





Trends in mortality from heart failure in Brazil: 1998 to 2019

Tendência da mortalidade por insuficiência cardíaca no Brasil: 1998 a 2019

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ABSTRACT: *Objective:* To analyze the trend of mortality from heart failure in Brazilians aged 50 years and over, within 21 years. *Methods:* Ecological study with time series analysis of mortality from heart failure in Brazil, according to regions and Federation Units, in individuals aged 50 years or older in the period from 1998 to 2019. Deaths that had heart failure as the underlying cause (coded as I50 according to the International Classification of Diseases) that occurred during the study period were included in the study. Data were obtained from the Mortality Information System of the Brazilian Ministry of Health. Statistical analyses were performed using the Stata 11.1 program, by estimating the mortality rate due to heart failure per 100 thousand inhabitants. In the trend analysis, the Prais-Winsten regression was used. *Results:* Between 1998 and 2019, 567,789 deaths from heart failure were recorded in adults aged over 50 years, which corresponds to an average rate of 75.5 per 100 thousand inhabitants. There was a downward trend per sex, regions, and in 23 Federation Units. The highest mortality rates were observed for older ages in all regions of the country. *Conclusion:* The trend in mortality rates from heart failure among Federation Units and Brazilian regions was downward over 21 years. There was an upward trend in mortality from heart failure in the northern region and in the category “other health facilities.”

Keywords: Heart failure. Aged. Time series studies. Mortality.

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RESUMO: *Objetivo:* Analisar a tendência da mortalidade por insuficiência cardíaca (IC) em brasileiros com 50 anos ou mais, em um período de 21 anos. *Métodos:* Estudo ecológico com análise de série temporal da mortalidade por IC no Brasil, segundo regiões e Unidades Federativas (UF), em indivíduos com 50 anos ou mais, no período de 1998 a 2019. Foram incluídos todos os óbitos registrados que tinham por causa básica a IC, codificada na Classificação Internacional de Doenças como I50, no período de 1998 a 2019. Os dados foram obtidos no Sistema de Informação sobre Mortalidade do Ministério da Saúde. As análises estatísticas foram realizadas no programa Stata 11.1, por meio do cálculo do coeficiente de mortalidade por IC por 100 mil habitantes. Na análise de tendência, foi utilizada a regressão de Prais-Winsten. *Resultados:* Entre os anos de 1998 a 2019, foram registrados 567.789 óbitos por IC em adultos com idade acima de 50 anos, o que corresponde à taxa média de 75,5 a cada 100 mil habitantes. A tendência foi decrescente por sexo, regiões e em 23 UF. As maiores taxas de mortalidade observadas ocorreram nas idades mais avançadas em todas as regiões do país. *Conclusão:* A tendência das taxas de mortalidade por IC entre as UF e regiões brasileiras foi decrescente ao longo de 21 anos. Houve tendência crescente da mortalidade por IC na região Norte e na categoria outros estabelecimentos de saúde.

Palavras-chave: Insuficiência cardíaca. Idosos. Estudos de séries temporais. Mortalidade.

INTRODUCTION

Heart failure (HF) is a cardiovascular disease (CVD) in which the heart may present structural or functional changes that cause the inability of ventricular filling and, consequently, the ejection of blood in an unsatisfactory amount to meet the body's needs. In some cases, cardiac output is preserved, but blood ejection occurs with elevated filling pressures at rest or during exertion¹.

CVDs are among the leading causes of death in the world, although a trend towards a reduction in incidence and mortality has been observed in several countries such as Colombia, Western European countries, the United States of America and Canada, and Brazil²⁻⁵. HF is considered the most prevalent disease, with an estimated 23 million people affected by the disease⁶, and the projection for 2030 is a 46% increase, affecting more than eight million people⁷.

In Brazil, HF is the main cause of hospitalization in the Brazilian Unified Health System (SUS). Between 2008 and 2018, there were more than two million hospitalizations and more than 252 thousand deaths. In 2019, the CVD mortality rate was 1.74 deaths per 100 thousand inhabitants, which corresponds to 364,132 deaths. Conversely, HF occupied 12.9% of hospitalizations, totaling an average of 196,271 hospitalizations, with a mortality rate of 11.48 deaths per 100 thousand inhabitants in the same year. The high rates of hospitalization and mortality generate expenses for the health service that exceed BRL 3 billion⁸⁻¹⁰.

