

Is Hypertension a Predictor of Mortality in People Living With HIV/AIDS?

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Abstract

Background: Hypertension is a chronic non-communicable disease that increases cardiovascular risk and significantly contributes to mortality. It is one of the most prevalent conditions among people living with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS).

Objectives: The objective of this study was to investigate hypertension as a predictor of mortality in people living with HIV/AIDS, analyzing the association of prior diagnosis of hypertension with morbidity and mortality in this population.

Methods: This retrospective cohort study evaluated the medical records of 1207 patients receiving treatment at the Specialized Care Service (SAE) of a city in the state of Paraná over 264 months.

Results: Among patients diagnosed with HIV/AIDS, 13.1% had hypertension. During the analyzed period, 52 deaths were recorded (4.31%), 30.77% of which occurred among patients with hypertension ($p = 0.0002$). Lower survival was observed among patients with hypertension ($p < 0.0001$), and mortality was significantly higher among women with hypertension ($p < 0.0001$). The hazard ratio (HR) for the general population was 3.1 (95% confidence interval [CI]: 1.7–5.6), with an HR of 1.7 for men (95% CI: 0.7–3.7) and 8.2 for women (95% CI: 3.1–21.6).

Conclusions: Hypertension was a significant predictor of mortality in people living with HIV/AIDS, with a particularly strong impact among women.

Keywords: Acquired Immunodeficiency Syndrome; Hypertension; Survival; Mortality.

Introduction

Human immunodeficiency virus (HIV) infection affects approximately 1 million people in Brazil and approximately 21 million worldwide.^{1,2} With the advent of antiretroviral therapy, there has been a significant improvement in the quality of life of infected patients, allowing many who previously progressed to end-stage immunodeficiency to regain normal quality of life.^{3,4} This improvement has resulted in increased life expectancy, but it has also brought to light problems related to chronic non-communicable diseases, among which hypertension stands out.³

Hypertension is one of the most common chronic diseases among people living with HIV, with an estimated occurrence of approximately 17.8%, which can reach 25%, depending on the population sample analyzed.⁵⁻⁷ This high incidence can be attributed to the virus's inflammatory activity, which can lead to endothelial dysfunction and increase the risk of

elevated blood pressure.³ Furthermore, the development of hypertension may also be associated with antiretroviral therapy, whose side effects may contribute to this condition, as well as other comorbidities, including dyslipidemia, diabetes mellitus, and HIV-related kidney disease.⁸

Hypertension imposes substantial costs on public health systems and further compromises the health of people living with HIV.³ Furthermore, as an independent cardiovascular risk factor, it increases the risk of adverse events, such as acute myocardial infarction and stroke.^{3,4} Among the population living with HIV, hypertension has also been related to the development of chronic kidney disease.⁷

Survival of individuals living with HIV has been a topic of growing interest in medical research. With the effective use of antiretroviral therapy, many patients experience a significant improvement in quality of life and an increase in life expectancy, thereby reducing mortality associated with acquired immunodeficiency syndrome (AIDS).⁹ However, this population faces not only complications related to the infection itself, but also an increased incidence of chronic comorbidities, including cardiovascular disease, diabetes, and hypertension.¹⁰ Studies show that the presence of comorbidities can complicate treatment and negatively impact patient survival, since the coexistence of multiple health conditions can result in higher hospitalization and mortality rates.¹¹ Thus, investigating the relationship between hypertension prior to HIV diagnosis and patient survival becomes essential for developing strategies

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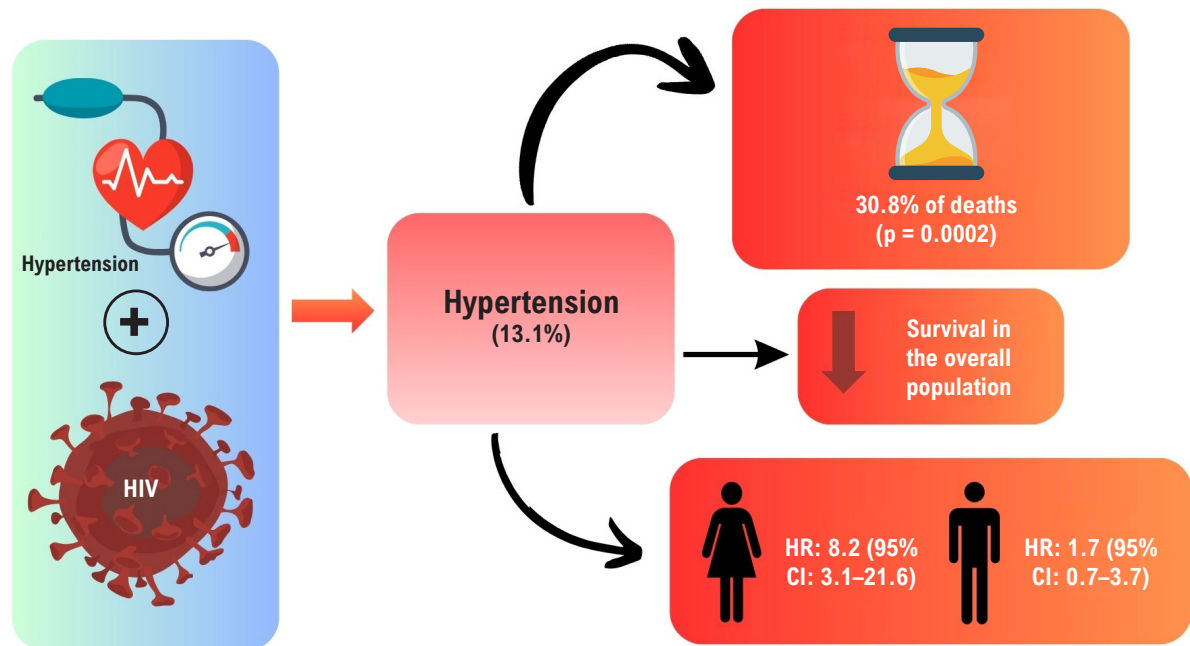
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Central Illustration: Is Hypertension a Predictor of Mortality in People Living With HIV/AIDS?



