CLINICAL AND EPIDEMIOLOGICAL PROFILE OF DEATHS FROM CARDIOVASCULAR DISEASES BEFORE AND AFTER THE COVID-19 PANDEMIC IN THE STATE OF MARANHÃO

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ABSTRACT

Introduction: Cardiovascular Diseases (CVD) are defined by a set of diseases of the heart and blood vessels. In the early years of the COVID-19 pandemic, there was a significant reduction in hospital admissions for all types of CVD. Objective: To analyze the clinical and epidemiological profile of deaths due to cardiovascular diseases in the state of Maranhão. Methods: Epidemiological, documentary, quantitative, descriptive and retrospective research, carried out jointly with the Department of Informatics of the Unified Health System, through the Mortality Information System, from 2015 to 2023. Results: A total of 71,052 deaths were recorded, with an annual average of 7,894.67 cases and a mortality rate of 111.61 per 100,000 inhabitants. Before the pandemic, deaths varied slightly, but increased significantly in 2020, reaching a peak in 2022. Most of the victims were men and elderly people aged 80 years or older, with a predominance of acute myocardial infarction and stroke. Vulnerability was higher among brown people and those with low education. Conclusion: These data reinforce the need for effective public health strategies to prevent and manage CVD, especially during health crises, such as the COVID-19 pandemic, which has aggravated disparities and challenges in cardiovascular care.

Keywords: Cardiovascular Diseases. Deaths. COVID-19.

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INTRODUCTION

Cardiovascular diseases (CVD) continue to be the leading causes of death globally and in Brazil. Between 1990 and 2019, global CVD mortality increased from 12.1 million to 18.6 million, driven by population aging and risk factors such as hypertension, diabetes, and obesity. In Brazil, CVD surpassed other chronic non-communicable diseases as the main cause of mortality, especially acute myocardial infarction and stroke (INSTITUTE FOR HEALTH METRICS AND EVALUATION, 2019).

The COVID-19 pandemic has exacerbated existing vulnerabilities in the management of CVD. Studies report reduced access to health services, delayed diagnoses, and interrupted treatments as contributors to worsening cardiovascular outcomes (Brasil, 2024). This study aims to analyze the clinical and epidemiological profile of CVD-related deaths in Maranhão before and after the pandemic, identifying temporal and demographic patterns to support public health actions.

METHOD

This was an epidemiological, documentary, quantitative, descriptive and retrospective research. Data were extracted from the Mortality Information System (SIM/DATASUS) in December 2024, covering the period from 2015 to 2023. Deaths due to CVD reported in Maranhão, categorized by ICD-10 codes related to acute myocardial infarction (I-21), stroke (I-64), and other cardiovascular diseases, were included. Deaths of residents of other states or incomplete records were excluded. Annual population data from the Brazilian Institute of Geography and Statistics (IBGE) were used to calculate mortality rates per 100,000 inhabitants. All information was systematically reviewed to ensure the integrity and consistency of the records. The data was organized into tables and analyzed using Microsoft Excel 2020. The analysis focused on descriptive statistics. Comparative graphs and tables have been developed to illustrate variations in mortality patterns before and after the onset of the COVID-19 pandemic. Although the study is descriptive, its methodological robustness ensures the validity of the observations made. According to resolutions No. 466/12 and No. 510/16 of the National Health Council, as this was an epidemiological and documentary research, the present study did not require authorization from the Research Ethics Committee

RESULTS AND DISCUSSION

In the period from 2015 to 2023, 71,052 deaths from CVD were reported in the state of Maranhão, with an annual average of 7,894.67 cases and an average mortality rate of 111.61 deaths per 100,000 inhabitants.

Graph 1 shows the distribution of CVD deaths in the state of Maranhão between 2015 and 2023.

