 (17,0; 94,7)	-65,2 (-78,2; -44,8)	Female
Paraná	3.969,8 (1.414,6; 7.202,7)	174,9 (55,5; 327,5)	4.783,6 (1.527,1; 8.418,0)	56,6 (18,2; 99,3)	-67,7 (-80,1; -43,2)	Female
Rio Grande do Sul	5.428,2 (1.946,4; 9.538,6)	161,1 (53,2; 304,8)	6.013,9 (1.634,0; 10.476,3)	61,3 (16,9; 106,3)	-62,0 (-78,8; -31,1)	Female
Santa Catarina	1.694,9 (533,0; 3.162,3)	141,4 (37,1; 284,6)	2.485,7 (756,8; 4.488,9)	47,8 (13,1; 89,2)	-66,2 (-81,1; -40,1)	Female
West-Central region	2.687,9 (1.116,2; 4.625,5)	141,9 (47,4; 252,0)	5.619,0 (1.926,9; 9.344,5)	58,4 (19,3; 99,1)	-58,9 (-74,0; -38,6)	Female
Distrito Federal	313,4 (119,0; 569,7)	111,0 (31,4; 215,6)	676,7 (210,6; 1.236,2)	38,7 (10,7; 72,5)	-65,2 (-80,9; -39,9)	Female
Goiás	1.365,0 (569,1; 2.310,0)	151,3 (49,7; 275,8)	2.599,4 (850,8; 4.378,6)	60,5 (19,4; 101,8)	-60,0 (-75,9; -33,5)	Female
Mato Grosso	503,1 (191,2; 821,2)	153,9 (53,0; 276,6)	1.238,7 (451,3; 2.040,3)	67,6 (23,4; 112,9)	-56,1 (-74,4; -27,9)	Female
Mato Grosso do Sul	506,4 (168,3; 884,5)	134,2 (39,8; 244,3)	1.104,2 (347,3; 1.943,2)	64,0 (20,3; 114,7)	-52,3 (-75,3; -4,2)	Female
Brazil	122.550,6 (49.390,5; 195.903,4)	149,4 (48,5; 250,1)	172.839,2 (57.565,9; 281.866,5)	65,7 (21,8; 109,2)	-56,0 (-67,6; -40,2)	Both
North region	5.168,8 (2.059,9; 8.326,1)	144,5 (42,0; 253,7)	11.426,4 (3.845,8; 18.906,0)	74,7 (23,4; 130,4)	-48,3 (-61,7; -28,9)	Both
Acre	253,5 (97,2; 411,7)	160,4 (48,6; 273,4)	526,6 (174,4; 855,7)	77,3 (24,6; 126,8)	-51,8 (-68,2; -28,2)	Both
Amapá	140,6 (53,8; 229,9)	149,4 (50,3; 252,6)	420,3 (139,6; 689,8)	78,6 (24,8; 137,6)	-47,4 (-64,4; -27,1)	Both

Amazonas	954,7 (385,7; 1.647,4)	142,1 (43,4; 262,3)	2.265,9 (706,9; 3.804,8)	75,6 (22,3; 131,1)	-46,8 (-64,5; -20,9)	Both
Pará	2.697,0 (984,5; 4.507,5)	142,3 (39,1; 253,4)	5.588,4 (1.783,2; 9.334,6)	75,5 (22,7; 132,8)	-47,0 (-62,2; -21,1)	Both
Rondônia	692,5 (310,9; 1.074,8)	200,5 (59,7; 332,8)	1.282,2 (453,3; 2.061,7)	78,9 (25,9; 132,0)	-60,6 (-72,6; -41,5)	Both
Roraima	92,4 (43,0; 148,8)	168,2 (59,0; 283,1)	334,1 (115,5; 521,7)	78,9 (24,3; 131,7)	-53,1 (-68,4; -32,0)	Both
Tocantins	338,2 (133,9; 538,6)	103,3 (26,5; 183,8)	1.008,9 (346,6; 1.754,5)	62,6 (20,1; 109,4)	-39,4 (-61,4; -2,8)	Both
Northeast region	31.417,3 (11.495,6; 51.663,0)	130,0 (40,3; 217,8)	48.579,2 (16.409,8; 80.307,2)	72,6 (24,4; 120,6)	-44,1 (-59,2; -23,1)	Both
Alagoas	2.380,4 (861,7; 4.049,9)	181,9 (53,9; 314,9)	3.475,9 (1.202,6; 5.711,6)	100,8 (35,0; 169,0)	-44,6 (-61,8; -16,7)	Both
Bahia	8.169,6 (2.874,0; 13.768,6)	124,9 (38,8; 214,5)	12.006,5 (3.760,2; 19.382,1)	65,8 (20,7; 105,6)	-47,3 (-65,9; -22,8)	Both
Ceará	3.870,4 (1.228,3; 6.496,8)	102,6 (28,1; 178,5)	7.253,0 (2.386,7; 12.286,0)	65,7 (21,7; 110,6)	-36,0 (-58,3; 4,6)	Both
Maranhão	2.957,3 (1.139,0; 4.887,8)	128,0 (39,4; 225,1)	6.431,3 (2.014,4; 10.988,9)	92,9 (28,7; 159,9)	-27,4 (-54,0; 14,8)	Both
Paraíba	2.492,1 (867,2; 4.326,9)	113,1 (36,8; 197,6)	3.500,0 (1.321,1; 6.006,1)	67,4 (25,5; 114,6)	-40,4 (-59,2; -5,9)	Both
Pernambuco	7.180,8 (2.928,2; 12.057,2)	166,9 (57,1; 288,7)	8.455,1 (2.699,8; 14.341,4)	76,3 (23,7; 130,9)	-54,3 (-69,1; -33,8)	Both
Piaui	1.734,9 (563,4; 2.832,6)	126,4 (35,8; 214,0)	3.074,4 (1.010,3; 5.249,4)	74,0 (24,3; 126,8)	-41,4 (-61,4; -15,2)	Both
Rio Grande do Norte	1.581,7 (497,0; 2.778,2)	102,5 (30,2; 183,5)	2.817,0 (920,7; 4.713,0)	66,1 (21,6; 110,2)	-35,6 (-60,5; 1,9)	Both
Sergipe	1.050,2 (285,3; 1.812,8)	133,2 (35,9; 238,7)	1.565,9 (517,3; 2.661,5)	62,6 (20,4; 108,7)	-53,0 (-69,2; -24,7)	Both
Southeast region	60.315,6 (24.560,5; 96.802,6)	161,6 (54,6; 272,3)	77.271,4 (25.458,7; 125.956,5)	64,0 (20,9; 105,2)	-60,4 (-71,2; -43,4)	Both
Espírito Santo	1.864,6 (647,2; 3.204,7)	137,9 (40,9; 241,3)	2.817,0 (907,1; 4.735,6)	55,0 (17,3; 93,9)	-60,1 (-74,5; -36,4)	Both
Minas Gerais	11.529,2 (4.199,6; 19.411,5)	127,7 (39,7; 229,4)	13.340,6 (3.839,0; 23.305,4)	44,7 (12,9; 78,1)	-65,0 (-77,5; -47,0)	Both
Rio de Janeiro	18.816,9 (8.173,8; 31.644,8)	206,7 (77,3; 359,5)	17.950,2 (5.869,4; 28.976,8)	74,4 (24,7; 118,5)	-64,0 (-76,0; -47,7)	Both
São Paulo	28.104,8 (10.539,0; 45.729,3)	159,1 (46,9; 279,0)	43.163,7 (14.015,7; 71.978,3)	69,9 (23,1; 117,8)	-56,1 (-68,8; -33,4)	Both
South region	20.308,9 (7.952,8; 33.659,3)	158,4 (48,6; 268,5)	24.870,4 (7.741,1; 42.851,8)	59,2 (18,0; 103,9)	-62,6 (-73,9; -47,7)	Both
Paraná	7.669,2 (2.991,2; 13.084,2)	170,2 (58,1; 295,9)	9.162,7 (2.756,6; 16.113,3)	59,8 (17,2; 105,4)	-64,9 (-78,0; -49,2)	Both
Rio Grande do Sul	9.482,9 (3.727,5; 16.091,2)	157,1 (45,9; 277,9)	10.976,8 (3.414,0; 18.710,8)	63,8 (19,7; 110,3)	-59,4 (-73,7; -37,1)	Both
Santa Catarina	3.156,8 (1.191,7; 5.121,8)	138,9 (37,0; 240,5)	4.730,9 (1.548,4; 8.228,2)	50,8 (14,4; 90,2)	-63,4 (-75,4; -44,3)	Both
West-Central region	5.340,0 (2.364,3; 8.377,6)	135,8 (45,5; 227,3)	10.691,7 (3.541,5; 17.870,7)	59,8 (18,4; 101,4)	-56,0 (-68,5; -37,6)	Both

Distrito Federal	552,6 (208,6; 907,3)	107,7 (31,7; 194,1)	1.265,6 (366,0; 2.296,2)	41,8 (10,7; 79,0)	-61,2 (-75,9; -35,0)	Both
Goiás	2.689,4 (1.140,7; 4.276,1)	142,7 (49,3; 242,7)	4.831,1 (1.528,7; 8.414,2)	60,2 (17,7; 105,5)	-57,8 (-72,0; -35,5)	Both
Mato Grosso	1.116,2 (483,6; 1.810,6)	151,6 (51,9; 261,6)	2.524,2 (894,7; 4.066,9)	69,8 (23,2; 114,9)	-53,9 (-69,8; -32,8)	Both
Mato Grosso do Sul	981,8 (391,4; 1.635,3)	125,3 (37,9; 229,0)	2.070,9 (635,8; 3.538,7)	64,9 (18,8; 113,4)	-48,2 (-65,9; -13,6)	Both

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

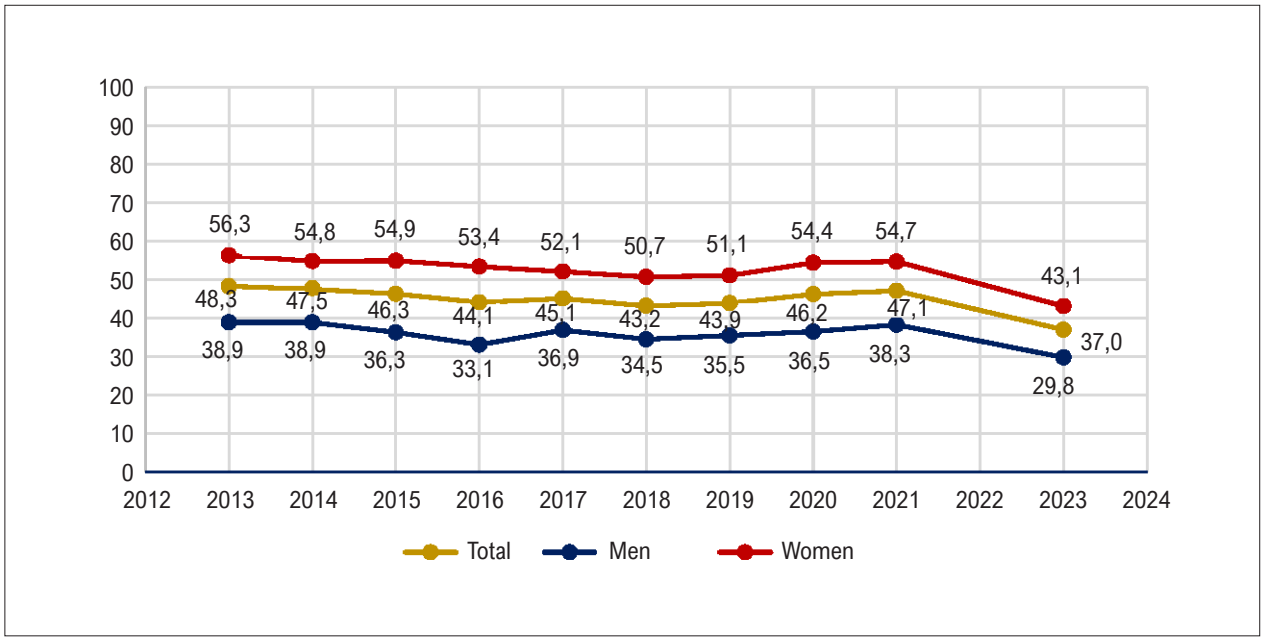

Chart 12.1 – *Percentage of physically inactive* adults aged ≥18 years in the capitals of the Brazilian states and Distrito Federal, per year, according to sex, between 2013 and 2023, obtained from Vigitel. *Less than 150 min/week of moderate-intensity physical activity or less than 75 min/week of vigorous-intensity physical activity. Source: Vigitel Brazil 2023.*[334]

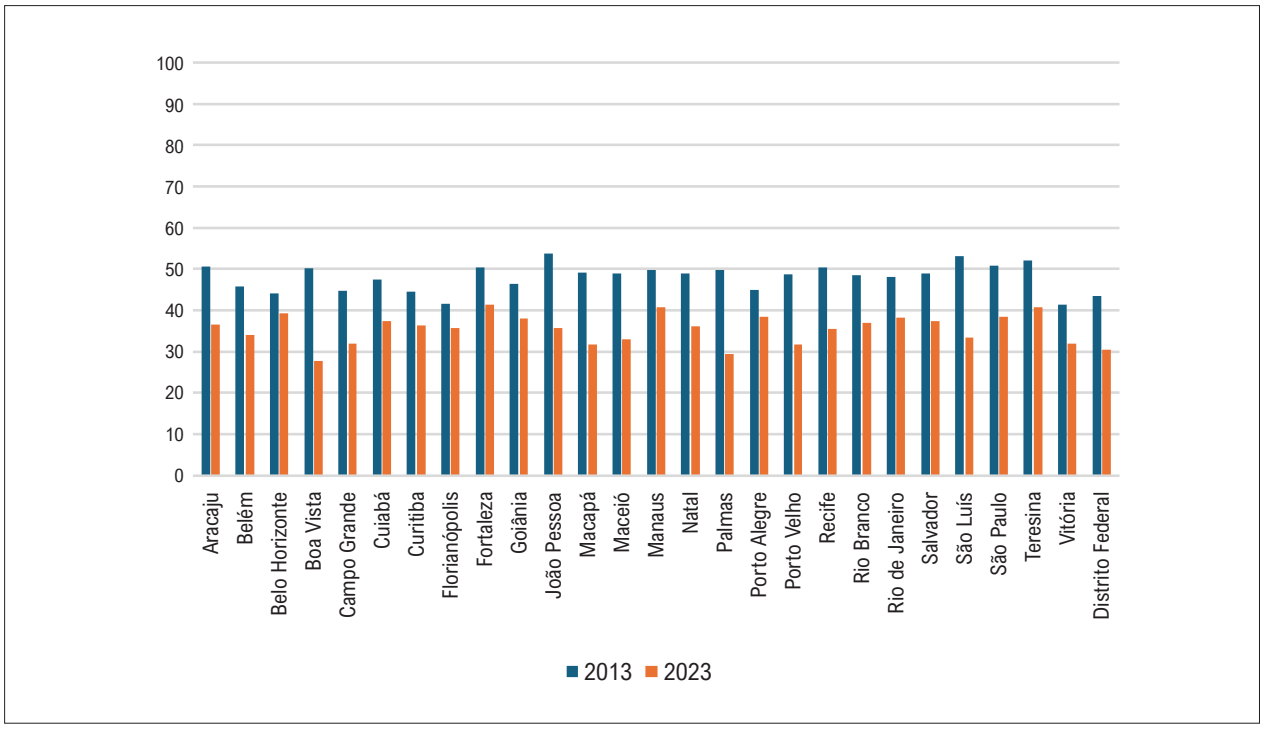

Chart 12.2 – *Percentage of physically inactive* adults aged ≥18 years in each capital of the Brazilian states and Distrito Federal, in 2013 and 2023, obtained from Vigitel. *Less than 150 min/week of moderate-intensity physical activity or less than 75 min/week of vigorous-intensity physical activity. Source: Vigitel Brazil 2023.*[334]

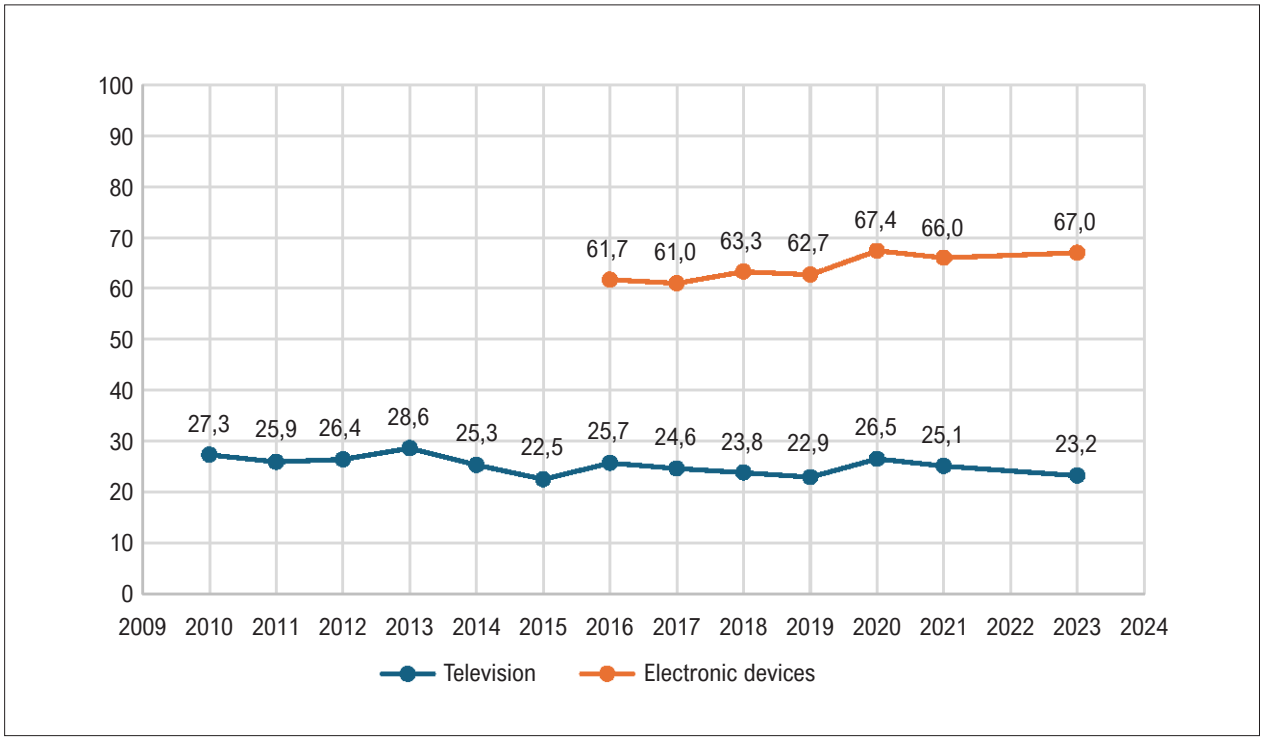

Chart 12.3 – *Percentage of adults in Brazil aged ≥18 years who spend ≥3 hours per day of their leisure time watching television or using electronic devices (television, computer, tablet, or cell phone), between 2010 and 2023, in the capitals of the Brazilian states and Distrito Federal, per year, from Vigitel. Source: Vigitel Brazil 2023.*[334]

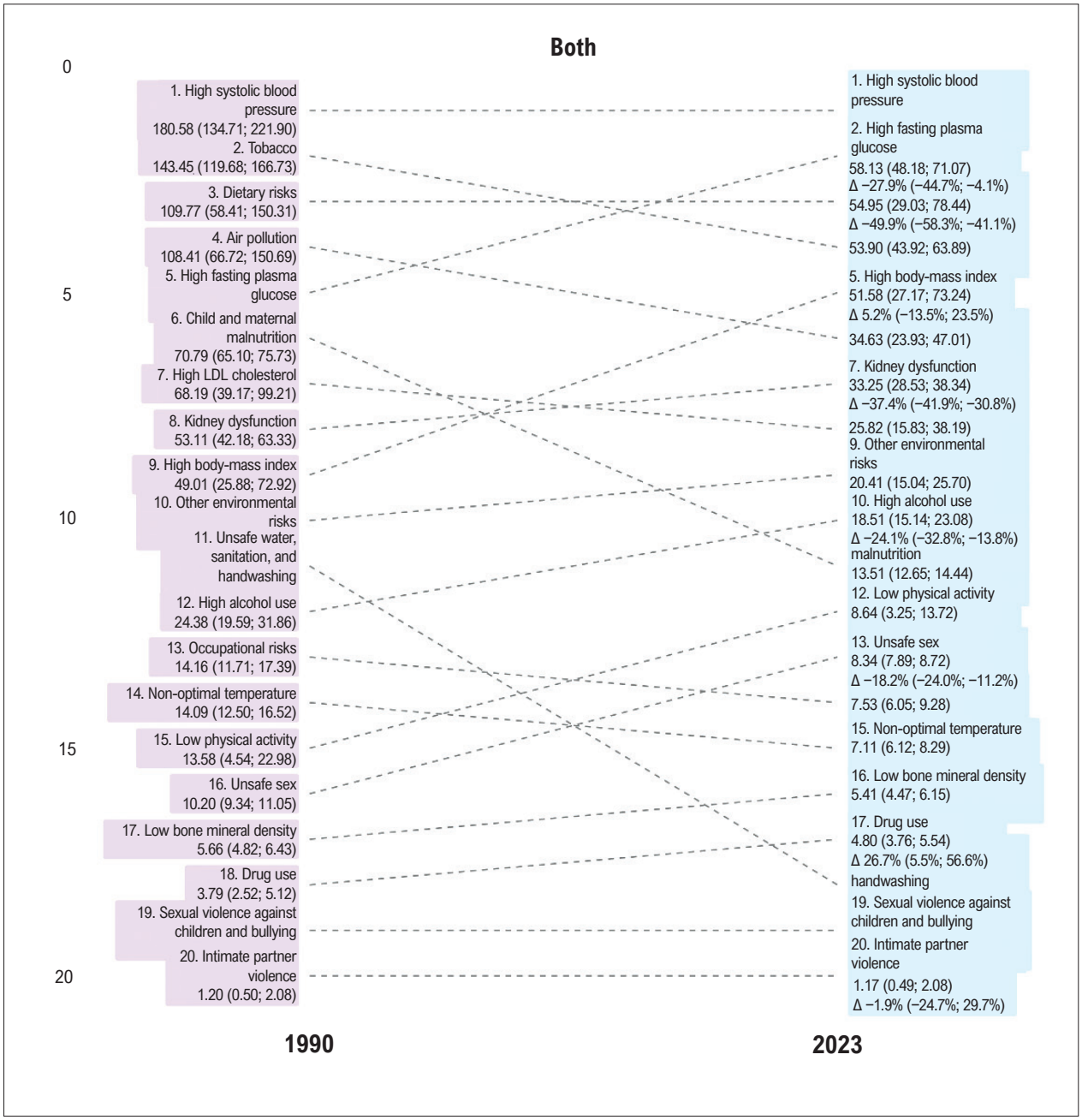

Chart 12.4 – *Comparison of the ranking of risk factors for attributable cardiovascular mortality in Brazil in 1990 and 2023 (both sexes), according to the GBD Study 2023. The values presented correspond to the attributable age-standardized mortality rates per 100,000 inhabitants, with their respective 95% uncertainty intervals. The lines connect the position of each risk factor in both years, enabling visualizing the ranking changes over time. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

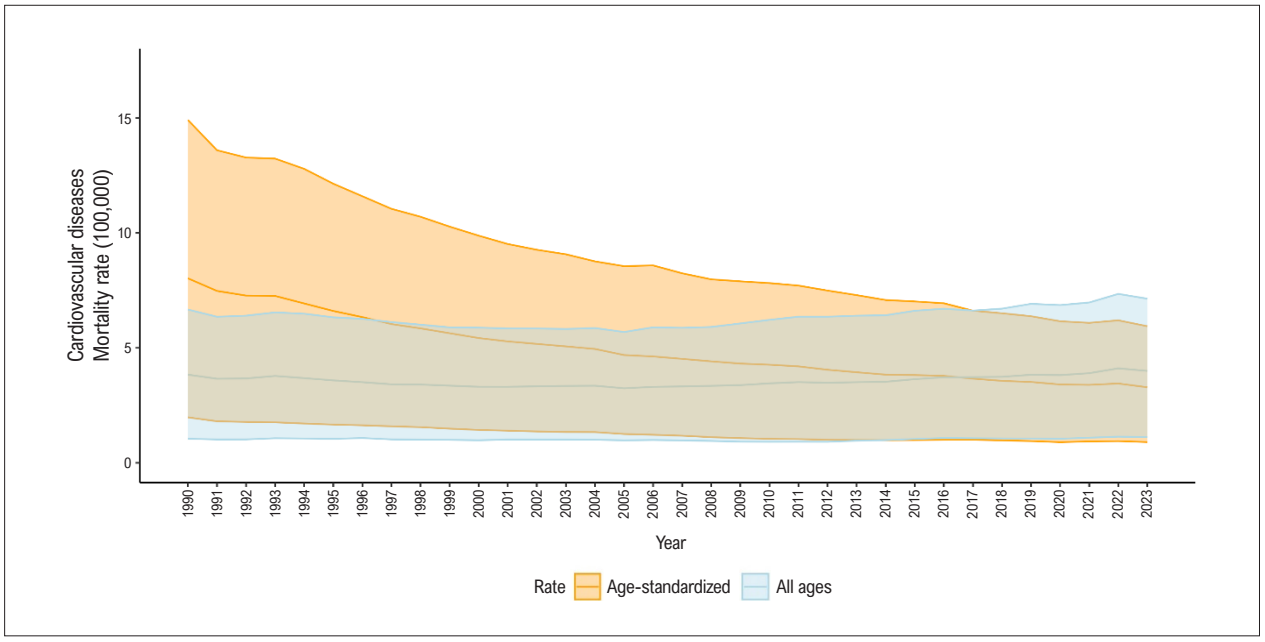

Chart 12.5 – *Temporal series of all-ages and age-standardized cardiovascular mortality rates attributable to low level of physical activity in Brazil. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

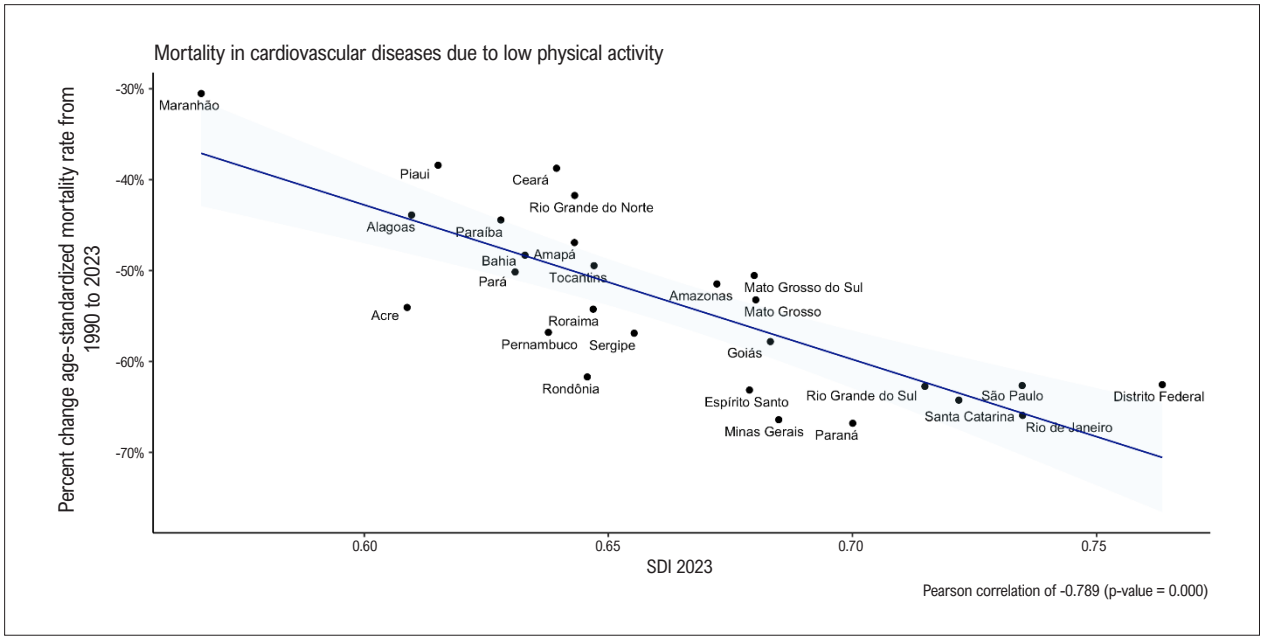

Chart 12.6 – *Correlation between the 2023 sociodemographic index (SDI) and the percent change of the age-standardized cardiovascular mortality rates attributable to low level of physical activity of the Brazilian Federative Units, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 13 – CARDIOVASCULAR DISEASES ATTRIBUTABLE TO DIETARY RISKS

See Tables 13.1 through 13.3 and Charts 13.1 through 13.5.