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CI: confidence interval; HR: hazard ratio.

that promote integrated care and improve health outcomes in this vulnerable population.¹²

In this context, it is crucial to understand whether hypertension diagnosed before HIV diagnosis affects these patients' survival, potentially acting as a predictive risk factor for death and influencing therapeutic decision-making. The literature on this correlation is still scarce, which makes this question even more relevant.

Given the above, the objective of this study was to analyze how hypertension, diagnosed before HIV diagnosis, impacts the survival of people living with HIV. This study also aimed to analyze other variables related to hypertension, to calculate the risk associated with the variables of death and hypertension, and to evaluate patient survival by means of survival curves.

Methods

Study design

This was a retrospective epidemiological cohort study. Data were collected through analysis of the medical records of patients receiving antiretroviral treatment at the Specialized Care Service (SAE, acronym in Portuguese) in Ponta Grossa, Paraná, Brazil. Additional analysis of deaths registered in the Mortality Information System (SIM) focused on deaths among people living with HIV/AIDS occurring between 2014 and 2023.

Medical records of patients with a history from January 2002 to January 2024 were selected, with analysis encompassing approximately 264 months.

Patient selection

Among the patients included in the study, 77 of the 1307 available medical records were excluded due to the absence of information on systolic and/or diastolic blood pressure and to lack of data on previous diagnosis of hypertension or the use of antihypertensive medication. Additionally, 23 patients under 18 years of age, whose HIV had been vertically transmitted, were also excluded. Thus, 1207 patients were included in the study (Figure 1).

Patients with hypertension

The classification of patients as hypertensive or non-hypertensive prior to HIV diagnosis was based on the criteria established by the Brazilian Guidelines of Hypertension.¹³ Individuals who presented systolic and/or diastolic blood pressure values equal to or greater than 140/90 mmHg, recorded in two measurements during the initial consultation at the SAE, were considered hypertensive. Additionally, patients who had a prior diagnosis of hypertension in their medical records and those undergoing antihypertensive treatment, as documented in the records, were included. The study also analyzed sociodemographic variables, including age, age range

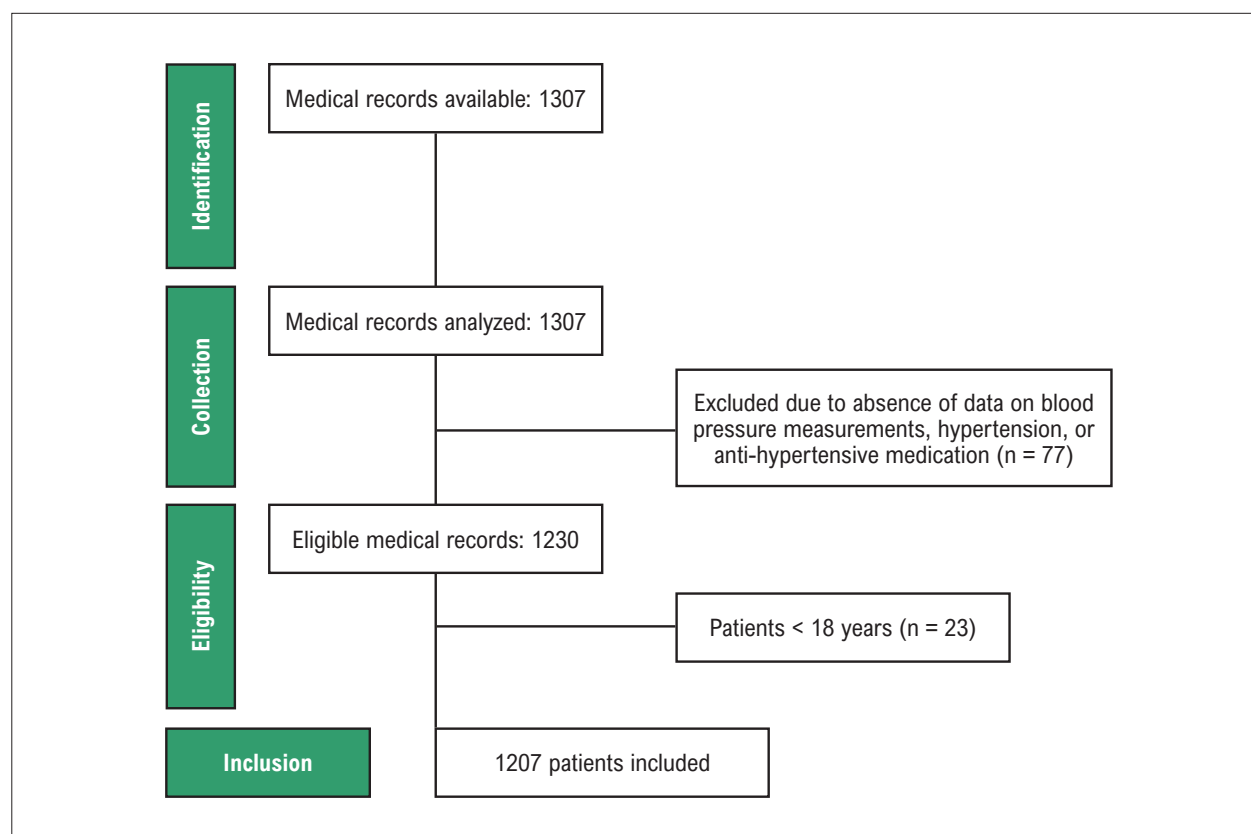


Figure 1 – Patient selection flowchart. Source: SAE. Prepared by the authors, 2024.

at diagnosis, sexual orientation, mode of transmission, education level, marital status, sex, and race/ethnicity.