The age group with the highest prevalence of HF is that of older adults, who commonly have multiple associated morbidities, such as hypertension, diabetes, chronic kidney and lung disease, which are related to an increased risk of HF¹. However, although individuals

aged 60 years are present in most studies on HF, there is an increase related to the disease in the age group of 50 years. Thus, knowing the magnitude of the disease in this age group enables interventions and management capable of improving the prognosis and survival of these individuals, especially in the identification of risk factors that are potentiated during the aging process, which cause changes in organs and, consequently, increase mortality from noncommunicable diseases^{5,11,12}.

Even with advances in the treatment and management of HF, it is still an important public health issue due to its high incidence, loss of quality of life for affected individuals, high rates of hospitalization, mortality, and high economic costs of health services⁹. In addition, epidemiological data on mortality from HF present disparities in the country. Hence, monitoring HF according to Brazilian regions allows subsidizing and intensifying proposals for planning actions aimed at health promotion and prevention. The objective of this study was to analyze the trend in mortality from HF in Brazil, according to regions and Federation Units (FU), in individuals aged 50 years or older, in a period of 21 years.

METHODS

This is an ecological study with time series analysis of mortality from HF in Brazil, according to regions and FU, on individuals aged 50 years or older, from 1998 to 2019.

Data were obtained from the Mortality Information System (*Sistema de Informação sobre Mortalidade* – SIM) of the Brazilian Ministry of Health (*Ministério da Saúde* – MS), by the Department of Informatics of SUS (DATASUS). Population estimates between the years 1980 and 2012 and the population projection from 2000 to 2030, by sex and age group, from the Brazilian Institute of Geography and Statistics (IBGE), were used.

All deaths recorded by the underlying cause of HF, coded in the International Classification of Diseases as I50, from 1998 to 2019, in individuals aged 50 years or older residing in Brazil, were included in the study. Data collection was also subdivided into Brazilian regions and FU.

Brazil is the largest country in South America, with an area of 8,540,345,538 km². It is subdivided into five regions (North, Northeast, Southeast, South, and Midwest) and has 27 FU. Its population projection, referring to the date of November 4, 2021, is 213,811,593 inhabitants, with the highest proportion of women (51.8%). The Human Development Index is 0.778, while the Gini index is 0.640¹³.

The study variables of interest were: sex (women; men); age group (50 to 59 years; 60 to 69 years; 70 to 79 years; 80 years or older); year of occurrence (1998 to 2019); place of residence (Brazil; Brazilian regions; FU); place of death (domicile; hospital; other health facilities; public highway; others). The variable “other health facilities” refers to the Health Centers or *Unidade Básica de Saúde* (UBS), polyclinics, medical offices, clinics, Mobile Health Unit, among others.

The database was created in a Microsoft Excel[®] spreadsheet. To demonstrate the spatio-temporal evolution, moving averages of the mortality rate (per 100 thousand inhabitants)

aggregated by FU were estimated. Ten series of four years were developed (1998–2001, 2000–2003, 2002–2005, 2004–2007, 2006–2009, 2008–2011, 2010–2013, 2012–2015, 2014–2017, 2016–2019). For drawing the thematic maps, the ArcGis software version 10.5 was used, with digital mesh in shapefile format provided by IBGE.

To estimate the mortality rates from HF, the following formula was devised: the number of deaths from HF of residents was the numerator; the total population of residents was the denominator; and, in the end, the result was multiplied by 100 thousand. The mortality rate was age-standardized using the direct method, considering as reference the world standard population of the World Health Organization, based on the 2010 Census and on world population projections for the 2000–2025 period. Crude rates were calculated per Brazilian macro-region and FU. The proportions of deaths from ill-defined causes and HF were estimated in relation to the total number of deaths (general mortality) in the period from 1998 to 2019.

To estimate the annual percent change (APC) of the rates, in the trend analysis, the Prais-Winsten regression was used¹⁴. The dependent variable was the HF mortality rate, whereas the independent variable corresponded to the years of the historical series. The quantitative trend estimation is calculated by the following expression: $APC = [-1 + 10b] * 100\%$. When the rate is positive, the time series is considered upward; when the rate is negative, it is classified as downward; and it is considered stationary when there is no significant difference between its value and zero ($p > 0.05$)¹⁴. This analysis was performed using the Stata 11.1 software.