Graph 1. Distribution of deaths from cardiovascular diseases, according to the year of notification, Maranhão, 2015 to 2023. (n = 71,052)
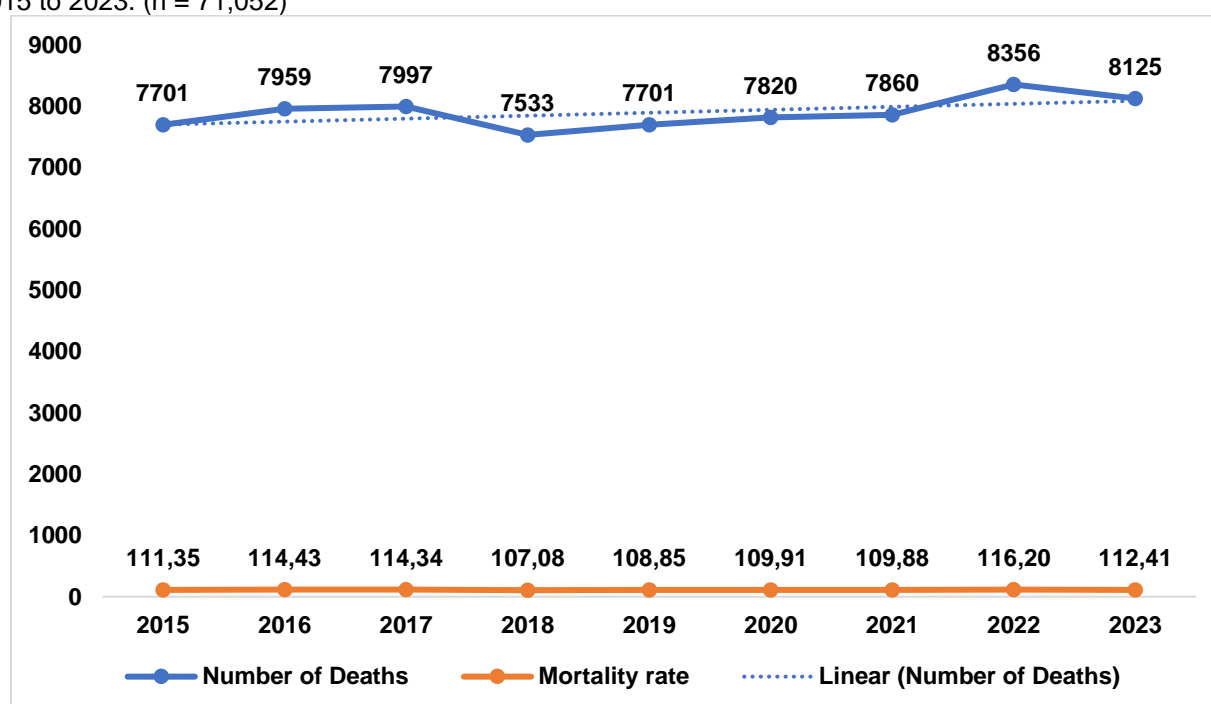
Source: DATASUS-SIM (2024).

During this period, the number of deaths varied slightly, with the lowest number of cases in 2018, with 7,533 deaths, and the highest in 2022, with 8,356 deaths. The mortality rate also showed small fluctuations, with the highest rate being reported in 2022, with 116.20 deaths for every 100,000 inhabitants. Overall, the number of deaths remained relatively stable, with a slightly upward trend in the linear trend line especially from 2019 onwards, marked by the onset of COVID-19 pandemic cases.

Silva *et al.* (2022) conducted a study on the epidemiological profile of CVD mortality in Brazil between 2016 and 2019 and observed that, in 2019, there was the highest number of CVD deaths, totaling about 364,132 deaths. During the four consecutive years (2016 to 2019), the Southeast region led with the highest percentage of deaths, followed by the Northeast region.

Similarly, Sales Filho, Costa, and Júnior (2023) analyzed the epidemiology of CVDs in the state of Acre, between 2009 and 2019, and found that about 8,492 people died from CVD in the state during this period. In Brazil, these diseases resulted in the death of 3,787,426 individuals, a number that has a great impact both on the lives of the population and on national public health.

This increase, especially noticeable from 2019 onwards, coincides with the beginning of the COVID-19 pandemic, suggesting that the impact of the health crisis may have influenced both directly, with COVID-19 as a cause of death, and indirectly, by overloading the health system and hindering access to treatment for other conditions, such as CVD (VICTOR *et al.,* 2022).

Global epidemiology of the virus has revealed that patients with preexisting CVD are disproportionately more vulnerable to increased morbidity and mortality related to their condition (GUO *et al.,* 2020).

