

Endocarditis – A 27-Year Epidemiological Analysis of Mortality in Brazil

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Abstract

Background: Infective endocarditis (IE) is frequently caused by viridans streptococci. Short-term in-hospital mortality in high-income settings ranges from 11% to 25%. In Brazil, rheumatic heart disease remains a leading valvular substrate; however, its declining prevalence in developing nations has limited country-specific analyses.

Objective: To describe the epidemiological profile of mortality from IE in Brazil, characterizing its magnitude and temporal trend.

Methods: We conducted a retrospective, exploratory epidemiological study with descriptive and analytic components using data from the Mortality Information System of the Department of Informatics of Brazil's Unified Health System. Chi-square tests of independence were applied ($p < 0.05$), and results were summarized in tables and figures. Variables included International Statistical Classification of Diseases and Related Health Problems, 10th Revision categories, year of death, region, and sex.

Results: From 1996 to 2022, 40,157 deaths associated with IE were recorded in Brazil (chi-square = 1,701.43). The Southeast region accounted for the greatest burden, with 21,429 deaths (53.36%; chi-square = 15,236.00). By sex (chi-square = 999.32), men were more affected than women (55.57% [22,315] vs 44.41% [17,835]); in 0.02% of records, sex was unspecified.

Conclusions: IE remains a condition of national and international concern, with substantial mortality in Brazil over the last 27 years. This overview of mortality patterns highlights regional disparities and sex differences and can inform public-health strategies and evidence-based interventions.

Keywords: Endocarditis; Mortality; Epidemiology.

Introduction

Infective endocarditis (IE) is most commonly caused by viridans streptococci.¹ Risk factors include valvular heart disease, prosthetic valves, grafts or intracardiac devices, congenital heart disease, and prior IE.^{2,3}

Mortality estimates vary due to differences in diagnostic criteria. Over the past two decades, population-based studies in high-income countries have reported 30-day (in-hospital) mortality of 11%-25%.³ In the United States, morbidity and mortality occur in 16%-30% of cases involving prosthetic-valve and in 25%-35% of cases involving native valves treated in hospital settings.⁴ Globally, up to 77% of IE cases are estimated to occur in developing countries, although this figure may be affected by reporting practices and access to care. In Brazil,

rheumatic heart disease remains a predominant valvular substrate; however, the disease's declining prevalence in developing nations has limited country-specific analyses.⁵

Clinically, IE may present acutely, evolve subacutely (often on pre-existing valvular lesions), or follow an indolent course over weeks to months.^{6,7} Cardiac conditions that produce turbulent flow (eg, mitral valve prolapse, hypertrophic cardiomyopathy, and cyanotic congenital heart disease) increase the risk of IE by promoting mechanical injury that leads to subsequent valvular degeneration and calcification.^{8,9}

Because of its global and national significance, this study outlines the epidemiological profile of IE mortality in Brazil over the past 27 years. It characterizes the distribution of IE and its associated risk factors in order to inform public policies and guide future strategies.

Method

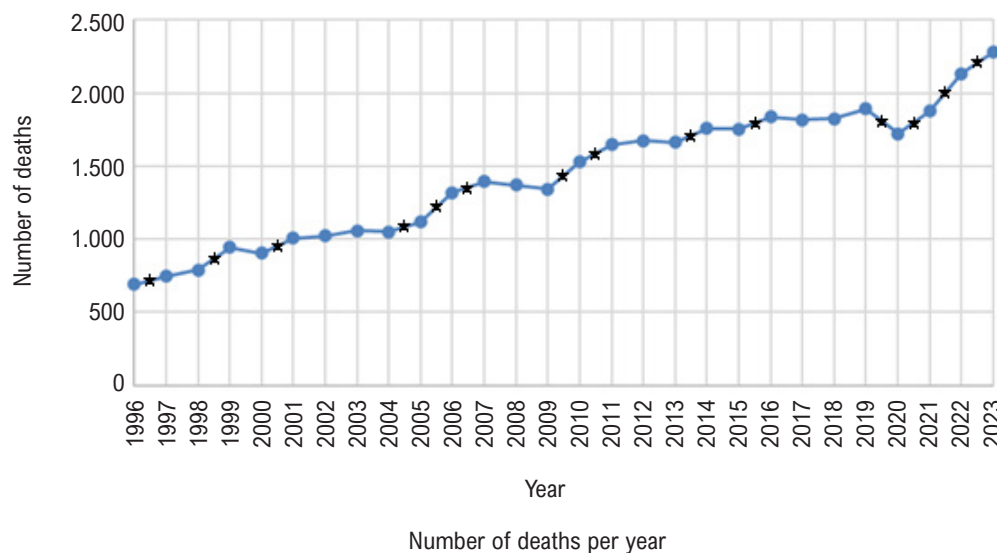
Study design and data source

We conducted a retrospective, exploratory, epidemiological study with descriptive and analytical components. We used data from the Mortality Information System (SIM), which is available through the Brazil's Unified Health System's

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Central Illustration: Endocarditis – A 27-Year Epidemiological Analysis of Mortality in Brazil



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Distribution of annual deaths from acute and subacute endocarditis and unspecified valve endocarditis in Brazil, 1996–2023. Statistical test: chi-square test of independence ($p < 0.05$). Source: Mortality Information System.