The present study was approved by the Research Ethics Committee of Hospital Universitário Júlio Müller (Certificate of Presentation for Ethical Consideration — CAAE: 41330620.1.0000.5541), under opinion No. 4.513.048.

RESULTS

Between 1998 and 2019, 567,789 deaths from HF were recorded in adults over 50 years of age. In the period, the average rate was 75.5 deaths per 100 thousand inhabitants, and women accounted for the highest proportion ($n=299,093$; 52.67%).

In the Brazilian regions, the highest mortality rate was found in the South (86.93 deaths/100 thousand inhabitants), with the highest proportion of deaths in the Southeast ($n=266,916$; 47.01%). However, both showed a downward trend (APC: -4.83; confidence interval — 95%CI -5.28–4.37/APC -3.98; 95%CI -4.80–3.16, respectively), as well as the North (APC -3.16; 95%CI -3.45–2.88) and Midwest (APC -5.81; 95%CI -6.43–5.17) regions. Conversely, the Northeast region had an upward trend (APC 2.67; 95%CI 3.39–1.96). The North and Northeast regions had the lowest mortality rates in recent years, with 62.12 and 69.51 deaths/100 thousand inhabitants, respectively (Table 1). In these regions, the proportions due to ill-defined causes showed the highest values, though with a reduction over the years (APC -91.88; 95%CI -96.59–80.70; APC -96.87; 95%CI -99.54–78.83), respectively (Supplementary Material).

Table 1. Number, percentage of deaths, average rate per 100 thousand inhabitants, and mortality trend from heart failure per Federation Unit. Brazil, 1998 to 2019.

	Federation Unit	Deaths		Average rate	APC*	95%CI†	Interpretation
		n	%				
Midwest	Federal District	4,310	0.76	56.6	-6.63	-11.26--1.75	Downward
	Goiás	19,260	3.39	93.2	-4.79	-5.48--4.09	Downward
	Mato Grosso	6,802	1.20	76.3	-5.59	-6.51--4.76	Downward
	Mato Grosso do Sul	5,496	0.97	68.9	-9.08	-11.59--6.57	Downward
North	Acre	1,398	0.25	79.0	-2.86	-4.11--1.59	Downward
	Amazonas	3,882	0.68	46.5	-2.48	-3.49--1.45	Downward
	Amapá	725	0.13	54.1	-3.73	-6.05--1.35	Downward
	Pará	12,251	2.16	59.5	-2.48	-3.14--1.81	Downward
	Rondônia	3,651	0.64	42.3	-4.50	-5.45--3.54	Downward
	Roraima	521	0.09	49.7	1.22	-2.44--5.02	Stationary
	Tocantins	3,319	0.58	81.0	-5.28	-6.57--3.99	Downward
Northeast	Alagoas	8,588	1.51	84.9	-3.89	-5.16--2.59	Downward
	Bahia	37,599	6.62	71.6	-3.11	-3.54--2.68	Downward
	Ceará	20,182	3.55	63.8	-1.59	-2.56--0.61	Downward
	Maranhão	12,758	2.25	62.8	-1.00	-0.96--0.97	Stationary
	Piauí	9,258	1.63	82.5	-2.02	-4.38--0.39	Stationary
	Pernambuco	21,043	3.71	64.1	-4.80	-5.52--4.08	Downward
	Paraíba	13,598	2.39	87.2	-0.69	-2.80--1.47	Stationary
	Rio Grande do Norte	7,526	1.33	61.6	-1.63	-3.07--0.17	Downward
	Sergipe	3,738	0.66	55.9	-4.30	-5.28--3.30	Downward
South	Paraná	41,996	7.40	98.1	-5.38	-6.31--4.45	Downward
	Rio Grande do Sul	43,113	7.59	81.3	-4.84	-5.33--4.34	Downward
	Santa Catarina	19,859	3.50	79.5	-4.10	-4.73--3.50	Downward
Southeast	Espírito Santo	6,941	1.22	56.1	-9.60	-12.49--6.62	Downward
	Minas Gerais	74,418	13.11	89.1	-3.81	-4.54--3.08	Downward
	Rio de Janeiro	54,306	9.56	71.1	-3.32	-4.52--2.10	Downward
	São Paulo	131,251	23.12	73.8	-4.11	-5.07--3.14	Downward

*Annual Percent Change; †confidence interval of the Annual Percent Change.