Graph 2 shows the distribution of deaths from CVDs in Maranhão, divided between the periods before and during/after the COVID-19 pandemic, from 2015 to 2023.

Graph 2. Distribution of deaths from cardiovascular diseases, according to the notification period, related to the COVID-19 pandemic, Maranhão, 2015 to 2023. (n = 71,052)
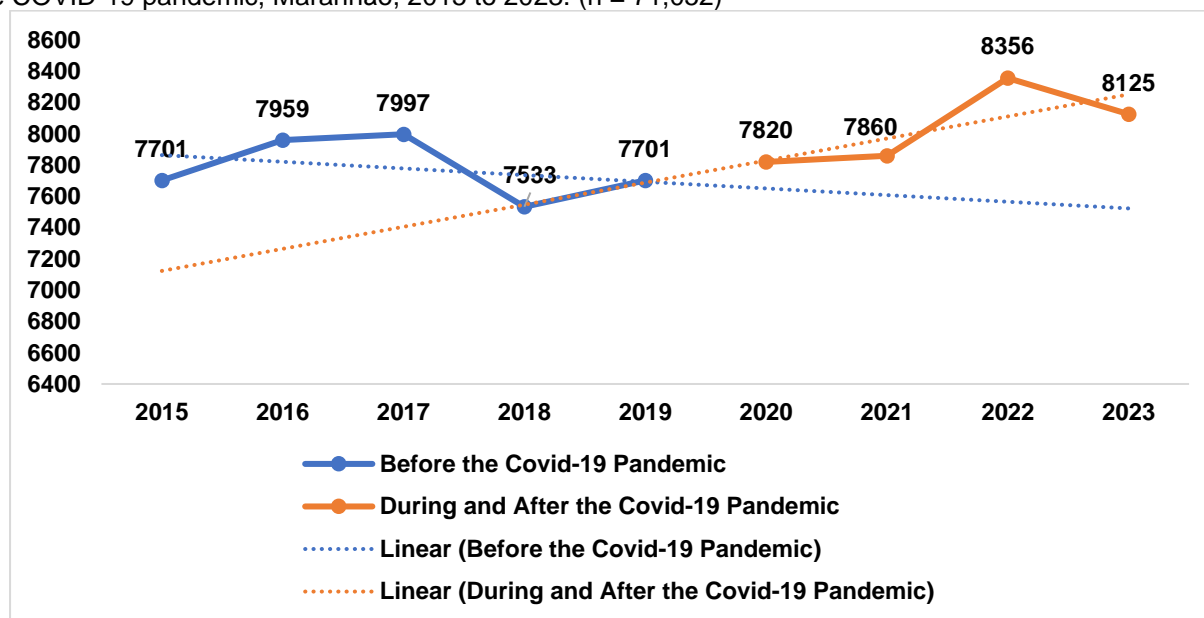
Source: DATASUS-SIM (2024).

Before the pandemic, the number of deaths from CVD showed a slight variation, with a noticeable drop between 2017 and 2018, a period in which deaths fluctuated between 7,997 and 7,533. The downward trend may be associated with advances in the

diagnosis and treatment of chronic diseases, as well as improvements in health services and preventive campaigns aimed at controlling risk factors (DE SOUZA; WATERS, 2023). These factors, combined with public health promotion policies, may have contributed to the gradual reduction in CVD deaths in the pre-pandemic period.

However, the arrival of COVID-19 in 2020 caused an abrupt change in this trajectory. During and after the pandemic, there was a significant increase in the number of deaths, with a peak in 2022 (8,356 deaths) and a slight decrease in 2023 (8,125 deaths). This increase can be explained by several factors. First, COVID-19 has been associated with cardiovascular complications both directly, by causing inflammation in the cardiovascular system, and indirectly, by overloading the health system, making it difficult to access regular care and treatment of preexisting chronic diseases (VOSKO; ZIRLIK; BUGGER, 2023; NORMANDO *et al.,* 2021).

In addition, the pandemic has caused delays in CVD diagnosis and treatment, with many patients avoiding or postponing visits to hospitals and clinics for fear of contracting the virus. This long-term impact on cardiovascular health may have contributed to the continued increase in CVD deaths, even after the pandemic was initially controlled (DALE *et al.,* 2023). Another relevant factor is the worsening of poor acquired lifestyles, which may also have exacerbated preexisting health problems, increasing the number of deaths (VOSKO; ZIRLIK; BUGGER, 2023).