Department of Informatics of (DATASUS). According to the December 2024 system update, finalized data are available through 2023. Records for endocarditis from 1996 to 2023 were retrieved via DATASUS/TabNet and exported to Microsoft Excel for tabulation and calculations.

Case definition

Endocarditis deaths were identified using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) codes I33 (Acute and subacute endocarditis) and I38 (Endocarditis, valve unspecified). However, the SIM/DATASUS interface only provides aggregated selections for these codes. Other potentially relevant codes, such as I33.9 (Acute and subacute endocarditis, unspecified) or B37.6 (Candidal endocarditis), are not selectable independently and therefore could not be included. ICD-10 code I39 (Endocarditis and heart valve disorders in diseases classified elsewhere) was selected during data retrieval; however, no records were available for any year in the study period.

Variables

Analyzed variables included the ICD-10 category, year of death, sex, and Brazilian macro-region.

Exclusions

The following variables were excluded: region/federal unit, race/ethnicity, ICD-10 chapter, ICD-10 group, cause of death,

ill-defined cause of death, federal unit, age group, education level, place of occurrence, year/month of death, month of death, age group as standardized by the Pan American Health Organization, specific age group, age group under 1 year, and civil status.

Statistical analysis

All analyses were performed in Python 3.11 using SciPy 1.11.9. Chi-square tests of independence were applied with a two-sided significance threshold of $p < 0.05$.

Ethics

Data were collected on September 9, 2024. Since all information was obtained from a public, de-identified database, an institutional ethics review was not required. The authors declare no conflicts of interest.

Results

Using SIM data from 1996 to 2023, chi-square tests of independence showed significant differences across years ($p < 0.05$). As detailed in Table 1 and Central Illustration, the annual count peaked in 2023 at 2,279 deaths (5.68% of the total) and was lowest in 1996 at 689 deaths (1.72%). Deaths were classified by region and ICD-10 category — I33 and I38. A total of 40,157 deaths were recorded (chi-square = 1,701.43), which represents a 230.77% increase over the study period.

Original Article

Table 1 – Annual deaths from acute and subacute endocarditis and unspecified valve endocarditis in Brazil, 1996-2023

Year of death	Total deaths
1996	689
1997	745
1998	789
1999	942
2000	906
2001	1,008
2002	1,023
2003	1,060
2004	1,049
2005	1,116
2006	1,320
2007	1,395
2008	1,372
2009	1,342
2010	1,527
2011	1,648
2012	1,676
2013	1,662
2014	1,757
2015	1,752
2016	1,837
2017	1,818
2018	1,823
2019	1,891
2020	1,722
2021	1,875
2022	2,134
2023	2,279
Total	40,157

*Statistical test: chi-square test of independence ($p < 0.05$).
Source: Mortality Information System.*

Based on SIM data from 1996-2023, chi-square tests of independence showed statistically significant differences in region and sex ($p < 0.001$). The Southeast region had the highest number of deaths, with 21,429 deaths (53.36%; chi-square = 15,236.00), followed by the Northeast (7,432; 18.51%), the South (6,771; 16.86%), the Central-West (2,939; 7.32%), and the North (1,586; 3.95%) (Table 2).

By sex, males predominated (chi-square = 999.32; $p < 0.001$), comprising 22,315 deaths (55.57%), while females accounted for 17,835 (44.41%) deaths. Sex was unspecified in seven records (0.02%) (Table 3).