In Figure 1, the spatial distribution of the mean annual rates of mortality from HF among the FU was calculated. The highest HF-related mortality rates were observed in the period from 1998 to 2007, in which most FU had rates between 75.0 and 150.0 deaths/100 thousand inhabitants, with smoothing over the years of study. In the first four triennia, the states of Paraná, Mato Grosso, Goiás, Minas Gerais, Tocantins, and the Federal District had high mortality rates (100.0 to 150.0 deaths/100 thousand inhabitants). Over the years, these rates have decreased, ranging from 25.0 to 75.0 deaths/100 thousand inhabitants (Figure 1).

Among the 27 FU, the highest mortality rates from HF in the study period were in Paraná (98.13 deaths/100 thousand inhabitants), Goiás (93.22 deaths/100 thousand inhabitants), and Minas Gerais (89.9 deaths/100 thousand inhabitants). The trend was stationary in the states of Roraima (APC 1.22; 95%CI -2.44–5.02), Piauí (APC -2.02; 95%CI -4.38–0.39), Paraíba (APC -0.69; 95%CI -2.80–1.47), and Maranhão (APC -100; 95%CI -0.96–0.97). The other states showed a downward trend (Table 1).

The trend of mortality from HF was downward between sexes over the analyzed years. In men, the highest mortality rates were observed in the Midwest and South regions of the country. Nevertheless, there was a reduction in the rate over the years in the Midwest

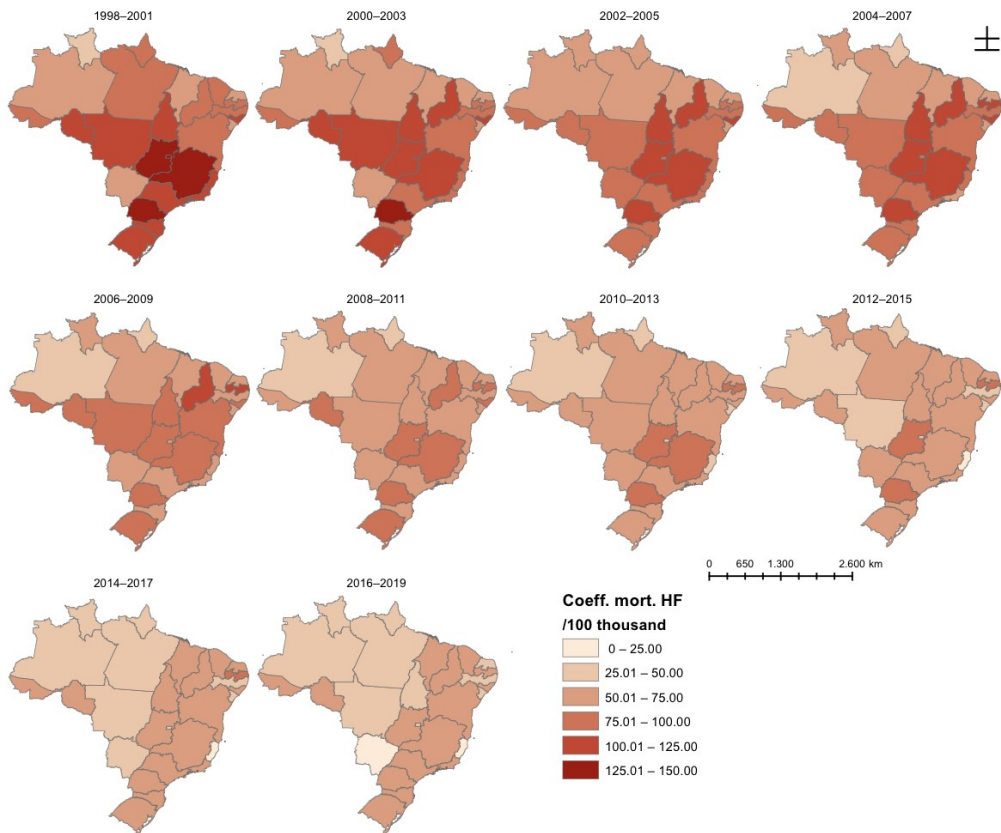


Figure 1. Spatial distribution of moving averages of heart failure mortality rates among Brazilians over 50 years of age. Brazil, 1998 to 2019.