Table 1 shows the sociodemographic characterization of deaths from CVDs in Maranhão, in the period from 2015 to 2023.

Table 1. Sociodemographic characterization of deaths from cardiovascular diseases in Maranhão, from 2015 to 2023. (n = 71,052)

Variables	N	%
Gender		
Female	30.610	43,1
Male	40.433	56,9
Ignored	9	0,0
Age group		
0 to 9 years	119	0,2
10 to 19 years old	232	0,3
20 to 29 years old	702	1,0
30 to 39 years old	1.816	2,6
40 to 49 years old	4.082	5,7
50 to 59 years old	7.648	10,8
60 to 69 years old	13.151	18,5
70 to 79 years old	18.450	26,0
80 years and over	24.828	34,9
Ignored	24	0,0
Color/Race		

White	13.286	18,7
Black	8.440	11,9
Yellow	267	0,4
Brown	47.631	67,0
Indigenous	241	0,3
Ignored	1.187	1,7
Schooling		
No	30.002	42,2
1 to 3 years	13.419	18,9
4 to 7 years	12.876	18,1
8 to 11 years	7.986	11,2
12 years and over	1.654	2,3
Ignored	5.115	7,2
Marital status		
Single	16.655	23,4
Married	26.564	37,4
Widower	15.885	22,4
Divorced	1.949	2,7
Other	6.639	9,3
Ignored	3.360	4,7

Source: DATASUS-SIM (2024).

Most deaths occurred among males, representing 56.9% of deaths. The most affected age group was 80 years and over, with 24,828 deaths (34.9%), followed by the 70 to 79 age group, with 18,450 deaths (26.0%). In relation to color/race, the highest prevalence was among brown persons, who correspond to 67.0% of deaths, while whites and blacks represent, respectively, 18.7% and 11.9%.

Confirming these results, the study by Fonseca *et al.* (2022) pointed out that, in the state of Tocantins, between 2015 and 2019, males were the most affected, with 1,859 deaths (54.77%), while females recorded 1,535 deaths (45.22%), with the elderly being the most affected in all the years analyzed, totaling 1,836 deaths (54.09%), with most deaths occurring in people who declared themselves brown, totaling 2,047 cases (60.31%).

Similarly, Sales Filho, Costa, and Júnior (2023) observed that, in the state of Acre, the number of deaths fluctuated over the period, but remained consistently higher among men (57.4%) compared to women (42.6%). And they found that the most affected age group was 60 to 80 years or older (70%), and among these, the most affected were individuals aged 80 years or older, with 2,758 deaths. Brown color/race was predominant, corresponding to approximately 66% of deaths.

Like the findings of this research, the study by Hata *et al.* (2019), carried out in Paraná between 2008 and 2017, revealed that 53.1% of deaths occurred in men, while 46.9% were in women, and the elderly were the most affected. However, they differed in

terms of color/race, since the highest number of deaths was recorded among white people, with 79.6%, followed by brown individuals, with 8,007 cases (12.8%).

In addition, Pellense *et al.* (2021) identified that most deaths from CVD between 2015 and 2019 occurred among the elderly, especially those aged 80 years or older, which is in line with the results of this research. On the other hand, they observed that the highest proportion of deaths was among white people (62.14%), followed by brown people (28.38%) and blacks (5.87%), which differs from the data found in this study for the state of Maranhão.

The Brazilian Society of Cardiology (SBDC, 2019) highlights that CVD can affect people of all ages, but the risk begins to increase significantly after the age of 60, doubling with each decade that follows. In addition, it is important to mention that the higher incidence of deaths among men reflects their greater vulnerability to health problems, especially chronic diseases. This is related to the fact that men tend to take less care of their own health and seek medical services less compared to women (SILVA *et al.,* 2022).

Regarding schooling, most of the deaths in this survey occurred among people without formal education, totaling 42.2%, and 18.9% had between 1 and 3 years of schooling. As for marital status, the most affected group was married, with 37.4% of deaths, followed by singles, with 23.4%.