Mortality data

To obtain information on the cause and date of death of people living with HIV/AIDS, it was necessary to cross-reference all notifications registered between 2014 and 2023 in the Notifiable Diseases Information System (SINAN) with data from the SIM. This additional verification step was essential to ensure that all cases of people living with HIV/AIDS classified in SINAN as deaths were identified in the mortality system, especially in cases where the death certificate indicated other causes without mentioning HIV/AIDS, which could compromise the consistency of the sample and exclude relevant data from the reports. The period from 2014 to 2023 was chosen due to the change in treatment guidelines for people living with HIV/AIDS, which was made universal from 2014 onwards, guaranteeing treatment for all people diagnosed with HIV infection, rather than just those with AIDS diagnosis. This change contributed to the decrease in factors associated with mortality from opportunistic infections and other conditions resulting from immunosuppression.

Statistical analysis

Categorical variables including death, age range at diagnosis, sexual orientation, mode of transmission, education level,

marital status, sex, and race/ethnicity were described using absolute and percentage frequencies. For the variable age at diagnosis, in addition to absolute and percentage frequencies, measures of central tendency (mean) and dispersion (standard deviation) were analyzed. The 95% confidence interval (CI) for these variables was also calculated. To verify whether hypertension influenced patient survival, Kaplan–Meier curves were used,¹⁴ covering a period of 264 months.

Descriptive tables were prepared comparing sociodemographic variables and the presence or absence of hypertension. Pearson's chi-square test with Yates correction was used to calculate p values,^{15,16} considering p values less than 0.05 statistically significant. The risk ratio between the variables hypertension and death was calculated, as well as the hazard ratios (HR) for these variables in relation to race/ethnicity, sex, sexual orientation, mode of transmission, and marital status, by means of a stratified analysis according to sociodemographic characteristics. This analysis showed high variability in the coefficients. Subsequently, multivariate analysis was performed using the Cox proportional hazards model, adjusted for all sociodemographic factors simultaneously. These measures of association were calculated considering a 95% CI.

Finally, Microsoft Excel® and R® (version 4.3.3) were used for the analyses. This study followed ethical research recommendations and received approval from the Research Ethics Committee of the State University of Ponta Grossa (UEPG, Paraná), under approval number 2.631.445.

Results

Patient characteristics

Of the 1207 patients included in the study, 954 were heterosexual, corresponding to 79% of the total. Among the patients included, 56.67% were male, and 43.33% were female. Regarding education level, measured in years of study, the majority of individuals (56.67% of the sample) had 0 to 4 years of formal education. The age group with the highest frequency in the study was 18 to 30 years, with 411 individuals, followed by the 31 to 40 age group, which had 349 patients, corresponding to 34.05% and 28.91%, respectively. The average age of the patients was 37.28 years, with a standard deviation of 11.72.

Among the participants, 465 (38.52%) were married or in a stable union, whereas 409 (33.90%) were single. Regarding race/ethnicity, the majority of patients were White, totaling 82.10% of the sample. Finally, analysis of mode of transmission showed that sexual transmission accounted for 95.28% of cases, totaling 1150 individuals. Other sociodemographic characteristics are displayed in Table 1.

Hypertension

Among the patients included in the study, 159 had hypertension prior to HIV/AIDS diagnosis, representing 13.17% of the study population. Patients without hypertension accounted for 86.83% of the total. During the analyzed period, 52 individuals died, representing 4.31% of the total patients. Among those with hypertension, 35.22% were in the 41 to 50 age range; this association did not show statistical significance ($p = 0.227$).

Regarding marital status, 33.33% of patients with hypertension were married or in a stable union, whereas approximately 29.56% of patients with hypertension were single, also without statistical significance ($p = 0.105$). Regarding sex, there was no statistically significant difference between female and male patients in relation to hypertension ($p = 0.358$), although the condition predominated among male patients, who constituted 60.38% of those with hypertension.

In relation to race/ethnicity, White patients presented the highest proportion of hypertension, corresponding to 83.02%, although without statistical significance ($p = 0.549$). A high prevalence of hypertension was also observed among patients whose HIV transmission occurred through sexual

contact, representing 98.05% of this group. However, the analysis did not reveal a statistically significant difference ($p = 0.575$) in relation to the association between hypertension and the mode of transmission. On the other hand, among heterosexual patients, the frequency of hypertension was approximately 87.42%, showing a statistically significant association ($p = 0.032$), as shown in Table 2.

Risk of death

The risk of death among patients with hypertension was estimated to be 2.92 times higher compared to patients without hypertension, suggesting that these patients face an almost threefold greater risk of dying due to complications associated with hypertension. This relationship is supported by a 95% CI ranging from 1.66 to 5.15 ($p < 0.001$), reinforcing the strength of the association.

When analyzing the HR in a stratified manner, between death and hypertension, a value of 3.1 was observed in the general population (95% CI: 1.7–5.6; $p < 0.001$), indicating that individuals with hypertension had a 3.1 times greater risk of death compared to those without the condition. White patients with hypertension had a HR of 3.01 (95% CI: 1.5–5.9; $p = 0.001$), showing a significant association between hypertension and mortality in this group.

Women with hypertension showed a HR of 8.2 (95% CI: 3.1–21.6; $p < 0.001$), indicating a strong association between hypertension and increased risk of death in this group. Regarding sexual orientation, heterosexual patients showed a HR of 3.0 (95% CI: 1.5–5.6; $p < 0.001$), demonstrating a significant relationship. Additionally, patients with hypertension who contracted HIV through sexual transmission showed a HR of 3.2 (95% CI: 1.7–5.8; $p < 0.001$), indicating a considerable risk of death. Regarding marital status, single and widowed patients with hypertension presented a HR of 4.8 (95% CI: 1.7–13.0; $p = 0.002$), suggesting that patients with hypertension who were not in a stable relationship had a higher risk of death (Table 3). Multivariate analysis revealed some differences compared to stratified analysis, showing that non-White patients had a twofold greater risk of death compared to White patients (95% CI: 1.0–3.9; $p = 0.042$). However, patients with hypertension had a HR of 3.5, greater than those without hypertension (95% CI: 1.7–6.9; $p < 0.001$), similar to what was found in stratified analysis. Men had a HR of 1.7, without a statistically significant difference when compared

Table 1 – Sociodemographic characteristics and frequency of hypertension in people living with HIV/AIDS undergoing antiretroviral treatment at the SAE, Ponta Grossa, Paraná, Brazil.