region. Regarding women, the lowest rates were observed in the North and Northeast regions, being 54.76 and 63.22 deaths/100 thousand inhabitants, respectively (Figure 2a).

The mortality rate from HF, by age group, increased with advancing age in all Brazilian regions, with a higher occurrence in individuals aged 80 years or older ($n=257,277$; 45.31%). The trend of HF occurrence over the years was downward in all analyzed age groups (50 to 59 years: APC -4.94; 95%CI -5.38–-4.49; 60 to 69 years: APC -4.87; 95%CI -5.65–-4.10; 70 to 79 years: APC -4.68; 95%CI -5.14–-4.21; 80 years or older: APC -2.68; 95%CI -3.08–-2.29) (Figure 2b).

Regarding the place of occurrence, the highest proportion of deaths from HF was in the hospital ($n=406,771$; 71.64%). The trend was upward only for other health facilities (APC 7.60; 95%CI 3.92–11.42) (Table 2).

DISCUSSION

This study analyzed the trend of HF mortality in Brazil, presenting a spatial overview of mortality rates in all FU and regions of the country, from 1998 to 2019. The analyses showed that the trend of mortality from HF in Brazilian individuals over 50 years of age was downward over 21 years, and this trend was also observed in both sexes and in 23 FU.

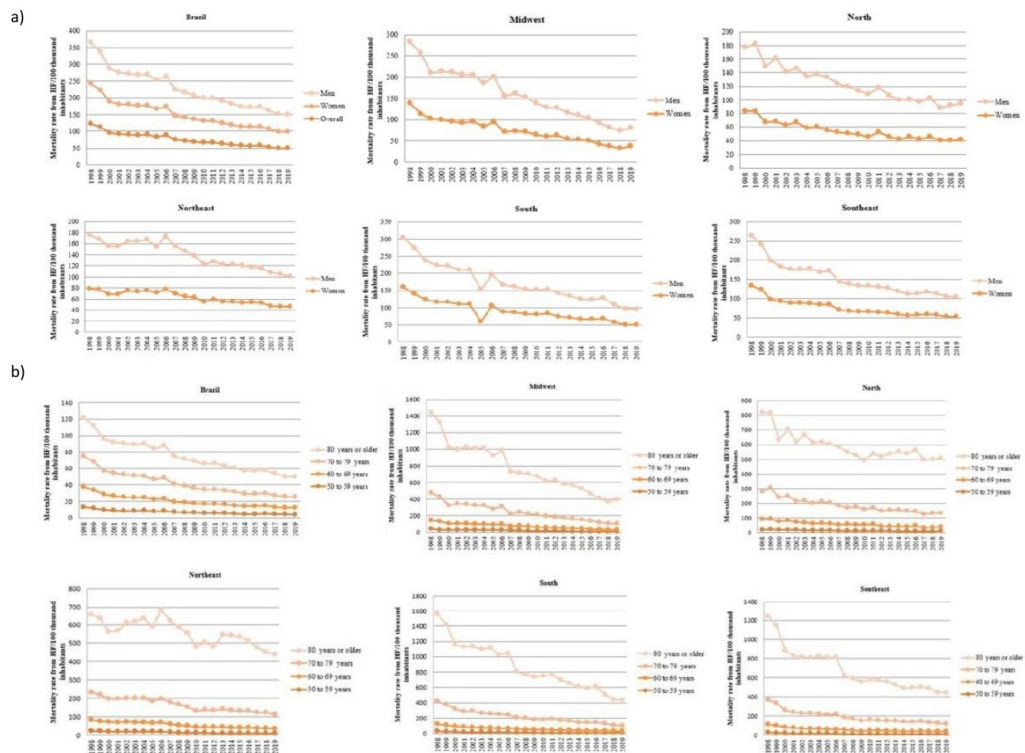


Figure 2. Heart failure mortality rate per sex and age group, per region. Brazil, 1998 to 2019.