Abbreviations used in chapter 13

APR	Adjusted Prevalence Ratio
CI	Confidence Interval
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life-Years
ELSI – Brasil	Brazilian Longitudinal Study of Aging
ERICA	Study of Cardiovascular Risks in Adolescents (in Portuguese, *Estudo de Riscos Cardiovasculares em Adolescentes*)
FU	Federative Unit
GBD	Global Burden of Diseases, Injuries, and Risk Factors Study
IHD	Ischemic Heart Disease
NCD	Noncommunicable Disease
PeNSE	Brazilian School Health Survey (in Portuguese, *Pesquisa Nacional de Saúde do Escolar*)
PNS	Brazilian Health Survey (in Portuguese, *Pesquisa Nacional de Saúde*)
POF	Household Budget Survey (in Portuguese, *Pesquisa de Orçamentos Familiares*)
pp	percentage point
PUFA	Polyunsaturated Fatty Acids
SDI	Sociodemographic Index
UI	Uncertainty Intervals
UPF	Ultra-Processed Food
Vigitel	Brazilian Telephone Survey for Surveillance of Noncommunicable Diseases (in Portuguese, *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*)

Introduction

- According to the *Global Burden of Diseases, Injuries, and Risk Factors Study* (GBD study), dietary risks consist in inadequate exposure to a set of 15 foods and nutrients, such as low consumption of fruits, vegetables, pulses, whole grains, nuts and seeds, milk, fibers, calcium, omega-3 fatty acids, and polyunsaturated fatty acids (PUFAs), in addition to high consumption of sodium, red and processed meats, sugar-sweetened beverages, and trans fatty acids.[6,397]
- Scientific evidence has shown that dietary patterns rich in *in natura*, minimally processed foods, such as vegetables, fruits, whole grains, sea food, and low-fat dairy, reduce cardiovascular risk.[398,399] However, dietary patterns characterized by high consumption of red meat and ultra-processed foods (UPFs), which are rich in energy, added sugars, saturated fats, and sodium, are associated with increased cardiovascular risk because they are related to metabolic risk factors, such as obesity, arterial hypertension, dyslipidemia, and type 2 diabetes mellitus.[400-402]
- In Brazil, dietary risks represent an important public health problem. Although a reduction in age-standardized mortality rates due to cardiovascular disease (CVD) attributable to dietary risks between 1990 and 2023 was observed, dietary risks remain the second major risk factor for CVD in the country, surpassed only by high systolic blood pressure (Chart 13.1).
- Secondary data from the 2019 GBD study have shown that the Brazilian population diet is inadequate, because it is rich in red meat and sodium and poor in whole grains, contributing to disability-adjusted life-years (DALYs) and deaths due to noncommunicable diseases (NCDs), such as CVD.[403] In addition, in Brazil, there has been an increase in the consumption of UPFs, which represent 13% to 21% of total energy consumption. A study has estimated that approximately 19,200 premature deaths, 74,900 incident cases, and 883,000 annual DALYs due to CVD were attributable to UPF consumption in Brazil in 2019, corresponding to approximately 22% of premature deaths from CVD.[404]

Prevalence

- According to data from the 2023 Brazilian Telephone Survey for Surveillance of Noncommunicable Diseases (Vigitel), 31.9% (95% CI, 30.5 - 33.3) of Brazilian adults have reported regular consumption of fruits and vegetables (≥ 5 days per week), and this consumption was more prevalent among women (35.3%; 95% CI, 33.4 – 37.1). Regular consumption of beans (≥ 5 days per week) has been reported by 58.6% (95% CI, 57.2 – 60.0) of the adults and varied across the Brazilian capitals, with prevalences ranging from 30.4% in Macapá (95% CI, 26.0 – 34.9) to 73.2% (95% CI, 69.2 – 77.3) in Belo Horizonte. The consumption of five or more groups of unprocessed or minimally processed foods has been reported by 30.1% (95% CI, 28.8 – 31.5) of the adults, and this practice was more frequent among older people and those with higher education level.[334]
- The 2023 Vigitel has shown that 14.9% (95% CI, 13.7 - 16.1) of the adults consumed soft drinks regularly, with higher prevalence among men (16.8%; 95% CI, 15.0 - 18.7) as compared to women (13.2%; 95% CI, 11.7 - 14.7), the highest frequency being observed among adults aged 18-24 years (22.6%; 95% CI, 18.8 - 26.4). The prevalence in the capitals differed, ranging from 7% (95% CI, 4.4 - 9.7) in Salvador to 24.1% (95% CI, 19.4 - 28.8) in Curitiba. The consumption of at least five groups of UPFs was observed in 17.7% (95% CI, 16.6 - 18.9) of the population, being more frequent among men (22.0%; 95% CI, 20.0 - 24.1) and young individuals aged 18-24 years (26.6%; 95% CI, 22.7 - 30.4). Of the capitals, Macapá had the highest prevalence

of UPF consumption (30.3%; 95% CI, 25.6 - 34.9), while Vitória had the lowest (12.3%; 95% CI, 8.8 - 15.8).[334]

- In 2024, Vigitel data showed persistence of the low adhesion of Brazilian adults to healthy dietary patterns. Only 31.4% reported regular consumption of fruits and vegetables (≥5 days per week), the prevalence being higher among women (35.5%). The frequency of the recommended consumption of those foods between 2019 and 2024 decreased from 23.1% in 2019 to 21.0% in 2024, corresponding to a reduction of 0.42 percentage point (pp) annually, mainly among women, whose percentage decreased from 26.9% in 2019 to 24.0% in 2024 (-0.71 pp/year).[237]
- In addition, the regular consumption (≥5 days per week) of beans, a traditional food of the Brazilian diet, showed a reduction in its time series analysis, ranging from 66.8% in 2007 to 56.4% in 2024 (-0.64 pp/year) among adults. The greatest reduction was observed among men, whose regular consumption decreased from 73.7% in 2007 to 62.5% in 2024 (-0.71 pp/year).[237]
- Regarding the unhealthy food groups, a trend towards reduction was observed in the regular consumption of soft drinks and artificial juices (≥5 days per week), from 30.9% in 2007 to 16.2% in 2024 (-1.04 pp/year). That reduction was higher among men, whose regular consumption decreased from 35.7% in 2007 to 19.1% in 2024 (-1.14 pp/year). In 2024, the consumption of five or more groups of UPFs in the day prior to the interview was observed in 25.5% (95% CI, 24.4 - 26.5) of the population, being more frequent among men (27.5%; 95% CI, 26.0 - 29.1) than among women (23.7%; 95% CI, 22.4 - 25.1). In the general population, the consumption of UPFs was higher among individuals aged 18-24 years (45.5%; 95% CI, 41.6 - 49.5) and those with complete secondary education and incomplete higher education (29.4%; 95% CI, 27.7 - 31.0). Of the Brazilian capitals, Porto Alegre had the highest prevalence of UPF consumption (32.6%; 95% CI, 29.3 - 35.9), while São Luís had the lowest (18%; 95% CI, 15.3 - 20.7).[237]
- Data from the Brazilian Longitudinal Study of Aging (ELSI-Brasil) have shown low consumption of fruits and vegetables (16.7%) among elderly with arterial hypertension, with higher prevalence of that consumption among women (18.9%). Among men, the regular consumption of those foods was associated with better arterial hypertension control (56.6%).[405]
- A study with participants of the Brazilian Cardioprotective Food Program, living in the Brazilian Northeastern region, has shown low adhesion to the dietary therapy goals for secondary CVD prevention, with inadequate consumption of carbohydrates (52.3%), proteins (70.9%), lipids (38.8%), and fibers (22.4%). In addition, men had higher intake of sodium (72.9%) and fibers (28.1%), and individuals with higher education level had a high consumption of saturated fatty acids (70.5%).[406]
- The study by Louzada *et al.* (2023) about UPF consumption with data from the 2017-2018 Household Budget Survey (in Portuguese, *Pesquisa de Orçamentos Familiares* - POF) has shown that UPFs represented around 19.7% of the energy value of the Brazilian diet. This consumption was high among women and in the states of Rio Grande do Sul (24.06%), Santa Catarina (23.23%), and São Paulo (22.38%).[407]
- The study by Malta *et al.* (2022) with data from the 2019 Brazilian Health Survey (PNS) has shown self-reported arterial hypertension prevalence of 23.9% among individuals reporting healthy food consumption, but lower among those reporting consumption of UPFs (14.3%) and of a high sodium diet (19.2%). After adjusting for age, sex, and education level, the adjusted prevalence ratios (APRs) showed an association between high salt consumption and arterial hypertension (APR =1.1), while the UPF consumption remained associated with lower prevalence of that condition (APR = 0.9). However, those authors have emphasized that those associations do not indicate a protective effect of UPFs, being limited by the cross-sectional characteristic of the study and its self-reported data.[408]
- Studies have shown that sugar-sweetened and artificially-sweetened beverages, classified as UPFs, are associated with weight gain and higher cardiovascular risk. Data from the 2013 PNS have shown higher consumption of sugar-sweetened soft drinks among men (52.9%), young adults (40.1%), and individuals with low education level (51.8%), and that the ingestion of ≥0.4 cups/day increases cardiovascular risk.[409] A population-based study with 1,162 adults has shown that women who consumed sugar-sweetened and artificially-sweetened beverages 6 to 7 days per week had a 92%-higher prevalence of hypertension as compared to those who did not consume those beverages or consumed them at a lower frequency.[410]
- Results from the 2019 Brazilian School Health Survey (PeNSE) have shown that 97.3% of the Brazilian students aged 13-17 years had consumed at least one UPF in the day preceding the survey. The highest percentages were observed in the states of São Paulo (49.7%), Pernambuco (52.8%), and Rio Grande do Sul (63.1%). In addition, students had low consumption of vegetables (26.9%) and fresh fruits (26.9%).[411]
- Castelucci *et al.* have assessed 118,497 adolescents participating in the 2019 PeNSE and observed a 17.3% frequency of regular soft drink consumption, mainly among male adolescents, screen users during the meals, frequent fast food consumers, and those engaged in sedentary activities more than 3 hours per day.[412]
- Madalosso *et al.* have assessed data from 36,952 adolescents participating in the Study of Cardiovascular Risks in Adolescents (ERICA), conducted from 2013 to 2014. Those authors have reported that UPFs contributed to 30.7% of total energy consumption. Adolescents in the highest tertile of UPF consumption (≥38.7% of the daily energy value) showed higher intake of sodium, saturated and trans fats, in addition to lower intake of proteins, fibers, polyunsaturated fats, vitamins, and minerals. Moreover, high UPF consumption was positively associated with higher LDL-cholesterol concentrations and inversely

associated with lower HDL-cholesterol concentrations.[274]

- A cross-sectional study with 517 adolescents has shown high prevalence of overweight (32.4%) and physical inactivity (52.4%), with a mean UPF consumption corresponding to 45% of calorie intake. Non-vulnerable adolescents had higher concentrations of triglycerides, higher alcohol consumption, and lower fiber intake as compared to vulnerable adolescents (no access to drinking water, sewage network, and adequate per capita income).[413]

Cardiovascular disease mortality attributable to level 2 dietary risk

- According to data from the 2023 GBD study,[33] age-standardized CVD mortality rates attributable to level 2 dietary risks in Brazil significantly decreased from 1990 to 2023, despite some differences according to geographic region and sex. For both sexes, that Brazilian CVD mortality rate dropped from 91.0 (95% UI, 53.4; 124.8) to 36.3 (95% UI, 20.6; 52.4) per 100,000 inhabitants, corresponding to a 60.2% reduction (Table 13.1).
- In 1990, the Southeast region had the highest regional rate (102.4/100,000; 95% UI, 61.4; 139.0), while the Northeast region, the lowest (73.6/100,000; 95% UI, 41.2; 102.9), although with no difference in uncertainty intervals (UI). Despite the reduction in all regions, the trends differed. In 2023, the rates ranged from 32.5 (95% UI, 18.3; 49.0) to 40.0 (95% UI, 23.0; 56.9), the highest rate observed in the Northeast and the lowest in the South region. The smallest reduction occurred in the Northeast (–45.6%; 95% UI, -56.1; -35.3) and the highest, in the South (–66.9%; 95% UI, -73.3; -59.2), followed by the Southeast region −65.5% (95% UI −72.2; −57.7) (Table 13.1).
- Of the Federative Units (FU), in 1990, the highest CVD mortality rates attributable do level 2 dietary risks were observed in Rio de Janeiro, 121.8/100,000 (95% UI, 72.5; 164.9), Paraná and Rondônia, 103.7/100,000 (95% UI, 60.3; 145.6 and 95% UI, 59.5; 144.5, respectively), Rio Grande do Sul, 97.0/100,000 (95% UI, 54.4; 134.6), and Pernambuco, 96.9/100,000 (95% UI, 55.0; 136.7). The lowest occurred in Ceará, 56.9/100,000 (95% UI, 30.5; 82.0), Bahia, 64.8/100,000 (95% UI, 37.8; 91.8), Amapá, 65.9/100,000 (95% UI, 35.1; 92.6), and Rio Grande do Norte, 66.7/100,000 (95% UI, 36.0; 92.0) (Table 13.1).
- In 2023, there was a reduction in the CVD mortality rates attributable do level 2 dietary risks, although with superposition of uncertainty intervals between 1990 and 2023 in most states (Table 13.1).
- The percent changes of the rates reinforce the territorial differences. The highest reductions occurred in Distrito Federal, -71.9 (95% UI, -77.7; -65.6), Paraná, -68.7 (95% UI, -74.9; -61.3), Rio de Janeiro, -67.8 (95% UI, -73.9; -60.5), Minas Gerais, -67.5 (95% UI, -73.8; -60.0), and Rio Grande do Sul, -66.3 (95% UI, -73.2; -58.7). The smallest decreases, between -35.6 (95% UI, -48.9; -21.9) and -41.7 (95% UI, -51.7; -29.1), concentrated in the Northeast region, except for Sergipe, -52.0 (95% UI, -62.2; -39.8), and Pernambuco, -55.8 (95% UI, -64.0; -46.9) (Table 13.1).
- In Brazil, men had the highest CVD mortality rates attributable to level 2 dietary risk both in 1990, 110.0/100,000 (95% UI, 63.2; 150.5), and 2023, 48.2/100,000 (95% UI, 27.0; 69.0), as compared to women, whose rates were 74.0/100,000 (95% UI, 42.5; 101.8) and 26.4/100,000 (95% UI, 15.3; 39.0), respectively. The percent reduction was greater among women, –64.3% (95% UI, -70.6; -57.3), than among men, –56.1% (95% UI, -64.9; -46.7), a pattern observed across all regions and Federative Units, except Maranhão. In 2023, mortality rates remained higher among men than women across all Brazilian regions, being approximately 83% higher in Brazil overall, 80% higher in the North, and 74% higher in the Northeast, although the uncertainty intervals overlap.
- The regional differences per sex reflect the general pattern, with greater reductions in CVD mortality rates attributable to level 2 dietary risk in the South and Southeast regions and less pronounced decreases in the North and Northeast regions. Among women, reductions greater than 70% stand out in Distrito Federal, -75.6 (95% UI, -81.1; -68.8), Paraná, -73.1 (95% UI, -78.3; -66.4), Minas Gerais, -70.9 (95% UI, -76.4; -64.0), and Rio de Janeiro, -70.7 (95% UI, -76.5; -63.9). Among men, the highest reductions were observed in Distrito Federal, -68.6 (95% UI, -76.0; -60.5), Rio de Janeiro, -65.0 (95% UI, -72.9; -56.7), Minas Gerais, -64.5 (95% UI, -72.4; -55.3), and in the FUs of the South, all greater than -60. The smallest reductions among men concentrated in the Northeast: Alagoas, -27.5 (95% UI, -44.2; -9.0), Ceará, -29.4 (95% UI, -43.9; -12.7), and Paraíba, -29.4 (95% UI, -44.1; -11.4). Among women, the smallest reductions were observed in Maranhão, -29.6 (95% UI, -45.7; -7.4), Piauí, -41.9 (95% UI, -54.5; -25.7), Paraíba, -43.3 (95% UI, -54.0; -27.0), Ceará, -47.9 (95% UI, -59.0; -35.6), and Amapá, -47.9 (95% UI, -59.0; -35.6) (Table 13.1).
- It is worth noting that there was a decline in the age-standardized CVD mortality rates attributable to level 2 dietary risk and an increase in the absolute number of deaths in most FUs, reflecting the increase in life expectancy and population growth (Table 13.1).
- The analysis of the CVD mortality attributable to level 2 dietary risk according to age group in Brazil has shown stability of the crude mortality rates between 1990 and 2023 [49.3 (95% UI, 29.9–66.0) and 44.6 (95% UI, 25.4–64.5) per 100,000 inhabitants, respectively], corresponding to a percent change of −9.7 (95% UI, −27.1 to 9.4) (Table 13.2).
- Among individuals aged 15-49 years, the rates decreased from 13.8 (95% UI, 9.8; 18.4) to 8.7 (95% UI, 6.5; 11.0) per 100,000 inhabitants, within the uncertainty interval, with percent change of −37.1% (95% UI, −47.6; −20.1). In the group aged 50-69 years, there was a statistically significant reduction from 189.6 (95% UI,

115.7; 249.1) to 79.3 (95% UI, 45.2; 111.1) per 100,000 inhabitants, with percent change of −58.2% (95% UI, −66.1; −49.4). Among individuals aged 70 years and older, the rates decreased from 777.8 (95% UI, 391.8; 1,125.0) to 332.2 (95% UI, 172.9; 511.4) per 100,000 inhabitants, with percent change of −57.3% (95% UI, −65.6; −47.7) (Table 13.2).

- The age-standardized CVD mortality rate attributable to level 2 dietary risk for the country was 91.0 (95% UI, 53.4; 124.8) per 100,000 inhabitants in 1990 and 36.3 (95% UI, 20.6; 52.4) in 2023, with percent change of -60.2 (95% UI, -67.6; -52.2), evidencing a statistically significant reduction in mortality after adjusting for age groups (Table 13.2).
- Chart 13.2 shows the proportional cardiovascular mortality attributable to level 2 dietary risk in Brazil in 2023, according to sex and age ranges. There is superposition of uncertainty intervals according to sex and age ranges. In general, men tend to have higher proportions, although with superposition of uncertainty intervals. The proportions tend to increase as age advances, peaking at the age of 45-64 years, when the influence of the dietary factors on cardiovascular mortality is more marked, especially in the male sex.
- Chart 13.3 shows the time series of CVD mortality attributable to level 2 dietary risk in Brazil between 1990 and 2023, evidencing different evolution patterns of all-age and age-standardized rates. The age-standardized rates show a consistent decline over the period, with little oscillations, indicating a reduction in mortality adjusted to age range. The all-age rates, however, remain stable in the period because of demographic changes, such as population aging.
- Analysis of the relationship between the sociodemographic index (SDI) and the percent change of age-standardized CVD mortality rates attributable to level 2 dietary risks in Brazil between 1990 and 2023 (Chart 13.4) has shown a consistent reduction in mortality in all FUs. Pearson's correlation was strongly negative ($r = -0.826$; $p < 0.001$), indicating that higher SDI levels in 2023 were associated with more marked reductions in mortality rates over the period, suggesting direct influence of socioeconomic development and social inequalities on the mitigation of the dietary risks associated with CVD.
- Although all FUs have shown a decline in mortality, the magnitude of the reduction varied substantially. The FUs with the highest SDI, such as Distrito Federal, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Paraná, Minas Gerais, and São Paulo, had reductions frequently exceeding 60%. Conversely, the FUs with the lowest SDI, mainly in the North and Northeast regions, such as Maranhão, Alagoas, Piauí, and Paraíba, had more modest reductions, between 30% and 45%.
- Chart 13.5 shows the distribution of age-standardized CVD mortality rates attributable to level 2 dietary risk stratified by CVD causes in Brazil in 1990 and 2023. In 2023, as compared to 1990, there was a reduction in the rates due to the same CVD causes, whose relative areas in the graph are smaller. Ischemic heart disease (IHD) remained the major component of total CVD, followed by stroke and hypertensive heart disease, while the other CVD causes maintain similar proportions to those of the previous period, but of smaller magnitudes.

Burden of cardiovascular disease attributable to level 2 dietary risk

- Table 13.3 shows the number of DALYs, all-age and age-standardized DALY rates due to CVD attributable to level 2 dietary risk, and the percent change of rates, for Brazil between 1990 and 2023. The age-standardized DALY rates showed a statistically significant reduction, from 2,140.5 (95% UI, 1,323.9; 2,855.3) to 880.1 (95% UI, 526.6; 1,224.4) per 100,000 inhabitants, with percent change of -58.9 (95% UI, -66.4; -51.1).
- Almost all age groups showed a reduction as follows: 15-49 years, nonsignificant reduction of -39.1 (95% UI, -49.1; -23.7); 50-69 years, statistically significant reduction of -58.2 (95% UI, -66.2; -49.7); 70+ years, nonsignificant reduction with superposition of uncertainty intervals.

Impact of the COVID-19 pandemic on food consumption

- During the COVID-19 pandemic, there were important changes in the food consumption patterns of the Brazilian population. Among adults, the consumption of vegetables decreased from 37% to 33%. In addition, there was an increase to 2 or more days per week in the consumption of UPFs, such as frozen meals (from 10.0% to 14.6%), salty snacks (from 9.5% to 13.2%), and chocolates/sweetened biscuits/slices of pie (from 41.3% to 47.1%).[414] Patients with DNC showed a 12.7% reduction in the consumption of vegetables and an increase in the consumption of frozen meals (53.7%), salty snacks (31.2%), and chocolates (12.5%).[415]
- Adolescents showed an increase in the prevalences of consumption of vegetables (from 27.34% to 30.5%) and unhealthy foods, such as frozen meals (from 13.26% to 17.3%), candies, and chocolates (from 48.58% to 52.51%).[389]

Impact of dietary risks on cardiovascular health

- Chronic inflammation is one of the major pathophysiological mechanisms involved in CVD emergence and progression. Strategies to stimulate the consumption of healthy foods, such as fruits and vegetables, seeds, whole grains, and fish that are high in omega-3 fatty acids, can reduce systemic inflammatory processes and improve cardiovascular health.[416]
- In an ecologic study, Victor *et al*. have assessed the CVD mortality data of 5,558 Brazilian municipalities in 2016, characterizing the food 'environments' according to the density of unprocessed foods and UPFs per 10,000 inhabitants. The municipalities with the lowest offer of unprocessed foods had the highest risk for IHD mortality in women. Those with higher availability of

UPFs showed high risk of death due to CVD, stroke, and IHD.[79]

- Nilson *et al.* have estimated the premature CVD deaths attributable to the consumption of UPFs by Brazilian adults for 2019. Approximately 22% of premature CVD deaths and 33% of premature all-cause deaths were attributable to UPFs. Reductions of 20% and 50% in UPF consumption could avoid approximately 21% and 52% of premature CVD deaths, respectively. Based on a hypothetical intake scenario equivalent to the first quintile of ingestion, prevention of approximately 81% of those deaths was estimated.[404]

Risk factor and prevention – Dietary risks

- Dietary risks are one of the major global risk factors for the development of DNCs, such as CVDs. In Brazil, they play an important role in the general classification of risks for CVDs, being ranked third according to the 2023 GBD study.[33]
- Unhealthy food is a modifiable risk factor for chronic disease. However, changing a dietary habit is complex, being influenced by socioeconomic, environmental, and cultural factors. The study by Jaime *et al.*, using secondary data from the 2013 PNS collected from 64,348 households, has shown differences in the regular consumption of beans and fish, as well as in the recommended consumption of fruits and vegetables in the Brazilian macroregions and FUs. According to that study, the distribution of those markers was influenced by sociodemographic variables, such as age, sex, education level, ethnicity, and residence place.[417]
- The section *Cardiovascular disease mortality attributable to level 2 dietary risk* of this chapter reported more significant reductions in CVD mortality attributable to level 2 dietary risk in some FUs with higher SDI, while those FUs with lower SDI showed less marked reductions. This shows that socioeconomic progress is associated with higher ability to prevent and manage those risk factors.
- The strategic plan to fight NCDs in Brazil for the 2021-2030 period has reported that, according to 2019 PNS, 77% of the Brazilian population does not consume the recommended amount of fruits/vegetables, 18% consume UPFs, and 15% drink sugar-sweetened beverages. Thus, that plan proposes the following: to increase by 30% the recommended consumption of fruits and vegetables; to reduce the UPF consumption; and to reduce by 30% the regular consumption of sweetened beverages in Brazil by 2030.[418]

Future directions

- Analysis of 2023 GBD data[33] has shown a reduction in CVD mortality attributable to level 2 dietary risks from 1990 to 2023. However, inequalities by region and sex persist, with the highest burden concentrated in the Northeast region and Northern states. In addition, the impact of dietary risks on women and men differed over the course of their lives, and there was a non-homogeneous reduction among different CVD subgroups.
- These findings reinforce the need for public policies aimed at equity, with specific interventions according to region, sex, and age group. The persistence of limiting factors, such as increased consumption of UPFs in past decades[407] and inequalities in access to adequate food, has evidenced the importance of integrated strategies to promote health and primary healthcare strengthening, especially in more vulnerable regions.
- Despite the Brazilian relevant scientific production on foods and cardiometabolic factors, important knowledge gaps in the specific contribution of dietary risks to CVD emergence, progression, and prognosis persist in the Brazilian context. These gaps are particularly evidenced when social inequalities, regional dietary patterns, biological mechanisms, and assessment of public policies are considered.
- The evidence available is mainly based on cross-sectional studies or ecological analyses, and longitudinal studies with clinical cardiovascular outcomes are scarce. Brazilian cohorts with detailed dietary assessment could enhance the prospective comprehension of the association between dietary patterns and cardiovascular events.
- Another relevant aspect refers to the Brazilian socioeconomic and regional heterogeneity. Inequalities in access to healthy foods, differences in sex, ethnicity, income, education level, and access to health services,[419] in addition to the urban/rural context significantly modulate the relationship between food and CVD. Furthermore, regarding secondary prevention, despite the existence of Brazilian dietary guidelines, there is limited evidence on the impact of the adhesion to such recommendations on the long-term clinical outcomes, mainly in the Brazilian health system.
- It is worth noting the importance of the approval, in 2024, of the Brazilian Tax Reform that established selective taxes for harmful products to health (alcohol, tobacco, and soft drinks). However, this advance has been threatened during the regulation of the tax rates, because a provision was inserted into the Complementary Bill nº 108/2024 to impose a maximum tax rate of only 2% on sugar-sweetened beverages. The civil society and government mobilization has succeeded in reversing this maneuver and removing the provision.[420] The international literature has shown that only tax rates of at least 20% of the final retail price, as recommended by the World Health Organization, can induce substantial changes in consumption patterns.[421] Thus, it is important to approve that the minimum taxation of soft drinks should be 20% to discourage consumption and support the goals of stability for adult obesity prevalence and of a 30% reduction in NCDs.[420]

Table 13.1 – Number of deaths and age-standardized mortality rates due to cardiovascular diseases attributable to level 2 dietary risks, according to sex, in Brazil, regions, and Federative Units, in 1990 and 2023, and percent changes of the rates in the period.

Sex/Location	1990		2023		Percent changes (95% UI)
	Number (95% UI)	Mort. rate (95% UI)	Number (95% UI)	Mort. rate (95% UI)	
Men					
Brazil	42.654,9 (25.272,2; 57.228,7)	110,0 (63,2; 150,5)	55.371,6 (31.096,0; 78.827,2)	48,2 (27,0; 69,0)	-56,1 (-64,9; -46,7)
North region	1.589,5 (923,7; 2.181,2)	89,8 (48,1; 125,5)	3.646,4 (2.066,1; 5.153,7)	50,0 (27,7; 71,6)	-44,3 (-54,7; -32,1)
Acre	70,8 (40,6; 97,5)	86,2 (46,9; 121,4)	159,4 (83,3; 224,2)	48,6 (25,1; 69,1)	-43,6 (-55,7; -27,4)
Amapá	37,1 (20,4; 50,2)	91,3 (47,2; 127,9)	127,8 (73,5; 185,3)	49,0 (27,1; 73,2)	-46,3 (-58,3; -32,0)
Amazonas	259,7 (145,9; 365,1)	78,2 (41,8; 111,9)	641,4 (367,2; 951,4)	45,5 (25,1; 68,7)	-41,8 (-54,0; -25,8)
Pará	835,7 (470,5; 1.158,1)	90,9 (47,9; 128,5)	1.766,0 (982,6; 2.548,2)	50,4 (27,5; 73,9)	-44,5 (-56,3; -29,7)
Rondônia	208,6 (130,2; 282,3)	113,2 (64,3; 158,6)	405,7 (229,3; 570,4)	51,6 (28,9; 73,7)	-54,5 (-63,1; -41,9)
Roraima	28,7 (17,6; 39,2)	98,1 (53,2; 139,7)	115,0 (65,0; 160,4)	55,2 (31,1; 78,4)	-43,7 (-56,5; -28,7)
Tocantins	148,8 (85,3; 204,2)	102,0 (53,2; 144,8)	431,1 (251,5; 596,1)	54,6 (31,7; 76,0)	-46,4 (-57,7; -33,8)
Northeast region	9.835,2 (5.525,1; 13.701,8)	87,9 (48,0; 123,5)	15.441,8 (8.571,8; 21.527,7)	52,2 (28,8; 73,3)	-40,6 (-51,4; -27,7)
Alagoas	568,2 (325,5; 808,7)	93,1 (52,7; 135,6)	1.012,2 (560,3; 1.429,9)	67,5 (36,8; 97,0)	-27,5 (-44,2; -9,0)
Bahia	2.256,0 (1.364,9; 3.145,1)	75,7 (44,2; 107,5)	3.505,6 (1.906,6; 4.975,4)	42,8 (23,1; 60,9)	-43,4 (-54,5; -30,5)
Ceará	1.128,4 (596,4; 1.612,4)	65,5 (34,1; 93,9)	2.258,7 (1.219,1; 3.183,7)	46,2 (24,8; 65,6)	-29,4 (-43,9; -12,7)
Maranhão	1.405,8 (728,3; 1.951,4)	118,7 (59,4; 167,5)	2.124,4 (1.193,3; 2.934,1)	67,1 (37,4; 93,1)	-43,5 (-55,2; -29,5)
Paraíba	790,4 (412,8; 1.116,4)	77,8 (40,8; 110,3)	1.227,7 (660,7; 1.683,6)	54,9 (29,6; 75,3)	-29,4 (-44,1; -11,4)
Pernambuco	2.177,1 (1.276,0; 3.055,0)	112,3 (63,7; 159,0)	2.699,3 (1.530,2; 3.788,2)	57,3 (32,2; 81,0)	-49,0 (-58,9; -37,3)
Piauí	630,4 (345,7; 869,0)	97,3 (52,0; 135,3)	1.083,1 (589,9; 1.534,2)	57,9 (31,6; 82,1)	-40,5 (-52,2; -25,1)
Rio Grande do Norte	589,0 (325,3; 819,0)	83,0 (45,3; 115,6)	1.052,0 (588,4; 1.478,9)	56,2 (31,3; 79,6)	-32,3 (-46,6; -17,0)
Sergipe	290,0 (155,3; 421,8)	79,3 (41,1; 115,1)	478,8 (265,7; 716,9)	44,1 (24,1; 66,6)	-44,3 (-56,8; -27,4)
Southeast region	22.164,1 (13.301,0; 29.981,5)	126,3 (73,0; 173,3)	24.704,6 (13.749,3; 35.135,0)	47,9 (26,6; 68,6)	-62,1 (-70,3; -52,8)
Espírito Santo	694,8 (403,2; 972,9)	105,9 (58,7; 149,9)	1.074,1 (641,2; 1.547,2)	47,7 (28,3; 68,8)	-54,9 (-64,5; -43,6)

Minas Gerais	4.595,5 (2.762,9; 6.423,8)	106,7 (61,6; 149,5)	4.987,1 (2.758,0; 7.408,6)	37,8 (21,0; 56,2)	-64,5 (-72,4; -55,3)
Rio de Janeiro	6.157,0 (3.682,8; 8.304,8)	154,5 (89,3; 210,8)	5.327,9 (3.047,0; 7.641,6)	54,0 (31,0; 77,6)	-65,0 (-72,9; -56,7)
São Paulo	10.716,8 (6.455,4; 14.451,6)	125,2 (72,8; 171,6)	13.315,5 (7.299,2; 18.597,3)	50,7 (27,5; 71,4)	-59,5 (-68,2; -50,2)
South region	7.099,9 (4.082,7; 9.636,5)	117,5 (65,1; 161,3)	7.628,3 (4.193,7; 11.091,3)	42,5 (23,4; 62,8)	-63,8 (-72,1; -55,3)
Paraná	2.636,2 (1.532,0; 3.633,5)	119,9 (67,6; 167,7)	2.872,1 (1.563,4; 4.226,1)	43,1 (23,4; 64,6)	-64,0 (-72,0; -54,7)
Rio Grande do Sul	3.288,5 (1.887,1; 4.438,7)	119,8 (65,4; 165,7)	3.028,0 (1.634,2; 4.492,1)	42,3 (23,0; 63,1)	-64,7 (-72,8; -56,2)
Santa Catarina	1.175,2 (655,9; 1.617,8)	107,7 (58,1; 151,6)	1.728,2 (988,6; 2.536,6)	42,0 (24,1; 63,1)	-61,0 (-69,5; -51,4)
West-Central region	1.966,2 (1.159,7; 2.706,8)	96,4 (54,5; 134,6)	3.950,5 (2.269,7; 5.671,1)	47,8 (27,1; 69,6)	-50,4 (-60,3; -39,7)
Distrito Federal	253,5 (159,5; 349,8)	101,1 (59,7; 143,3)	408,8 (244,1; 615,0)	31,8 (18,4; 48,8)	-68,6 (-76,0; -60,5)
Goiás	892,7 (507,8; 1.252,7)	92,9 (50,6; 131,3)	1.799,4 (1.008,3; 2.542,1)	48,2 (26,7; 68,8)	-48,1 (-59,0; -35,1)
Mato Grosso	361,1 (213,2; 505,2)	91,6 (49,3; 131,2)	880,3 (499,9; 1.234,2)	50,5 (28,5; 72,4)	-44,8 (-55,5; -31,0)
Mato Grosso do Sul	458,8 (273,7; 633,8)	107,1 (61,1; 149,6)	862,0 (494,6; 1.254,8)	58,3 (33,3; 85,0)	-45,6 (-58,0; -33,9)
Women					
Brazil	31.039,4 (18.446,8; 42.238,3)	74,0 (42,5; 101,8)	39.187,0 (22.596,2; 57.976,3)	26,4 (15,3; 39,0)	-64,3 (-70,6; -57,3)
North region	1.065,5 (605,0; 1.482,9)	64,6 (35,0; 91,0)	2.160,1 (1.212,2; 3.125,4)	27,8 (15,2; 40,5)	-57,0 (-64,0; -48,1)
Acre	41,5 (24,3; 59,0)	64,6 (35,7; 92,3)	96,1 (55,5; 138,6)	27,9 (15,8; 41,2)	-56,7 (-65,6; -46,7)
Amapá	24,0 (13,0; 34,3)	47,5 (25,3; 68,6)	69,4 (39,0; 107,6)	24,9 (13,2; 39,0)	-47,6 (-60,5; -33,2)
Amazonas	181,5 (107,1; 263,2)	58,8 (32,7; 86,0)	378,0 (223,3; 571,2)	24,5 (14,0; 36,8)	-58,3 (-67,0; -48,6)
Pará	603,7 (336,9; 848,0)	65,0 (34,5; 92,4)	1.065,8 (569,9; 1.578,2)	27,6 (14,4; 41,3)	-57,4 (-64,9; -48,4)
Rondônia	108,0 (67,2; 148,9)	89,9 (52,1; 126,1)	235,4 (134,7; 335,8)	30,8 (17,4; 44,7)	-65,7 (-72,3; -58,7)
Roraima	13,6 (8,3; 19,2)	68,5 (40,2; 96,8)	55,4 (33,1; 77,1)	30,3 (17,6; 43,2)	-55,8 (-64,7; -43,9)
Tocantins	93,1 (56,7; 129,3)	74,8 (44,4; 105,2)	260,1 (154,4; 357,0)	32,7 (19,2; 45,3)	-56,2 (-65,7; -44,7)
Northeast region	7.513,7 (4.298,8; 10.568,5)	60,9 (34,1; 86,9)	11.473,9 (6.616,5; 16.342,7)	30,0 (17,4; 42,5)	-50,8 (-60,1; -40,2)
Alagoas	465,4 (264,4; 654,6)	70,5 (38,9; 100,8)	775,1 (440,1; 1.097,6)	40,3 (22,8; 57,0)	-42,9 (-55,1; -27,4)
Bahia	1.862,1 (1.061,7; 2.675,1)	55,1 (30,7; 79,7)	2.761,3 (1.589,8; 4.052,3)	26,5 (15,5; 38,8)	-51,9 (-61,5; -41,0)