Variables/categories	Total	%	95% CI
Sexual orientation			
Bisexual	37	3.07%	2.10–4.20
Heterosexual	954	79.04%	76.60–81.28
Homosexual	164	13.59%	11.73–15.68
Unknown	52	4.31%	3.26–5.65

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Sex			
Female	523	43.33%	40.51–46.18
Male	684	56.67%	53.81–59.84
Death			
No	1155	95.69%	94.34–96.73
Yes	52	4.31%	3.26–5.65
Education level (years of study)			
0 to 4 years	684	56.67%	53.81–59.48
5 to 9 years	475	39.36%	36.59–42.18
Unknown	48	3.98%	2.97–5.27
Age range			
18 to 30 years	411	34.05%	31.39–36.81
31 to 40 years	349	28.91%	26.38–31.57
41 to 50 years	266	22.03%	19.75–24.50
51 to 60 years	135	11.18%	9.48–13.13
61 to 70 years	42	3.47%	2.54–4.71
> 70 years	4	0.33%	0.10–0.90
Marital status			
Married	465	38.52%	35.77–41.34
Divorced	83	6.87%	5.54–8.49
Widowed	45	3.73%	2.76–4.99
Single	409	33.90%	31.22–36.64
Unknown	205	16.98%	14.93–19.24
Race			
White	991	82.10%	79.79–84.20
Non-White	194	16.08%	14.06–18.29
Unknown	22	1.82%	1.17–2.79
Mode of transmission			
Occupational	3	0.25%	0.06–0.78
Sexual	1150	95.28%	93.88–96.73
Blood transfusion	3	0.25%	0.06–0.78
Injectable drug use	14	1.16%	0.66–1.98
Vertical	2	0.17%	0.02–0.66
Unknown	35	2.90%	2.05–4.05
Hypertension			
No	1048	86.83%	84.75–88.65
Yes	159	13.17%	11.34–15.24
Overall total	1207	100.00%	99.60–100.00

Source: SAE. Prepared by the authors, 2024. CI: confidence interval.

Table 2 – Sociodemographic characteristics related to hypertension in people living with HIV/AIDS undergoing antiretroviral treatment at the SAE, Ponta Grossa, Paraná, Brazil

Variables/categories	Non-hypertensive		Hypertensive		Total	%	p value
	N	%	N	%			
Age range							
18 to 30 years	391	37.33%	20	12.58%	411	34.05%	0.227
31 to 40 years	316	30.15%	33	20.75%	349	28.91%	
41 to 50 years	210	20.03%	56	35.22%	266	22.03%	
51 to 60 years	100	9.54%	35	22.01%	135	11.18%	
61 to 70 years	29	2.76%	13	8.18%	42	3.49%	
> 70 years	2	0.19%	2	1.26%	4	0.34%	
Marital status							
Married	412	39.32%	53	33.33%	465	38.52%	0.105
Divorced	71	6.77%	12	7.54%	83	6.87%	
Single	362	34.54%	47	29.56%	409	33.89%	
Widowed	35	3.34%	10	6.30%	45	3.73%	
Unknown	168	16.03%	37	23.27%	205	16.98%	
Sexual orientation							
Bisexual	34	3.24%	3	1.89%	37	3.07%	0.032
Heterosexual	815	77.77%	139	87.42%	954	79.04%	
Homosexual	149	14.22%	15	9.43%	164	13.59%	
Unknown	50	4.77%	2	1.26%	52	4.31%	
Mode of transmission							
Occupational	2	0.17%	1	0.06%	3	0.25%	0.575
Sexual	995	82.44%	155	98.05%	1150	95.28%	
Blood transfusion	3	0.25%		0.00%	3	0.25%	
Injectable drug use	14	1.16%		0.00%	14	1.16%	
Vertical	2	0.17%		0.00%	2	0.17%	
Unknown	32	2.65%	3	1.89%	35	2.90%	
Sex							
Female	460	43.89%	63	39.62%	523	43.33%	0.358
Male	588	56.11%	96	60.38%	684	56.67%	
Race							
White	859	81.97%	132	83.02%	991	82.10%	0.549
Non-White	167	15.93%	27	16.98%	194	16.08%	
Unknown	22	2.10%		0.00%	22	1.82%	
Overall total	1048	100.00%	159	100.00%	1207	100.00%	

Source: SAE. Prepared by the authors, 2024.

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to women (95% CI: 0.9–3.3; $p=0.088$). Regarding patients who acquired HIV through sexual contact, when compared to those whose mode of transmission was not sexual, they had a HR of 0.1 (95% CI: 0.03–0.7; $p=0.016$), as shown in Table 3.

Patient survival

Kaplan–Meier survival curves were plotted to analyze the survival of people living with HIV and to stratify different patient groups, comparing those with and without hypertension. The results indicated that the survival of hypertensive people living with HIV was significantly lower compared to non-hypertensive people living with HIV ($p < 0.001$), as illustrated in Figure 2a.

Furthermore, analysis revealed that White patients with hypertension (Figure 2b) also presented lower survival ($p < 0.001$), indicating a strong association between hypertension and mortality in this group. With respect to sex, women (Figure 2c) showed a significant reduction in survival ($p < 0.001$), suggesting that hypertension has a considerable impact on the risk of death in the female sex.

Analysis of marital status also provided relevant results. Widowed and single patients (Figure 2d) showed lower survival ($p < 0.001$), suggesting that the lack of a social support network may be related to an increased risk of mortality in patients with hypertension. Similarly, heterosexual patients (Figure 2e) showed a p value < 0.001 , indicating reduced survival in this group. Finally, patients who contracted HIV through sexual transmission (Figure 2f) also showed significantly lower survival ($p < 0.001$), emphasizing the need for special attention in these cases.