Sales Filho, Costa and Júnior (2023) also demonstrated that mortality increases as the level of education decreases. Individuals without any level of education accounted for 33.1% of deaths. Similarly, Fonseca *et al.* (2022) found that the highest number of cases was recorded among those with "none" level of education, totaling 1,435 deaths (42.28%) in the period analyzed, with married marital status being the most reported, with 1,182 deaths (34.82%).

Table 2 presents the sociodemographic characterization of CVD deaths in Maranhão, comparing the periods before the pandemic (2015–2019) and during/after the pandemic (2020–2023).

Table 2. Sociodemographic characterization of deaths from cardiovascular diseases in Maranhão, before and during/after the pandemic. (n = 71,052)

Variables	2015 – 2019 (n=38,891)		2020 – 2023 (n = 32,161)	
	N	%	N	%
Sex				
Female	16.760	43,1	13.850	43,1
Male	22.123	56,9	18.310	56,9
Ignored	8	0,0	1	0,0

Age group				
0 to 9 years	74	0,2	45	0,1
10 to 19 years old	135	0,3	97	0,3
20 to 29 years old	420	1,1	282	0,9
30 to 39 years old	1.025	2,6	791	2,5
40 to 49 years old	2.214	5,7	1.868	5,8
50 to 59 years old	4.272	11,0	3.376	10,5
60 to 69 years old	7.232	18,6	5.919	18,4
70 to 79 years old	10.131	26,0	8.319	25,9
80 years and over	13.374	34,4	11.454	35,6
Ignored	14	0,0	10	0,0
Color/Race				
White	7.395	19,0	5.891	18,3
Black	4.543	11,7	3.897	12,1
Yellow	151	0,4	116	0,4
Brown	25.906	66,6	21.725	67,6
Indigenous	128	0,3	113	0,4
Ignored	768	2,0	419	1,3
Schooling				
No	17.012	43,7	12.990	40,4
1 to 3 years	7.545	19,4	5.874	18,3
4 to 7 years	6.891	17,7	5.985	18,6
8 to 11 years	3.849	9,9	4.137	12,9
12 years and over	740	1,9	914	2,8
Ignored	2.854	7,3	2.261	7,0
Marital status				
Single	8.535	21,9	8.120	25,2
Married	15.059	38,7	11.505	35,8
Widower	8.767	22,5	7.118	22,1
Divorced	951	2,4	998	3,1
Other	3.714	9,5	2.925	9,1
Ignored	1.865	4,8	1.495	4,6

Source: DATASUS-SIM (2024).

In both periods, most deaths occurred among men (56.9%), with the age group of 80 years and over being the most affected, accounting for 34.4% of deaths before the pandemic and 35.6% during/after. With regard to color/race, the brown population was the most affected, accounting for 66.6% and 67.6% of deaths, respectively, before and during/after the pandemic.

In a study conducted by Normando *et al.* (2020), an increase in the lethality of hospitalizations for cardiovascular diseases was observed, which is directly related to the severity of COVID-19. This increase in the case fatality rate has particularly affected the economically active portion of the population, aged between 20 and 59 years, which brings an additional concern in the midst of the ongoing economic crisis.

Marinho *et al.* (2022) identified an increase in the mortality rate of 26.3% (ranging from 23.3% to 29.3%) among black and brown individuals in Brazil in 2020, in contrast to a rate of 15.1% (from 14.1% to 16.1%) among white people. These data are in line with the

results of the present study, which revealed that, during the pandemic, most CVD deaths in Maranhão occurred in people who self-declared themselves brown. The authors also noted that excess mortality was more pronounced among men, with rates of 23.3% compared to 16.8% for women, in all regions of the country.

It is noteworthy that this pattern can be attributed to a combination of biological and behavioral factors that make men more susceptible to CVD, including a greater propensity for unhealthy lifestyle habits, as well as a higher risk of exposure to stress factors (Bett *et al.,* 2022).

This high mortality rate among the elderly is worrisome, since this age group is naturally more vulnerable to complications resulting from chronic diseases, including CVD. The aging of the population, associated with an increase in comorbidities, may be contributing to this situation, making it essential to develop public health strategies focused on the prevention and management of diseases in this age group (ALENCAR *et al.,* 2021).

As for education, the largest group was that of people without education, with 43.7% of deaths before the pandemic and 40.4% during/after. Regarding marital status, married people had the highest prevalence of deaths, representing 38.7% before the pandemic and 35.8% during/after.