These results may be associated with prevention actions, the control of comorbidities associated with HF, the advancement of drug therapy, greater adherence to treatment and its continuity, as well as lifestyle changes^{1,15}.

Few epidemiological data on HF are known, especially in middle-income countries such as Brazil. However, it is known in the scientific literature that, in developed countries, there is stabilization and reduction in the incidence of mortality from HF^{1,15}.

Despite the methodological differences, another study carried out in Brazil, from 2008 to 2015, showed a significant decline, of 10.7%, in the mortality rate from HF¹⁶. The research conducted by Santos et al.¹⁷, despite not presenting an analysis of annual percent change, verified a progressive reduction in HF mortality rates in Brazil from 2008 to 2018. Other countries that showed a downward trend over the years were Argentina, Spain, and the United States of America¹⁸⁻²⁰.

Table 2. Trends in proportional mortality from heart failure, per place of occurrence, per Brazilian regions. Brazil, 1998 to 2019.

Place of occurrence	Deaths		Average proportional mortality			APC*	95%CI†		Interpretation	
	n	%								
Hospital	406,771	71.64	53.88			-3.61	-3.96--3.25		Downward	
Health facilities	22,296	3.92	2.70			7.60	3.92--11.42		Upward	
Domicile	123,400	21.73	16.82			-5.50	-6.03--4.97		Downward	
Public highway	3,736	0.66	0.53			-7.68	-8.58--6.77		Downward	
Others	8,747	1.54	1.19			-5.03	-6.55--3.49		Downward	
Ignored	2,839	0.50	0.51			-19.51	-23.44--15.39		Downward	
	North		Northeast			South	Southeast		Midwest	
	Deaths		Deaths			Deaths	Deaths		Deaths	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Hospital	18,786	42.7	89,054	44.5	72,540	55.7	200,564	53.7	25,827	50.8
Health facilities	446	1.0	2,683	1.3	1,842	1.4	16,463	4.4	862	1.7
Domicile	5,912	13.4	39,559	19.7	25,703	19.7	44,108	11.8	8,118	15.9
Public highway	220	0.5	1,113	0.5	812	0.6	1,209	0.3	382	0.7
Others	334	0.8	1,328	0.6	2,264	1.7	4,236	1.1	585	1.2
Ignored	49	0.1	553	0.3	1,807	1.4	336	0.1	94	0.8

*Annual Percentage Change; †95% confidence interval of the Annual Percentage Change; APC: Annual Percentage Change.

Thus, the country's development over the years may have contributed to the reduction of mortality from HF, and the associated factors are the implementation of public policies, the expansion of healthcare networks, the expansion of Primary Health Care (PHC) coverage, and the ease of access to these services as well as socio-economic growth and the reduction of social inequality¹⁷. Between 2000 and 2016, there was an expansion of PHC by the Family Health Strategy (FHS) and an increase in financial transfers destined for primary health care, both considered the main initiatives in the country, which significantly contributed to the reduction of hospitalizations for HF^{21,22}.

Another factor that may have impacted this reduction is the global plan to combat non-communicable diseases (NCDs), including CVD, of which Brazil is a part and whose main goal is to reduce, by 2030, early mortality by 2% per year, mainly in individuals under 70 years of age²³. In addition, the HF guideline based on current scientific evidence proposes innovative and more effective diagnoses, treatments, and therapeutic interventions, which have a positive impact on clinical practice and epidemiological data, in addition to providing information for formulating micro-policies in the several spheres of health and regions of the country²⁴.

Concerning the regions, the Southeast had the highest occurrence of mortality from HF, as described in other studies^{25,26}. This region is mostly characterized by the older adult population. In addition, it has the largest number of hospitals and availability of access to specialized services²⁷, which allows for a more accurate diagnosis on death certificates. It is worth considering that the classification of the cause of death can be impaired in less favored regions concerning specialized services, which leads to a greater risk of error in identifying the underlying cause of death.