Ceará	948,7 (531,9; 1.371,2)	49,3 (27,5; 71,8)	1.643,6 (891,8; 2.388,7)	25,7 (14,1; 37,3)	-47,9 (-59,0; -35,6)
Maranhão	617,9 (344,8; 874,9)	54,3 (29,3; 77,7)	1.430,8 (824,8; 1.990,4)	38,3 (21,9; 53,4)	-29,6 (-45,7; -7,4)
Paraíba	697,1 (401,8; 989,9)	63,3 (36,8; 90,7)	940,7 (549,4; 1.322,4)	30,7 (17,9; 42,7)	-51,5 (-60,5; -39,7)
Pernambuco	1.877,5 (1.085,5; 2.624,9)	83,8 (47,4; 118,3)	2.041,1 (1.169,5; 2.886,0)	31,8 (18,3; 44,9)	-62,1 (-69,0; -54,4)
Piauí	387,3 (233,2; 553,7)	58,3 (34,5; 84,8)	790,6 (450,6; 1.118,1)	33,9 (19,4; 47,6)	-41,9 (-54,5; -25,7)
Rio Grande do Norte	417,5 (218,9; 579,9)	52,5 (27,2; 73,5)	744,2 (408,1; 1.047,6)	29,7 (16,4; 41,5)	-43,3 (-54,0; -27,0)
Sergipe	240,4 (132,2; 347,6)	59,7 (32,0; 87,6)	346,6 (201,9; 517,4)	24,2 (14,0; 36,2)	-59,4 (-68,1; -47,8)
Southeast region	15.964,4 (9.726,7; 21.570,9)	81,8 (47,7; 112,2)	17.413,2 (9.628,8; 26.170,9)	25,2 (14,1; 37,7)	-69,2 (-75,2; -62,4)
Espírito Santo	483,3 (279,7; 685,9)	72,2 (40,1; 104,9)	719,6 (431,8; 1.045,6)	25,4 (15,3; 36,7)	-64,8 (-71,8; -55,6)
Minas Gerais	3.421,4 (2.078,3; 4.737,4)	74,0 (43,1; 102,9)	3.613,2 (2.007,2; 5.528,8)	21,5 (12,1; 32,9)	-70,9 (-76,4; -64,0)
Rio de Janeiro	4.728,9 (2.792,1; 6.438,5)	96,0 (55,0; 133,3)	3.996,6 (2.210,9; 6.141,0)	28,2 (16,0; 42,6)	-70,7 (-76,5; -63,9)
São Paulo	7.330,8 (4.580,8; 9.794,6)	79,3 (47,0; 108,0)	9.083,8 (5.063,4; 13.488,9)	25,7 (14,5; 38,0)	-67,6 (-73,8; -59,9)
South region	5.254,9 (3.087,5; 7.298,2)	80,7 (45,2; 114,6)	5.661,1 (3.167,9; 8.586,6)	24,2 (13,6; 36,6)	-70,1 (-75,3; -62,8)
Paraná	1.877,9 (1.131,8; 2.585,3)	88,1 (50,2; 124,0)	1.978,6 (1.123,2; 2.970,5)	23,7 (13,4; 35,6)	-73,1 (-78,3; -66,4)
Rio Grande do Sul	2.508,8 (1.449,6; 3.535,5)	77,9 (43,3; 110,9)	2.468,6 (1.397,5; 3.744,9)	24,7 (14,0; 37,2)	-68,3 (-73,4; -60,2)
Santa Catarina	868,2 (503,5; 1.212,2)	75,3 (41,3; 106,9)	1.213,9 (682,3; 1.806,2)	23,8 (13,3; 35,5)	-68,4 (-74,4; -60,0)
West-Central region	1.240,8 (754,4; 1.705,1)	68,8 (38,8; 96,4)	2.478,6 (1.493,1; 3.631,1)	26,3 (15,6; 38,6)	-61,8 (-68,6; -53,4)
Distrito Federal	183,5 (119,7; 248,3)	66,0 (39,7; 91,3)	274,6 (161,4; 425,8)	16,1 (9,2; 25,2)	-75,6 (-81,1; -68,8)
Goiás	570,1 (341,4; 792,6)	66,7 (36,7; 95,2)	1.127,2 (664,6; 1.657,0)	26,7 (15,5; 39,2)	-60,0 (-67,2; -50,4)
Mato Grosso	203,1 (119,6; 280,2)	67,5 (36,8; 94,0)	507,9 (315,7; 732,6)	28,9 (17,4; 42,0)	-57,2 (-65,7; -45,6)
Mato Grosso do Sul	284,1 (171,2; 398,7)	77,3 (43,6; 109,9)	568,8 (322,8; 827,1)	33,4 (18,9; 48,8)	-56,8 (-65,4; -46,0)
Both sexes					
Brazil	73.694,2 (44.721,7; 98.516,8)	91,0 (53,4; 124,8)	94.558,6 (53.842,3; 136.752,3)	36,3 (20,6; 52,4)	-60,2 (-67,6; -52,2)
North region	2.655,0 (1.554,4; 3.677,9)	77,4 (42,7; 109,2)	5.806,5 (3.268,1; 8.394,5)	38,5 (21,2; 56,6)	-50,3 (-58,8; -40,3)
Acre	112,4 (65,8; 156,2)	76,5 (42,4; 107,8)	255,5 (139,7; 358,5)	37,9 (20,3; 54,2)	-50,5 (-59,7; -40,2)

Amapá	61,2 (34,2; 84,2)	65,9 (35,1; 92,6)	197,2 (111,9; 293,4)	36,4 (20,0; 54,7)	-44,7 (-57,3; -32,2)
Amazonas	441,2 (258,3; 621,9)	68,7 (38,2; 98,4)	1.019,4 (577,7; 1.515,6)	34,4 (19,0; 51,7)	-49,8 (-59,6; -38,1)
Pará	1.439,5 (819,3; 2.003,7)	77,8 (42,3; 110,8)	2.831,8 (1.543,3; 4.119,1)	38,5 (20,6; 56,7)	-50,5 (-59,8; -39,1)
Rondônia	316,6 (198,3; 425,9)	103,7 (59,5; 144,5)	641,1 (375,8; 896,5)	41,1 (23,7; 58,5)	-60,4 (-66,8; -51,9)
Roraima	42,3 (26,1; 57,1)	84,8 (48,0; 118,2)	170,3 (101,7; 230,4)	42,6 (25,0; 59,5)	-49,8 (-60,7; -39,5)
Tocantins	242,0 (140,1; 333,7)	88,3 (48,3; 124,9)	691,2 (407,2; 963,6)	43,6 (25,5; 60,9)	-50,6 (-60,0; -40,8)
Northeast region	17.348,9 (9.905,6; 23.964,5)	73,6 (41,2; 102,9)	26.915,8 (15.464,8; 38.211,1)	40,0 (23,0; 56,9)	-45,6 (-56,1; -35,3)
Alagoas	1.033,5 (600,4; 1.480,1)	81,2 (46,0; 117,1)	1.787,3 (1.038,0; 2.525,5)	52,3 (30,1; 74,4)	-35,6 (-48,9; -21,9)
Bahia	4.118,1 (2.470,6; 5.735,0)	64,8 (37,8; 91,8)	6.267,0 (3.613,8; 9.118,0)	34,0 (19,6; 49,2)	-47,5 (-57,7; -36,5)
Ceará	2.077,0 (1.128,4; 2.956,0)	56,9 (30,5; 82,0)	3.902,3 (2.116,4; 5.590,2)	35,0 (19,1; 49,9)	-38,6 (-50,7; -26,3)
Maranhão	2.023,7 (1.077,5; 2.774,2)	85,8 (44,2; 119,5)	3.555,2 (2.049,6; 4.918,3)	51,4 (29,4; 71,6)	-40,1 (-52,2; -27,4)
Paraíba	1.487,4 (809,8; 2.070,1)	70,0 (38,1; 98,6)	2.168,4 (1.228,7; 3.032,4)	41,4 (23,4; 57,9)	-40,8 (-51,6; -29,2)
Pernambuco	4.054,6 (2.364,9; 5.659,2)	96,9 (55,0; 136,7)	4.740,4 (2.748,9; 6.640,7)	42,9 (24,8; 60,3)	-55,8 (-64,0; -46,9)
Piauí	1.017,7 (587,6; 1.392,0)	77,2 (43,8; 106,6)	1.873,7 (1.073,9; 2.593,4)	45,0 (25,8; 62,2)	-41,7 (-51,7; -29,1)
Rio Grande do Norte	1.006,5 (551,2; 1.382,5)	66,7 (36,0; 92,0)	1.796,1 (1.005,3; 2.497,5)	41,6 (23,3; 57,6)	-37,6 (-49,5; -25,0)
Sergipe	530,4 (285,6; 771,8)	68,7 (36,1; 100,9)	825,4 (471,8; 1.214,0)	33,0 (18,6; 48,7)	-52,0 (-62,2; -39,8)
Southeast region	38.128,5 (23.514,1; 50.843,4)	102,4 (61,4; 139,0)	42.117,9 (23.532,2; 61.880,3)	35,3 (19,8; 51,9)	-65,5 (-72,2; -57,7)
Espírito Santo	1.178,1 (688,4; 1.623,8)	88,5 (50,5; 124,3)	1.793,7 (1.087,8; 2.588,4)	35,5 (21,5; 51,3)	-59,9 (-67,4; -51,2)
Minas Gerais	8.016,9 (4.887,1; 11.001,7)	89,6 (53,0; 122,8)	8.600,3 (4.732,6; 12.953,8)	29,1 (16,1; 43,7)	-67,5 (-73,8; -60,0)
Rio de Janeiro	10.885,9 (6.621,0; 14.654,0)	121,8 (72,5; 164,9)	9.324,5 (5.261,4; 13.767,7)	39,2 (22,3; 57,9)	-67,8 (-73,9; -60,5)
São Paulo	18.047,6 (11.244,9; 23.933,7)	100,5 (61,0; 136,3)	22.399,3 (12.384,5; 32.101,6)	36,8 (20,4; 52,8)	-63,4 (-70,5; -55,4)
South region	12.354,8 (7.397,8; 16.764,0)	98,1 (55,8; 136,3)	13.289,5 (7.461,4; 19.979,9)	32,5 (18,3; 49,0)	-66,9 (-73,3; -59,2)
Paraná	4.514,1 (2.745,8; 6.181,7)	103,7 (60,3; 145,6)	4.850,7 (2.726,5; 7.280,6)	32,5 (18,3; 49,1)	-68,7 (-74,9; -61,3)
Rio Grande do Sul	5.797,3 (3.399,2; 7.848,9)	97,0 (54,4; 134,6)	5.496,6 (3.042,3; 8.245,3)	32,7 (18,3; 48,9)	-66,3 (-73,2; -58,7)

Santa Catarina	2.043,4 (1.181,5; 2.793,6)	90,7 (50,9; 126,0)	2.942,2 (1.684,1; 4.395,9)	32,1 (18,3; 48,4)	-64,5 (-72,0; -56,1)
West-Central region	3.206,9 (1.931,1; 4.338,3)	82,9 (47,6; 113,9)	6.429,0 (3.767,8; 9.358,7)	36,3 (21,1; 53,5)	-56,2 (-64,3; -46,8)
Distrito Federal	437,0 (280,2; 586,8)	81,0 (49,8; 112,7)	683,4 (404,8; 1.047,1)	22,8 (13,2; 35,3)	-71,9 (-77,7; -65,6)
Goiás	1.462,8 (852,9; 1.998,2)	80,0 (45,1; 112,2)	2.926,6 (1.685,9; 4.246,4)	36,7 (20,9; 53,8)	-54,1 (-62,6; -43,7)
Mato Grosso	564,2 (334,4; 783,7)	80,7 (43,8; 113,6)	1.388,2 (824,1; 1.937,9)	39,5 (23,2; 56,4)	-51,1 (-60,8; -40,2)
Mato Grosso do Sul	742,9 (444,3; 1.012,0)	92,8 (53,5; 128,9)	1.430,8 (836,0; 2.105,4)	45,1 (26,3; 66,4)	-51,4 (-60,7; -40,6)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 13.2 – Number of deaths, all-age and age-standardized cardiovascular disease mortality rates attributable to dietary risks, stratified by age groups in Brazil, in 1990 and 2023, and percent changes of the rates in the period

Age group	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rates (95% UI)	Number (95% UI)	Rates (95% UI)	
15-49 years	Brazil	10,608.4 (7,511.5; 14,106.8)	13.8 (9.8; 18.4)	9,535.8 (7,131.8; 12,071.6)	8.7 (6.5; 11.0)	-37.1 (-47.6; -20.1)
50-69 years	Brazil	29,836.5 (18,216.5; 39,211.8)	189.6 (115.7; 249.1)	34,645.9 (19,735.1; 48,523.3)	79.3 (45.2; 111.1)	-58.2 (-66.1; -49.4)
70+ years	Brazil	33,249.4 (16,750.9; 48,092.9)	777.8 (391.8; 1.125.0)	50,376.9 (26,213.2; 77,542.0)	332.2 (172.9; 511.4)	-57.3 (-65.6; -47.7)
All ages	Brazil	73,694.2 (44,721.7; 98,516.8)	49.3 (29.9; 66.0)	94,558.6 (53,842.3; 136,752.3)	44.6 (25.4; 64.5)	-9.7 (-27.1; 9.4)
Age-standardized	Brazil	NA	91.0 (53.4; 124.8)	NA	36.3 (20.6; 52.4)	-60.2 (-67.6; -52.2)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 13.3 – Number of DALYs, all-age and age-standardized DALY rates due to cardiovascular diseases attributable to level 2 dietary risks, in Brazil, in 1990 and 2023, and percent changes of the rates in the period

Age group	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rates (95% UI)	Number (95% UI)	Rates (95% UI)	
DALYs						
15-49 years	Brazil	555,461.1 (400,041.7; 739,007.5)	722.8 (520.5; 961.6)	483,609.5 (358,473.8; 614,506.6)	440.1 (326.2; 559.2)	-39.1 (-49.1; -23.7)
50-69 years	Brazil	944,672.0 (579,018.1; 1,242,832.5)	6,001.5 (3,678.5; 7,895.7)	1,094,716.5 (624,429.2; 1,526,439.8)	2,506.4 (1,429.6; 3,494.8)	-58.2 (-66.2; -49.7)
70+ years	Brazil	511,673.4 (259,649.3; 742,135.4)	11,968.9 (6,073.6; 17,359.8)	743,275.6 (385,136.8; 1,135,139.0)	4,902.0 (2,540.0; 7,486.4)	-59.0 (-67.4; -49.9)
All ages	Brazil	2,011,806.4 (1,268,717.6; 2,691,489.2)	1,347.2 (849.6; 1,802.4)	2,321,601.5 (1,382,941.2; 3,233,547.2)	1,094.7 (652.1; 1,524.7)	-18.7 (-34.5; -2.1)
Age-standardized	Brazil	NA	2,140.5 (1,323.9; 2,855.3)	NA	880.1 (526.6; 1,224.4)	-58.9 (-66.4; -51.1)

Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.[33]

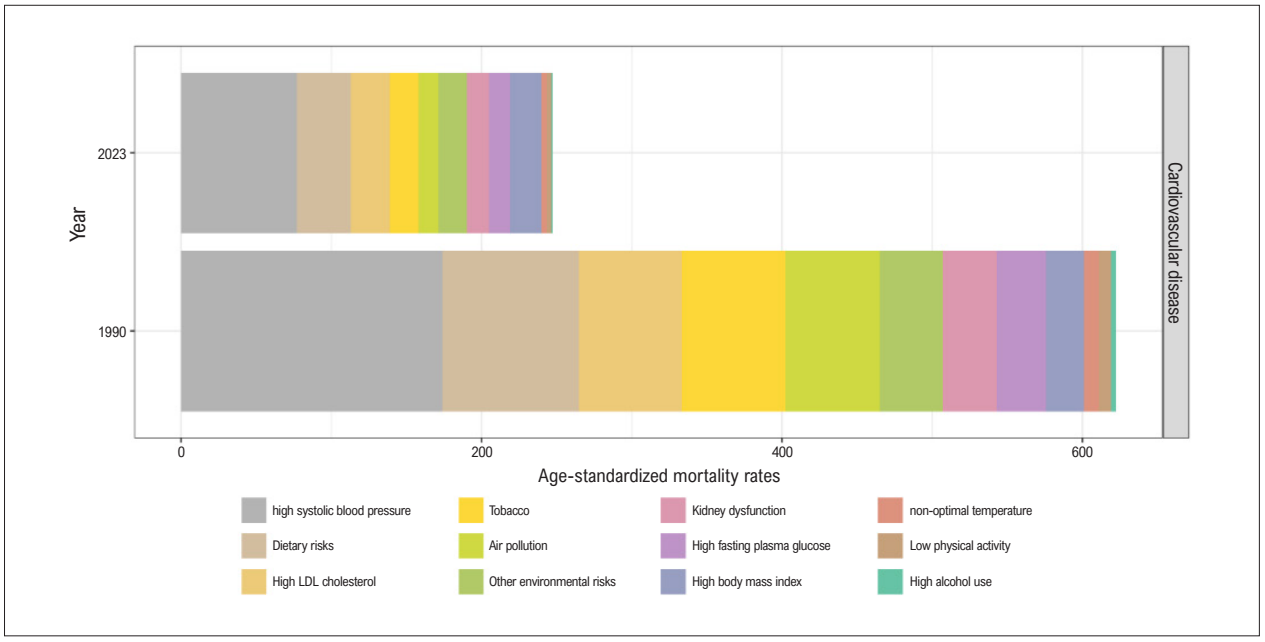

Chart 13.1 – *Age-standardized cardiovascular disease mortality rates attributable to risk factors, in Brazil, in 1990 and 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

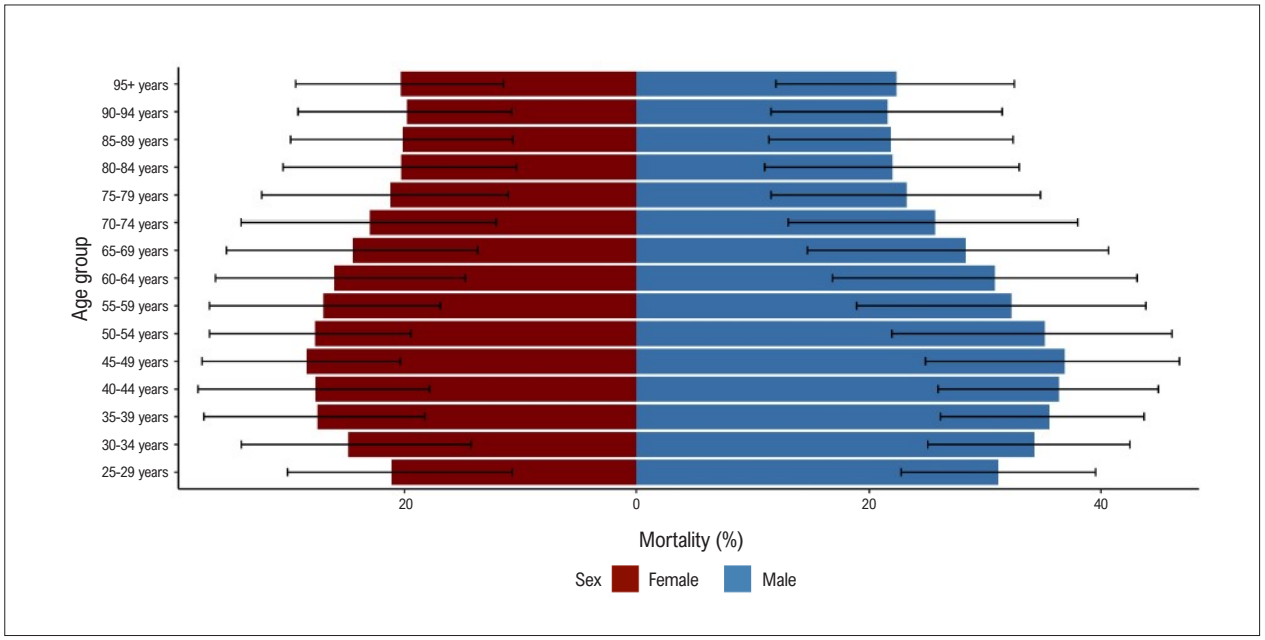

Chart 13.2 – *Proportional cardiovascular disease mortality attributable to level 2 dietary risks, according to sex and age groups, in Brazil in 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

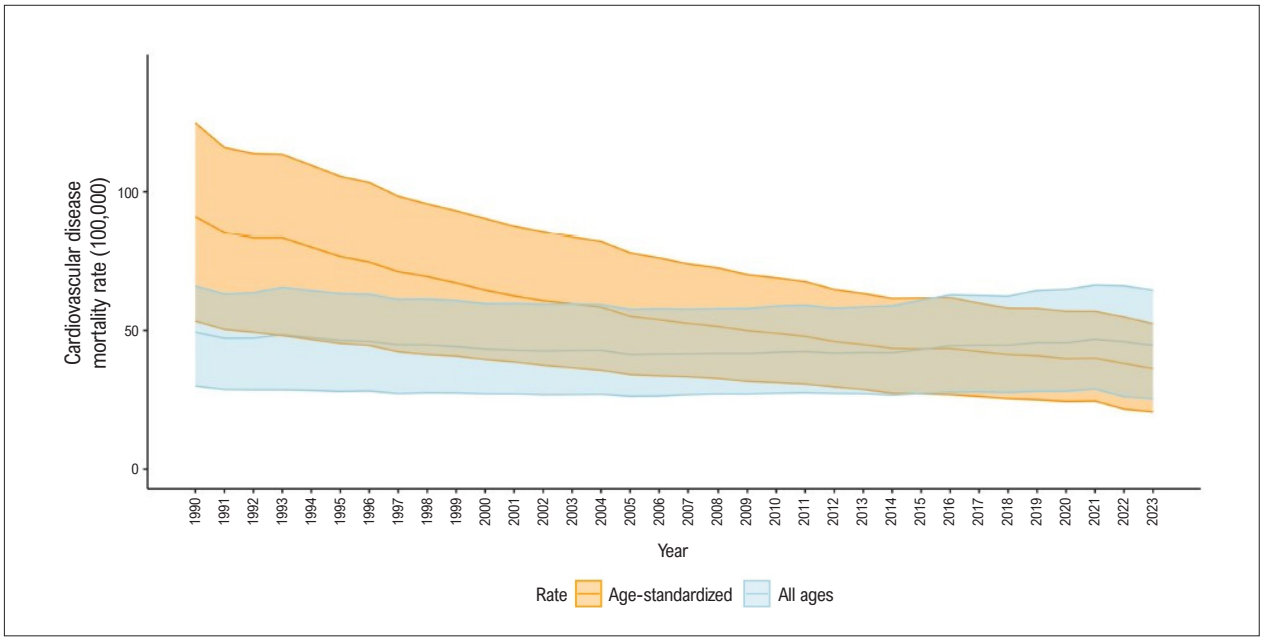

Chart 13.3 – *All-age and age-standardized cardiovascular disease mortality rates attributable to level 2 dietary risk, in Brazil, from 1990 to 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

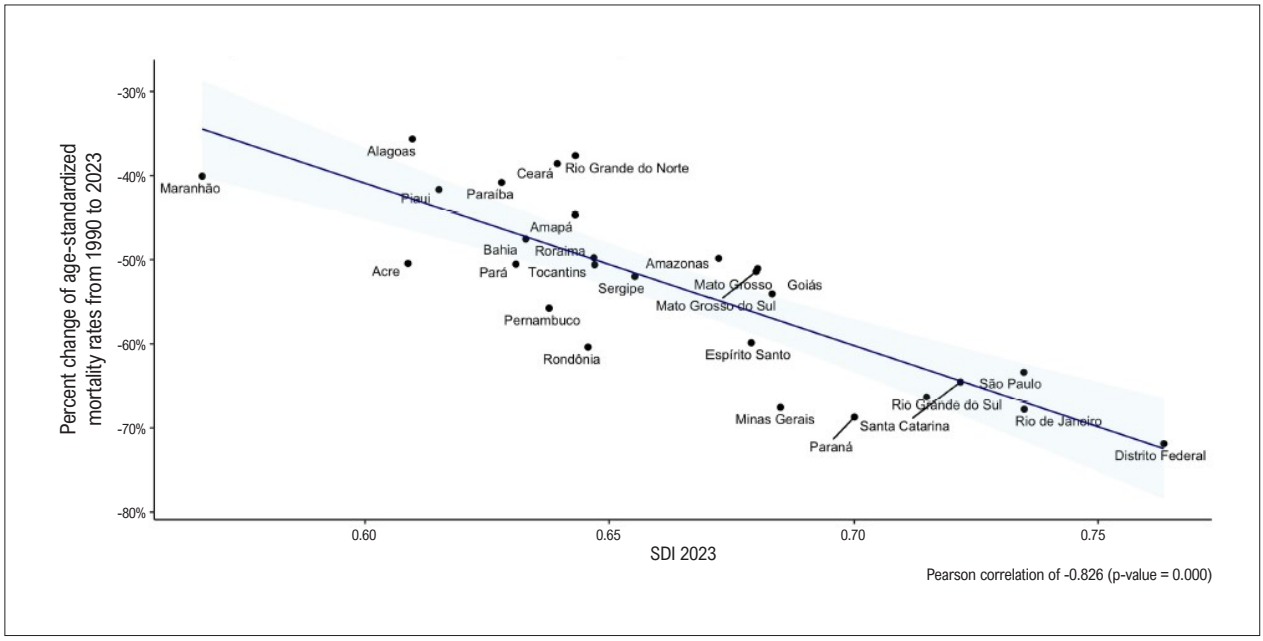

Chart 13.4 – *Correlation between the 2023 sociodemographic index (SDI) and the percent change of age-standardized cardiovascular disease mortality rates attributable to level 2 dietary risk, from 1990 to 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

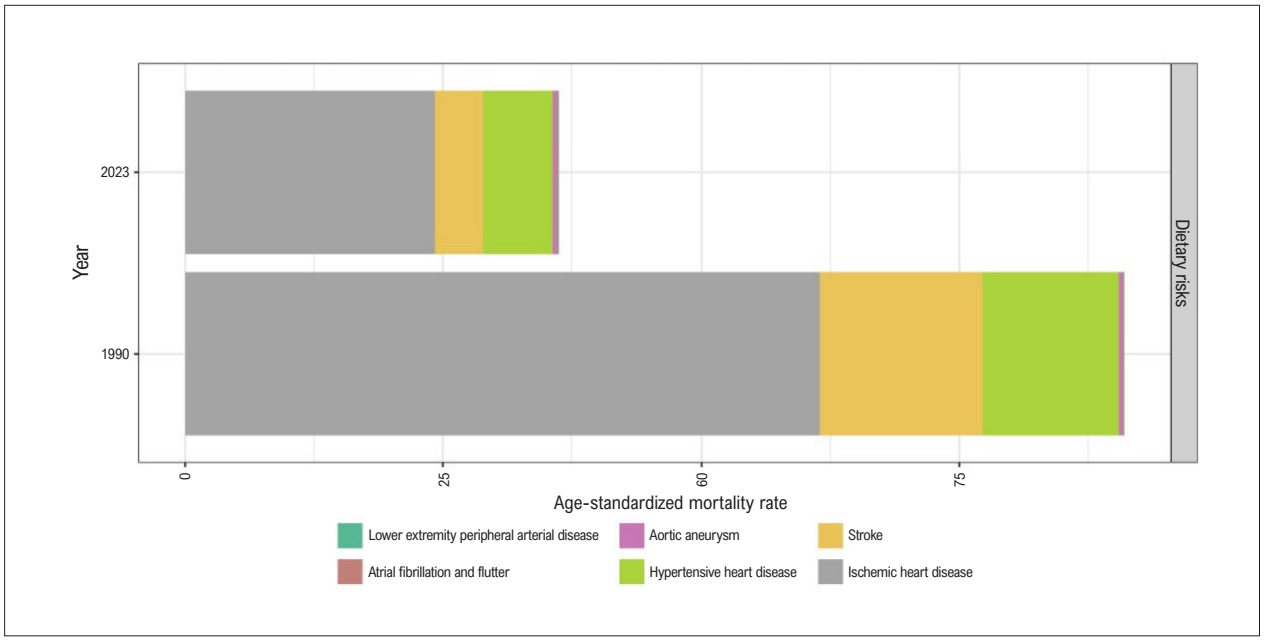

Chart 13.5 – *Age-standardized cardiovascular disease mortality rates attributable to level 2 dietary risk, stratified by causes in Brazil in 1990 and 2023. Source: Data derived from 2023 Global Burden of Disease Study, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 14 – CONGENITAL MALFORMATIONS OF THE CIRCULATORY SYSTEM AND PEDIATRICS

See Tables 14.1 through 14.3 and Charts 14.1 through 14.5.

Abbreviations used in chapter 14

CM	Congenital Malformation
CMCS	Congenital Malformations of the Circulatory System
DALYs	Disability-Adjusted Life-Years
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th Revision
MRt	Mortality Rate
SDI	Sociodemographic Index
SIH/SUS	Inpatient Information System of the Brazilian Unified Health System (in Portuguese, *Sistema de Informação Hospitalar do SUS*)

Introduction

- Congenital malformations of the circulatory system (CMCSs) are structural or functional abnormalities of the heart and great vessels present at birth, resulting from abnormal embryonic development.[422,423] Their incidence and prevalence vary according to the country and geographic region, because they depend on individual factors, such as maternal health,[423] exposure to teratogenic agents and genetic mutations,[424,425] as well as on social factors, such as socioeconomic development, population access to health services,[423] human resources, and diagnostic and therapeutic capacity for CMCS.[424,426]
- Congenital malformations (CMs) have been the second cause of death of children under 1 year of age in middle- and high-income countries since the 1980s.[426,427] In Brazil, there were 58,788 deaths of individuals under 20 years in 2023. Of such deaths, 54.46% occurred in children under 1 year of age, corresponding to a mortality rate (MRt) of 1.261 per 100,000 live births. In children under 1 year of age, the leading causes of death were the perinatal ones (those occurring in the first 28 days of extrauterine life), followed by CMs, and respiratory diseases. Of the CMs, CMCSs accounted for 50% of the deaths.[34] In the post-neonatal age group (28-364 days of life), CMCSs were the leading cause of death, corresponding to a MRt of 119.40 per 100,000 live births.[34]
- Congenital malformations of the circulatory system are important not only as causes of death in childhood and adolescence, but also as causes of morbidity and burden of disease in adulthood. With the advancements in surgical and therapeutic techniques in recent years, allowing longer survival beyond the perinatal period and early childhood, the prevalence of chronic cardiovascular conditions associated or aggravated by CMCSs has increased in childhood and adulthood.[428-430] In addition, patients with congenital heart diseases, even the repaired ones, have worse prognosis regarding physical performance and shorter longevity as compared to healthy individuals of the same age.[429-431] In a metanalysis including 30 articles, Vanreusel *et al.* have shown that the pathophysiological changes of the microvascular dysfunction present in heart failure of other etiologies is similar to those of the microvascular dysfunction found in congenital heart diseases.[432] In patients undergoing Fontan surgery, for example, post-procedure right ventricular remodeling can lead to ventricular failure with progressive ejection fraction reduction.[423,433-435]

Incidence

- The incidence of CMCSs can be influenced by the already mentioned diagnostic capacity and risk factors.
- According to the GBD Study 2017, the estimated global incidence of CMCS was 20 to 1000 live births.[423]
- That incidence of CMCS has gradually risen in children under 1 year of age over the past decades, probably due to improvement in diagnostic processes.[436] Better detection has been noted in cases of small ventricular and/or atrial septal defects, patent *foramen ovale* and patent *ductus arteriosus*, which are pathological conditions of high morbidity and mortality if not identified.[423,431,432] Patients whose CMCSs are early identified and who receive the necessary support can progress with spontaneous closure of the defect,[436] as observed in ventricular septal defects, whose annual rate of spontaneous closure is 20-25%.[437]
- In Brazil, studies have shown incidences varying according to the patient's age group. In Brazil, the CMCS incidence rate per 100,000 inhabitants in 1990 was 37.23 (95% UI 27.16; 54.08) in both sexes combined and all ages, being higher in the male than in the female sex [42.81 (95% UI 30.32; 63.33) and 31.78 (95% UI 23.95; 44.58), respectively]. That rate dropped in 2023 [23.13/100,000 inhabitants (95% UI 16.72; 34.28)], remaining higher in the male than in the female sex [26.63/100,000 inhabitants (95% UI 18.68; 39.96) and 19.81/100,000 inhabitants (95% UI 14.83; 28.08), respectively]. In Brazil, the incidence rate varied 0.04-0.06 from 1990 to 2023.
- In a Swedish population study assessing all live-born infants with CMCS from 1970 to 2017 (total of 67,814), the incidence of ventricular and atrial septal defects was 52.7%, with the largest increase over time observed for mild structural defects. There was a reduction in surgical interventions for such defects from 40.7% in 1970 to below 15% after 2014. At the same time, however, surgical interventions for complex congenital heart diseases increased from 57.1% to 76.8%.[436]
- A decreasing gradient in CMCS incidence rates was observed from the least developed to the most developed geographic regions in both 1990 and 2023, with male sex predominance maintained.
- In 1990, in the Northeast region and both sexes combined, the incidence rate was 47.88/100,000 inhabitants (95% UI

35.73; 67.54), being higher in the male than in the female sex [56.07/100,000 inhabitants (95% UI 40.73; 79.13) and 40.04/100,000 inhabitants (95% UI 30.50; 55.46), respectively]. In the North region, the incidence rate was 42.21/100,000 inhabitants (95% UI 30.41; 62.42) in both sexes combined, being higher in the male than in the female sex [47.85/100,000 inhabitants (95% UI 33.28; 72.52) and 36.40 (95% UI 27.42; 52.09), respectively]. In the West-Central region, in 1990, the incidence rate was 40.54/100,000 inhabitants (95% UI 30.08; 57.14) in both sexes combined, being higher in the male than in the female sex [45.70/100,000 inhabitants (95% UI 32.96; 67.49) and 35.34/100,000 inhabitants (95% UI 26.89; 47.36), respectively]. In the Southeast region, in 1990, the incidence rate was 31.21/100,000 inhabitants (95% UI 21.96; 46.64) in both sexes combined, being higher in the male than in the female sex [35.97/100,000 inhabitants (95% UI 24.70; 55.53) and 26.56/100,000 inhabitants (95% UI 19.55; 37.97), respectively].