Discussion

The Central Illustration summarizes the main study findings. The sociodemographic profile of people living with HIV was predominantly heterosexual, with low education level, concentrated in the 18 to 40 age range, and an average age of 37.2 years. A substantial proportion was married or in a stable relationship. Male predominance was also observed, along with a majority of White individuals and patients who contracted HIV through sexual transmission. This profile is similar to that found in previous studies, especially in samples from the South Region of Brazil, which portray a predominantly White, heterosexual, and young population, although the prevalence of men is more pronounced in other locations.¹⁷ In addition, some studies have indicated a higher prevalence of men compared to women, varying with the population's racial profile of the population.¹⁸

The prevalence of hypertension before HIV infection in the study population was 13.17%. It is worth emphasizing that this frequency occurred among individuals who already had hypertension at the time of HIV diagnosis, which may partly explain differences compared with studies reporting around 33%.⁶ However, the majority of individuals with elevated blood pressure levels were between 41 and 50 years old, indicating age as an independent risk factor for the development of hypertension.¹⁹ The younger age of the sample raises questions about a potential increase in the

prevalence of hypertension in younger age groups, especially in individuals between 30 and 39 years old.²⁰ Furthermore, the profile of patients with hypertension as predominantly White men with sexual transmission is a common trend observed among the majority of studies including people living with HIV.²¹

During the study period, 52 patients died. The risk association was higher among those with hypertension compared to those without. The increase in mortality from cardiovascular causes in people living with HIV signals a change in the mortality profile of this population, especially after the introduction of highly active antiretroviral therapy, which has promoted greater survival but also led to the emergence of comorbidities, including chronic non-communicable diseases, such as hypertension.^{22,23}

The elevated risk ratio between hypertension and death in this group highlights the importance of this comorbidity, which has a high prevalence among people living with HIV. It is estimated that about 35% of individuals on antiretroviral therapy and approximately 13% of those not undergoing this therapy suffer from hypertension.^{24,25} This emphasizes the need for effective management of blood pressure levels in this population, especially considering that the advent of antiretroviral therapy has brought about a shift toward mortality from causes unrelated to immunosuppression, and cardiovascular diseases, with hypertension as one of the main risk factors, has been a growing concern.²⁴

The relationship between hypertension and death suggests a higher probability of death in patients with hypertension compared to those without. This result is consistent with other studies that have associated hypertension with a higher probability of death, although they have not demonstrated that hypertension increases mortality or loss to follow-up in combined outcomes.²⁶ When assessing stratified subgroups, women presented elevated HR, reaching statistical significance. This finding contradicts the conclusion of the aforementioned study, which described the female sex as protective.²⁶ In the present study, men showed a lower risk of death compared to women. In the United States, analyses focused solely on the female sex revealed a higher risk ratio among women with hypertension compared to those without.²⁷ Although stratified analysis could suggest a difference between the sexes, the multivariate model showed that, after adjusting for other variables, male sex presented a tendency towards higher risk (HR = 1.7), but without reaching statistical significance ($p = 0.088$). This indicates that sex, in isolation, may not be as strong a determinant of death as ethnicity or mode of transmission in this specific population.²⁶ It is worth underscoring the wide CI obtained in the sample of women; this occurred in other analyses as well, which may indicate high variability in the sample and a small number of events in these subgroups. Accordingly, some of these estimates, the p value shows statistical significance, may present some uncertainty, given the wide CI observed.

In this study, White people living with HIV presented hypertension as a more significant predictor of death compared to those who were not White. This result contrasts with the existing literature, which suggests that White individuals generally have a lower compared

Table 3 – HR among study groups of patients living with HIV/AIDS undergoing antiretroviral treatment at the SAE, Ponta Grossa, Paraná, Brazil

	Stratified analysis				Multivariate analysis*		
	HR	95% CI	p value		HR	95% CI	p value
Overall	3.1	1.7–5.6	<0.001	Hypertensive	3.5	1.7–6.9	<0.001
White	3.0	1.5–5.9	0.001	Reference			
Non-White	3.1	0.9–10.5	0.061		2.0	1.0–3.9	0.042
Men	1.7	0.7–3.7	0.181		1.7	0.9–3.3	0.088
Women	8.2	3.1–21.6	<0.001	Reference			
Heterosexual	3.0	1.5–5.6	<0.001		0.5	0.1–1.9	0.380
Homosexual	4.4	0.4–44.9	0.201		0.7	0.1–3.2	0.709
Bisexual	2.3	0.2–26.0	0.501	Reference			
Sexual transmission	3.2	1.7–5.8	<0.001		0.1	0.03–0.7	0.016
Married	2.0	0.8–5.3	0.121	Reference			
Divorced	4.1	0.7–21.9	0.096		2.5	0.7–8.8	0.133
Single and widowed	4.8	1.7–13.0	0.002		0.9	0.5–1.7	0.832

Source: SAE. Prepared by the authors, 2024. *Likelihood test $p = 0.002$; Wald test $p \leq 0.001$. CI: confidence interval; HR: hazard ratio.