Among 23 FU, the trend of HF mortality rate was downward. A study carried out in the state of Paraíba showed that, between 2008 and 2017, there was a reduction of 2.5%¹⁶, and in the state of São Paulo, when comparing the rates of the years 1992–1993 with those of 2008–2009, there was a decrease of 29%²⁸. The disparities found between the FU and Brazilian regions may be related to cultural, demographic, and socioeconomic characteristics, to diversities of the etiology of the disease, and to the implementation of policies aimed at HF, in addition to indicating the fragility of notifications/underreporting of cases, the access to health services, and their distribution^{29,30}.

Despite these weaknesses, there is a trend towards a reduction in deaths from HF, as well as from ill-defined causes, indicating a qualitative improvement in mortality statistics. However, the North and Northeast regions maintain high rates, thus compromising the analysis of mortality according to causes of death.

The highest mortality rates were verified in men, while the highest proportion of deaths were among women, as in another study, which obtained a similar finding¹⁸. The increase in the rate in the male population may be related to greater vulnerability to chronic diseases, the worse prognosis of the disease as well as the lack of the habit of attending health services by this population³¹.

Among age groups, the mortality trend was downward. Nonetheless, the highest mortality rates occurred in individuals aged 80 years or older. Mortality in these people is homogeneous in all regions of the country. Despite the socioeconomic and cultural differences, this result shows that the population has had broader access to specialized health services, which contributes to the longer survival of these individuals. Consequently, high mortality rates are shifted to older ages^{15,32}.

These data tend to increase with population aging in Brazil, which reinforces the need for public policies that address this population and provide them with a better quality of life and maintenance of their functional capacity³³. Furthermore, the high rates of morbidity and mortality from HF in older adults result from physical and psychological factors²⁹. For this population, the clinical scenario is complex, with the presence of multiple signs and symptoms associated with other comorbidities¹¹. Fatigue and dyspnea are the main symptoms that can affect the performance of activities of daily living and the social life of these individuals. In addition to physical impairments, patients with HF may have depressive symptoms that reduce their ability to self-care, leading to low adherence to disease treatment and worsening of the general clinical condition, factors that increase the risk of recurrent hospitalizations^{34,35}.

As for the place where the deaths occurred, the highest rates were found in the hospital setting. Patients with HF present complications as a result of associated comorbidities and the chronic course of the disease, which lead to recurrent hospitalizations¹⁷. Moreover, in many situations, the individual with HF is hospitalized only in severe clinical conditions, due to the difficulty of accessing specialized health services or even the unavailability of hospital beds³⁶.

In this study, however, we could observe an upward trend of deaths from HF in the category “other health facilities,” which shows that individuals with HF may have been referred to less complex health services, and the death may have occurred due to inadequate management and health care. In addition, this result can be attributed to the strengthening and expansion of PHC, as well as the articulation of emergency services, which expand the responses to approach HF at different healthcare levels³⁷.

In the literature, there is a gap in studies on mortality from HF in these health services, which is why there is a need to perform research aimed at identifying the contributing factors for this increase and specifically pointing out which health facility in question, because in the SIM there is no separation in this category, which includes Health Centers/UBS, polyclinics, medical offices, clinics, Mobile Health Unit, among others.

Although this study has limitations related to the specific aspects of research carried out with secondary databases, such as an error in the classification of death and information presented in an aggregated way (as in the category “other health facilities”), the obtained results are relevant, as they allowed the visualization of the geographic areas with the highest mortality rate from HF in the Brazilian regions, in the period of 21 years. Therefore, our findings demonstrate the relevance of the topic as a public health issue, especially in the study age group (older adults), requiring the formulation

of health policies that consider national and regional aspects. In addition, it is important to carry out future research to identify factors that contribute to the decrease in mortality from HF, allowing the intensification of care for these patients, aiming at improving their quality of life.

We conclude that the trend of mortality rates from HF in adults aged 50 years or older among FU and Brazilian regions was downward over 21 years. There is an important variation among FU; however, the age group of 80 years or older was the one with the highest mortality rates. Besides, there was an upward trend in mortality from HF in the category “other health facilities.”

With the achieved results, the study allowed us to trace the situational diagnosis of mortality from HF in Brazil and emphasize the importance of developing research that support strategies and promote public policies aimed at improving the aging process with quality and better health conditions for that population.

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