- The lowest incidence rate in 1990 was observed in the South region, 30.26/100,000 inhabitants (95% UI 21.55; 43.86) in both sexes combined, being higher in the male than in the female sex [33.46/100,000 inhabitants (95% UI 23.34; 50.13) and 27.09/100,000 inhabitants (95% UI 19.71; 38.46), respectively].
- That same ranking was observed in 2023, whose incidence rates as compared to those in 1990 showed a reduction when considering all ages. In 2023, in the Northeast region and both sexes combined, the incidence rate was 32.84/100,000 inhabitants (95% UI 24.18; 47.97), being higher in the male than in the female sex [38.14/100,000 inhabitants (95% UI 27.25; 57.98) and 27.86/100,000 inhabitants (95% UI 21.05; 39.21), respectively]. In the North region, the incidence rate was 27.64/100,000 inhabitants (95% UI 19.97; 40.79) in both sexes combined, being higher in the male than in the female sex [30.91/100,000 inhabitants (95% UI 21.99; 45.47) and 24.39 (95% UI 18.01; 34.57), respectively]. In 2023, the incidence rate in the West-Central region was 22.53/100,000 inhabitants (95% UI 16.76; 32.89) in both sexes combined, being higher in the male than in the female sex [25.24/100,000 inhabitants (95% UI 18.14; 38.32) and 19.91/100,000 inhabitants (95% UI 15.15; 27.51), respectively]. In the Southeast region, the incidence rate was 17.94/100,000 inhabitants (95% UI 12.67; 26.24) in both sexes combined, being higher in the male than in the female sex [20.88/100,000 inhabitants (95% UI 14.36; 30.87) and 15.20/100,000 inhabitants (95% UI 11.05; 22.03), respectively].
- The lowest incidence rates in 2023 were again observed in the South region, 17.39/100,000 inhabitants (95% UI 12.53; 25.62) in both sexes combined, being higher in the male than in the female sex [19.66/100,000 inhabitants (95% UI 13.63; 29.92) and 15.23/100,000 inhabitants (95% UI 11.21; 21.64), respectively].
- In children under 5 years of age in Brazil, in 2023, the CMCS incidence rate in both sexes combined was 330.05/100,000 inhabitants (95% UI 489.24; 238.61), being higher in the male sex. The highest CMCS incidence rate of all Brazilian geographic regions was observed in the Northeast region, 377.17/100,000 inhabitants (95% UI 277.77; 550.96) in both sexes combined, being 415.51/100,000 inhabitants (95% UI 296.90; 631.65) in the male sex and 337.17/100,000 inhabitants (95% UI 254.73; 474.53) in the female sex. Between 1990 and 2023, the incidence rate remained stable in the population of children under 5 years of age. (Chart 14.1)

Prevalence

- The CMCS prevalence depends on its overall incidence (number of live births with CMCS per period), the severity of the malformations, and therapeutic effectiveness – especially surgical and interventional – among other factors that affect survival.[435] Thus, prevalence can initially increase, because of increased survival from CMCS, but later decreases over time because of spontaneous resolution or therapy completion.
- Gradual and consistent reduction in the global CMCS prevalence has been observed. The same has occurred in Brazil, when analyzing both the entire country and all its geographic regions, with prevalence rates higher in the female sex, which is the opposite of that observed in the incidence rates regarding sex. In 1990, the CMCS prevalence rate per 100,000 inhabitants worldwide in both sexes combined and all ages was 220.28 (95% UI 195.25; 243.52), being higher in the female than in the male sex [222.73 (95% UI 198.23; 245.87) and 217.87 (95% UI 192.82; 241.58), respectively]. In 2023, that rate was 198.21 (95% UI 218.44; 175.35) in both sexes combined, being higher in the female than in the male sex [203.38 (95% UI 179.35; 224.01) and 193.09 (95% UI 171.38; 213.77), respectively].
- In 1990, the CMCS prevalence rate per 100,000 inhabitants in Brazil was 233.46 (95% UI 208.44; 252.67) in both sexes combined and all ages, being higher in the female than in the male sex [245.63 (95% UI 220.49; 267.65) and 221.02 (95% UI 197.27; 241.35), respectively]. In 2023, that rate was 177.60 (95% UI 160.25; 193.72), remaining higher in the female than in the male sex [192.17 (95% UI 173.57; 209.40) and 162.19 (95% UI 145.16; 177.68), respectively].
- In children under 5 years of age, the CMCS prevalence rates showed the same trend towards reduction over time seen in other age groups; however, the central trends were three times higher, with the smallest reduction rate seen between 1990 and 2023 (10.01% in the other age groups and 1.80% in children under 5 years of age). In addition, children under 5 years of age had higher CMCS prevalence in the male than in the female sex.
- In 1990, the global CMCS prevalence rate per 100,000 inhabitants was 651.53 (95% UI 557.73; 743.07) in both sexes combined, being 654.07 (95% UI 563.86; 742.39) in the male and 648.83 (95% UI 551.19; 749.51) in the female sex. In 2023, those rates were 639.42 (95% UI 549.01; 730.74) in both sexes combined, 640.91 (95% UI 553.41; 728.76) in the male sex, and 637.84 (95% UI 544.63; 738.86) in the female sex.

- In Brazil, the CMCS prevalence rates in children under 5 years of age followed the trend observed worldwide. In 1990, the CMCS prevalence rate per 100,000 inhabitants was 536.44 (95% UI 557.73; 743.07) in both sexes combined, being 654.07 (95% UI 563.86; 742.39) in the male sex and 648.83 (95% UI 551.19; 749.51) in the female sex. In 2023, those rates were 536.44 (95% UI 473.07; 599.45) in both sexes combined, 561.91 (95% UI 492.48; 630.32) in the male sex, and 509.88 (95% UI 453.95; 565.84) in the female sex.
- Assessing the CMCS prevalence rate per 100,000 inhabitants per Brazilian geographic region, the West-Central region had the highest value. In 1990, that rate was 281.42 (95% UI 256.23; 304.83) in both sexes combined, being higher in the female than in the male sex [296.57 (95% UI 270.84; 322.08) and 266.43 (95% UI 241.82; 290.43), respectively]. In that same year, that rate was 242.28 (95% UI 215.98; 322.08) in the North region and 237.73 (95% UI 212.39; 262.57) in the Northeast region, being similar for both sexes combined and always higher in the female sex [(241.35 (95% UI 267.06; 214.83) and 233.95 (95% UI 258.50; 209.18), respectively]. The prevalence rates of the South and Southeast regions [228.14 (95% UI 248.33; 204.10) and 223.95 (95% UI 242.73; 200.08), respectively] were the lowest in 1990 in both sexes combined, being higher in the female sex [(248.06 (95% UI 271.79; 223.57) and 207.97 (95% UI 230.33; 184.19), respectively].
- In 2023, the West-Central region had the highest rates as compared to other regions, 210.91/100,000 inhabitants (95% UI 230.75; 188.72) in both sexes combined, being higher in the female than in the male sex [233.68/100,000 inhabitants (95% UI 210.87; 255.33) and 187.41/100,000 inhabitants (95% UI 167.10; 205.20), respectively]. In the sequence of the 2023 ranking, there is the South region with prevalence rate per 100,000 inhabitants of 182.46 (95% UI 163.68; 198.63) in both sexes combined, being higher in the female than in the male sex [(201.90 (95% UI 181.15; 220.64) and 162.04 (95% UI 143.97; 177.69), respectively]. The lowest prevalence rates were observed in the Southeast [174.93 (95% UI 190.64; 159.05)], North [(173.80 (95% UI 189.82; 153.01)], and Northeast region [(170.48 (95% UI 186.50; 151.66)] in both sexes combined, with higher rates in the female sex [(188.89 (95% UI 206.80; 170.50), 189.91 (95% UI 207.63; 168.32), and 180.68 (95% UI 196.64; 159.57), respectively] as compared to the male sex [(159.94 (95% UI 175.54; 143.63), 157.64 (95% UI 172.86; 138.50), and 159.62 (95% UI 176.42; 143.65), respectively]. In children under 5 years of age, the CMCS prevalence rates per geographic region followed the pattern observed in other age groups. (Chart 14.1)

Burden of Disease

- In Brazil, between 1990 and 2023, DALYs (disability-adjusted life-years) due to CMCS decreased by 38.5% (95% UI -46.1; -19.2) in both sexes combined and all age groups. Regarding children under 5 years of age, the reduction was 39.4% (95% UI -47.0; -17.9). The reduction in DALYs due to CMCS, thus, was not age-dependent. (Table 14.1)
- The DALY rates due to CMCS were higher in the male sex up to 2015, when they became higher in the female sex. (Chart 14.2)
- Despite the consistent decline in DALY rates, regional differences persist, with higher values concentrated in regions with higher population density and higher absolute number of births, reflecting the combination of population magnitude, age structure, and access to health services.
- Of the Brazilian geographic regions, the Northeast showed the greatest percent change of DALY rates, -48.1% (95% UI -57.4; -6.8), while the North region had the smallest percent change of DALY rates, -20.1% (95% UI -31.0; -0.3) in both sexes combined. (Table 14.1 and Chart 14.3)
- The Brazilian Federative Units showed a reduction in DALYs due to CMCS, except for Roraima (+10.5%; 95% UI -15.2; 48.1), Amazonas (+22.4%; 95% UI 1.4; 48.4), Amapá (+10.6%; 95% UI -20.1; 42.6), and Mato Grosso (+11.5%; 95% UI -12.8; 43.2).
- The reduction in DALYs due to CMCS suggests an improvement in congenital heart disease survival and clinical-surgical management, in addition to advancements in early diagnosis and neonatal care.

Mortality

- According to the GBD Study 2023, in Brazil, the CMCS MRt per 100,000 inhabitants in all age groups decreased from 4.9 (95% UI: 4.3–5.4) in 1990 to 3.0 (95% UI: 2.6–3.9) in 2023, with a percent change of −39.0% (95% UI: −46.7 to −19.9) (Table 14.2).
- According to the GBD Study 2023, when assessed by age group, the MRt in Brazil per 100,000 inhabitants in 2023 was higher in children under 5 years of age: 24,4 (95% II 21,4; 33,1). Between 5 years and 14 years, there was a reduction in MRt to 0,9 (95% UI 0,7; 1,2), showing that CMCS mortality occurs early, mainly in the first five years of life.
- According to the GBD Study 2023, there was a 40% reduction in MRt from CMCS among children under 5 years of age throughout the temporal series from 1990 to 2023.
- Of the CMCS, unspecified congenital malformations of heart (ICD-10 Q24.9) were the leading cause of mortality, with proportional mortality of 41.08% in 2023. Throughout the temporal series, there was an improvement in the diagnosis of death from CMCS, with an increase in proportional mortality from septal and valvular malformations, in addition to a reduction in proportional mortality from unspecified congenital malformations of heart. (Table 14.3)
- The Federative Units with the highest MRt in 1990 continued to show the highest MRt in 2023. Those with the highest reductions were Paraíba, -64.1 (95% UI -74.1; -42.9), and Maranhão, -53.7 (95% UI -68.9; -27.3). In the North region, the Federative Units with an increase in the MRt were: Amapá, 11.8 (95% UI -20.9; 46.7); Amazonas, 23.6 (95% UI 2.0; 51.0); and Roraima, 11.0 (95% UI -15.3; 50.4). (Table 14.2)

- There was a statistically significant correlation between the percent changes of MRt and the sociodemographic index (SDI), with progressive reduction in mortality as the SDI increased, indicating lower risk of death from CMCS in the Federative Units with higher socioeconomic development. (Chart 14.4)
- Despite the favorable trend, the correlation between the 2023 SDI and the percent changes of MRt from CMCS evidences structural inequalities in health care, emphasizing the importance of public policies aimed at reducing inequities and increasing access to specialized care, mainly in the North and Northeast regions.[438]
- The West-Central region had the smallest reduction in MRt from CMCS in the 1990-2023 period. (Chart 14.5)

Impact of the Covid-19 pandemic

- The Covid-19 pandemic has impacted infant mortality in Brazil unequally in the different age groups, pandemic periods, and Brazilian geographic regions. Initially, between 2019 and 2020, there was a 9% reduction in the all-cause MRt in individuals under 20 years, from 72.5 to 66.1 per 100,000 inhabitants, with practically stable MRt in 2021 (66.0 per 100,000 inhabitants; variation of -0.1%). This behavior suggests an indirect protective effect of the social distancing measures, with the decrease in the infectious and external causes. However, in 2022, this trend reversed, with an increase in MRt to 101.7 per 100,000 inhabitants (+4.08). In the period, there was a 10% decrease in the number of live births, emphasizing that the change in rates was not only due to population variation, but also to changes in the mortality pattern. Individuals under 1 year had the highest MRt from CMCS, which, in the pandemic period, decreased from 295 per 100,000 live births in 2019 to 255 per 100,000 live births in 2022. The MRt from diseases of the circulatory system decreased from 1.6 (2019) to 1.4 (2020–2021), and increased to 2.4 in 2022, suggesting a possible impact of the pandemic on the access to diagnosis and treatment of those conditions.[439-441]

Associated Costs

- Similarly to the congenital heart diseases that represent a diverse group regarding severity and complexity, their associated costs vary significantly but have been falling over time with the refinement of therapeutic techniques, catheter interventions, and new surgical techniques.
- A Brazilian ecological study using data from the Inpatient Information System of the Brazilian Unified Health System (SIH/SUS) made available at DATASUS-TABNET, in the period from 2019 to 2023, has included female and male individuals of ages ranging from under 1 year to 80 years or older. That study has identified an incidence of 686 hospital admissions per 100,000 live births in that group in Brazil, with a mean hospitalization cost of R$ 12,289.63 between 2019 and 2023.[442] In the period studied, the total cost of hospitalizations was R$ 1,144,156,358.19. There were 91,437 admissions for CMCS in all Brazilian regions in that period, and, in 2023, the greatest number of cases was observed, analyzing the frequency ratio in the years (21.00%). In 2020, the smallest number of admissions was reported (17.41%), representing a 3.25% reduction in the number of admissions in relation to 2019. These data probably reflect the effects of the pandemic, with lower CMCS detectability or lower capacity of the health system for hospitalizations from CMCS.

Future directions

- The CMCSs comprise a highly heterogeneous group of pathological conditions, with variable impacts in terms of frequency, mortality, quality of life, burden of disease, costs, and effects on the health system. This group includes cyanotic and non-cyanotic heart diseases. Of the latter, congenital valvulopathies and septal defects, for example, can highly differ regarding the severity of their clinical presentations.
- Because of their highly diverse clinical, anatomical, and pathophysiological characteristics, it is difficult to standardize a classification and registry system of the CMCSs that allows their detailed comparison between countries and regions. In this chapter, the group of CMCSs was considered as a combined unit, but further detailed characterization of specific conditions is needed to better inform public policies targeted at this group. The rarity of some of these diseases when considered individually makes it difficult to obtain adequate sample sizes for precise estimates, especially regarding therapeutics. Pediatric cardiology has advanced considerably in recent decades, which has paradoxically increased the impact of CMCSs on society, with longer survival of individuals. With this increase in survival, individuals with CMCSs reach adulthood with a combination of clinical conditions that require careful analysis in terms of the interaction between congenital conditions and acquired risk factors for cardiovascular diseases.

Conclusion

- The CMCSs comprise a heterogeneous group of malformations. Despite the low incidence of severe malformations, they have high mortality in the perinatal period.
- The prevalence of CMCSs has consistently decreased, reflecting the advance of therapeutics. In the most severe conditions, those advances have enabled improved survival, although morbidity remains high throughout life.

Table 14.1 – DALY rates per 100,000 inhabitants and absolute numbers of DALYs due to congenital malformations of the circulatory system in 1990 and 2023, and percent change of the rates in the period, according to sex, in Brazil, its geographic regions, and Federative Units.

Sex and location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	385,158.8 (338,851.2; 438,472.1)	468.5 (411.6; 533.6)	209,907.0 (186,438.7; 264,757.5)	273.7 (240.9; 342.8)	-41.6 (-49.1; -26.1)
North Region	27,996.6 (22,559.1; 31,619.8)	453.8 (367.2; 512.2)	26,615.2 (22,750.8; 31,321.1)	338.6 (285.9; 400.1)	-25.4 (-36.7; -6.4)
Acre	2,090.5 (1,074.8; 2,904.9)	684.3 (363.7; 949.9)	1,603.4 (1,182.6; 2,172.9)	370.0 (272.8; 501.5)	-45.9 (-64.2; 3.3)
Amapá	612.4 (468.0; 779.6)	303.7 (232.6; 396.4)	1,278.2 (928.3; 1,618.4)	353.8 (257.2; 448.8)	16.5 (-34.5; 69.3)
Amazonas	4,717.7 (4,061.2; 5,567.1)	373.7 (321.4; 445.4)	7,072.5 (5,776.9; 8,915.6)	433.6 (352.7; 549.4)	16.0 (-12.6; 50.9)
Pará	14,190.9 (10,916.9; 16,263.7)	482.6 (373.4; 554.3)	10,813.6 (8,915.0; 13,276.7)	305.2 (251.4; 374.6)	-36.8 (-49.5; -17.2)
Rondônia	2,768.8 (2,142.1; 3,450.3)	397.9 (308.0; 496.0)	2,051.3 (1,535.4; 2,764.7)	296.1 (221.4; 398.0)	-25.6 (-44.3; 3.7)
Roraima	547.2 (397.5; 732.8)	400.4 (291.2; 536.7)	1,573.7 (1,136.9; 2,166.7)	417.3 (302.0; 574.2)	4.2 (-28.7; 66.8)
Tocantins	3,069.0 (2,155.1; 4,398.5)	491.1 (345.3; 703.0)	2,222.4 (1,669.6; 2,922.7)	274.3 (205.5; 361.2)	-44.1 (-64.9; -7.0)
Northeast Region	134,622.9 (99,267.0; 177,124.9)	489.1 (360.5; 643.1)	61,677.9 (47,996.3; 91,238.9)	233.0 (181.5; 343.3)	-52.4 (-66.0; -20.9)
Alagoas	7,099.8 (4,966.8; 9,947.2)	398.9 (278.8; 557.9)	3,505.6 (2,402.4; 6,316.3)	213.7 (146.8; 383.4)	-46.4 (-65.3; -11.1)
Bahia	34,519.3 (26,035.3; 44,086.5)	469.7 (354.9; 601.4)	15,417.3 (12,228.0; 21,471.9)	244.0 (193.3; 340.9)	-48.1 (-61.4; -21.5)
Ceará	17,244.3 (12,161.1; 23,593.9)	415.8 (293.8; 568.5)	9,001.9 (6,572.3; 14,123.0)	209.8 (152.8; 328.5)	-49.5 (-65.5; -10.0)
Maranhão	21,808.2 (14,369.6; 34,466.9)	568.8 (376.7; 894.5)	9,690.0 (7,106.2; 14,454.7)	229.9 (168.9; 342.1)	-59.6 (-77.2; -31.6)
Paraíba	12,787.5 (9,230.2; 18,185.6)	708.7 (511.0; 1,008.8)	4,386.3 (3,253.5; 6,985.3)	233.5 (173.4; 371.9)	-67.1 (-79.6; -43.1)
Pernambuco	24,260.0 (17,774.2; 31,080.1)	550.8 (404.2; 705.9)	10,384.0 (7,929.8; 15,179.8)	258.0 (196.8; 377.1)	-53.2 (-67.0; -19.0)
Piaui	6,926.1 (4,642.9; 10,060.3)	411.5 (276.6; 596.8)	3,868.9 (2,855.4; 5,647.3)	254.2 (187.5; 369.7)	-38.2 (-61.4; 6.3)
Rio Grande do Norte	6,140.9 (4,264.3; 7,954.6)	387.4 (269.8; 502.4)	2,816.0 (1,938.0; 4,874.6)	181.1 (124.8; 314.3)	-53.3 (-67.7; -23.2)
Sergipe	3,836.8 (2,803.2; 5,039.8)	410.0 (300.1; 537.4)	2,607.9 (2,023.3; 3,591.1)	266.1 (206.5; 367.8)	-35.1 (-54.0; -2.7)
Southeast Region	140,063.9 (122,375.8; 168,511.7)	436.5 (380.5; 525.0)	74,234.1 (64,748.9; 93,775.7)	275.7 (237.8; 350.9)	-36.8 (-46.1; -24.2)
Espírito Santo	7,320.2 (6,214.2; 8,540.8)	489.2 (416.2; 573.0)	4,464.3 (3,675.0; 5,621.6)	308.6 (250.5; 387.6)	-36.9 (-50.3; -16.6)

Minas Gerais	35,739.9 (31,063.5; 44,867.1)	410.0 (355.8; 515.1)	18,977.2 (16,242.1; 23,674.1)	272.0 (231.6; 336.6)	-33.7 (-45.7; -16.3)
Rio de Janeiro	27,456.3 (23,801.6; 31,640.8)	465.0 (400.3; 537.1)	13,344.1 (11,221.7; 16,717.1)	273.7 (227.6; 349.7)	-41.1 (-51.9; -22.5)
São Paulo	69,547.5 (59,622.5; 89,525.4)	435.5 (374.3; 558.9)	37,448.4 (31,888.4; 48,193.8)	274.9 (234.4; 356.7)	-36.9 (-46.8; -24.1)
South Region	55,833.4 (48,711.8; 65,127.2)	500.6 (435.2; 585.0)	27,547.2 (24,071.8; 32,851.2)	289.2 (255.5; 341.8)	-42.2 (-52.0; -30.0)
Paraná	22,033.5 (19,158.2; 26,022.6)	470.5 (409.0; 555.9)	11,434.2 (9,616.5; 13,564.8)	278.5 (231.3; 329.8)	-40.8 (-53.1; -25.2)
Rio Grande do Sul	19,839.7 (17,012.3; 26,007.7)	464.3 (395.6; 606.5)	9,222.2 (7,911.1; 10,999.1)	303.6 (260.2; 363.0)	-34.6 (-48.9; -19.4)
Santa Catarina	13,960.2 (10,134.9; 16,090.2)	633.8 (452.8; 731.9)	6,890.8 (5,754.5; 8,555.2)	289.8 (241.1; 364.7)	-54.3 (-65.3; -26.2)
West-Central Region	26,642.0 (23,089.4; 29,876.1)	496.2 (430.2; 557.1)	19,832.7 (17,332.3; 23,092.9)	342.3 (298.2; 403.9)	-31.0 (-41.5; -14.8)
Distrito Federal	4,184.6 (3,630.5; 4,884.9)	430.7 (373.9; 502.5)	2,636.0 (2,123.5; 3,198.7)	266.3 (216.6; 327.7)	-38.2 (-51.5; -22.0)
Goiás	14,764.1 (10,820.3; 17,012.0)	667.0 (488.8; 771.6)	9,227.1 (7,526.9; 10,952.4)	380.3 (310.2; 455.5)	-43.0 (-55.3; -27.2)
Mato Grosso	3,639.4 (2,646.6; 4,823.7)	318.2 (231.9; 425.5)	4,561.4 (3,618.7; 5,778.0)	343.3 (272.1; 434.7)	7.9 (-21.8; 60.6)
Mato Grosso do Sul	4,054.0 (3,391.0; 5,421.7)	390.7 (327.0; 522.9)	3,408.2 (2,791.3; 4,204.5)	324.7 (263.2; 402.2)	-16.9 (-37.3; 7.0)
Female					
Brazil	319,071.8 (252,458.6; 366,692.6)	399.7 (316.0; 459.0)	194,275.9 (165,308.3; 266,982.0)	260.4 (222.0; 357.8)	-34.9 (-46.8; -0.8)
North Region	21,764.7 (16,349.4; 25,449.2)	364.3 (275.9; 424.2)	23,974.3 (20,081.8; 30,053.1)	315.5 (263.6; 395.3)	-13.4 (-30.2; 25.7)
Acre	1,199.9 (707.5; 1,782.1)	414.2 (247.1; 612.3)	1,291.5 (971.9; 1,655.5)	310.7 (233.8; 397.6)	-25.0 (-52.8; 40.8)
Amapá	566.7 (448.7; 728.4)	289.8 (227.6; 373.3)	1,058.1 (816.5; 1,318.2)	301.8 (232.2; 377.4)	4.1 (-24.6; 51.7)
Amazonas	3,804.5 (3,172.2; 4,618.8)	306.9 (254.2; 375.2)	6,319.7 (5,008.0; 7,938.9)	399.2 (312.0; 502.7)	30.1 (2.1; 63.8)
Pará	11,330.6 (8,312.5; 13,351.1)	397.6 (293.5; 468.8)	10,083.8 (8,090.9; 13,162.4)	293.9 (235.1; 384.6)	-26.1 (-45.8; 23.4)
Rondônia	2,062.5 (1,571.7; 2,543.4)	309.4 (235.6; 380.3)	1,864.4 (1,406.3; 2,533.2)	278.8 (209.0; 381.2)	-9.9 (-36.1; 39.8)
Roraima	383.6 (279.0; 508.8)	296.9 (219.0; 392.0)	1,277.5 (930.4; 1,699.4)	354.2 (258.0; 470.5)	19.3 (-17.9; 71.4)
Tocantins	2,416.9 (1,587.7; 3,441.9)	402.4 (264.2; 572.4)	2,079.2 (1,585.5; 2,760.5)	267.5 (203.6; 353.4)	-33.5 (-55.7; 11.5)
Northeast Region	111,263.1 (80,578.8; 148,781.8)	416.4 (301.1; 556.4)	60,853.0 (45,078.3; 93,598.7)	237.7 (175.7; 365.4)	-42.9 (-62.7; -2.2)
Alagoas	6,051.3 (4,228.4; 8,246.7)	344.2 (240.7; 468.2)	3,425.3 (2,285.6; 6,123.3)	215.4 (143.9; 385.4)	-37.4 (-61.7; 4.9)
Bahia	30,664.9 (23,309.6; 39,261.4)	432.0 (328.7; 552.2)	15,609.3 (12,008.1; 22,458.3)	255.2 (196.6; 366.7)	-40.9 (-60.5; -4.6)

Ceará	12,935.6 (9,212.5; 17,901.8)	324.1 (230.3; 448.8)	8,487.6 (6,085.3; 14,047.5)	205.1 (146.7; 340.6)	-36.7 (-61.5; 18.2)
Maranhão	16,165.6 (10,148.4; 24,469.2)	433.5 (273.8; 654.1)	9,325.4 (6,267.3; 14,794.2)	229.1 (154.7; 360.1)	-47.2 (-68.2; -3.0)
Paraíba	10,548.6 (7,275.6; 14,845.8)	600.1 (413.8; 845.3)	4,373.5 (3,111.1; 6,421.7)	240.6 (171.6; 354.8)	-59.9 (-74.2; -34.2)
Pernambuco	20,627.6 (13,464.1; 28,463.9)	476.4 (310.9; 657.1)	10,649.5 (7,792.4; 14,862.7)	272.4 (198.9; 381.9)	-42.8 (-64.8; 8.1)
Piaui	5,765.7 (3,585.5; 8,477.2)	353.4 (220.0; 519.1)	3,919.7 (2,812.1; 6,048.4)	267.6 (192.4; 413.7)	-24.3 (-53.7; 46.4)
Rio Grande do Norte	5,380.4 (4,025.1; 7,096.1)	350.9 (262.4; 462.3)	2,830.5 (1,885.2; 4,882.4)	188.8 (125.7; 325.8)	-46.2 (-68.7; 3.2)
Sergipe	3,123.4 (2,340.8; 4,081.7)	345.9 (258.7; 451.4)	2,232.2 (1,555.9; 3,339.1)	235.6 (164.0; 354.0)	-31.9 (-55.6; 6.7)
Southeast Region	119,590.7 (99,941.6; 141,779.7)	383.1 (319.1; 452.5)	67,452.0 (56,938.1; 90,964.7)	255.3 (214.9; 344.2)	-33.4 (-45.0; -5.2)
Espírito Santo	5,668.0 (4,414.8; 6,510.8)	390.8 (305.0; 449.6)	3,678.7 (2,995.5; 4,464.6)	260.9 (212.5; 320.1)	-33.2 (-47.1; -8.4)
Minas Gerais	31,535.9 (26,189.8; 37,426.6)	369.2 (306.1; 438.4)	17,815.1 (14,679.6; 23,082.1)	261.7 (216.2; 341.5)	-29.1 (-42.0; 0.6)
Rio de Janeiro	22,892.8 (17,808.9; 26,939.3)	397.2 (308.1; 470.2)	12,023.1 (9,754.1; 16,345.5)	247.7 (200.8; 345.1)	-37.6 (-52.7; -4.7)
São Paulo	59,494.1 (50,159.2; 70,411.9)	385.1 (324.2; 454.7)	33,935.1 (28,228.4; 47,521.1)	254.2 (210.0; 354.3)	-34.0 (-46.4; -4.3)
South Region	44,816.6 (34,120.6; 51,539.0)	413.6 (313.5; 475.5)	24,453.5 (20,510.8; 31,018.5)	263.2 (222.7; 337.3)	-36.4 (-49.1; -3.6)
Paraná	18,580.5 (13,969.6; 21,624.8)	410.4 (307.6; 478.0)	10,037.2 (8,252.0; 12,779.6)	250.2 (205.1; 319.9)	-39.0 (-52.1; -3.0)
Rio Grande do Sul	16,545.4 (13,208.2; 19,385.0)	397.1 (314.9; 466.6)	8,408.0 (6,958.4; 10,195.3)	285.4 (234.4; 351.0)	-28.1 (-42.4; 1.1)
Santa Catarina	9,690.6 (7,004.7; 11,627.4)	452.8 (326.6; 545.0)	6,008.3 (4,885.8; 8,342.9)	258.6 (208.1; 368.4)	-42.9 (-57.6; -1.1)
West-Central Region	21,636.8 (16,747.9; 24,778.4)	418.0 (323.5; 479.9)	17,543.1 (14,952.3; 21,515.3)	310.2 (262.8; 383.8)	-25.8 (-38.9; 2.5)
Distrito Federal	3,740.7 (3,036.2; 4,359.6)	393.8 (319.2; 458.9)	2,287.6 (1,835.9; 2,881.7)	232.0 (182.4; 298.1)	-41.1 (-51.8; -19.2)
Goiás	11,297.4 (7,783.0; 13,817.0)	527.0 (362.2; 644.6)	8,219.2 (6,453.0; 9,942.6)	348.4 (275.4; 424.8)	-33.9 (-49.8; 1.1)
Mato Grosso	2,950.8 (2,256.2; 3,819.3)	272.0 (207.4; 351.9)	4,043.5 (3,091.2; 5,484.9)	314.2 (238.7; 428.0)	15.5 (-11.6; 54.6)
Mato Grosso do Sul	3,647.9 (3,133.5; 4,658.1)	367.0 (315.4; 468.2)	2,992.9 (2,439.5; 3,861.9)	291.3 (235.1; 382.8)	-20.6 (-36.0; 8.6)
Both					
Brazil	704,230.6 (617,343.0; 777,227.8)	434.8 (381.2; 479.7)	404,182.9 (357,186.5; 526,393.8)	267.2 (236.2; 352.5)	-38.5 (-46.1; -19.2)
North Region	49,761.3 (41,205.6; 55,616.9)	409.8 (342.9; 455.9)	50,589.4 (44,729.2; 58,429.5)	327.3 (288.9; 378.1)	-20.1 (-31.0; -0.3)
Acre	3,290.4 (1,844.9; 4,369.6)	552.4 (312.2; 732.7)	2,894.9 (2,337.8; 3,547.9)	341.1 (275.3; 418.4)	-38.3 (-56.9; 11.9)