Low education may be associated with limited understanding of risk factors, restricted access to health information, and difficulties in adopting healthy lifestyles. Individuals without formal education may also face barriers to accessing adequate health services, resulting in late diagnoses and inadequate treatment of conditions that contribute to cardiovascular mortality (VICTOR *et al.,* 2022).

These data show a consistent profile of CVD victims in the state, with only slight variations between the periods analyzed, reinforcing the vulnerability of groups such as the elderly, browns, and people with low education.

The mechanisms that contribute to the development of CVD are increasingly being recognized as overlapping with pathways that regulate immune system function. An example of this is age, which is the main risk factor for CVD, and the impact of aging on immune function may be equally relevant to the susceptibility and severity of COVID-19 (DRIGGIN *et al.,* 2020).

Furthermore, based on the results mentioned, it is essential to highlight the high number of records classified as "unknown/blank". This may indicate a failure in the health

surveillance system, significantly compromising the ability to identify the epidemiological situation of the state for this variable during the period analyzed.

Table 3 presents the number of deaths reported by CVDs in Maranhão, according to the ICD-10 category, in the period from 2015 to 2023.

Table 3. Distribution of deaths due to cardiovascular diseases, according to the ICD-10 category, Maranhão, 2015 to 2023. (n= 71,052)

Variables	N	%
ICD-10 Category		
I-20 Angina pectoris	70	0,1
I-21 Acute myocardial infarction	28.950	40,7
I-22 Recurrent myocardial infarction	122	0,2
I-23 Some Current Complications Subsequent to Acute Myocardial Infarction	2	0,0
I-24 Other Acute Ischemic Heart Diseases	347	0,5
I-25 Chronic ischemic heart disease	1.935	2,7
I-50 Heart failure	7.207	10,1
I-60 Hemorragia subaracnóidea	1.260	1,8
I-61 Intracerebral Hemorrhage	4.190	5,9
I-62 Other non-traumatic intracranial hemorrhages	285	0,4
I-63 Infarto cerebral	536	0,8
I-64 Stroke not specified as ischemic hemorrhage	17.460	24,6
I-66 Occlusion and stenosis of cerebral arteries that do not result in cerebral infarction	1	0,0
I-67 Other cerebrovascular diseases	4.102	5,8
I-69 Sequelae of cerebrovascular diseases	4.585	6,5

Source: DATASUS-SIM (2024).

According to the data presented above, most deaths from CVDs were cases diagnosed in the ICD-10 category, I 21 - Acute myocardial infarction, with 28,950 notifications (40.7%), followed by deaths by ICD-10, I 64 - Stroke not specified as ischemic hemorrhagic, with 17,460 (24.6%) occurrences.

This high prevalence of acute myocardial infarctions (ICD-10 I-21) indicates a worrying public health situation, since this type of event is often preceded by risk factors that can be prevented (BETT *et al.,* 2022). In addition, the second highest number of deaths, related to ICD-10 I-64, which covers cerebrovascular accidents (CVA) not specified as hemorrhagic or ischemic, also highlights the severity of cerebrovascular diseases in the region. Strokes are one of the leading causes of death and disability worldwide (DE SOUZA; WATERS, 2023), and the fact that a significant proportion of deaths are not clearly classified as hemorrhagic or ischemic may point to a need for better registration and diagnosis in medical care (NASCIMENTO, 2019).

According to the findings of Sales Filho, Costa, and Júnior (2023), in the state of Acre, among the diseases analyzed, ICD I-21, I-50 and cerebrovascular diseases, excluding cardiomyopathies, accounted for approximately 68.1% of CVD deaths in the state and 62.5% in the country as a whole.

In addition, a study conducted by Wu *et al.* (2020) in Wuhan, China, revealed that among 44,672 confirmed cases of COVID-19, case fatality rates were significantly higher among patients with CVD (10.5%) and hypertension (6.0%), values that far exceed the global case fatality rate of 2.3%. These data highlight the vulnerability of patients with cardiovascular conditions to infections, especially in situations of health crisis such as the COVID-19 pandemic.

Graph 3 shows the distribution of deaths from CVDs, according to the place of occurrence, in Maranhão, from 2015 to 2023.