Table 2 – Deaths from acute and subacute endocarditis and unspecified valve endocarditis by region, Brazil, 1996-2023

Region of Brazil	Total deaths
North	1,586
Northeast	7,432
Southeast	21,429*
South	6,771
Central-West	2,939
Total	40,157

**Statistical test: chi-square test of independence ($p < 0.001$).
Source: Mortality Information System.*

Table 3 – Deaths from acute and subacute endocarditis and unspecified valve endocarditis by sex, Brazil, 1996-2023

Sex	Total deaths
Male	22,315*
Female	17,835
Unknown	7
Total	40,157

**Statistical test: chi-square test of independence ($p < 0.001$).
Source: Mortality Information System.*

Discussion

This study reveals a consistent rise in deaths due to acute and subacute endocarditis in Brazil between 1996 and 2023, amounting to 40,157 fatalities. There were 698 deaths in 1996, rising to 2,279 in 2023 — a 230.77% increase. This progressive increase may be due to population aging, the increased use of implantable cardiac devices, and the spread of resistant pathogens.¹⁰ Improvements in reporting and diagnostic sensitivity, particularly with echocardiography, may also contribute.¹¹

Although this dataset could not identify individual cases of co-infection with COVID-19, the pandemic years (2020-2022) showed a statistically significant increase in IE mortality. Causality cannot be established; however, the available evidence suggests that the pandemic may have indirectly influenced IE outcomes. International reports describe uncommon cases of coinfection with both COVID-19 and IE, predominantly in middle-aged men, with frequent aortic valve involvement and complications such as pulmonary edema and embolic events.¹² Respiratory manifestations of COVID-19 can mask or delay IE diagnosis, potentially worsening outcomes. Additional factors, such as diagnostic delays, health system strain, and secondary infections (particularly those caused by *Staphylococcus aureus*), may also have contributed.¹³ These observations underscore the need for ongoing surveillance, timely reporting, and high clinical suspicion for IE during overlapping infectious outbreaks to mitigate adverse outcomes in high-risk groups.

Geographically, the Southeast accounted for the largest proportion of deaths (53.36%; 21,429), followed by the Northeast (18.51%; 7,432), the South (16.86%; 6,771), the Central-West (7.32%; 2,939), and the North (3.95%; 1,586). This concentration likely reflects population size and greater diagnostic and reporting capacity. Brazil has 598,573 physicians, 182,852 of whom (30.5%) are in the Southeast.¹⁴ Of the 20,324 cardiologists nationwide, 10,770 practice in the Southeast — more than half of the national total.¹⁵ Greater diagnostic availability may therefore increase case ascertainment in the region rather than indicating an intrinsically higher mortality risk.

A male predominance was observed (55.57% vs. 44.41% among females). While secondary databases are subject to underreporting and coding variability, this pattern aligns with international and regional data. Large cohorts have documented higher IE incidence among men, suggesting biological and behavioral contributors. For example, Østergaard et al. (2019) reported a significantly higher incidence among high-risk men in Denmark.¹⁶ Likewise, a Latin American systematic review found a male predominance across clinical and microbiological series with cross-country variability.¹⁷

Proposed explanations include behavioral risk factors (eg, higher prevalence of injection drug use, alcohol consumption, and health care-associated exposures in men) as well as sex-related differences in immune and cardiovascular responses. However, these differences should be interpreted cautiously, as mortality proportions from administrative data may also reflect biases in access to care and diagnosis.¹⁶

According to Lima et al.,¹ IE is a life-threatening condition with a challenging diagnosis that demands precise investigative approaches to optimize clinical outcomes and mitigate disease burden.

Conclusion

This study demonstrates a substantial and progressive increase in IE-related mortality in Brazil from 1996 to 2023, with a total of 40,157 deaths — a 230.77% increase over the study period. The Southeast region had the highest number of deaths, which is consistent with its larger population and greater concentration of health professionals, including cardiologists. A male predominance (55.57%) was observed, suggesting behavioral and biological contributors to risk.

Chi-square tests of independence revealed significant differences by year ($p < 0.05$), region, and sex ($p < 0.001$), indicating a nonrandom distribution of deaths and supporting the robustness of these findings. These results underscore

the need for continued epidemiological surveillance and improved case reporting, particularly in high-risk regions and populations.

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Author Contributions

Conception and design of the research: Silva LCS, Salim MDS, Viegas RFM; Acquisition of data: Silva LCS, Castanheira LYFA, Salim MDS, Aquino DR; Analysis and interpretation of the data: Silva LCS, Castanheira LYFA, Salim MDS, Viegas RFM, Aquino DR; Statistical analysis: Silva LCS; Writing of the manuscript: Silva LCS, Castanheira LYFA, Salim MDS; Critical revision of the manuscript for content: Silva LCS, Viegas RFM, Ruivo GF, Cortelli SC, Aquino DR, Viégas TMRF.

Potential conflict of interest

No potential conflict of interest relevant to this article was reported.