Amapá	1,179.1 (960.5; 1,435.7)	296.9 (241.0; 365.6)	2,336.3 (1,877.6; 2,798.0)	328.4 (263.9; 393.7)	10.6 (-20.1; 42.6)
Amazonas	8,522.2 (7,550.1; 9,702.9)	340.6 (301.7; 388.1)	13,392.3 (11,277.4; 15,582.3)	416.7 (349.8; 485.9)	22.4 (1.4; 48.4)
Pará	25,521.5 (20,050.5; 28,530.0)	440.9 (349.0; 492.8)	20,897.5 (17,729.6; 25,793.8)	299.7 (254.1; 370.8)	-32.0 (-44.2; -4.0)
Rondônia	4,831.3 (4,046.0; 5,635.5)	354.5 (296.6; 413.7)	3,915.7 (3,182.2; 5,043.5)	287.6 (233.5; 371.8)	-18.9 (-35.2; 7.1)
Roraima	930.8 (746.6; 1,131.6)	349.6 (279.8; 424.2)	2,851.1 (2,253.4; 3,522.7)	386.5 (305.7; 477.3)	10.5 (-15.2; 48.1)
Tocantins	5,485.9 (4,041.5; 7,328.2)	447.6 (331.6; 595.9)	4,301.6 (3,439.5; 5,428.6)	271.0 (216.1; 340.9)	-39.4 (-57.4; -6.8)
Northeast Region	245,886.0 (202,331.3; 302,571.2)	453.4 (373.5; 557.4)	122,530.9 (101,316.4; 182,075.6)	235.3 (194.3; 350.2)	-48.1 (-60.7; -19.6)
Alagoas	13,151.2 (10,372.0; 16,787.5)	371.8 (293.5; 472.8)	6,930.9 (5,221.4; 12,120.9)	214.6 (162.1; 374.1)	-42.3 (-60.1; -9.0)
Bahia	65,184.2 (54,202.3; 78,858.4)	451.5 (374.5; 545.5)	31,026.6 (25,611.4; 42,793.8)	249.5 (205.8; 341.5)	-44.7 (-56.9; -18.6)
Ceará	30,179.9 (24,234.9; 38,015.6)	371.1 (298.6; 467.0)	17,489.5 (13,779.4; 28,891.7)	207.5 (163.0; 341.8)	-44.1 (-59.6; -4.8)
Maranhão	37,973.8 (27,797.4; 51,676.5)	502.2 (369.6; 681.9)	19,015.4 (14,746.3; 29,320.5)	229.5 (178.3; 348.5)	-54.3 (-68.7; -28.7)
Paraíba	23,336.1 (18,457.2; 30,033.1)	655.4 (518.1; 843.8)	8,759.8 (6,964.9; 13,198.1)	237.1 (187.9; 356.5)	-63.8 (-74.0; -43.5)
Pernambuco	44,887.6 (33,493.4; 55,849.5)	514.0 (382.9; 639.5)	21,033.5 (17,194.8; 29,683.6)	265.1 (216.2; 374.9)	-48.4 (-61.0; -11.1)
Piaui	12,691.7 (9,518.8; 16,968.0)	383.0 (287.3; 510.4)	7,788.7 (6,270.0; 11,383.5)	260.8 (210.6; 379.7)	-31.9 (-52.3; 16.8)
Rio Grande do Norte	11,521.3 (9,495.1; 14,174.6)	369.6 (305.0; 453.9)	5,646.5 (4,256.2; 9,390.1)	184.9 (140.0; 306.9)	-50.0 (-64.4; -16.6)
Sergipe	6,960.3 (5,792.2; 8,461.0)	378.7 (315.0; 460.4)	4,840.0 (3,883.5; 6,815.4)	251.2 (201.7; 356.0)	-33.7 (-48.9; -8.6)
Southeast Region	259,654.6 (236,095.1; 290,065.7)	410.3 (371.8; 457.1)	141,686.1 (124,198.1; 179,302.8)	265.7 (232.5; 341.3)	-35.2 (-43.3; -21.3)
Espírito Santo	12,988.2 (11,372.6; 14,368.6)	440.9 (385.6; 488.3)	8,142.9 (7,108.7; 9,581.9)	285.3 (249.1; 336.2)	-35.3 (-44.2; -20.7)
Minas Gerais	67,275.7 (60,302.5; 75,580.5)	389.9 (349.2; 437.6)	36,792.4 (31,853.1; 46,824.8)	266.9 (231.4; 337.9)	-31.5 (-42.0; -20.1)
Rio de Janeiro	50,349.1 (43,418.6; 55,433.4)	431.7 (373.4; 477.1)	25,367.2 (21,513.5; 32,487.4)	261.0 (220.7; 334.5)	-39.5 (-48.7; -19.2)
São Paulo	129,041.6 (116,536.1; 148,304.4)	410.8 (371.2; 470.7)	71,383.6 (62,022.7; 92,482.3)	264.8 (230.3; 340.7)	-35.5 (-45.0; -23.1)
South Region	100,650.0 (87,359.9; 109,847.1)	458.0 (395.9; 499.0)	52,000.7 (46,518.0; 62,380.6)	276.5 (247.0; 332.6)	-39.6 (-47.4; -22.9)
Paraná	40,614.0 (34,992.9; 44,981.6)	441.1 (379.7; 488.4)	21,471.4 (18,731.8; 25,677.6)	264.7 (230.1; 318.0)	-40.0 (-49.2; -23.4)
Rio Grande do Sul	36,385.1 (32,465.2; 40,907.2)	431.3 (383.8; 485.5)	17,630.2 (15,699.9; 19,981.7)	294.7 (260.6; 335.5)	-31.7 (-40.8; -19.8)

Santa Catarina	23,650.9 (17,938.4; 26,483.9)	545.1 (410.5; 610.9)	12,899.1 (11,140.6; 16,494.7)	274.6 (235.8; 354.6)	-49.6 (-59.5; -20.5)
West-Central Region	48,278.8 (41,101.3; 53,144.6)	457.9 (389.9; 504.1)	37,375.8 (33,179.3; 43,128.1)	326.6 (291.7; 378.8)	-28.7 (-37.9; -14.6)
Distrito Federal	7,925.2 (7,105.0; 8,914.3)	412.6 (369.2; 464.2)	4,923.6 (4,231.5; 5,933.9)	249.5 (211.7; 302.9)	-39.5 (-47.5; -26.0)
Goiás	26,061.5 (18,862.4; 29,607.7)	598.3 (432.8; 681.4)	17,446.3 (15,141.7; 19,972.0)	364.7 (315.8; 417.8)	-39.1 (-49.8; -21.3)
Mato Grosso	6,590.2 (5,407.9; 8,450.7)	295.6 (242.6; 381.8)	8,604.9 (7,215.1; 10,543.8)	329.1 (274.3; 403.4)	11.3 (-12.8; 43.2)
Mato Grosso do Sul	7,701.9 (6,938.0; 8,995.1)	379.2 (341.7; 442.4)	6,401.0 (5,509.6; 8,053.6)	308.4 (263.1; 387.4)	-18.7 (-30.6; -4.6)

Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 14.2 – Mortality rates per 100,000 inhabitants and absolute numbers of deaths due to congenital malformations of the circulatory system in 1990 and 2023, and percent change of the rates in the period, according to sex, in Brazil, its geographic regions, and Federative Units.

Sex and location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male					
Brazil	4,292.2 (3,755.4; 4,882.2)	5.3 (4.6; 6.0)	2,378.5 (2,120.3; 3,150.7)	3.0 (2.7; 3.9)	-42.0 (-49.6; -27.3)
North Region	308.6 (254.7; 349.4)	5.0 (4.2; 5.7)	297.5 (252.9; 350.7)	3.8 (3.2; 4.5)	-25.0 (-36.7; -6.0)
Acre	23.2 (12.0; 32.4)	7.6 (4.1; 10.6)	17.8 (13.1; 24.3)	4.1 (3.0; 5.6)	-46.0 (-64.3; 3.1)
Amapá	6.6 (5.1; 8.8)	3.3 (2.5; 4.7)	14.2 (10.2; 17.9)	3.9 (2.8; 5.0)	18.6 (-36.1; 75.4)
Amazonas	51.6 (43.8; 62.3)	4.1 (3.5; 5.0)	79.0 (63.6; 99.9)	4.8 (3.9; 6.1)	17.5 (-11.9; 54.5)
Pará	156.6 (122.0; 181.3)	5.3 (4.2; 6.2)	121.0 (99.7; 150.8)	3.4 (2.8; 4.2)	-36.4 (-49.4; -17.2)
Rondônia	30.6 (23.4; 38.5)	4.4 (3.4; 5.6)	23.0 (17.1; 31.5)	3.3 (2.4; 4.4)	-25.8 (-45.0; 4.6)
Roraima	6.0 (4.3; 8.2)	4.4 (3.2; 6.0)	17.5 (12.3; 24.2)	4.7 (3.3; 6.4)	4.6 (-30.4; 69.8)
Tocantins	33.9 (23.5; 49.2)	5.5 (3.8; 7.9)	25.0 (18.7; 33.3)	3.1 (2.3; 4.1)	-43.8 (-65.5; -4.5)
Northeast Region	1,490.8 (1,090.7; 1,974.4)	5.4 (4.0; 7.3)	690.4 (527.4; 1,064.3)	2.6 (2.0; 4.0)	-52.4 (-66.5; -20.4)
Alagoas	78.5 (54.8; 111.4)	4.4 (3.1; 6.3)	38.9 (26.2; 72.1)	2.4 (1.6; 4.4)	-46.7 (-66.0; -11.2)
Bahia	381.3 (284.4; 489.7)	5.2 (3.9; 6.7)	173.3 (135.0; 243.5)	2.7 (2.1; 3.8)	-47.8 (-62.0; -21.1)
Ceará	190.8 (133.4; 262.4)	4.6 (3.2; 6.4)	100.0 (71.7; 162.7)	2.3 (1.7; 3.8)	-50.0 (-66.2; -10.1)
Maranhão	242.6 (157.7; 383.5)	6.4 (4.2; 10.0)	109.4 (79.0; 167.5)	2.6 (1.9; 4.0)	-59.3 (-77.2; -28.8)
Paraíba	142.0 (102.5; 202.3)	7.9 (5.7; 11.2)	49.0 (36.3; 79.9)	2.6 (1.9; 4.2)	-67.2 (-80.2; -42.4)
Pernambuco	269.5 (198.1; 345.0)	6.1 (4.5; 7.9)	116.9 (88.9; 177.3)	2.9 (2.2; 4.3)	-53.1 (-67.7; -19.4)
Piaui	76.4 (50.3; 110.7)	4.6 (3.0; 6.6)	43.3 (31.5; 65.0)	2.8 (2.0; 4.2)	-38.2 (-61.7; 7.0)
Rio Grande do Norte	67.7 (46.2; 87.7)	4.3 (2.9; 5.7)	31.0 (20.7; 55.4)	2.0 (1.3; 3.5)	-53.8 (-69.3; -23.8)
Sergipe	42.2 (30.3; 55.9)	4.5 (3.3; 6.0)	28.5 (22.0; 40.2)	2.9 (2.2; 4.1)	-36.0 (-55.4; -2.9)
Southeast Region	1,573.9 (1,371.5; 1,879.6)	4.9 (4.3; 5.9)	847.7 (747.2; 1,102.8)	3.1 (2.7; 3.9)	-37.8 (-47.0; -25.8)
Espírito Santo	81.3 (69.6; 95.2)	5.5 (4.7; 6.4)	51.1 (41.7; 63.2)	3.5 (2.8; 4.3)	-36.5 (-50.1; -15.8)
Minas Gerais	401.1 (347.1; 511.1)	4.6 (4.0; 6.0)	218.2 (185.3; 286.0)	3.0 (2.6; 3.8)	-34.4 (-46.6; -16.8)
Rio de Janeiro	309.8 (268.8; 360.1)	5.2 (4.5; 6.1)	153.8 (129.3; 194.7)	3.1 (2.6; 3.9)	-41.7 (-52.1; -23.1)
São Paulo	781.7 (675.1; 988.4)	4.9 (4.2; 6.2)	424.6 (365.7; 563.5)	3.0 (2.6; 4.0)	-38.1 (-47.8; -24.4)
South Region	623.3 (550.1; 726.5)	5.6 (4.9; 6.5)	317.6 (273.2; 383.8)	3.2 (2.8; 3.8)	-42.5 (-52.7; -30.8)
Paraná	244.9 (213.1; 289.9)	5.3 (4.6; 6.2)	130.6 (108.2; 159.6)	3.1 (2.6; 3.7)	-40.9 (-53.4; -25.6)
Rio Grande do Sul	222.6 (191.0; 298.4)	5.2 (4.5; 7.0)	107.8 (90.2; 132.5)	3.4 (2.9; 4.1)	-35.0 (-49.8; -20.5)
Santa Catarina	155.9 (115.9; 179.9)	7.1 (5.2; 8.2)	79.2 (65.6; 102.5)	3.2 (2.7; 4.1)	-54.5 (-65.2; -26.6)
West-Central Region	295.7 (257.3; 331.2)	5.5 (4.8; 6.2)	225.3 (194.4; 263.5)	3.8 (3.3; 4.5)	-31.0 (-42.0; -14.7)
Distrito Federal	46.5 (40.0; 54.7)	4.8 (4.2; 5.7)	29.8 (23.8; 37.4)	3.0 (2.4; 3.7)	-38.7 (-52.1; -22.0)
Goiás	164.5 (120.0; 189.3)	7.5 (5.5; 8.6)	105.3 (85.9; 126.8)	4.3 (3.5; 5.1)	-42.9 (-55.2; -27.2)
Mato Grosso	39.9 (28.7; 54.4)	3.5 (2.5; 4.9)	51.4 (41.1; 66.4)	3.8 (3.0; 4.9)	8.8 (-22.9; 66.7)
Mato Grosso do Sul	44.8 (37.7; 60.8)	4.3 (3.7; 5.9)	38.8 (31.6; 47.5)	3.6 (2.9; 4.5)	-16.4 (-37.6; 8.8)

Female					
Brazil	3,555.7 (2,770.2; 4,177.3)	4.5 (3.5; 5.3)	2,200.6 (1,850.0; 3,019.1)	2.9 (2.4; 4.0)	-35.5 (-47.3; -0.6)
North Region	239.8 (179.6; 282.5)	4.0 (3.1; 4.7)	268.1 (226.7; 341.2)	3.5 (2.9; 4.5)	-13.2 (-30.1; 26.3)
Acre	13.2 (7.6; 19.9)	4.6 (2.7; 6.9)	14.4 (10.6; 18.6)	3.5 (2.5; 4.5)	-24.9 (-53.1; 42.2)
Amapá	6.1 (4.6; 7.8)	3.1 (2.4; 4.1)	11.4 (8.8; 14.4)	3.3 (2.5; 4.1)	4.3 (-26.2; 58.4)
Amazonas	41.7 (34.3; 51.3)	3.4 (2.8; 4.2)	70.6 (56.6; 89.2)	4.5 (3.5; 5.6)	31.1 (2.2; 67.5)
Pará	125.3 (91.7; 148.1)	4.4 (3.3; 5.2)	113.2 (89.7; 152.2)	3.3 (2.6; 4.4)	-25.8 (-45.6; 23.6)
Rondônia	22.7 (17.1; 28.1)	3.5 (2.6; 4.3)	21.0 (15.3; 28.5)	3.1 (2.3; 4.3)	-10.0 (-36.3; 41.8)
Roraima	4.2 (3.1; 5.6)	3.3 (2.4; 4.4)	14.2 (10.2; 18.8)	3.9 (2.8; 5.2)	19.8 (-19.5; 73.0)
Tocantins	26.6 (17.4; 38.3)	4.5 (2.9; 6.4)	23.2 (17.3; 31.3)	3.0 (2.2; 4.0)	-33.4 (-56.5; 12.6)
Northeast Region	1,231.8 (893.6; 1,659.4)	4.6 (3.4; 6.2)	683.4 (486.3; 1,075.7)	2.6 (1.9; 4.2)	-43.0 (-63.2; -1.3)
Alagoas	67.3 (46.4; 92.1)	3.9 (2.7; 5.3)	38.7 (24.9; 70.4)	2.4 (1.6; 4.4)	-37.4 (-62.3; 5.8)
Bahia	340.0 (260.1; 438.9)	4.8 (3.7; 6.2)	175.8 (131.1; 258.4)	2.8 (2.1; 4.1)	-41.1 (-60.8; -4.2)
Ceará	142.9 (101.5; 199.5)	3.6 (2.6; 5.0)	94.3 (64.0; 158.7)	2.3 (1.5; 3.8)	-37.4 (-62.1; 18.7)
Maranhão	177.9 (110.7; 272.5)	4.8 (3.0; 7.3)	105.4 (69.4; 166.8)	2.6 (1.7; 4.1)	-46.0 (-67.8; 0.1)
Paraíba	117.1 (80.3; 166.5)	6.7 (4.6; 9.5)	48.7 (34.2; 71.1)	2.7 (1.9; 3.9)	-60.3 (-74.9; -34.4)
Pernambuco	229.1 (148.9; 318.8)	5.3 (3.5; 7.4)	120.2 (85.3; 169.0)	3.0 (2.2; 4.3)	-42.9 (-65.3; 9.6)
Piaui	63.6 (39.4; 95.4)	3.9 (2.5; 5.9)	44.3 (31.4; 68.6)	3.0 (2.1; 4.6)	-24.0 (-54.0; 46.9)
Rio Grande do Norte	59.4 (44.4; 78.2)	3.9 (2.9; 5.1)	31.3 (20.3; 55.2)	2.1 (1.3; 3.7)	-47.0 (-69.2; 2.5)
Sergipe	34.5 (25.7; 45.5)	3.8 (2.9; 5.1)	24.8 (17.0; 38.6)	2.6 (1.8; 4.0)	-32.5 (-56.7; 6.7)
Southeast Region	1,344.0 (1,104.3; 1,612.1)	4.3 (3.5; 5.2)	771.5 (649.0; 1,022.5)	2.8 (2.4; 3.8)	-34.4 (-45.6; -5.2)
Espírito Santo	63.2 (49.2; 73.1)	4.4 (3.4; 5.1)	42.0 (33.5; 51.9)	2.9 (2.3; 3.6)	-33.7 (-48.0; -9.0)
Minas Gerais	354.8 (293.9; 426.4)	4.2 (3.5; 5.0)	203.9 (167.4; 268.3)	2.9 (2.4; 3.9)	-30.4 (-43.0; -0.1)
Rio de Janeiro	258.9 (199.7; 308.6)	4.5 (3.5; 5.3)	139.4 (113.4; 187.6)	2.8 (2.2; 3.9)	-38.4 (-53.0; -5.1)
São Paulo	667.0 (550.8; 805.4)	4.3 (3.6; 5.2)	386.2 (320.5; 527.1)	2.8 (2.3; 4.0)	-35.1 (-47.8; -4.0)
South Region	500.2 (383.7; 579.8)	4.6 (3.5; 5.4)	279.8 (231.2; 355.6)	2.9 (2.5; 3.8)	-37.1 (-50.2; -4.0)
Paraná	206.3 (154.0; 237.7)	4.6 (3.4; 5.3)	113.4 (93.3; 145.4)	2.8 (2.3; 3.6)	-39.8 (-52.9; -3.2)
Rio Grande do Sul	185.4 (147.5; 217.6)	4.5 (3.5; 5.2)	97.6 (80.3; 120.9)	3.2 (2.6; 3.9)	-28.7 (-43.0; 0.8)
Santa Catarina	108.4 (77.7; 129.8)	5.1 (3.6; 6.1)	68.8 (55.4; 96.3)	2.9 (2.3; 4.1)	-43.5 (-58.3; -1.5)
West-Central Region	239.9 (184.6; 276.3)	4.7 (3.6; 5.4)	197.7 (166.1; 239.9)	3.4 (2.9; 4.2)	-26.4 (-38.9; 2.7)
Distrito Federal	41.5 (33.2; 48.7)	4.4 (3.5; 5.2)	25.7 (20.5; 32.5)	2.5 (2.0; 3.3)	-42.3 (-54.1; -19.5)
Goiás	126.0 (85.8; 154.8)	5.9 (4.0; 7.3)	93.5 (74.9; 115.7)	3.9 (3.0; 4.8)	-34.3 (-50.2; 1.6)
Mato Grosso	32.1 (24.1; 41.6)	3.0 (2.2; 3.9)	44.7 (33.3; 61.2)	3.5 (2.6; 4.7)	15.3 (-12.5; 58.1)
Mato Grosso do Sul	40.3 (34.8; 52.2)	4.1 (3.5; 5.3)	33.8 (27.4; 44.0)	3.2 (2.6; 4.3)	-20.8 (-36.9; 8.0)
Both					
Brazil	7,847.9 (6,862.4; 8,701.9)	4.9 (4.3; 5.4)	4,579.1 (4,053.7; 6,056.0)	3.0 (2.6; 3.9)	-39.0 (-46.7; -19.9)
North Region	548.4 (455.3; 616.5)	4.5 (3.8; 5.1)	565.6 (495.5; 661.9)	3.6 (3.2; 4.2)	-19.8 (-30.9; -0.7)
Acre	36.4 (20.3; 48.5)	6.1 (3.5; 8.2)	32.2 (25.9; 39.9)	3.8 (3.0; 4.7)	-38.3 (-57.2; 11.5)
Amapá	12.7 (10.3; 16.0)	3.2 (2.6; 4.1)	25.5 (20.6; 30.7)	3.6 (2.9; 4.3)	11.8 (-20.9; 46.7)
Amazonas	93.3 (82.1; 107.5)	3.8 (3.3; 4.4)	149.6 (125.4; 174.0)	4.6 (3.9; 5.4)	23.6 (2.0; 51.0)

Pará	281.9 (220.7; 317.0)	4.9 (3.9; 5.5)	234.3 (197.7; 292.7)	3.3 (2.8; 4.2)	-31.7 (-43.8; -4.0)
Rondônia	53.3 (44.5; 62.6)	3.9 (3.3; 4.6)	44.0 (35.4; 57.4)	3.2 (2.6; 4.2)	-19.0 (-35.8; 7.7)
Roraima	10.2 (8.1; 12.6)	3.9 (3.1; 4.8)	31.7 (24.9; 39.0)	4.3 (3.4; 5.3)	11.0 (-15.3; 50.4)
Tocantins	60.6 (43.9; 81.3)	5.0 (3.6; 6.7)	48.2 (37.9; 61.1)	3.0 (2.4; 3.8)	-39.2 (-57.7; -6.3)
Northeast Region	2,722.7 (2,202.9; 3,338.2)	5.0 (4.1; 6.2)	1,373.8 (1,114.4; 2,099.2)	2.6 (2.1; 4.0)	-48.2 (-61.1; -19.9)
Alagoas	145.8 (114.2; 187.9)	4.1 (3.2; 5.3)	77.6 (56.7; 140.3)	2.4 (1.7; 4.3)	-42.4 (-60.3; -9.3)
Bahia	721.3 (602.4; 873.4)	5.0 (4.2; 6.1)	349.1 (283.1; 503.5)	2.8 (2.2; 3.9)	-44.7 (-57.2; -19.4)
Ceará	333.7 (265.6; 421.8)	4.1 (3.3; 5.2)	194.2 (151.4; 328.6)	2.3 (1.8; 3.9)	-44.6 (-60.5; -5.8)
Maranhão	420.5 (306.5; 574.4)	5.6 (4.1; 7.7)	214.8 (163.2; 333.7)	2.6 (2.0; 4.0)	-53.7 (-68.9; -27.3)
Paraíba	259.1 (204.2; 332.8)	7.3 (5.8; 9.4)	97.6 (75.9; 151.6)	2.6 (2.0; 4.1)	-64.1 (-74.1; -42.9)
Pernambuco	498.6 (376.9; 621.3)	5.7 (4.3; 7.1)	237.2 (191.3; 338.5)	3.0 (2.4; 4.2)	-48.5 (-61.5; -11.3)
Piaui	140.0 (103.4; 188.7)	4.3 (3.1; 5.7)	87.6 (69.3; 129.7)	2.9 (2.3; 4.3)	-31.8 (-52.3; 17.2)
Rio Grande do Norte	127.1 (103.5; 156.0)	4.1 (3.4; 5.0)	62.4 (46.2; 108.3)	2.0 (1.5; 3.5)	-50.6 (-64.9; -16.9)
Sergipe	76.7 (62.9; 94.3)	4.2 (3.4; 5.2)	53.3 (41.4; 78.0)	2.7 (2.1; 4.0)	-34.5 (-50.0; -8.9)
Southeast Region	2,917.8 (2,639.4; 3,291.4)	4.6 (4.2; 5.2)	1,619.2 (1,448.9; 2,121.4)	3.0 (2.6; 3.8)	-36.2 (-44.0; -22.0)
Espírito Santo	144.6 (126.5; 161.5)	4.9 (4.3; 5.5)	93.2 (81.2; 110.9)	3.2 (2.8; 3.8)	-35.3 (-44.1; -20.7)
Minas Gerais	755.9 (681.6; 862.0)	4.4 (4.0; 5.0)	422.2 (362.9; 551.5)	3.0 (2.6; 3.8)	-32.5 (-42.9; -20.9)
Rio de Janeiro	568.7 (487.1; 625.5)	4.9 (4.2; 5.4)	293.2 (255.2; 372.8)	2.9 (2.5; 3.8)	-40.2 (-49.3; -20.1)
São Paulo	1,448.7 (1,296.7; 1,667.3)	4.6 (4.1; 5.3)	810.7 (704.3; 1,072.1)	2.9 (2.5; 3.8)	-36.7 (-45.9; -23.8)
South Region	1,123.5 (966.3; 1,234.5)	5.1 (4.4; 5.6)	597.5 (531.8; 728.7)	3.1 (2.7; 3.7)	-40.1 (-47.8; -23.2)
Paraná	451.2 (387.9; 496.5)	4.9 (4.2; 5.4)	244.1 (212.7; 296.1)	2.9 (2.6; 3.5)	-40.4 (-49.6; -23.4)
Rio Grande do Sul	408.0 (360.9; 464.0)	4.8 (4.3; 5.5)	205.4 (181.6; 235.4)	3.3 (2.9; 3.7)	-32.2 (-41.6; -20.4)
Santa Catarina	264.3 (201.6; 294.6)	6.1 (4.6; 6.8)	148.0 (127.0; 191.9)	3.1 (2.6; 4.0)	-50.0 (-59.8; -21.2)
West-Central Region	535.5 (452.7; 591.1)	5.1 (4.3; 5.6)	423.0 (376.4; 484.9)	3.6 (3.2; 4.2)	-28.9 (-38.1; -15.2)
Distrito Federal	87.9 (78.4; 99.6)	4.6 (4.1; 5.2)	55.5 (47.7; 69.6)	2.8 (2.3; 3.4)	-40.4 (-49.3; -26.5)
Goiás	290.5 (210.5; 330.0)	6.7 (4.9; 7.6)	198.8 (171.4; 229.1)	4.1 (3.5; 4.7)	-39.2 (-49.9; -22.4)
Mato Grosso	72.0 (57.7; 92.1)	3.3 (2.6; 4.2)	96.1 (79.4; 118.8)	3.6 (3.0; 4.5)	11.7 (-13.3; 45.5)
Mato Grosso do Sul	85.1 (76.2; 100.8)	4.2 (3.8; 5.0)	72.5 (61.5; 91.1)	3.4 (2.9; 4.4)	-18.5 (-31.4; -3.6)

Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 14.3 – Proportional mortality and absolute numbers of deaths from congenital malformations of the circulatory system according to the International Classification of Diseases, 10th revision (ICD-10), in 1996 and 2023.