Graph 3. Deaths from cardiovascular diseases according to place of occurrence, Maranhão, 2015 to 2023. (n= 71,052)
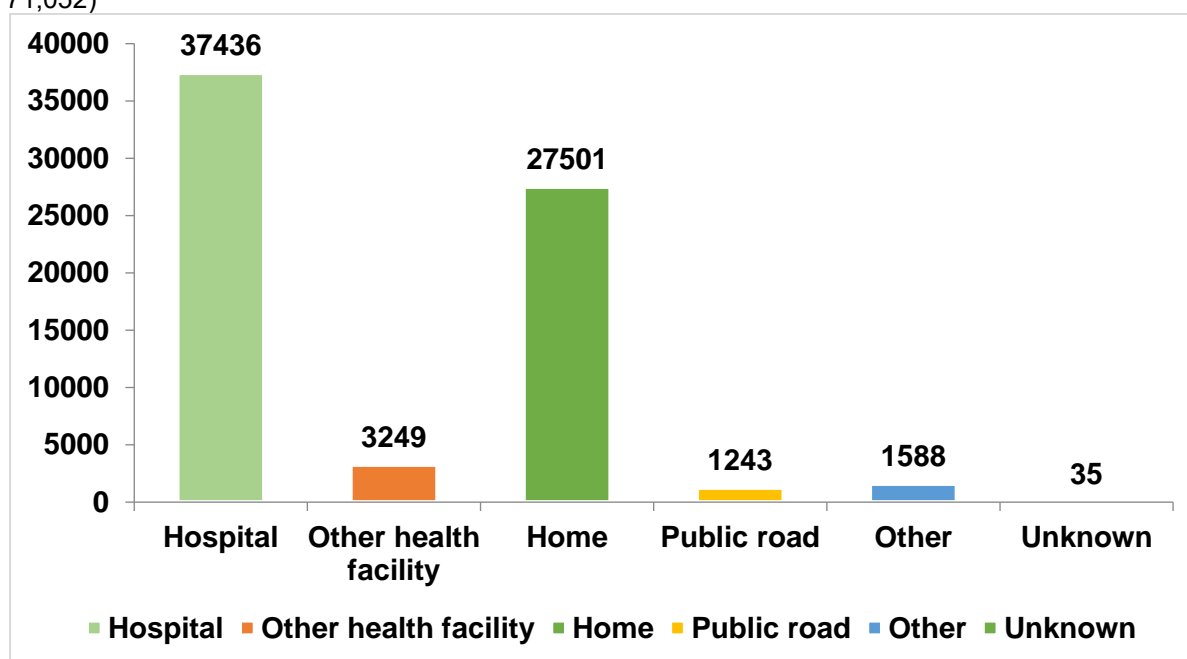
Source: DATASUS-SIM (2024).

It is possible to verify that, in the period evaluated, most deaths due to CVD in Maranhão occurred both in the hospital environment (52.7%) and in the home environment (38.7%).

The prevalence of deaths in the hospital environment reflects the search for medical treatment in advanced stages of CVD, when complications are already severe enough to

require hospitalization, possibly due to late diagnoses or difficulties in regular follow-up (NASCIMENTO *et al.,* 2021; NORMANDO *et al.,* 2021).

At the same time, the high rate of household deaths suggests barriers in accessing timely medical care, especially in areas far from urban centers, where the hospital network is limited. This may be related to logistical challenges, lack of resources, and socioeconomic issues, which prevent regular access to essential medical care for the control of these diseases (GIATTINO *et al.,* 2022; ARMSTRONG *et al.,* 2022).

In addition, these findings are in line with other studies that have shown that, during the pandemic, there was a decrease in the number of patients seeking medical care, an increase in hospitalizations and procedures related to CVDs, as well as patients arriving at hospitals in more severe stages. As a consequence, there was an increase in in-hospital mortality due to CVD (JARDIM *et al.,* 2021; NASCIMENTO *et al.,* 2021).

Similarly, Sales Filho, Costa, and Júnior (2023) analyzed the state of Acre and found that, between 2009 and 2019, most deaths (about 69%) occurred in hospitals, followed by 23.8% of deaths at home and 1.6% on public roads. Silva *et al.* (2022) also observed that, in Brazil, the most common place for the occurrence of deaths was the hospital environment in all years evaluated.