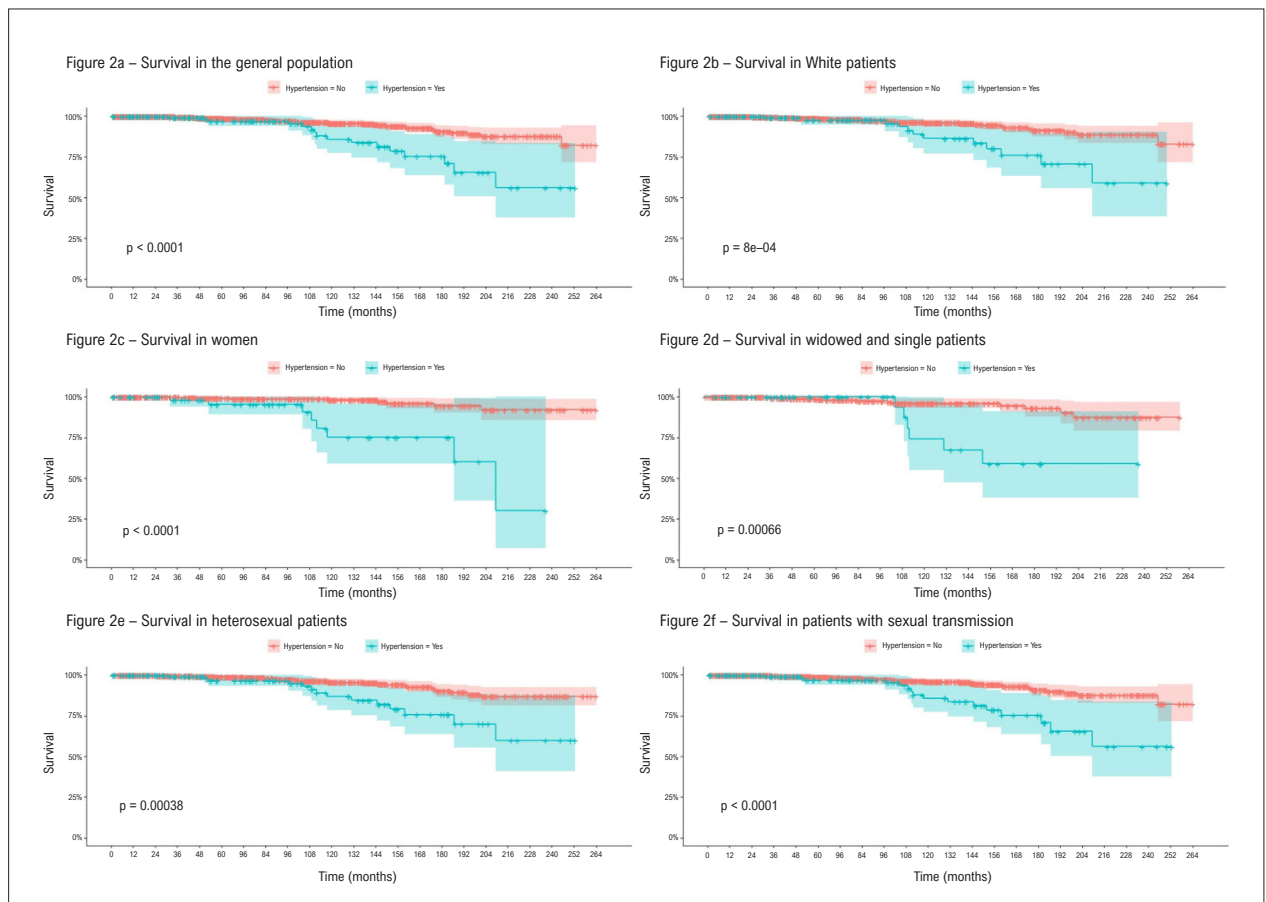


Figure 2 – Kaplan–Meier survival curves for the general population (2a), White patients (2b), women (2c), widowed and single patients (2d), heterosexual patients (2e), and patients who contracted the virus through sexual transmission (2f), among people living with HIV/AIDS undergoing antiretroviral treatment at the SAE, Ponta Grossa, Paraná, Brazil. Source: SAE. Prepared by the authors, 2024.

risk of mortality.²⁷ For example, a study by Weng et al.²⁸ highlighted that the racial disparity in mortality from cardiovascular diseases is often more pronounced in non-White populations, who face additional challenges such as limited access to medical care and inadequate management of chronic diseases. This data was reinforced by multivariate analysis, which showed that non-White patients had a twofold risk of death compared to White patients. This is an alarming finding that corroborates previous studies on structural inequalities in access to healthcare.^{27,28}

Furthermore, when focusing solely on survival analysis, White patients tend to have more favorable rates, suggesting that hypertension could act as a survival marker in this group.²⁹ Other studies have corroborated this observation, indicating that White patients with hypertension may have better control of blood pressure levels and, consequently, greater survival compared to patients who are not White.^{29,30}

Survival curves revealed that hypertension had a significant negative impact on the overall population's survival, with hypertensive patients showing lower survival rates compared to those without hypertension. This finding is consistent with several studies showing reduced life expectancy among patients with hypertension, especially those living with HIV.²⁹ However, since the follow-up period was long, changes in antiretroviral treatment may have contributed to differences in the survival curve, particularly after 72 months, which may suggest a time-dependent effect resulting from changes in Brazilian guidelines on HIV/AIDS treatment.

The data indicated that White patients with hypertension demonstrated lower survival, which contrasts with other studies suggesting that blood pressure control is more effective among White patients, resulting in lower mortality and, consequently, better survival.²⁸ The literature frequently highlights that the disparity in hypertension control may be linked to unequal access to healthcare and variations in clinical management across different racial groups, which may explain the increased mortality among White patients with hypertension in this particular context.³¹

The results of this study indicate that women with hypertension had lower survival rates compared to non-hypertensive women; this finding differs from several reports in the literature. It has traditionally been observed that women tend to die from cardiovascular diseases at older ages than men, a dynamic that generally places female sex as a protective factor in relation to mortality, especially in populations living with HIV.^{26,30} A possible explanation for the increased cardiovascular risk in women living with HIV and hypertension may be the complex interaction between these conditions, which can exacerbate traditional cardiovascular risk factors. Furthermore, the stigma associated with HIV can hinder access to adequate care, leading to inadequate control of hypertension and, consequently, higher cardiovascular mortality among these women.

These results underscore the complexity of the interaction between hypertension, sex, and race in the mortality of patients living with HIV. There is an increasingly evident need for specific management strategies that consider the nuances of

these interactions in order to improve health outcomes in these vulnerable groups. The discussion regarding the impact of comorbidities, such as hypertension, on the population living with HIV is fundamental to informing clinical practices and health policies that seek to reduce inequalities and improve these patients' quality of life.