Congenital malformations	ICD-10	1996	2023
Cardiac chambers and connections	Q20	4.90% (198)	7.94% (327)
Cardiac septa	Q21	10.12% (409)	20.35% (837)
Pulmonary and tricuspid valves	Q22	1.51% (61)	5.71% (235)
Aortic and mitral valves	Q23	1.44% (58)	9.14% (376)
Congenital malformations of heart, unspecified	Q24.9	74.05% (2.990)	41.08% (1.690)
Great arteries	Q25	4.1% (166)	11.67% (480)
Great veins	Q26	0.17% (7)	1.24% (51)
Peripheral vascular system	Q27	1.03% (42)	1.07%
Other congenital malformations of circulatory system	Q28	2.69% (109)	1.80% (74)

Source: Data from Ministry of Health of Brazil – Hospital Information System of the Unified Health System (SIH/SUS).[34]

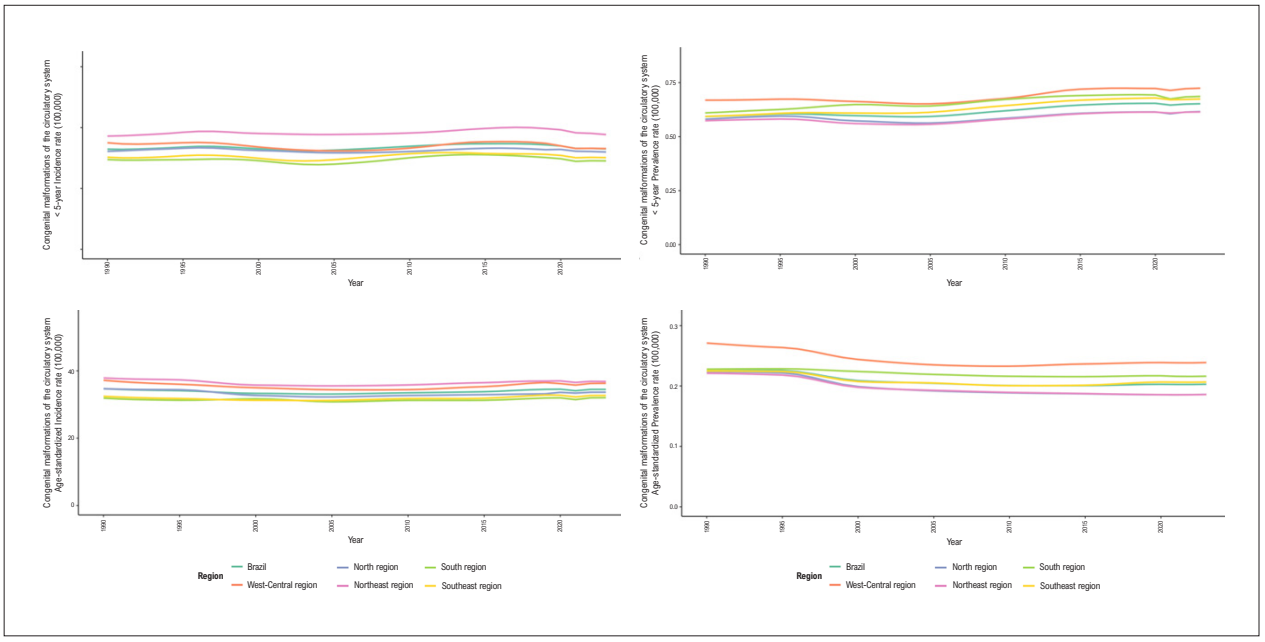

Chart 14.1 – *Age-standardized and under-5-year incidence and prevalence rates of congenital malformations of the circulatory system in Brazil, from 1990 to 2023, according to Brazilian geographic regions. Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

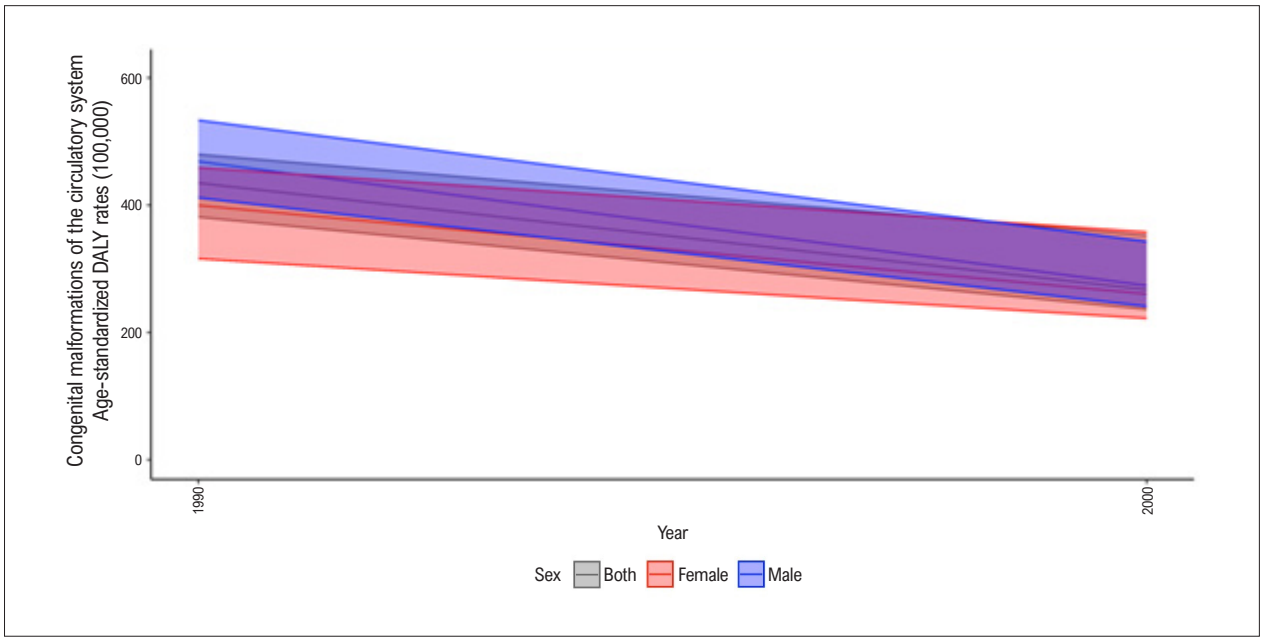

Chart 14.2 – *Age-standardized DALY rates due to congenital malformations of the circulatory system, according to sex, in Brazil, from 1990 to 2023. Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

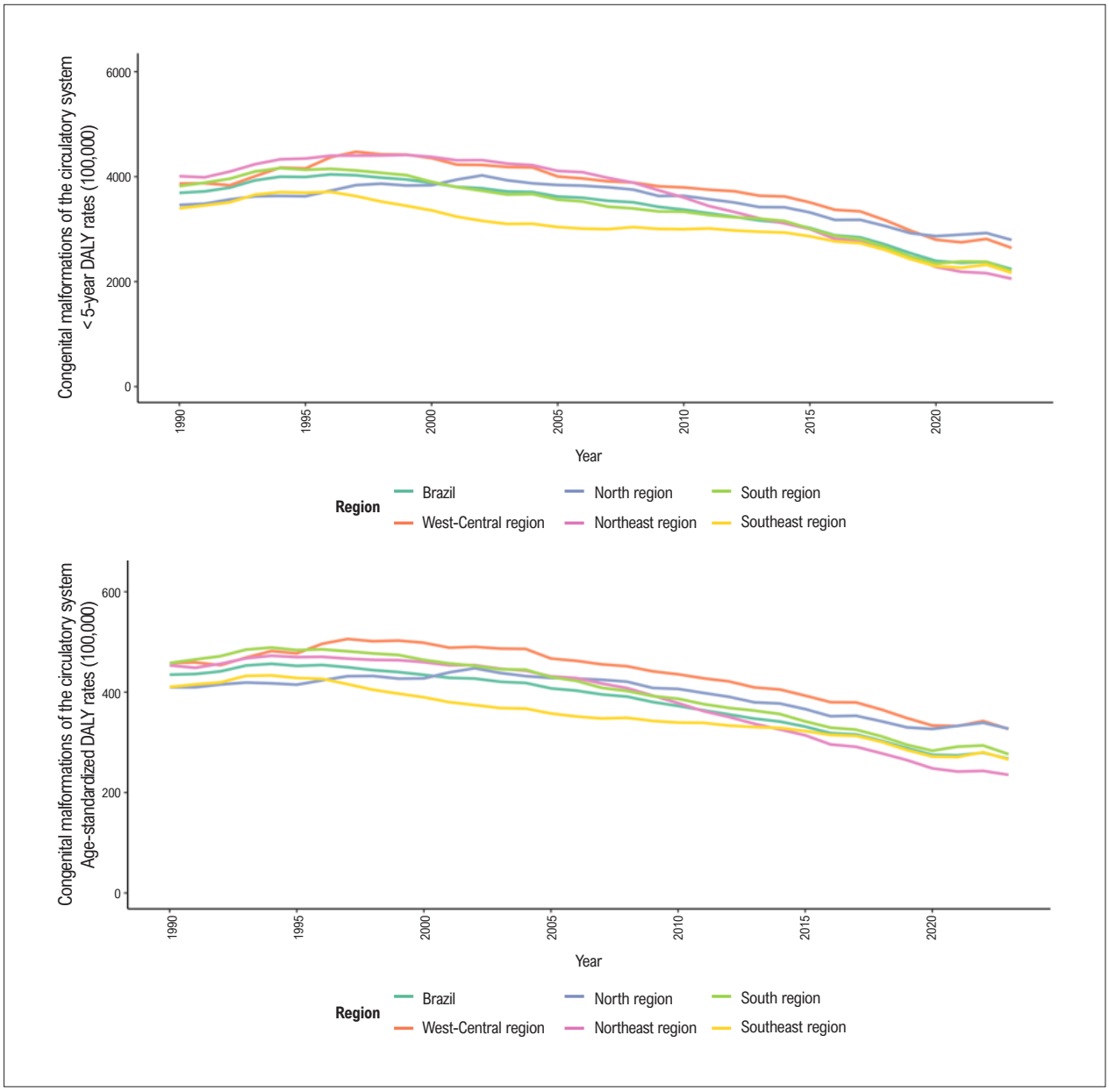

Chart 14.3 – *Age-standardized and under-5-year DALY rates due to congenital malformations of the circulatory system, in Brazil and its geographic regions, 1990-2023. Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

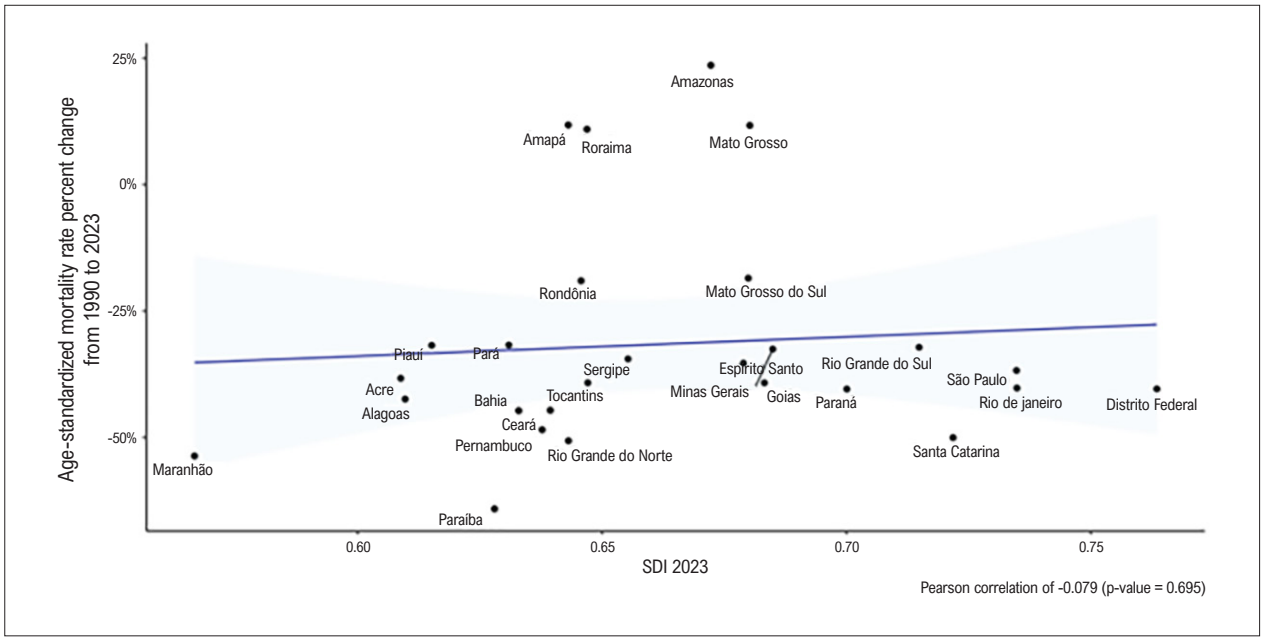

Chart 14.4 – *Correlation between the 2023 sociodemographic index (SDI) and the percent changes of mortality rates due to congenital malformations of the circulatory system in Brazil, from 1990 to 2023. Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

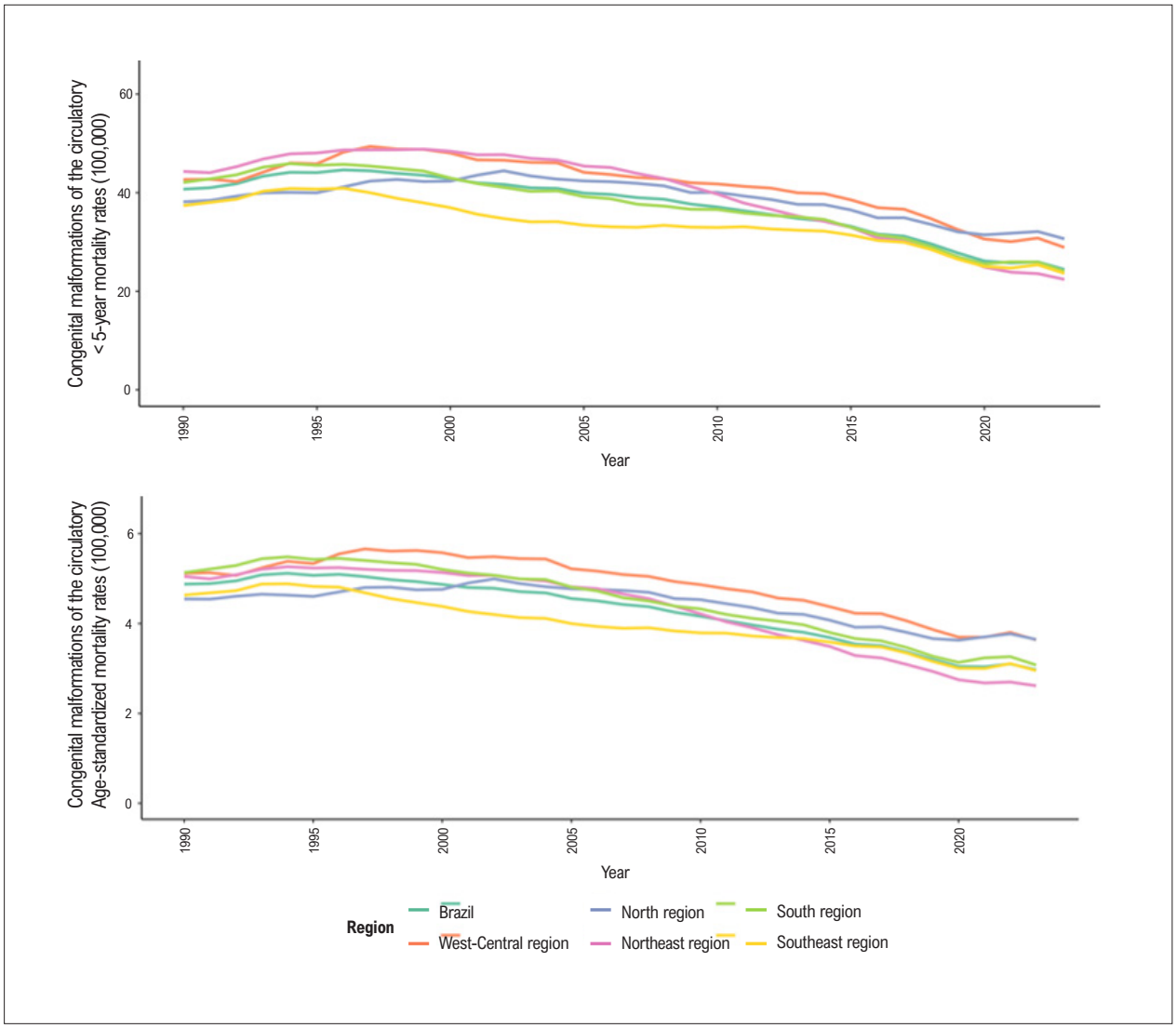

Chart 14.5 – *Age-standardized and under-5-year mortality rates due to congenital malformations of the circulatory system in Brazil and its geographic regions, 1990-2023. Source: Data derived from Global Burden of Disease 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

CHAPTER 15 – CHRONIC KIDNEY DISEASE

ICD-10 N18.

See Tables 15.1 through 15.7 and Charts 15.1 through 15.5.

Abbreviations used in chapter 15

ACEI	Angiotensin-Converting-Enzyme Inhibitor
ARB	Agiotensin Receptor Blocker
CI	Confidence Interval
CKD	Chronic Kidney Disease
CVD	Cardiovascular Disease
DALYs	Disability-Adjusted Life Years
eGFR	Estimated Glomerular Filtration Rate
ELSA-Brasil	Brazilian Longitudinal Study of Adult Health
ESRD	End-Stage Renal Disease
GBD	Global Burden of Disease
GFR	Glomerular Filtration Rate
GLP-1	Glucagon-Like Peptide-1
HD	Hemodialysis
HDF	Hemodiafiltration
KDIGO	Kidney Disease: Improving Global Outcomes
KRT	Kidney Replacement Therapy
KTx	Kidney Transplant
OR	Odds Ratio
PD	Peritoneal Dialysis
PNS	Brazilian National Health Survey
SBN	Brazilian Society of Nephrology (in Portuguese, Sociedade Brasileira de Nefrologia)
SDI	Sociodemographic Index
SGLT2	Sodium-Glucose Cotransporter 2
SUS	Brazilian Unified Health System (in Portuguese, Sistema Único de Saúde)
UI	Uncertainty Interval
YLD	Years Lived with Disability
YLL	Years of Life Lost due to premature mortality

Introduction

- Chronic kidney disease (CKD) is a prevalent health condition characterized by abnormalities of the kidney structure or function sustained for at least three months.[443] These abnormalities can be defined by a glomerular filtration rate (GFR) lower than 60mL/min/1.73m^2 and/or presence of markers of kidney damage, such as albuminuria (urinary albumin-to-creatinine ratio) >30mg/g.[444]
- KDIGO (*Kidney Disease: Improving Global Outcomes*) classifies CKD into two domains based on GFR (G1-G5) and albuminuria (A1-A3).[445] The GFR is usually determined from serum creatinine measurement, using standardized formulas that consider sex and age. According to its last update, KDIGO recommends not using race/ethnicity as a variable and stimulates the use of calculators that combine different sources of information, such as serum cystatin-C.[445] The KDIGO CKD classification is widely endorsed by Brazilian entities.
- The increasing understanding of the interactions of CKD, cardiovascular disease (CVD), diabetes, and obesity has led to the development of the concept of cardiovascular-kidney-metabolic syndrome, which recognizes those conditions as interdependent manifestations of the same pathophysiological *continuum*. In such context, CKD not only shares risk factors with CVD and metabolic diseases but also acts as an important magnifier of cardiovascular risk and of adverse outcomes in health.
- Sometimes CKD manifests clinically only in its terminal phases, making its diagnosis a challenge for population health programs.[446] End-stage renal disease (ESRD) is characterized by the inability to properly maintain homeostasis without adopting kidney replacement therapies (KRT), such as hemodialysis (HD), hemodiafiltration (HDF), peritoneal dialysis (PD), and kidney transplant (KTx).[447]
- According to GBD Study 2023, the global prevalence of CKD in adults was estimated as 14.2% (95% CI, 13.4-15.2%) in 2023, adding up to an estimate of 788 million individuals with CKD (95% CI, 743-843 million).[448] In addition, it is worth emphasizing that these rates have progressively increased over recent decades, and CKD is estimated to rise from the 16th to the 5th leading cause of years of life lost to premature mortality (YLL).[448,449]
- Patients with CKD have significantly higher mortality than the general population, mainly from cardiovascular causes, with which CKD shares risk factors and often has a bidirectional relationship of cause and effect.[450,451] In this chapter, kidney disease is addressed as a "cardiovascular risk factor", except in the section about the burden of disease attributed to CKD. The GBD Study uses the terminology "kidney dysfunction", defined by estimated glomerular filtration rate (eGFR) <60 mL/min/1.73m^2 and/or clinically significant albuminuria (albumin-creatinine ratio ≥30 mg/g). Unlike CKD modeled as disease and used to estimate its own prevalence, incidence, and burden, kidney dysfunction is used in the comparative risk analysis to estimate the burden of other diseases, especially CVD, attributable to impaired kidney function.

Prevalence

- The actual prevalence of CKD in the Brazilian population is unknown, because the condition is often asymptomatic in its initial stages and the diagnosis is mainly determined

based on laboratory criteria. Brazilian systematic review studies have been unable to compile data because of their heterogeneity, with CKD prevalence ranging from 1.43% to 27.3%, depending on the method/source used.[452] A systematic review with international meta-analysis performed to assess CKD prevalence in Latin America has reported CKD prevalence in the Brazilian population of 13.91% (95% CI, 9.65-18.79%), based on six studies with high heterogeneity (I^2 = 98.7%)[453] (Table 15.1).

- The general population has limited awareness of CKD. Albuquerque *et al.*, in a randomized population-based study conducted with 735 individuals in the city of Fortaleza, Ceará state, have identified that only 17% of the interviewees knew the concept of CKD, 6% knew the concept of creatinine, and less than 15% knew the risk factors for CKD, such as arterial hypertension and diabetes *mellitus*.[454] Limited public awareness is an obstacle to clinical diagnosis and management, as well as to the performance of studies that evidence the actual CKD prevalence in the population.
- Gouvea *et al.*, assessing data from the last Brazilian National Health Survey (PNS) performed in 2019 with 85,854 Brazilians, have found that 1.4% (95% CI, 1.3-1.6) of the population reports having CKD, with a similar distribution between sexes (men, 1.3% [95% CI, 1.2-1.5], and women, 1.5% [95% CI, 1.3-1.7]), with higher prevalence in populations with low educational level (2% [95% CI, 1.7-2.4]) and being more common among those at higher risk as follows: elderly > 75 years, 3.4% (95% CI, 2.2-5.2); individuals with hypertension, 3.3% (95% CI, 2.9-3.7); individuals with diabetes, 4.1% (95% CI, 3.4-5.0); and individuals with dyslipidemia, 3.3% (95% CI, 2.8-0.9).[455] The general rate of self-reported CKD in the population was 1.4% [95% CI, 1.3-1.6], the same identified in the 2013 PNS.[456]
- Aguiar *et al.*, analyzing a subsample of 7,457 participants from the 2013 PNS, which had collected biochemical tests, have identified CKD prevalence of 6.5% (95% CI, 5.9-7.1) in that population when using the GFR <60ml/min/1.73m^2 criterion.[457]
- Samaan *et al.*, assessing data from laboratory tests of more than 1.5 million Brazilians from supplementary health insurance, have shown, using the GFR <60ml/min/1.73m^2 criterion, CKD prevalence of 3.8%, more common in men (4.0% *versus* 3.7% in women) and more prevalent with age increase (up to affecting 32.4% of individuals >75 years).[458]
- Cross-sectional studies of populations at high risk (outpatients with arterial hypertension, diabetes *mellitus*, heart diseases) tend to show higher CKD rates. Comini *et al.*, studying patients from primary care in the city of Viçosa, Minas Gerais state, have reported that 15.4% of the patients with hypertension and/or diabetes showed some degree of CKD.[459] In another study, Samaan *et al.*, assessing patients referred for cardiology care at a specialized hospital in São Paulo, have identified an even higher CKD prevalence, which reached 31% of the population at risk.[460]
- The prevalence of CKD in its asymptomatic stages is internationally underestimated. The REVEAL-CKD Study was aimed at identifying the prevalence of unrecorded stage 3 CKD (GFR of 30-60 ml/min/1.73m^2) of patients from several countries. In Brazil, the study has found that 92% of the patients from the São Paulo University with stage 3 CKD, according to the laboratory criterion of GFR, were not recorded as patients with CKD in the assessed databases. In addition, the study has shown that only 4.9% of the Brazilian patients had their albuminuria measured, an essential information for diagnosis and follow-up.[461]
- Barreto *et al.*, assessing data from the ELSA-Brazil multicenter study, a cohort of public servants that followed 14,363 adults up at its baseline, initiated in 2008-2010, have estimated CKD prevalence of 8.9%. In that same study, higher CKD prevalence was evidenced among racial minorities, odds ratio (OR) being higher among black individuals (OR 1.23; 95% CI, 1.03-1.47), 'pardos' (OR 1.16; 95% CI, 1.00-1.35), and Indigenous (OR 1.72; 95% CI, 1.07-2.76).[462]
- Among Brazilian Indigenous populations, CKD prevalence has been sparsely investigated. However, the most reliable surveys conducted in Indigenous populations in Northeastern Brazil have reported prevalence estimates ranging from 3.3% to 6.2%, with higher prevalences observed in more urbanized Indigenous populations.[463] Gomes *et al.*, analyzing 1,715 Truká Indigenous adults, have shown CKD prevalence of 10% (95% CI, 8.6-11.5). In addition, in that native population, CKD seemed not associated with classic risk factors, such as arterial hypertension and diabetes, rising the hypothesis of alternative etiologies of CKD in Indigenous populations, such as Mesoamerican nephropathy (associated with agricultural work in tropical areas).[464]
- The prevalence of ESRD is better described at national level because of the possibility of screening and more properly quantifying patients in the different modalities of KRT, considering that most of those therapies are covered by the Brazilian Unified Health System (SUS). In Brazil, approximately 80% of the dialysis therapies and 90% of KTx are funded by the SUS.
- The Brazilian Society of Nephrology (SBN) annually performs the Brazilian Dialysis Survey, in which the clinics providing that service voluntarily inform data for the SBN registry. Nerbass *et al.*, in the last updated survey (2024), reported 172,585 patients receiving dialysis in Brazil (87.3% on HD, 7.1% on HDF, and 5.6% on PD), and the estimated prevalence rate of KRT with dialysis methods per million population was 812.[465] Annually, dialysis surveys evidence an increase in the Brazilian population on that type of therapy.
- Santos *et al.*, analyzing data from the SUS database, have identified 161,685 patients on dialysis in Brazil in 2023 (the SBN survey in that same year indicated approximately 157,000 patients undergoing KRT).[466] The study showed that the number of Brazilians on dialysis increased from 133,000 to 161,000 (21%) from 2015 to 2023.

Incidence

- Studies on the incidence of ckd in brazil are even scarcer, thus almost all national information on CKD incidence is restricted to cases of incident esrd on krt.
- Carvalho *et al*. have assessed data from the elsa-brazil study, involving 12,399 participants with no evidence of ckd at baseline who attended a subsequent visit. the incidence of albuminuria (albumin-to-creatinine ratio ≥30 mg/g) was 2.82% in a mean follow-up of 3.84 (±0.57) years. several adiposity indices assessed in the study were associated with the incidence of albuminuria.[467]
- According to nerbass *et al*., based on the last brazilian dialysis survey, the number of patients on dialysis increased 52,944 in 2024, with 249 incident patients on dialysis per 1 million inhabitants.[465]
- The upward trend in the number of patients on krt should remain throughout the next years. international studies have suggested that brazil may have a 6.9% increase between 2022 and 2032 in the absolute number of patients with ckd g3-5, in addition to substantial increases of 170% in the population on dialysis and of 80% in the kidney transplanted population.[468] Lima *et al*. have assessed the trends of esrd in brazil, projecting incidence and prevalence rates of dialysis for 2039 of 338 patients per million population and 1,225 patients per million population, respectively.[469]
- Although the absolute number of patients living with a functioning kidney transplant is uncertain in brazil, data have shown that 6,297 ktx were performed in brazil in 2024.[470]

Mortality

General Mortality Attributable to CKD

- Chronic kidney disease is a relevant cause of mortality in Brazil, with growing impact over the past decades. Evidence from national ecological studies, time series analyses, and estimates based on secondary data have shown consistent increase in CKD mortality rates, accompanied by elevation in the absolute number of deaths.
- Gouvea *et al*. have identified that the age-standardized CKD mortality rate increased from 2.82 to 3.24 deaths per 100,000 inhabitants from 2009 to 2020, corresponding to a mean annual percent change of 1.29%. During that period, 81,034 Brazilians died due to CKD. The increase in mortality was progressive in the period studied, suggesting a sustained upward trend of mortality, with deaths attributable to CKD concentrated in the elderly population ≥75 years, in which those deaths represented 43.1%.[471]
- Regional studies have shown heterogeneity in the CKD mortality dynamics in Brazil. Ecological studies performed with data of hospitalizations for CKD and mortality from the disease in the Espírito Santo state, from 1996 and 2017, have shown that the mortality rate remained stable at 2.92 per 100,000 inhabitants, while hospitalizations for CKD increased 6.3% per year, with a mean incidence rate of 45.8 per 100,000 inhabitants.[472] However, in the Brazilian North region, during the same period of 1997-2017, there was a downward trend of CKD mortality (mean of 0.88% per year) and stability of hospitalizations for CKD (22.9 per 100,000 inhabitants).[473]
- Data from the GDB Study 2023 have shown that there were 86,074 (95% UI, 74,020-99,168) deaths attributable to kidney dysfunction in Brazil, a rate of 40.6 per 100,000 (95% UI, 34.9-46.8). For comparison, data from 1990 showed 41,320 (95% UI, 34,048-48,385) deaths and a rate of 27.2 per 100,000 (95% UI, 22.8-32.4), corresponding to a percent change of 46.7% (95% UI, 37.3-59.0) in the period. However, analyzing the age-standardized rates, there was a reduction from 53.1 (95% UI, 42.2-63.3) to 33.3 per 100,000 inhabitants (95% UI, 28.5-38.3), corresponding to a percent change of 37.4% (95% UI, -41.9; -30.8), suggesting that the increase in the number should be mainly due to population aging (Table 15.2 and Chart 15.1). This same pattern was identified in both sexes. The burden of mortality attributed to kidney dysfunction has a strong age gradient, mainly concentrated in individuals aged ≥50 years. Mortality attributed to kidney dysfunction decreases significantly in younger age groups, with reductions of 62.7% (95% UI, -68.2; -54.8) in children <5 years and of 44.0% (95% UI, -53.9; -30.7) in those aged 5-14 years. Data indicate that the all-age mortality increase reflects mainly population aging and not necessarily a proportional increase in individual risk.
- The GBD Study 2023 identifies important regional disparities in mortality attributed to kidney dysfunction in Brazil (Table 15.3). The South and Southeast regions have some of the highest reductions in age-standardized rates in the period, with reductions of 46.9% (95% UI, -51.6; -40.9) and 44.4% (95% UI, -48.8; -38.5), respectively. In the South region, the rate decreased from 59.0 per 100,000 inhabitants (95% UI, 46.4-70.9) in 1990 to 31.3 per 100,000 inhabitants (95% UI, 26.5-36.4) in 2023. In the Southeast region, the reduction was from 59.2 per 100,000 inhabitants (95% UI, 47.3-70.5) to 32.9 per 100,000 inhabitants (95% UI, 28.2-38.2). However, the North and Northeast regions had smaller reductions, with percent changes varying from -22.1% (95% UI, -28.2; -13.4) to -20.4% (95% UI, -27.4; -12.0), respectively. The rates remained relatively higher in those regions, with 39.1 per 100,000 inhabitants (95% UI, 33.7-44.6) in the North region and 33.9 per 100,000 inhabitants (95% UI, 28.2-38.9) in the Northeast region.
- Among patients undergoing KRT, mortality remained high. In the 2019 Brazilian Dialysis Survey, the annual crude mortality rate was 18.2%.[474] Data from the last 3 years suggest rate stability: 17.1% in 2022, 16.2% in 2023, and 16.5% in 2024.[475] These values are comparable to those observed in several countries and reflect the high burden of comorbidities, especially CVD, in that population.

Cardiovascular Mortality Attributable to CKD

- According to GBD 2023 estimates, mortality from CVD attributable to kidney dysfunction in Brazil, increased in absolute numbers from 26,803.3 deaths (95% UI, 19,443.8–34,025.4) in 1990 to 37,675.1 deaths (95% UI, 26,969.7–48,357.6) in 2023. However, the age-standardized mortality rate per 100,000 inhabitants decreased from 36.0 (95% UI, 25.5–46.1) to 14.5 (95% UI, 10.3–18.6), a reduction of 59.8% (95% UI, -61.7; -57.8) (Table 15.4 and Chart 15.2). Despite the increase in the absolute number of deaths, this reduction in age-standardized rates was strongly influenced by the decrease in mortality from ischemic heart disease and stroke attributable to kidney dysfunction. The age-standardized rate of ischemic heart disease attributable to kidney dysfunction decreased 21.6 (95% UI, 15.0–29.7) to 9.3 (95% UI, 6.5–12.8) per 100,000 inhabitants, representing a point reduction of 57.0%. For stroke, the rate decreased from 13.9 (95% UI, 8.7–19.6) to 4.7 (95% UI, 2.8–6.7), a point reduction of 66.2%. For lower extremity peripheral arterial disease, the reduction was smaller, from 0.51 (95% UI, 0.31–0.69) to 0.48 (95% UI, 0.29–0.65), a point reduction of 5.1% (Chart 15.3).
- According to data from the GBD Study 2023, cardiovascular mortality attributable to kidney dysfunction increases progressively according to the age group up to 70-74 years and reaches the highest rate in patients older than 95 years (Chart 15.4).
- When comparing by sex, men had higher rates in the entire period. Among men, the age-standardized rate decreased from 39.8 (95% UI, 28.9–49.9) in 1990 to 17.6 (95% UI, 12.8–22.6) in 2023, a reduction of 55.8% (95% UI, -58.1; -53.6). Among women, the rate decreased from 32.3 (95% UI, 22.5–42.4) to 11.9 (95% UI, 8.2–15.7), a higher proportional reduction of 63.3% (95% UI, -65.6; -61.0).
- Regarding temporal trend by age group, the reduction in the mortality rates from CVD attributable to kidney dysfunction occurred in all age groups. Among individuals aged 15-49 years, the rate dropped from 2.8 (95% UI, 2.1–3.5) to 1.8 (95% UI, 1.4–2.3) per 100,000 inhabitants, a reduction of 34.8% (95% UI, -39.6; -29.7). In the age group of 50-69 years, the rate decreased from 62.1 (95% UI, 48.5–77.5) to 26.9 (95% UI, 21.0–33.7), a reduction of 56.7% (95% UI, -58.8; -54.3). Among individuals aged 70 years or older, the rate decreased from 347.7 (95% UI, 237.5–456.9) to 157.6 (95% UI, 107.7–208.8), a reduction of 54.7% (95% UI, -57.9; -51.7).
- In 2023, the highest age-standardized rates were observed in the states of Amazonas [20.3 (95% UI, 14.7–25.8)], Maranhão [19.8 (95% UI, 14.0–25.4)], and Alagoas [19.5 (95% UI, 14.4–25.4)] per 100,000 inhabitants. The smallest rates were observed in the Distrito Federal [10.9 (95% UI, 7.6–13.9)], Minas Gerais [11.6 (95% UI, 8.3–15.3)], and Santa Catarina [12.2 (95% UI, 8.5–16.0)]. This pattern evidences important regional heterogeneity.
- The analysis of the relationship between the sociodemographic index (SDI) of 2023 and the percent change of mortality rates from CVD attributable to kidney dysfunction from 1990 to 2023 shows a consistent gradient. The Federative Units with higher SDI had more significant reductions in age-standardized rates in the period, while those with lower SDI had smaller reductions, indicating persistence of the burden of mortality. The Federative Units with higher socioeconomic development, such as São Paulo, Rio de Janeiro, and Distrito Federal, had more significant reductions in their mortality rates, while others, such as Maranhão, Piauí, and Alagoas, maintained relatively smaller reductions and higher rates in 2023. This pattern suggests that the decrease in cardiovascular mortality attributable to kidney dysfunction partially accompanied the improvement in socioeconomic conditions and in access to health services, reflecting structural inequalities in prevention, diagnosis, and management of CKD and its cardiovascular complications in Brazil (Chart 15.5).
- Despite the consistent reduction in age-standardized rates, the increase in the absolute number of deaths emphasizes the increasing role of CKD as a determinant of cardiovascular mortality in Brazil, especially in the context of population aging and high prevalence of cardiometabolic factors.