In addition, a relevant and widely mentioned point in the literature is the worrying increase in deaths occurring at home (BRANT *et al.,* 2020; BRANT *et al.,* 2022). This demonstrates that the pandemic has had a profound impact on the management of CVD in Brazil. Brant *et al.* (2022), for example, reported that, in Belo Horizonte (MG), the increase in household deaths due to CVD in 2020 was more significant among socially vulnerable individuals.

Graph 4 shows CVD deaths according to the municipalities in Maranhão that reported the highest number of deaths in the period from 2015 to 2023

Graph 4. Deaths from cardiovascular diseases, according to the municipality of notification, Maranhão, 2015 to 2023. (n= 71,052)
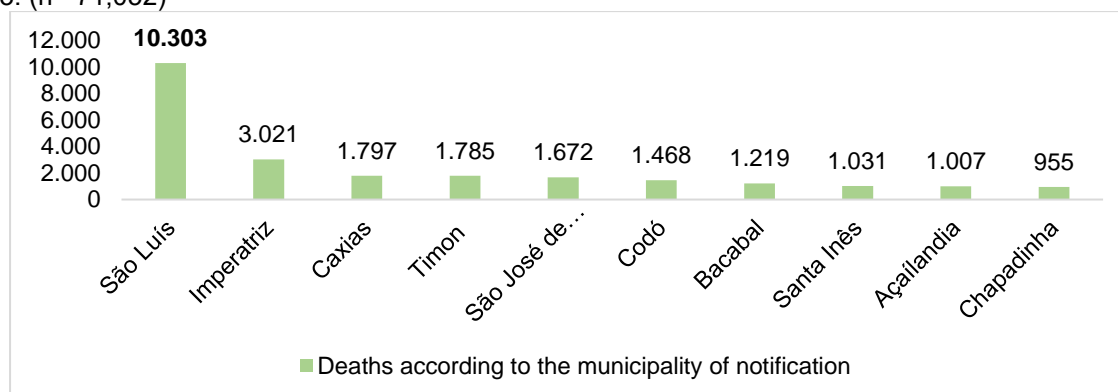
Source: DATASUS-SIM (2024).

It was observed that São Luís, capital of the state of Maranhão, had the highest number of reported CVD deaths, about 10,303 cases, which corresponds to 14.5% of the total CVD deaths reported in the state.

It is noteworthy that the fact that São Luís concentrates the largest number of deaths can be explained by the size of the capital's population, which is the largest in the state, and by the fact that it houses the main hospital centers and high-complexity health units, which leads to a greater concentration of diagnoses and treatments, and consequently of registered deaths. In addition, urbanization and lifestyles in large cities may contribute to a higher prevalence of CVDs.

Similarly, Ottero (2022) examined the trend in mortality from Ischemic Heart Diseases (IHD) and Cerebrovascular Diseases (CBVD) in the 27 capitals of Brazil, from 1990 to 2018. The analysis revealed a reduction in mortality from cerebrovascular diseases in all capitals. The city of Vitória, capital of the Southeast, stood out with the greatest reduction in the mortality rate from CBVD, with an annual decrease of -5.6%, while Macapá, capital of the North, showed the smallest reduction, with -1.7% per year. Regarding IHD, a downward trend was observed in the capitals of the South, Southeast and most of the capitals of the Midwest. However, the capitals of the North and Northeast showed greater variability in IHD mortality trends, reflecting the persistence of high cases, and corroborating the prevalence of cases in the capital of Maranhão (OTTERO, 2022).

In view of this scenario, the crucial importance of health professionals in understanding the mortality profile due to cardiovascular diseases in Maranhão is highlighted. This understanding is essential for them to act proactively in the prevention of these diseases, through the promotion of health education, providing effective guidance

and strategies to mitigate the risk factors associated with CVDs. The central objective is to contribute significantly to the reduction of mortality rates related to these conditions in the state.

CONCLUSION

This study showed a significant increase in CVD mortality during the COVID-19 pandemic, with exacerbated impacts among vulnerable populations. Strengthening the health system, coupled with equitable policies and effective prevention strategies, is essential to mitigate the effects of future health emergencies.

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