This study's strengths include comprehensive analysis of the relationship between hypertension and mortality in patients living with HIV, using a large database and a diverse sample, as well as the inclusion of sociodemographic variables that elucidate aspects of inequality in health outcomes. The use of survival curves provides a clear visualization of hypertension's impact on mortality, strengthening the conclusions.

The study limitations include the fact that it relied on secondary data, originating from the medical records of patients under treatment at the service, which may compromise the accuracy of the information. This study did not consider some relevant factors, such as the patients' lifestyle and treatment adherence. Additional study limitations include the observational design which does not establish causality, difficulties in isolating influencing factors, and the study's limited generalizability.

Conclusions

This study has highlighted the importance of understanding the relationship between hypertension and mortality in patients living with HIV, demonstrating that sociodemographic factors, such as race and sex, influence these outcomes. The results suggest that hypertension was a significant predictor of mortality among the population analyzed. However, this study's limitations, including its observational design and reliance on secondary data, underscore the need for future research exploring causal relationships and additional contributing factors. These findings may help inform clinical management strategies and public health interventions aimed at improving quality of life and survival in this vulnerable population.

Author Contributions

Conception and design of the research: Fante GE, Zuber JFS, Martins CM, Muller EV; acquisition of data: Fante GE, Dall'Omo PAP, Valle KB, Zuber JFS, Muller EV; analysis and interpretation of the data and writing of the manuscript: Fante GE, Dall'Omo PAP, Valle KB, Benetoli A, Zuber JFS, Martins CM, Muller EV; statistical analysis: Fante GE, Benetoli A, Martins CM, Muller EV; critical revision of the manuscript for intellectual content: Benetoli A, Zuber JFS, Martins CM, Muller EV.

Potential Conflict of Interest

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

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Study Association

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Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Universidade Estadual de Ponta Grossa under the protocol number 2.631.445 (02/05/2018). All studies involving humans were conducted following the ethical standards outlined in the 1975 Declaration of Helsinki and its later amendments.

Use of Artificial Intelligence

During the preparation of this work, the author(s) used ChatGPT to correct grammatical errors and translate some excerpts from English into Portuguese, as well as from Portuguese into English. After using this tool/service, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the published article.

Availability of Research Data

The data cannot be made publicly available.

References

1. Brasil. Ministério da Saúde. Departamento de HIV/Aids, Tuberculose, Hepatites Virais e Infecções Sexualmente Transmissíveis. Boletim epidemiológico HIV e Aids 2023 [Internet]. Brasília: Ministério da Saúde; 2023 [cited 2026 May 19]. Available from: <https://www.gov.br/aids/pt-br/central-de-conteudo/boletins-epidemiologicos/2023/hiv-aids/boletim-epidemiologico-hiv-e-aids-2023.pdf/view>.
2. Ventura JD. Human Immunodeficiency Virus 1 (HIV-1): Viral Latency, the Reservoir, and the Cure. *Yale J Biol Med*. 2020;93(4):549-60.
3. Ou-Yang H, Fu HY, Luo Y, Xu ZY, Liu J, Gao R, et al. Inflammation Markers and the Risk of Hypertension in People Living with HIV. *Front Immunol*. 2023;14:1133640. doi: 10.3389/fimmu.2023.1133640.
4. Masenga SK, Eljovich F, Koethe JR, Hamooya BM, Heimbürger DC, Munsaka SM, et al. Hypertension and Metabolic Syndrome in Persons with HIV. *Curr Hypertens Rep*. 2020;22(10):78. doi: 10.1007/s11906-020-01089-3.
5. Pontes-Pereira PS, Antonini M, Fedocci EMM, Costa CRB, Esquivel-Rubio AI, Botelho EP, et al. Prevalence of Chronic Non-Communicable Diseases in People Living with HIV. *Acta Paul Enferm*. 2023;36:eAPE01132. doi: 10.37689/acta-ape/2023AO011322.
6. Arruda ER Jr, Lacerda HR, Moura LC, Albuquerque MF, Miranda DB Filho, Diniz GT, et al. Profile of Patients with Hypertension Included in a Cohort with HIV/AIDS in the State of Pernambuco, Brazil. *Arq Bras Cardiol*. 2010;95(5):640-7. doi: 10.1590/s0066-782x2010005000138.
7. Muller EV, Gimeno SGA. Risk Factors for Cardiovascular Disease in HIV/AIDS Patients Treated with Highly Active Antiretroviral Therapy (HAART) in the Central-Southern Region of the State of Paraná - Brazil. *Cien Saude Colet*. 2019;24(5):1903-14. doi: 10.1590/1413-81232018245.16682017.
8. Pangmekeh PJ, Awolu MM, Gustave S, Gladys T, Cumber SN. Association between Highly Active Antiretroviral Therapy (HAART) and Hypertension in Persons Living with HIV/AIDS at the Bamenda Regional Hospital, Cameroon. *Pan Afr Med J*. 2019;33:87. doi: 10.11604/pamj.2019.33.87.15574.
9. Portilla-Tamarit J, Reus S, Portilla I, Fuster Ruiz-de-Apodaca MJ, Portilla J. Impact of Advanced HIV Disease on Quality of Life and Mortality in the Era of Combined Antiretroviral Treatment. *J Clin Med*. 2021;10(4):716. doi: 10.3390/jcm10040716.
10. Raposeiras-Roubín S, Triant V. Ischemic Heart Disease in HIV: An In-depth Look at Cardiovascular Risk. *Rev Esp Cardiol*. 2016;69(12):1204-13. doi: 10.1016/j.rec.2016.10.005.
11. Naidoo K, Rampersad S, Karim SA. Improving Survival with Tuberculosis & HIV Treatment Integration: A Mini-Review. *Indian J Med Res*. 2019;150(2):131-8. doi: 10.4103/ijmr.IJMR_660_19.
12. Shade SB, Osmand T, Kwarisiima D, Brown LB, Luo A, Mwebaza B, et al. Costs of Integrating Hypertension Care Into HIV Care in Rural East African Clinics. *AIDS*. 2021;35(6):911-9. doi: 10.1097/QAD.0000000000002834.
13. Barroso WKS, Rodrigues CIS, Bortolotto LA, Mota-Gomes MA, Brandão AA, Feitosa ADM, et al. Brazilian Guidelines of Hypertension - 2020. *Arq Bras Cardiol*. 2021;116(3):516-658. doi: 10.36660/abc.20201238.
14. Goel MK, Khanna P, Kishore J. Understanding Survival Analysis: Kaplan-Meier Estimate. *Int J Ayurveda Res*. 2010;1(4):274-8. doi: 10.4103/0974-7788.76794.
15. Shih JH, Fay MP. Pearson's Chi-Square Test and Rank Correlation Inferences for Clustered Data. *Biometrics*. 2017;73(3):822-34. doi: 10.1111/biom.12653.
16. Giannini EH. Design, Measurement, and Analysis of Clinical Investigations. In: Cassidy JT, Petty RE, Laxer RM, Lindsley CB, editors. *Textbook of Pediatric Rheumatology*. 5th ed. Philadelphia: Elsevier Saunders; 2005. p. 142-173.
17. Moreira LFS. Perfil Sociodemográfico, Clínico, Imunológico e Viroológico de Portadores de Infecção pelo HIV-1 em Acompanhamento no Único Serviço Público de Tratamento de HIV em São Bento do Sul/Santa Catarina [Thesis]. Rio de Janeiro: Fundação Oswaldo Cruz; 2023.
18. Silva HRT, Ataides JAB, Tabosa JCF, Cruz WO, Silva JRM Filho, Lemos GD, et al. Sociodemographic Profile of HIV/AIDS Patients Admitted to Hospital Universitário Alcides Carneiro for Treatment of Opportunistic Infections. *Braz J Dev*. 2022;8(7):51769-91. doi: 10.34117/bjdv8n7-204.
19. Lima MAC, Cunha GHD, Galvão MTC, Rocha RP, Franco KB, Fontenele MSM. Systemic Arterial Hypertension in People Living with HIV/AIDS: Integrative Review. *Rev Bras Enferm*. 2017;70(6):1309-17. doi: 10.1590/0034-7167-2016-0416.
20. Santiago ERC, Diniz ADS, Oliveira JS, Leal VS, Andrade MIS, Lira PIC. Prevalence of Systemic Arterial Hypertension and Associated Factors among Adults from the Semi-Arid Region of Pernambuco, Brazil. *Arq Bras Cardiol*. 2019;113(4):687-95. doi: 10.5935/abc.20190145.
21. Cunha GHD, Lima MAC, Galvão MTC, Fecine FV, Fontenele MSM, Siqueira LR. Prevalence of Arterial Hypertension and Risk Factors among People with Acquired Immunodeficiency Syndrome. *Rev Lat Am Enfermagem*. 2018;26:e3066. doi: 10.1590/1518-8345.2684.3066.
22. Nunes AA, Caliani LS, Nunes MS, Silva AS, Mello LM. Profile Analysis of Patients with HIV/AIDS Hospitalized after the Introduction of Antiretroviral Therapy. *Cien Saude Colet*. 2015;20(10):3191-8. doi: 10.1590/1413-812320152010.03062015.
23. Paula AA, Pires DF, Alves P Filho, Lemos KRV, Veloso VG, Grinsztejn B, et al. Mortality Profiles among People Living with HIV/AIDS: Comparison between Rio de Janeiro and Other Federative Units between 1999 and 2015. *Rev Bras Epidemiol*. 2020;23:e200017. doi: 10.1590/1980-549720200017.
24. De Anda-Duran I, Kimbrough AD, Bazzano LA. HIV and Hypertension Epidemiology. *Curr Opin Cardiol*. 2023;38(4):297-303. doi: 10.1097/HCO.0000000000001050.