Burden of Disease

Burden of Disease Attributed to CKD

- In recent decades, CKD, here assessed as disease instead of risk factor, has occupied an increasing position among the leading causes of burden of disease globally. Data from the GBD Study have shown that CKD accounted for approximately 45 million DALYs globally in 2023, corresponding to around 1.5-1.7% of the total burden of disease globally. This number represents a substantial increase as compared to previous estimates, reflecting the increase in incidence and cardiometabolic risk factors, as well as population aging. Globally, CKD has grown faster than many other non-communicable diseases. From 1990 to 2023, CKD was a cause of disease with one of the highest proportional increases in the global burden of DALYs.[448]
- In Brazil, the CKD contribution to the total burden of disease has also increased progressively. Estimates of the GBD Study indicate that CKD is among the 20 leading causes of burden of disease, and the age-standardized DALY rate due to CKD in Brazil is comparable to that of other middle-income countries.[448] The analysis of the components of DALYs indicates that the greatest part of the burden of CKD is related to YLLs, which represent 70–75% of the total burden, while the years lived with disability (YLD) account for approximately 25–30%. This pattern reflects the high mortality associated with the advanced stages of kidney disease and the high incidence of cardiovascular complications in that population.
- In 2023, the global burden of disease attributable to CKD in Brazil was estimated as 2,194,707 (95% UI, 1,939,764-2,474,469) disability-adjusted life

years (DALYs), corresponding to a rate of 1,034.9 per 100,000 inhabitants (95% UI, 914,7-1,166.8). In 1990, 1,208,761 DALYs (95% UI, 1,039,186.7-1,365,098.9) were estimated with rate of 809.5 per 100,000 (95% UI, 695.9-914.1), corresponding to an increase of 27.8% (22.0-35.8) in the period. However, the age-standardized rate decreased from 1,288.6 per 100,000 inhabitants (95% UI, 1,089.0-1,478.8) in 1990 to 842.8 per 100,000 inhabitants (95% UI, 744.0-948.9) in 2023, a reduction of 34,6% (95% UI, -38.4; -29.7) (Table 15.5). Similarly to general mortality, the distribution between sexes was similar and the age gradient was present, concentrating mainly in individuals ≥ 50 years.

- The increase in DALYs attributable to CKD from 1990 to 2023 can be mainly attributed to: (1) population aging, which increases the prevalence of chronic diseases; (2) increased prevalence of diabetes mellitus and arterial hypertension, the major risk factors for CKD; (3) longer survival of patients with CVD and metabolic diseases, enabling more individuals to develop kidney complications over time.

Burden of Cardiovascular Disease Attributable to CKD

- In the GBD Study 2023, the analysis of CKD-attributable risk factors shows that a substantial proportion of CKD burden is related to modifiable risk factors. Among the major determinants, arterial hypertension, diabetes mellitus, and high body mass index stand out. In addition, these factors are widely acknowledged as key determinants of CVD, reinforcing the close interrelationship between the epidemiology and pathophysiological mechanisms of both entities.
- Data from the GBD Study 2023 showed that the burden of DALYs due to CVD attributable to kidney dysfunction increased substantially in Brazil from 1990 to 2023 in absolute numbers, passing from 637,627.1 DALYs (95% UI, 482,030.1–791,751.7) in 1990 to 811,608.5 (95% UI, 615,152.0–1,016,635.5) in 2023. However, there was a significant reduction in the age-standardized DALY rate, from 732.7 per 100,000 inhabitants (95% UI, 545.9–916.5) to 306.9 per 100,000 inhabitants (95% UI, 231.4–384.5), corresponding to a relative reduction of 58.1% (95% UI, -60.0 to -56.3). Significant regional heterogeneity was observed, with substantial reductions in the South and Southeast regions, such as in the states of Paraná [67.0% (95% UI, -69.2; -64.8)], Santa Catarina [67.1% (95% UI, -69.3; -64.4)], and Rio de Janeiro [64.7% (95% UI, -66.9; -62.6)], while smaller reductions occurred in the Northeast and North states, particularly in Maranhão [33.9% (95% UI, -40.7; -25.5)], Ceará [36.1% (95% UI, -42.4; -29.0)], and Tocantins [41.4% (95% UI, -46.9; -34.5)] (Table 15.6).
- Analyzing according to sex, men had higher age-standardized rates attributable to kidney dysfunction as compared to women in both 1990 and 2023. Among men, the age-standardized DALY rates decreased from 863.9 per 100,000 inhabitants (95% UI, 647.9–1,075.9) to 389.8 (95% UI, 299.1–485.2), a reduction of 54.9% (95% UI, -57.4; -52.5). Among women, the reduction was even greater, from 611.1 (95% UI, 457.1–787.3) to 236.0 (95% UI, 175.8–296.4) per 100,000 inhabitants, corresponding to a percent change of -61.4% (95% UI, -63.3; -59.2) (Table 15.7).

Economic Impact of CKD

- CKD imposes a substantial economic burden on healthcare systems, with costs rising sharply as the disease progresses to advanced stages. In Brazil, most direct costs attributable to CKD are concentrated in KRT, especially HD, which is the most common modality among patients on chronic dialysis. Data from the Brazilian Dialysis Survey show continuous growth of the population on dialysis treatment in the country, accompanying population aging and the high prevalence of arterial hypertension and diabetes mellitus, the leading factors associated with CKD progression.[465,474]
- Estimates based on SUS data for the 2013-2015 period indicate that CKD accounts for a disproportionately large share of public healthcare expenditure, although patients receiving dialysis represent only a very small fraction of the Brazilian population. Alcalde and Kirsztajn have estimated that expenses of SUS with CKD were mainly concentrated in the CKD stages requiring dialysis, with annual expenditure exceeding R$ 2 billion in the period analyzed, a value that might have increased in the subsequent years because of the increase in the number of patients receiving KRT and the update of the values paid for the procedures.[475] In addition, that study has shown a strong cost gradient across disease stages: the annual cost per patient on HD was several times higher than the cost of managing patients in the early stages of CKD, reinforcing the substantial opportunity cost associated with preventable disease progression.[475] In a subsequent economic analysis using Brazilian data, Alcalde, Kirsztajn, and Cherchiglia have demonstrated that prevention and early management strategies of CKD are substantially more cost-effective than dialysis treatment, estimating that the annual cost of providing HD to a single patient could finance the care of dozens of patients with stage 4 CKD or hundreds to thousands of patients in the early stages of the disease.[476]
- In addition to the direct costs of dialysis, CKD is associated with greater use of the healthcare services, recurrent hospitalizations, and higher risk of cardiovascular, infectious, and metabolic events. This impact is particularly relevant because patients with CKD often have multimorbidity and require longitudinal care, serial laboratory tests, nephroprotective medications, management of complications, and, in advanced stages, vascular access, hospitalizations, and KRT-related procedures. Studies based on Brazilian administrative records reinforce that KRT is one of the most complex lines of chronic care and one of the most reliant on public financing from SUS.[477]
- In addition, the economic impact of CKD is magnified by underdiagnosis. In the multinational REVEAL-CKD study,

which included Brazilian data from the University of São Paulo system, 11,262 patients had laboratory evidence of stage 3 CKD, but most of them had no CKD diagnosis recorded.[461] These findings suggest lost opportunities for risk stratification, implementation of nephroprotective therapies, and prevention of progression to higher-cost stages.

- Finally, CKD generates substantial indirect costs resulting from functional disabilities, absence from work, early retirement, and premature mortality. Patients receiving HD require treatment several times per week, which limits workforce participation and imposes additional costs on patients, their families, and the health care system. Thus, strategies of early detection, arterial hypertension and diabetes control, proper use of nephroprotective therapies, and organization of lines of care for CKD should be interpreted as not only clinical measures, but interventions of high economic value for SUS.

Knowledge and Implementation of Strategies to Prevent CKD Progression

- The lack of public awareness about CKD continues to be a significant barrier to early diagnosis and timely implementation of nephroprotective measures in Brazil. As previously noted, the Brazilian population remains largely unaware of CKD and its risk factors, underscoring the need for health education strategies.[454]
- This limited population awareness is accompanied by gaps in clinical recognition and risk stratification within healthcare services. In a multinational study with Brazilian data extracted from the São Paulo healthcare system database, the proportion of unrecorded stage 3 CKD was 97.0% in Brazil and the availability of urinary albumin-creatinine ratio testing was only 4.9%, the lowest among the countries assessed, evidencing underdiagnosis and underutilization of key markers of kidney risk.[461] Similarly, the Brazilian CHECK-CKD study, conducted in a nationwide laboratory database, has shown that 42% of the creatinine measurements lacked an accompanying urinary albumin-to-creatinine ratio measurement in up to 12 months, although approximately 10.8% of the tests suggested CKD.[478]
- In primary care, Brazilian data have shown that the implementation of kidney care is unequal and incomplete. In a city of the São Paulo state, among 1,066 individuals with at least one risk factor for CKD (arterial hypertension, diabetes, or age >60 years), there was creatinine record in 79.4% of the medical records and assessment of proteinuria in 58.8%, but only 16.7% of the patients had CKD assigned in the medical records as a diagnosis. Of the individuals meeting criteria for referral to a specialist, only 31.6% had been referred to a nephrologist. These findings are particularly relevant because they evidence that the problem in Brazil regards not only testing availability, but laboratory data translation into clinical diagnosis, risk stratification, and therapeutic decision.[479]
- Data from Brazilian patients with diabetes mellitus have suggested that the implementation of CKD screening and of nephroprotective drug treatment falls short of optimal practice. In a study conducted in the city of Divinópolis, Minas Gerais state, with 265 patients with type 2 diabetes followed up at basic healthcare clinics, 41.2% of them had kidney impairment, but only 21.9% had been tested for isolated albuminuria and 12.1% had had their urinary albumin-to-creatinine ratio measured. Of those with kidney impairment, only 61.2% were receiving a nephroprotective drug, evidencing that incomplete laboratory identification is accompanied by insufficient pharmacological implementation.[480]
- Brazilian studies have shown that the renin–angiotensin system blockade remains the major pharmacological strategy effectively and widely implemented. In a study of quality indicators, 82.8% of patients with arterial hypertension and CKD were receiving renin–angiotensin system blockers,[478] which suggests reasonable uptake of that classic nephroprotective strategy, although there remains room for improvement in its implementation.
- In recent years, the pharmacological arsenal to delay CKD progression has expanded significantly with the incorporation of SGLT2 inhibitors and, in selected settings, non-steroid mineralocorticoid receptor antagonists and GLP-1 receptor agonists.[481-483] However, Brazilian studies with population data or from real practice included in this chapter still predominantly report the implementation of ACEI/ARB and do not provide robust national series on the use of SGLT2 inhibitors or finerenone in the routine of primary care or general outpatient clinics. It is worth noting that GLP-1 agonists and non-steroid mineralocorticoid receptor antagonists are treatment strategies not yet available for SUS patients.
- Nevertheless, recent documents have shown a clear shift in the therapeutic paradigm. The Brazilian Society of Cardiology guidelines for the management of arterial hypertension recommend the use of SGLT2 inhibitors for patients with CKD undergoing conservative treatment.[234] The contemporary understanding of the existence of cardiovascular-kidney-metabolic syndrome reinforces that those drugs should be prioritized especially for individuals with cardiovascular risk factors, CKD, or at high risk for heart failure.[484]

Perspectives

- Chronic kidney disease is an important public health issue in Brazil, with increasing impact on morbidity, mortality, and the healthcare system. High CKD prevalence in populations with cardiovascular risk factors reinforces the need for integration of the strategies of cardiovascular prevention and CKD management.
- The CKD burden tends to increase in next decades due to demographic and epidemiological changes in Brazil.
- Because of the increasing economic burden of CKD, strategies for prevention and early diagnosis of the disease can represent an important opportunity for cost

reduction in the healthcare system. Of the interventions with high potential impact, the following stand out: (1) strict control of risk factors, especially arterial hypertension and diabetes mellitus; (2) implementation of population strategies of kidney disease screening in populations at risk; and (3) use of pharmacological therapies to delay CKD progression at its earlier stages.

- Primary care is paramount for the early identification and management of CKD. Programs for health education and regular follow-up of patients with risk factors have high potential to reduce disease progression.
- Policies aimed at widening KRT modalities, especially the expansion of the national program of PD and KTx, as well as optimizing dialysis therapy, can contribute to improve the healthcare system efficiency and reduce the economic impact of the disease.
- The current Brazilian scenario appears to be characterized by three levels of challenge. The first is educational, with limited public awareness about CKD and its risk factors. The second is structural, with subdiagnosis, underrecording, and insufficient use of albuminuria measurement for screening and risk stratification. The third is therapeutic, in which classic nephroprotective pharmacological strategies have already been partially implemented, but their monitoring and continuity of care remain suboptimal, and reliable national data on the large-scale implementation of newer therapies are still lacking.

Table 15.1 – Prevalence of chronic kidney disease (CKD) in Brazil

Study	Population	CKD definition	Prevalence	95% CI
Aguiar et al., 2020	PNS 2013; 60,202 adults	Self-reported medical diagnosis	1.42%	1.3–1.5%
		Samples with laboratory tests	6.5%	5.9-7.1%
Gouvêa et al., 2022	PNS 2019; Brazilian adults	Self-reported diagnosis (all)	1.4%	1.3–1.6%
		elderly > 75 years	3.4%	2.2-5.2%
		hypertension	3.3%	2.9-3.7%
		diabetes	4.1%	3.4-5.0%
Marinho et al., 2020	Metropolitan region of Manaus; 4,001 adults	Self-reported CKD	2.1%	1.6–2.5%
Comini et al., 2020	Viçosa-MG; 841 individuals with SAH and/or DM from PC	eGFR <60 ml/min/1.73m² and/or ACR ≥30 mg/g	15.4%	NR
Barreto et al., 2016	14,363 adults from the ELSA-Brazil Study	eGFR <60 ml/min/1.73m² and/or ACR ≥30 mg/g	8.9%	NR
Vera-Ponce et al., 2025	Latin-America systematic review/ metanalysis; 6 Brazilian studies	KDIGO/KDOQI criteria	Brazil: 13.9%	9.6–18.8%
Gomes et al., 2024	1,715 individuals from the Truká Indigenous people	eGFR <60 ml/min/1.73m² and/or ACR ≥30 mg/g	10%	8.6-11.5%

Note: ACR/UACR = urinary albumin-creatinine ratio; 95% CI = 95% confidence interval; CKD = chronic kidney disease; DM = diabetes mellitus; eGFR = estimated glomerular filtration rate; KDIGO = Kidney Disease: Improving Global Outcomes; KDOQI = Kidney Disease Outcomes Quality Initiative; PC = primary care; PNS = Brazilian National Health Survey; SAH = systemic arterial hypertension.

Table 15.2 – Number of deaths and all-age and age-standardized mortality rates (per 100,000) from all causes attributable to kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, according to sex and age group, in Brazil

Age group	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
<5 years	Brazil	106.7 (88.2; 128.5)	1.2 (1.0; 1.5)	38.4 (31.2; 45.7)	0.5 (0.4; 0.6)	-59.3 (-68.6; -46.2)
5-14 years	Brazil	85.6 (69.5; 104.3)	0.5 (0.4; 0.6)	41.6 (32.7; 50.4)	0.3 (0.2; 0.3)	-40.0 (-55.0; -21.1)
15-49 years	Brazil	2,999.5 (2,598.3; 3,370.9)	7.9 (6.9; 8.9)	3,381.2 (3,027.0; 3,780.0)	6.3 (5.6; 7.0)	-21.2 (-27.8; -14.3)
50-69 years	Brazil	8,960.0 (7,507.6; 10,485.9)	118.7 (99.4; 138.9)	16,222.2 (14,213.4; 18,306.8)	79.4 (69.5; 89.6)	-33.1 (-38.4; -26.1)
70+ years	Brazil	9,887.2 (7,706.0; 12,030.8)	518.7 (404.2; 631.1)	25,790.4 (21,919.9; 29,674.7)	401.6 (341.3; 462.1)	-22.6 (-30.1; -12.1)
All ages	Brazil	22,038.9 (18,279.9; 25,582.8)	29.9 (24.8; 34.7)	45,473.8 (39,354.5; 51,522.8)	44.1 (38.2; 50.0)	47.8 (36.6; 63.3)
Age-standardized	Brazil	NA	60.0 (48.9; 70.6)	NA	40.9 (35.5; 46.4)	-31.8 (-37.0; -23.9)
Female						
<5 years	Brazil	85.4 (70.3; 101.3)	1.0 (0.8; 1.2)	24.7 (20.1; 29.6)	0.3 (0.3; 0.4)	-66.9 (-74.3; -58.0)
5-14 years	Brazil	80.7 (66.8; 97.3)	0.5 (0.4; 0.6)	33.0 (26.9; 40.3)	0.2 (0.2; 0.3)	-48.3 (-60.8; -32.5)
15-49 years	Brazil	2,224.8 (2,007.7; 2,458.4)	5.7 (5.1; 6.3)	2,410.5 (2,198.6; 2,660.3)	4.3 (3.9; 4.8)	-24.2 (-29.4; -18.2)
50-69 years	Brazil	5,887.6 (4,974.4; 6,858.6)	71.9 (60.7; 83.7)	10,459.9 (9,215.4; 11,863.6)	45.0 (39.7; 51.0)	-37.4 (-42.6; -31.1)
70+ years	Brazil	11,003.0 (8,324.2; 13,729.5)	464.5 (351.4; 579.6)	27,672.0 (21,217.2; 33,364.4)	316.6 (242.7; 381.7)	-31.8 (-39.1; -22.5)
All ages	Brazil	19,281.6 (15,831.0; 23,293.4)	25.5 (21.0; 30.8)	40,600.1 (32,811.4; 47,655.7)	37.2 (30.1; 43.7)	45.9 (32.2; 58.6)
Age-standardized	Brazil	NA	46.9 (37.6; 57.4)	NA	27.3 (22.2; 31.9)	-41.9 (-46.5; -35.8)
Both						
<5 years	Brazil	192.1 (164.7; 217.7)	1.1 (1.0; 1.3).	63.1 (54.3; 72.1)	0.4 (0.4; 0.5)	-62.7 (-68.2; -54.8)
5-14 years	Brazil	166.3 (142.7; 193.8)	0.5 (0.4; 0.5)	74.6 (63.9; 87.6)	0.3 (0.2; 0.3)	-44.0 (-53.9; -30.7)
15-49 years	Brazil	5,224.3 (4,663.4; 5,777.7)	6.8 (6.1; 7.5)	5,791.7 (5,275.2; 6,414.8)	5.3 (4.8; 5.8)	-22.5 (-26.9; -18.2)
50-69 years	Brazil	14,847.5 (12,480.7; 17,175.8)	94.3 (79.3; 109.1)	26,682.1 (23,750.9; 30,221.9)	61.1 (54.4; 69.2)	-35.2 (-39.7; -30.3)
70+ years	Brazil	20,890.2 (15,895.0; 25,613.8)	488.7 (371.8; 599.1)	53,462.4 (43,812.6; 63,032.3)	352.6 (289.0; 415.7)	-27.8 (-33.8; -18.3)
All ages	Brazil	41,320.5 (34,048.1; 48,384.9)	27.7 (22.8; 32.4)	86,073.8 (74,020.5; 99,168.1)	40.6 (34.9; 46.8)	46.7 (37.3; 59.0)
Age-standardized	Brazil	NA	53.1 (42.2; 63.3)	NA	33.3 (28.5; 38.3)	-37.4 (-41.9; -30.8)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 15.3 – Number of deaths and age-standardized mortality rates (per 100,000) from kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, in Brazil, its geographic regions, and Federative Units

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	41,320.5 (34,048.1; 48,384.9)	53.1 (42.2; 63.3)	86,073.8 (74,020.5; 99,168.1)	33.3 (28.5; 38.3)	-37.4 (-41.9; -30.8)
North region	1,683.2 (1,400.0; 1,962.8)	50.3 (40.6; 60.6)	5,817.8 (5,068.4; 6,583.8)	39.1 (33.7; 44.6)	-22.1 (-28.2; -13.4)
Acre	69.8 (59.1; 80.7)	48.7 (40.2; 56.6)	247.3 (207.8; 278.8)	37.6 (31.4; 42.7)	-22.7 (-32.3; -11.3)
Amapá	40.9 (33.6; 49.1)	44.9 (36.8; 55.2)	214.8 (181.8; 245.8)	40.4 (33.8; 46.4)	-10.0 (-20.5; 3.4)
Amazonas	371.8 (310.1; 430.8)	58.3 (46.9; 68.6)	1,328.0 (1,143.7; 1,498.6)	45.2 (38.3; 51.9)	-22.4 (-30.5; -12.1)
Pará	869.2 (711.3; 1,042.7)	47.7 (38.1; 58.1)	2,632.0 (2,255.0; 3,020.0)	36.2 (30.7; 41.7)	-24.0 (-32.0; -15.3)
Rondônia	177.8 (147.8; 204.6)	61.8 (50.7; 73.1)	635.7 (539.5; 713.5)	42.1 (35.2; 47.5)	-32.0 (-39.9; -21.6)
Roraima	25.0 (21.1; 29.0)	53.2 (43.7; 63.1)	159.0 (137.0; 180.9)	42.1 (35.0; 48.5)	-20.9 (-29.9; -8.0)
Tocantins	128.6 (108.6; 148.1)	52.1 (42.3; 61.9)	601.2 (506.1; 702.3)	38.4 (32.1; 44.9)	-26.4 (-34.3; -15.7)
Northeast region	9,868.7 (8,046.2; 11,702.3)	42.5 (33.8; 51.1)	22,792.2 (18,995.1; 26,142.9)	33.9 (28.2; 38.9)	-20.4 (-27.4; -12.0)
Alagoas	640.0 (525.9; 765.2)	51.1 (40.7; 62.3)	1,437.0 (1,218.5; 1,657.7)	42.5 (35.9; 49.1)	-16.9 (-25.9; -4.7)
Bahia	2,445.2 (2,011.1; 2,903.7)	38.4 (30.5; 46.4)	6,087.5 (5,051.7; 6,985.2)	32.8 (27.4; 37.6)	-14.5 (-22.2; -5.8)
Ceará	1,209.6 (962.3; 1.440.0)	33.9 (26.6; 40.7)	3,206.0 (2,641.7; 3,725.4)	28.5 (23.6; 32.9)	-16.0 (-24.2; -5.4)
Maranhão	976.9 (787.8; 1,171.5)	43.6 (34.6; 52.4)	2,870.8 (2,401.2; 3,297.8)	41.8 (34.8; 48.0)	-4.3 (-15.5; 8.8)
Paraíba	930.0 (762.3; 1,096.7)	44.1 (35.7; 52.6)	1,788.3 (1,478.2; 2,072.2)	34.0 (28.2; 39.2)	-22.9 (-31.2; -13.2)
Pernambuco	2,238.5 (1,828.9; 2,681.2)	54.9 (44.2; 66.4)	3,848.3 (3,257.2; 4,449.5)	35.1 (29.6; 40.7)	-36.1 (-41.9; -28.7)
Piauí	509.0 (408.4; 609.2)	39.6 (31.4; 48.0)	1,400.2 (1,115.4; 1,645.8)	33.6 (26.8; 39.4)	-15.3 (-24.9; -3.5)
Rio Grande do Norte	534.9 (425.4; 646.9)	35.8 (28.3; 44.0)	1,329.2 (1,092.8; 1,547.0)	30.5 (25.2; 35.5)	-14.7 (-25.0; -2.1)
Sergipe	384.4 (320.2; 452.7)	50.2 (40.7; 59.3)	825.0 (691.0; 951.1)	33.3 (27.7; 38.4)	-33.7 (-40.4; -24.7)
Southeast region	20,986.5 (17,335.6; 24,575.6)	59.2 (47.3; 70.5)	39,076.1 (33,491.9; 45,369.0)	32.9 (28.2; 38.2)	-44.4 (-48.8; -38.5)
Espírito Santo	729.9 (588.3; 868.9)	56.6 (44.7; 68.4)	1,672.7 (1,433.0; 1,916.3)	33.4 (28.5; 38.2)	-41.1 (-47.4; -33.3)
Minas Gerais	4,640.6 (3,901.1; 5,334.5)	53.5 (43.3; 62.8)	9,038.2 (7,688.0; 10,390.6)	30.5 (25.9; 34.9)	-43.0 (-47.8; -36.9)

Rio de Janeiro	5,587.4 (4,548.6; 6,649.9)	66.0 (52.6; 80.0)	9,347.1 (8,130.1; 10,742.8)	39.3 (34.1; 45.1)	-40.5 (-46.3; -33.4)
São Paulo	10,028.6 (8,379.6; 11,758.9)	59.0 (47.6; 70.2)	19,018.1 (16,177.0; 22,296.9)	31.6 (26.8; 37.1)	-46.4 (-50.4; -40.8)
South region	6,985.0 (5,704.6; 8,263.4)	59.0 (46.4; 70.9)	12,674.5 (10,770.8; 14,753.1)	31.3 (26.5; 36.4)	-46.9 (-51.6; -40.9)
Paraná	2,644.7 (2,196.0; 3,109.8)	64.2 (50.8; 76.8)	4,794.7 (4,115.2; 5,564.2)	32.6 (27.8; 37.9)	-49.2 (-53.5; -44.1)
Rio Grande do Sul	3,226.7 (2,586.5; 3,817.2)	57.8 (45.1; 69.7)	5,369.8 (4,520.5; 6,224.3)	31.9 (26.8; 37.0)	-44.8 (-49.6; -38.0)
Santa Catarina	1,113.5 (904.8; 1,334.3)	52.5 (41.5; 63.7)	2,510.0 (2,104.7; 2,959.1)	28.4 (23.7; 33.5)	-46.0 (-51.0; -38.2)
West-Central region	1,797.1 (1,500.7; 2,075.4)	49.2 (39.2; 58.5)	5,713.2 (4,936.7; 6,550.8)	33.2 (28.4; 38.2)	-32.4 (-37.2; -25.0)
Distrito Federal	241.2 (200.2; 281.3)	48.4 (38.5; 58.4)	735.1 (616.6; 846.3)	25.5 (21.2; 29.6)	-47.3 (-53.5; -38.5)
Goiás	827.1 (689.3; 967.1)	47.9 (38.3; 57.5)	2,561.0 (2,206.8; 2,940.9)	33.1 (28.3; 38.2)	-30.9 (-37.0; -22.8)
Mato Grosso	318.8 (260.7; 373.3)	48.4 (38.8; 58.2)	1,271.2 (1,092.5; 1,445.7)	37.5 (31.9; 42.7)	-22.5 (-31.3; -12.4)
Mato Grosso do Sul	410.1 (338.1; 485.1)	53.5 (42.5; 64.6)	1,145.9 (972.0; 1,336.4)	36.7 (31.0; 43.0)	-31.4 (-37.7; -23.9)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 15.4 – Number of deaths and age-standardized mortality rates (per 100,000) from cardiovascular disease attributable to kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, in Brazil, its geographic regions, and Federative Units

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	26,803.3 (19,443.8; 34,025.4)	36.0 (25.5; 46.1)	37,675.1 (26,969.7; 48,357.6)	14.5 (10.3; 18.6)	-59.8 (-61.7; -57.8)
North region	1,019.0 (747.2; 1,294.5)	33.0 (23.1; 42.8)	2,398.8 (1,738.8; 3,025.9)	16.4 (11.6; 20.8)	-50.4 (-53.4; -47.0)
Acre	37.1 (27.5; 46.9)	28.3 (20.5; 36.2)	90.6 (65.6; 116.2)	14.0 (10.0; 18.0)	-50.6 (-56.2; -43.8)
Amapá	22.5 (16.3; 29.8)	26.5 (18.7; 35.4)	79.5 (57.2; 101.8)	15.4 (10.8; 20.1)	-41.9 (-48.1; -34.6)
Amazonas	246.2 (192.6; 299.1)	41.2 (30.5; 51.5)	583.8 (433.9; 728.5)	20.3 (14.7; 25.8)	-50.7 (-55.2; -46.1)
Pará	532.0 (386.9; 697.9)	31.5 (21.7; 41.9)	1.126.7 (801.4; 1.438.6)	15.7 (10.9; 20.2)	-50.1 (-54.4; -45.4)
Rondônia	96.9 (70.5; 122.2)	37.9 (26.1; 48.9)	223.8 (158.8; 289.6)	14.9 (10.4; 19.3)	-60.6 (-64.6; -55.9)
Roraima	12.8 (9.6; 16.3)	31.9 (22.3; 41.8)	56.9 (42.1; 73.4)	15.9 (11.5; 20.8)	-50.2 (-56.2; -43.8)
Tocantins	71.4 (52.3; 89.5)	31.3 (21.5; 39.9)	237.5 (170.3; 311.2)	15.2 (10.8; 20.0)	-51.4 (-56.6; -44.8)
Northeast region	6,042.8 (4,314.6; 7,882.2)	27.0 (19.0; 35.4)	10,362.7 (7,378.3; 13,210.3)	15.3 (10.9; 19.5)	-43.4 (-47.6; -38.5)
Alagoas	377.3 (265.6; 494.7)	31.5 (22.0; 41.7)	659.5 (489.8; 856.2)	19.5 (14.4; 25.4)	-38.0 (-45.5; -28.1)
Bahia	1,452.9 (1,033.2; 1,903.1)	23.9 (16.4; 31.5)	2,543.5 (1,806.7; 3,284.1)	13.5 (9.6; 17.5)	-43.5 (-47.5; -39.0)
Ceará	771.4 (541.1; 1,002.1)	22.3 (15.1; 29.0)	1,562.2 (1,122.6; 1,998.1)	13.7 (9.8; 17.6)	-38.4 (-44.5; -31.3)
Maranhão	620.3 (440.7; 803.7)	29.0 (20.3; 37.7)	1,357.6 (961.5; 1,728.3)	19.8 (14.0; 25.4)	-31.5 (-38.6; -23.2)
Paraíba	521.3 (365.1; 674.8)	25.3 (17.5; 32.5)	816.2 (592.7; 1,070.9)	15.4 (11.2; 20.1)	-39.1 (-45.3; -31.7)
Pernambuco	1,414.0 (1,007.2; 1,839.7)	35.8 (25.2; 46.7)	1,756.7 (1,274.4; 2,317.5)	16.0 (11.5; 21.1)	-55.4 (-59.1; -50.7)
Piaui	314.4 (225.6; 405.3)	25.2 (17.6; 32.7)	688.8 (477.3; 886.0)	16.4 (11.4; 21.1)	-35.1 (-41.7; -24.5)
Rio Grande do Norte	352.0 (249.0; 463.0)	24.1 (16.7; 31.9)	637.4 (464.5; 844.4)	14.5 (10.5; 19.0)	-39.8 (-47.0; -30.6)
Sergipe	219.3 (152.2; 286.2)	29.6 (20.2; 38.8)	340.9 (246.2; 441.4)	13.7 (9.8; 17.8)	-53.6 (-58.2; -47.6)
Southeast region	13,734.2 (10,092.1; 17,394.7)	40.7 (28.9; 52.0)	16,746.5 (12,090.8; 21,714.0)	14.0 (10.0; 18.2)	-65.6 (-67.6; -63.7)
Espírito Santo	499.4 (373.0; 634.2)	40.4 (29.7; 51.8)	737.0 (544.7; 915.9)	14.6 (10.7; 18.2)	-63.8 (-67.3; -60.2)
Minas Gerais	2,747.4 (1,983.8; 3,508.9)	33.6 (24.0; 43.3)	3,469.6 (2,492.8; 4,581.0)	11.6 (8.3; 15.3)	-65.5 (-68.0; -62.9)
Rio de Janeiro	3,914.2 (2,865.7; 4,986.7)	47.8 (34.2; 61.7)	3,872.3 (2,816.7; 4,961.1)	16.1 (11.7; 20.7)	-66.3 (-68.5; -64.1)
São Paulo	6,573.1 (4,872.6; 8,335.8)	40.9 (29.6; 52.1)	8,667.7 (6,229.2; 11,166.0)	14.3 (10.2; 18.4)	-65.0 (-67.1; -62.8)