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Study association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Data Availability Statement

The content is available at the link: <http://tabnet.datasus.gov.br> and <http://www2.datasus.gov.br>

References

1. Lima MAN, Ferreira AF, Santana YO, Amorim AMM, Macedo EM, Paula KB, et al. Endocardite Infecçiosa: Mecanismos, Diagnóstico e Tratamento. *Braz J Implantol Health Sci*. 2024;6(1):1737-54. doi: 10.36557/2674-8169.2024v6n1p1737-1754.
2. Carvalho LC, Teixeira FAO, Moraes PHA, Pereira AL, Nogueira THM, Borges JML, et al. Endocardite Infecçiosa: Uma Abordagem sobre a Variância Microbiológica diante Diferentes Fatores. *Braz J Health Rev*. 2022;5(1):2867-74. doi: 10.34119/bjhrv5n1-254.
3. Sousa C, Pinto FJ. Infective Endocarditis: Still More Challenges Than Convictions. *Arq Bras Cardiol*. 2022;118(5):976-88. doi: 10.36660/abc.20200798.
4. Holland TL, Baddour LM, Bayer AS, Hoen B, Miro JM, Fowler VG Jr. Infective Endocarditis. *Nat Rev Dis Primers*. 2016;2:16059. doi: 10.1038/nrdp.2016.59.
5. Hoen B, Duval X. Infective Endocarditis. *N Engl J Med*. 2013;369(8):785. doi: 10.1056/NEJMc1307282.

6. Guzmán LM, Navarro MG. Current Concepts on Antibiotic Prophylaxis for Bacterial Endocarditis in Dentistry. *Rev ADM*. 2009;56(1):32-8.
7. Habib G, Hoen B, Tornos P, Thuny F, Prendergast B, Vilacosta I, et al. Guidelines on the Prevention, Diagnosis, and Treatment of Infective Endocarditis (New Version 2009): the Task Force on the Prevention, Diagnosis, and Treatment of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and the International Society of Chemotherapy (ISC) for Infection and Cancer. *Eur Heart J*. 2009;30(19):2369-413. doi: 10.1093/eurheartj/ehp285.
8. Mesquita CT, Yahiro DS, Silva NS, Ribeiro BFC, Sales J, Laranja MA, et al. Infective endocarditis: A Narrative Review. *Med Cien Arte*. 2023;2(1):73-84.
9. Brasil. Ministério da Saúde. Departamento de Informática do Sistema Único de Saúde (DATASUS). Notificações de Mortalidade por Endocardite Aguda, Subaguda e Endocardite Valvar Não Especificada – Sistema de Informações sobre Mortalidade (SIM) – Brasil [Internet]. Brasília: Ministério da Saúde; 2025 [cited 2025 Nov 14]. Available from: <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def>.
10. Pant S, Patel NJ, Deshmukh A, Golwala H, Patel N, Badheka A, et al. Trends in Infective Endocarditis Incidence, Microbiology, and Valve Replacement in the United States from 2000 to 2011. *J Am Coll Cardiol*. 2015;65(19):2070-6. doi: 10.1016/j.jacc.2015.03.518.
11. Cahill TJ, Prendergast BD. Infective Endocarditis. *Lancet*. 2016;387(10021):882-93. doi: 10.1016/S0140-6736(15)00067-7.
12. George A, Venkataramanan SVA, John KJ, Mishra AK. Infective Endocarditis and COVID -19 Coinfection: An Updated Review. *Acta Biomed*. 2022;93(1):e2022030. doi: 10.23750/abm.v93i1.10982.
13. Alizadehasl A, Salehi P, Roudbari S, Peighambari MM. Infectious Endocarditis of the Prosthetic Mitral Valve after COVID-19 Infection. *Eur Heart J*. 2020;41(48):4604. doi: 10.1093/eurheartj/ehaa852.
14. Conselho Federal de Medicina. Demografia médica no Brasil [Internet]. Brasília: CFM; 2024 [cited 2025 Nov 14]. Available from: <https://demografia.cfm.org.br/dashboard/>.
15. Scheffer M, editor. Demografia Médica no Brasil 2023. São Paulo: FMUSP/AMB; 2023.
16. Østergaard L, Valeur N, Ihlemann N, Bundgaard H, Gislason G, Torp-Pedersen C, et al. Incidence of Infective Endocarditis among Patients Considered at High Risk. *Eur Heart J*. 2018;39(7):623-9. doi: 10.1093/eurheartj/ehx682.
17. Urina-Jassir M, Jaimes-Reyes MA, Martinez-Vernaza S, Quiroga-Vergara C, Urina-Triana M. Clinical, Microbiological, and Imaging Characteristics of Infective Endocarditis in Latin America: A Systematic Review. *Int J Infect Dis*. 2022;117:312-21. doi: 10.1016/j.ijid.2022.02.022.



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