25. Xu Y, Chen X, Wang K. Global Prevalence of Hypertension among People Living with HIV: A Systematic Review and Meta-Analysis. *J Am Soc Hypertens.* 2017;11(8):530-40. doi: 10.1016/j.jash.2017.06.004.
26. Albrecht S, Franzeck FC, Mapesi H, Hatz C, Kalinjuma AV, Glass TR, et al. Age-Related Comorbidities and Mortality in People Living with HIV in Rural Tanzania. *AIDS.* 2019;33(6):1031-41. doi: 10.1097/QAD.0000000000002171.
27. Sadinski LM, Westreich D, Edmonds A, Breger TL, Cole SR, Ramirez C, et al. Hypertension and One-Year Risk of All-Cause Mortality among Women with Treated HIV in the United States. *AIDS.* 2023;37(4):679-88. doi: 10.1097/QAD.0000000000003461.
28. Weng X, Kompaniyets L, Buchacz K, Thompson-Paul AM, Woodruff RC, Hoover KW, et al. Hypertension Prevalence and Control among People with and without HIV - United States, 2022. *Am J Hypertens.* 2024;37(9):661-6. doi: 10.1093/ajh/hpae048.
29. Müller EV, Borges PKO. HIV/AIDS Patients Survival on Antiretroviral Treatment and Associated Factors in the Campos Gerais Region, Paraná state: 2002-2014. *Braz J Dev.* 2020;6(5):28523-42. doi: 10.34117/bjdv6n5-339.
30. Rogalska-Płońska M, Rogalski P, Leszczyszyn-Pynka M, Stempkowska J, Kocbach P, Kowalczyk-Kot A, et al. Hypertension, Dyslipidaemia, and Cardiovascular Risk in HIV-Infected Adults in Poland. *Kardiologia Pol.* 2017;75(12):1324-31. doi: 10.5603/KPa.2017.0148.
31. Abrahamowicz AA, Ebinger J, Whelton SP, Commodore-Mensah Y, Yang E. Racial and Ethnic Disparities in Hypertension: Barriers and Opportunities to Improve Blood Pressure Control. *Curr Cardiol Rep.* 2023;25(1):17-27. doi: 10.1007/s11886-022-01826-x.



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