South region	4,924.6 (3,641.1; 6,248.2)	42.8 (30.6; 55.0)	5,741.0 (4,146.5; 7,353.0)	14.1 (10.0; 18.2)	-67.1 (-69.1; -65.0)
Paraná	1,856.9 (1,395.8; 2,350.3)	46.9 (34.1; 60.1)	2,212.2 (1,616.7; 2,818.1)	14.9 (10.7; 19.1)	-68.2 (-70.3; -65.7)
Rio Grande do Sul	2,295.8 (1,696.5; 2,898.4)	41.9 (29.9; 54.1)	2,446.5 (1,768.5; 3,114.4)	14.4 (10.3; 18.4)	-65.6 (-68.0; -63.0)
Santa Catarina	772.0 (551.0; 992.9)	37.8 (26.1; 48.6)	1,082.3 (778.3; 1,416.8)	12.2 (8.5; 16.0)	-67.8 (-70.7; -65.2)
West-Central region	1,082.7 (792.8; 1,369.6)	31.8 (22.6; 41.2)	2,426.1 (1,746.6; 3,095.0)	14.1 (9.9; 18.2)	-55.7 (-58.4; -52.7)
Distrito Federal	147.0 (110.0; 184.8)	32.8 (23.5; 42.1)	309.9 (219.6; 395.2)	10.9 (7.6; 13.9)	-66.7 (-69.9; -63.1)
Goiás	491.4 (359.1; 629.2)	30.3 (21.4; 39.5)	1.092.5 (792.5; 1.384.7)	14.1 (10.0; 17.9)	-53.5 (-57.4; -48.9)
Mato Grosso	181.9 (133.2; 229.5)	30.1 (21.4; 39.1)	485.2 (350.3; 619.1)	14.4 (10.0; 18.6)	-52.3 (-56.6; -47.5)
Mato Grosso do Sul	262.4 (190.7; 333.7)	36.4 (26.1; 47.5)	538.6 (398.8; 696.7)	17.2 (12.4; 22.3)	-52.6 (-57.2; -48.5)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 15.5 – Number of DALYs and age-standardized DALY rates (per 100,000) attributable to kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, in Brazil and its geographic regions

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	1,208,761.4 (1,039,186.7; 1,365,098.9)	1,288.6 (1,089.0; 1,478.8)	2,194,707.0 (1,939,764.5; 2,474,469.0)	842.8 (744.0; 948.9)	-34.6 (-38.4; -29.7)
North region	54,608.9 (47,521.2; 61,354.7)	1,205.8 (1,026.1; 1,371.8)	166,437.4 (148,712.2; 184,940.3)	1,012.7 (900.8; 1,129.6)	-16.0 (-21.7; -8.7)
Northeast region	282,662.1 (241,850.4; 317,693.6)	1,063.8 (901.2; 1,211.4)	585,740.1 (509,022.6; 655,712.0)	878.5 (764.6; 983.6)	-17.4 (-23.8; -10.1)
Southeast region	614,632.9 (527,399.6; 693,870.0)	1,420.5 (1,202.7; 1,637.7)	972,812.3 (858,702.3; 1,102,902.6)	825.3 (729.5; 938.2)	-41.9 (-45.8; -36.8)
South region	198,373.0 (168,416.5; 225,996.2)	1,369.2 (1,148.6; 1,575.9)	316,213.5 (276,935.7; 360,037.3)	769.7 (675.0; 876.6)	-43.8 (-47.9; -38.6)
West-Central region	58,484.4 (50,588.5; 65,878.0)	1,201.3 (1,013.7; 1,374.0)	153,503.7 (136,254.3; 172,974.6)	830.4 (734.4; 934.6)	-30.9 (-35.1; -25.4)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 15.6 – Number of DALYs and age-standardized DALY rates (per 100,000) due to cardiovascular disease attributable to kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, in Brazil, its geographic regions, and Federative Units

Location	1990		2023		Percent change of rates (95% UI)
	Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Brazil	637,627.1 (482,030.1; 791,751.7)	732.7 (545.9; 916.5)	811,608.5 (615,152.0; 1,016,635.5)	306.9 (231.4; 384.5)	-58.1 (-60.0; -56.3)
North region	24,498.3 (19,057.3; 30,216.6)	640.9 (477.6; 802.7)	54,226.5 (41,404.5; 66,171.9)	341.0 (257.1; 420.4)	-46.8 (-49.9; -43.3)
Acre	903.3 (694.8; 1,130.9)	554.9 (419.2; 696.4)	2,085.8 (1,569.8; 2,664.6)	295.5 (220.6; 377.7)	-46.8 (-52.5; -41.0)
Amapá	524.2 (397.0; 666.6)	530.6 (399.7; 685.7)	1,848.1 (1,391.6; 2,298.4)	322.5 (239.9; 405.2)	-39.2 (-46.0; -32.3)
Amazonas	5,927.8 (4,753.5; 7,115.9)	800.0 (625.9; 972.2)	13,665.4 (10,471.2; 16,801.6)	427.6 (320.5; 527.3)	-46.5 (-51.1; -41.6)
Pará	12,281.3 (9,263.4; 15,595.4)	610.8 (457.8; 791.3)	24,917.9 (18,705.5; 30,827.5)	325.0 (240.1; 403.0)	-46.8 (-51.3; -41.9)
Rondônia	2,624.3 (1,944.8; 3,243.5)	726.1 (522.8; 910.7)	5,034.7 (3,679.8; 6,434.1)	303.2 (221.4; 390.4)	-58.2 (-62.3; -53.7)
Roraima	367.1 (279.4; 462.8)	624.2 (460.7; 802.5)	1,464.8 (1,098.8; 1,880.8)	328.7 (244.9; 423.8)	-47.3 (-53.8; -40.2)
Tocantins	1,870.4 (1,436.5; 2,326.4)	544.7 (398.5; 684.5)	5,209.8 (3,930.1; 6,687.8)	319.4 (239.3; 412.4)	-41.4 (-46.9; -34.5)
Northeast region	136,614.7 (101,365.4; 173,761.4)	552.9 (405.1; 709.6)	218,799.3 (165,738.3; 276,197.4)	324.8 (245.7; 410.9)	-41.3 (-45.5; -36.6)
Alagoas	9,013.6 (6,610.0; 11,288.3)	675.7 (489.6; 862.7)	14,947.6 (11,191.6; 18,595.3)	425.7 (317.2; 534.0)	-37.0 (-43.9; -28.3)
Bahia	32,805.4 (24,784.8; 41,763.6)	492.3 (364.5; 633.4)	53,687.1 (40,453.1; 67,589.4)	292.2 (220.3; 367.4)	-40.7 (-44.8; -36.6)
Ceará	17,106.7 (12,680.8; 21,791.4)	444.9 (324.3; 569.1)	31,531.1 (23,673.7; 39,782.8)	284.4 (213.4; 358.1)	-36.1 (-42.4; -29.0)
Maranhão	15,364.7 (11,683.2; 19,842.8)	618.4 (458.8; 803.0)	28,731.6 (21,755.8; 35,940.2)	409.0 (307.9; 510.5)	-33.9 (-40.7; -25.5)
Paraíba	11,346.5 (8,411.0; 14,236.9)	514.4 (377.8; 645.5)	17,157.1 (12,814.5; 21,843.2)	331.3 (248.1; 421.2)	-35.6 (-42.0; -28.7)
Pernambuco	31,777.0 (23,549.7; 40,410.9)	719.5 (526.5; 921.2)	38,292.1 (28,805.4; 48,861.4)	342.2 (256.9; 437.5)	-52.4 (-56.5; -48.0)
Piauí	7,307.6 (5,489.8; 9,256.0)	523.0 (387.3; 666.6)	13,814.7 (10,206.6; 17,274.9)	333.0 (245.2; 416.7)	-36.3 (-42.8; -27.6)
Rio Grande do Norte	7,239.7 (5,380.9; 9,222.3)	466.6 (344.7; 597.1)	13,169.9 (9,836.2; 17,016.4)	307.0 (229.9; 397.1)	-34.2 (-41.9; -24.9)
Sergipe	4,653.5 (3,446.8; 5,881.3)	579.5 (424.4; 738.5)	7,468.0 (5,693.1; 9,375.1)	292.2 (222.1; 369.0)	-49.6 (-54.4; -43.8)
Southeast region	330,823.0 (249,927.4; 410,023.8)	822.9 (619.5; 1,030.5)	362,563.0 (275,338.1; 458,286.8)	301.2 (228.5; 381.5)	-63.4 (-65.3; -61.4)
Espírito Santo	11,883.0 (9,187.7; 14,664.0)	825.4 (629.5; 1,031.0)	16,074.1 (12,347.9; 19,451.3)	311.8 (239.6; 377.4)	-62.2 (-66.0; -58.6)
Minas Gerais	66,537.9 (50,006.8; 82,238.4)	691.0 (511.4; 864.4)	73,870.0 (55,755.9; 92,790.4)	249.2 (187.6; 313.2)	-63.9 (-66.1; -61.3)

Rio de Janeiro	95,705.9 (72,603.3; 119,725.3)	1,000.4 (753.0; 1,255.4)	84,422.6 (64,053.1; 107,032.4)	353.4 (267.7; 444.9)	-64.7 (-66.9; -62.6)
São Paulo	156,696.3 (118,541.1; 194,375.9)	804.2 (606.5; 1,011.6)	188,196.3 (142,438.5; 239,488.9)	305.3 (230.8; 388.3)	-62.0 (-64.3; -59.5)
South region	117,463.1 (90,372.4; 145,954.1)	858.8 (642.9; 1,076.2)	121,579.9 (92,514.1; 152,003.0)	289.4 (219.0; 361.9)	-66.3 (-68.1; -64.3)
Paraná	45,126.5 (35,105.1; 55,538.3)	945.2 (715.1; 1,186.0)	47,937.8 (36,739.9; 59,489.8)	311.6 (237.5; 388.1)	-67.0 (-69.2; -64.8)
Rio Grande do Sul	54,136.4 (41,657.9; 66,656.6)	842.2 (632.5; 1,046.4)	50,249.7 (38,273.9; 62,811.4)	295.5 (223.5; 368.9)	-64.9 (-67.1; -62.5)
Santa Catarina	18,200.2 (13,860.2; 23,021.8)	740.9 (547.0; 943.4)	23,392.4 (17,709.6; 29,695.9)	244.1 (182.3; 310.9)	-67.1 (-69.3; -64.4)
West-Central region	28,228.0 (21,389.3; 34,917.2)	656.2 (487.2; 824.4)	54,439.7 (41,156.9; 67,760.4)	295.5 (220.9; 368.4)	-55.0 (-57.8; -52.0)
Distrito Federal	3,947.1 (3,046.7; 4,868.9)	651.3 (489.3; 816.7)	6,701.8 (5,089.7; 8,229.9)	215.1 (162.3; 265.2)	-67.0 (-69.7; -63.5)
Goiás	12,845.3 (9,704.1; 16,129.6)	635.1 (469.3; 807.0)	24,727.7 (18,641.9; 30,770.4)	299.7 (224.0; 372.7)	-52.8 (-57.0; -48.3)
Mato Grosso	4,807.6 (3,632.6; 6,022.6)	615.9 (455.5; 778.2)	11,108.8 (8,325.2; 13,860.1)	297.5 (220.5; 371.9)	-51.7 (-55.7; -47.1)
Mato Grosso do Sul	6,628.0 (4,996.6; 8,217.1)	747.8 (557.6; 937.9)	11,901.4 (9,126.3; 15,399.2)	364.0 (276.5; 470.2)	-51.3 (-55.5; -46.9)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

Table 15.7 – Number of DALYs, and all-age and age-standardized DALY rates (per 100,000) due to cardiovascular disease attributable to kidney dysfunction, in 1990 and 2023, and percent change of rates in the period, according to sex and age group, in Brazil

Age group and sex	Location	1990		2023		Percent change of rates (95% UI)
		Number (95% UI)	Rate (95% UI)	Number (95% UI)	Rate (95% UI)	
Male						
15-49 years	Brazil	69,171.2 (50,629.5; 85,852.8)	183.0 (133.9; 227.1)	64,878.7 (48,229.2; 81,563.2)	120.0 (89.2; 150.9)	-34.4 (-40.9; -28.8)
50-69 years	Brazil	188,071.4 (147,538.3; 236,288.3)	2,490.7 (1,953.9; 3,129.3)	232,683.2 (179,973.9; 286,357.7)	1,138.5 (880.6; 1,401.2)	-54.3 (-56.9; -51.9)
70+ years	Brazil	105,746.5 (74,134.8; 138,802.9)	5,547.3 (3,889.0; 7,281.3)	165,970.5 (115,300.6; 215,843.9)	2,584.4 (1,795.4; 3,361.0)	-53.4 (-56.4; -50.2)
All ages	Brazil	362,989.0 (274,074.2; 456,094.0)	491.8 (371.3; 617.9)	463,532.4 (356,365.5; 573,186.3)	449.8 (345.8; 556.2)	-8.5 (-13.7; -3.8)
Age-standardized	Brazil	NA	863.9 (647.9; 1,075.9)	NA	389.8 (299.1; 485.2)	-54.9 (-57.4; -52.5)
Female						
15-49 years	Brazil	41,332.9 (32,113.7; 51,239.1)	105.9 (82.2; 131.2)	36,117.2 (28,163.5; 44,669.3)	64.7 (50.4; 80.0)	-38.9 (-44.5; -32.4)
50-69 years	Brazil	114,545.4 (91,520.7; 141,515.7)	1,398.7 (1,117.5; 1,728.0)	132,083.1 (102,290.5; 168,393.1)	568.3 (440.1; 724.6)	-59.4 (-62.3; -55.7)
70+ years	Brazil	118,759.7 (80,918.5; 153,924.2)	5,013.6 (3,416.1; 6,498.2)	179,875.7 (122,397.9; 240,968.9)	2,057.9 (1,400.3; 2,756.9)	-59.0 (-61.7; -55.7)
All ages	Brazil	274,638.0 (207,576.9; 347,106.5)	363.7 (274.9; 459.6)	348,076.0 (257,829.8; 438,805.8)	319.3 (236.5; 402.5)	-12.2 (-17.9; -6.1)
Age-standardized	Brazil	NA	611.1 (457.1; 787.3)	NA	236.0 (175.8; 296.4)	-61.4 (-63.3; -59.2)
Both						
15-49 years	Brazil	110,504.1 (82.441.3; 135,189.6)	143.8 (107.3; 175.9)	100,996.0 (76,931.1; 125,325.0)	91.9 (70.0; 114.0)	-36.1 (-40.4; -31.5)
50-69 years	Brazil	302,616.8 (238,623.6; 374,378.9)	1,922.5 (1,516.0; 2,378.4)	364,766.3 (282,906.1; 453,914.4)	835.1 (647.7; 1,039.2)	-56.6 (-58.8; -54.3)
70+ years	Brazil	224,506.2 (156,346.4; 293,373.5)	5,251.6 (3,657.2; 6,862.5)	345,846.2 (235,532.3; 451,380.3)	2,280.9 (1,553.4; 2,976.9)	-56.6 (-59.0; -54.1)
All ages	Brazil	637,627.1 (482,030.1; 791,751.7)	427.0 (322.8; 530.2)	811,608.5 (615,152.0; 1,016,635.5)	382.7 (290.1; 479.4)	-10.4 (-14.7; -5.7)
Age-standardized	Brazil	NA	732.7 (545.9; 916.5)	NA	306.9 (231.4; 384.5)	-58.1 (-60.0; -56.3)

Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.[33]

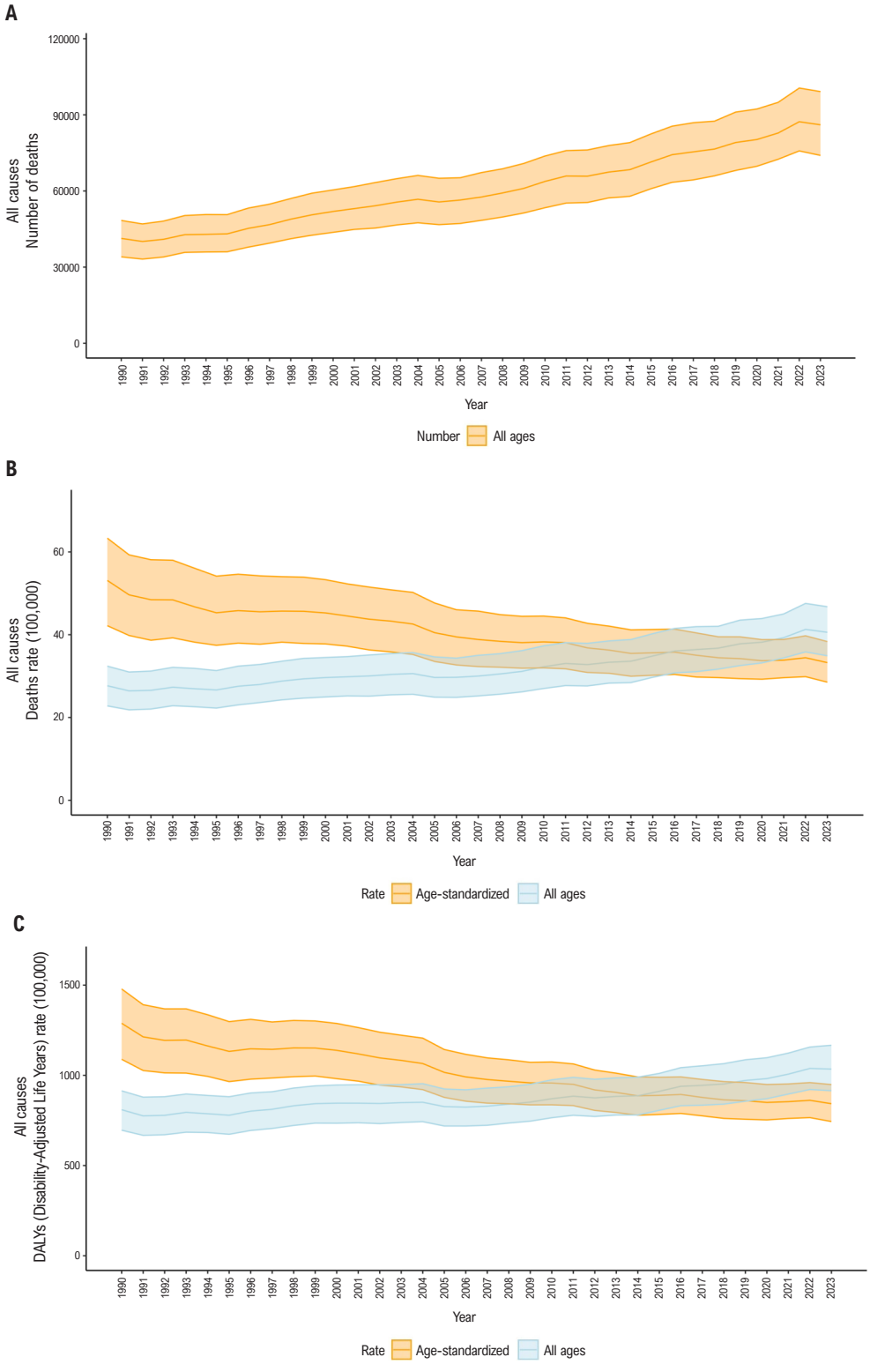

Chart 15.1 – *Temporal trend of total mortality in absolute numbers (A) all-age and age-standardized total mortality rate (B) and all-age and age-standardized DALY rate due to all causes (C) attributable to chronic kidney disease. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

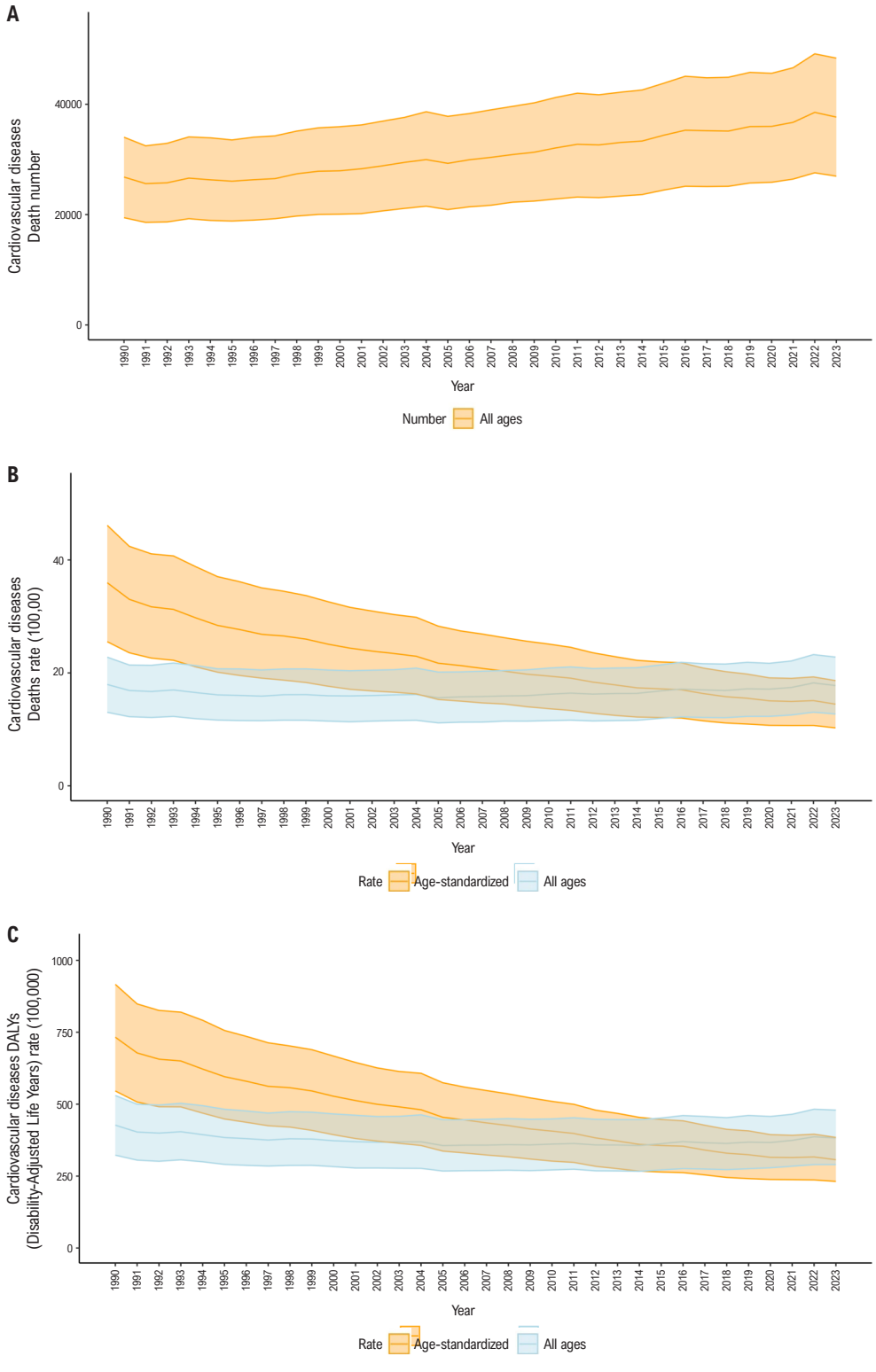

Chart 15.2 – *Temporal trend of total cardiovascular mortality in absolute numbers (A) all-age and age-standardized mortality rate (B) and all-age and age-standardized DALY rate (C) attributable to chronic kidney disease. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

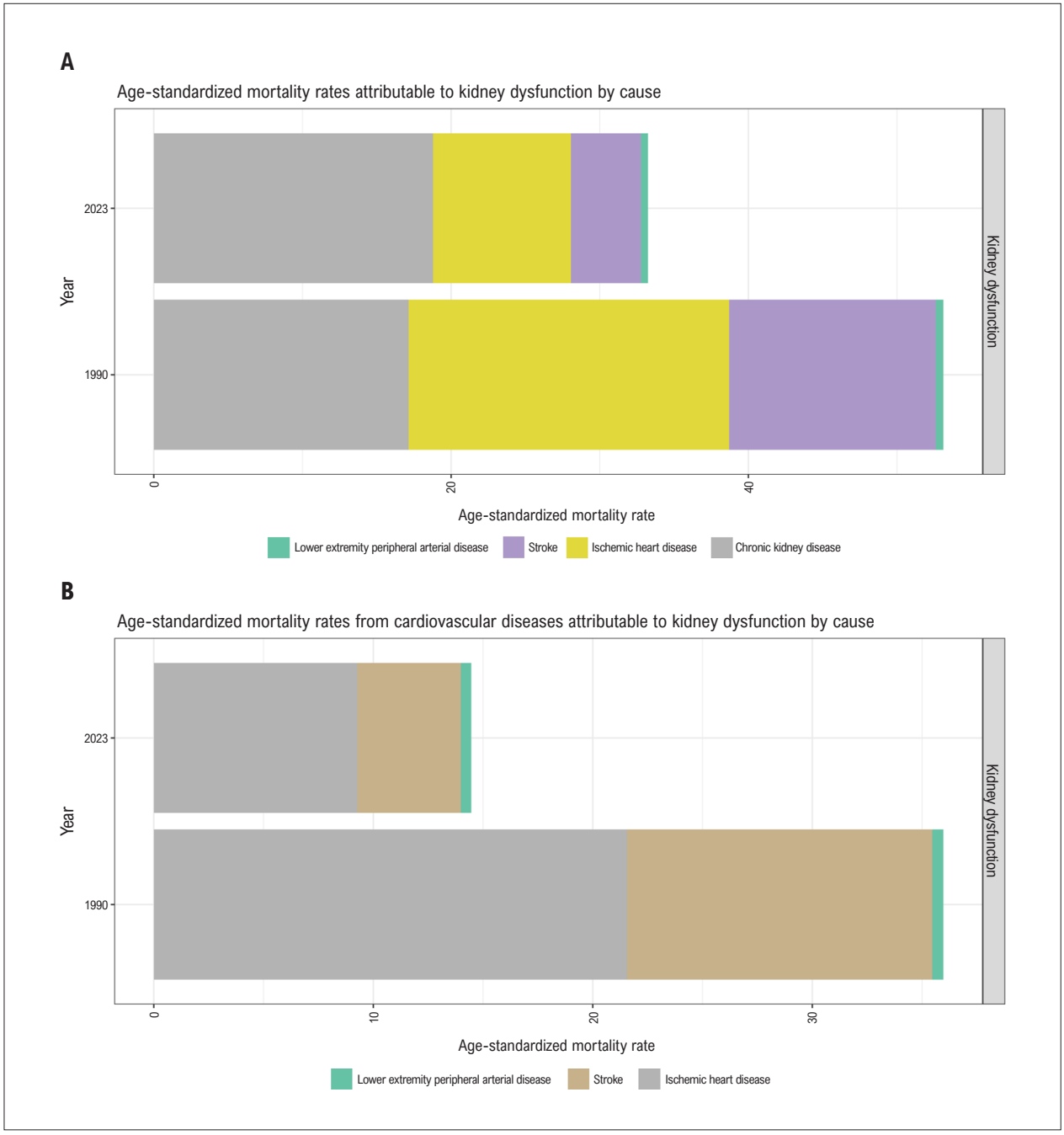

Chart 15.3 – *Total and cardiovascular age-standardized mortality rates attributable to chronic kidney disease, according to specific (A) and cardiovascular causes (ischemic heart disease, stroke, and peripheral arterial disease) (B). Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

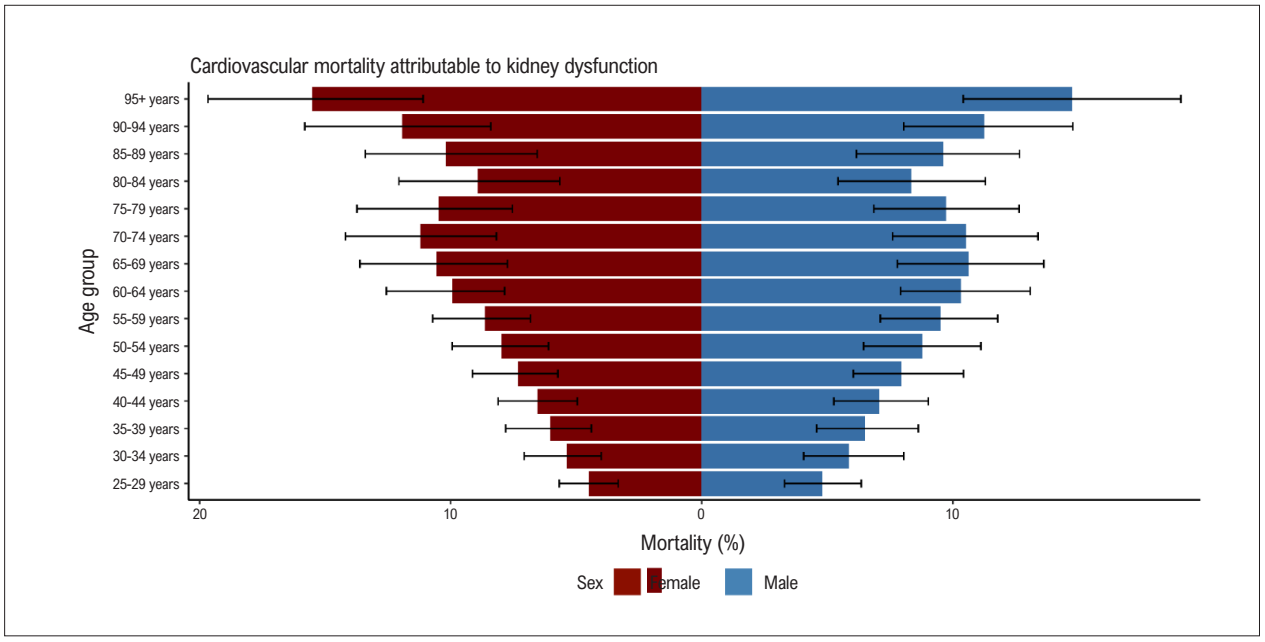

Chart 15.4 – *Cardiovascular mortality attributable to kidney dysfunction, according to sex and age group. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

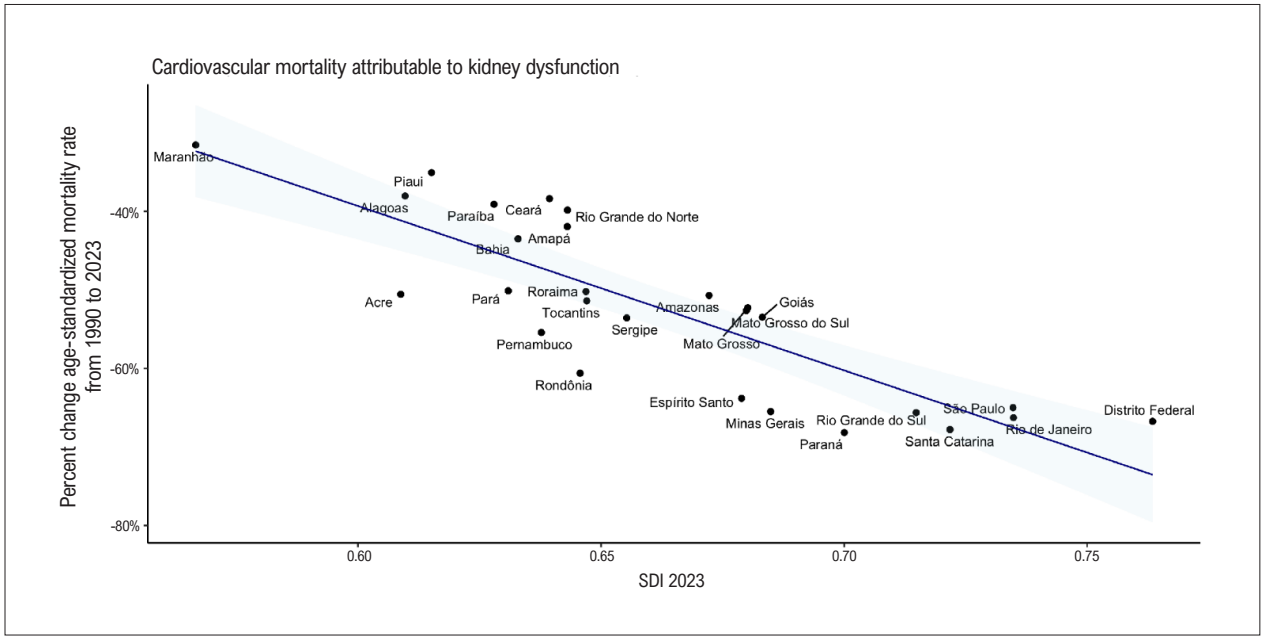

Chart 15.5 – *Correlation of the 2023 Sociodemographic Index (SDI) and the percent change of age-standardized cardiovascular mortality rates attributable to kidney dysfunction, per 100,000 inhabitants, in Brazilian Federative Units, from 1990 to 2023. Source: Data derived from Global Burden of Disease Study 2023, Institute for Health Metrics and Evaluation, University of Washington.*[33]

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