Research Article
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Cardiogenic shock: Trends of hospital mortality in Brazil from 2011 to 2020

Abstract

Introduction: Cardiogenic shock (CS) is a state of tissue hypoperfusion and circulatory failure that can evolve with multiple organ dysfunction and death. The most common cause, responsible for 80% of cases is acute myocardial infarction (AMI). Despite therapeutic advances, its occurrence is still a predictor of a high mortality rate between 35% and 40%.

Objective: To study the hospital mortality profile of cardiogenic shock in Brazil from 2011 to 2020.

Methodology: This is an ecological study design of cardiogenic shock in Brazil. We analyzed a secondary data from the Department of Informatics of the SUS (DATASUS).

Results: The results showed n=9572 deaths from CS were reported between 2011 and 2020. Despite fluctuations over the years, there was a substantial increase in the number of deaths and mortality rates during this decade. Most deaths occurred in the elderly (76.48%), men (51%) and Caucasians (n=49%). Regarding the regions, the Southeast leads with the highest absolute number (n = 6160), but the Northeast had the highest mortality rate throughout the period.

Conclusion: Despite medical advances in cardiology care, CS is a condition with high levels of mortality. Due to the potential severity and lethality, early recognition and adequate management of this pathology are essential. It also highlights the importance of carrying out studies that include less developed regions such as the Northeast, so that they are priorities in public health interventions.

Keywords: shock cardiogenic, epidemiology, hospital mortality

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Introduction

Cardiogenic shock (CS) is a state of tissue hypoperfusion and circulatory failure resulting from ventricular dysfunction.[1] It can occur due to ischemic events or the progression of long-standing heart disease, potentially leading to multisystem cellular and metabolic impairment, severe organ dysfunction, and death.[2] The most common cause of CS, accounting for 80% of cases, is acute myocardial infarction (AMI) that progresses with left ventricular dysfunction.[3] Despite therapeutic advances in the early management of AMI having reduced the incidence of CS, its occurrence is still a predictor of a high mortality rate.[4]

According to Van Diepen et al,[5] although the mortality rate is decreasing over time, it remains high, between 35% and 40%. Currently, the diagnosis of congenital heart disease (CHD) is based on clinical parameters such as the presence of systolic blood pressure (SBP) ≤ 90 mmHg and evidence of signs of peripheral vasoconstriction (oliguria, cyanosis, and diaphoresis), hemodynamic parameters, and laboratory metabolic variables. Complementary exams such as echocardiography and coronary angiography are also important for defining the etiology, stratifying the severity, and determining the prognosis.[3] Regarding the clinical picture, the patient may present with weak pulses, low peripheral perfusion, severe hypotension, tachycardia, tachypnea, oliguria, and clouding of consciousness associated with resistance to therapeutic measures.[4] Regarding classification, in 2019, the Society for Cardiovascular Angiography and Interventions (SCAI) proposed a new model that groups patients in shock into different stages, aiming to facilitate the identification of risk phases, clinical deterioration, need for treatment intensification, and mortality prediction.[1]

In relation to treatment, patient management aims to ensure tissue perfusion, increase the chances of recovery of cardiac function, and/or enable definitive therapies to be performed in the case of irreversibility of myocardial dysfunction. Therefore, initial care aimed at both stabilization and the search for the etiological diagnosis of shock should be performed early. According to the severity, risk classification, and etiology of shock, therapeutic measures may include hemodynamic monitoring, general life support, volume replacement, use of vasoactive drugs, early revascularization therapies, and temporary mechanical circulatory assistance, especially when patients are refractory to initial treatments.[3]

Although there is a classification tool aimed at standardizing patients in order to better define therapeutic approaches, it is known that the choice of treatment for cardiogenic shock varies substantially between institutions and physicians, especially regarding indications, duration, and choice of mechanical circulatory support (MCS) devices.[6] Therefore, it is observed that despite advances in the treatment of cardiovascular diseases, cardiogenic shock still persists with high mortality rates, representing a therapeutic challenge for physicians.[7] One of the causes of this problem is the limitations of the treatments employed, since patients with different degrees of severity may have varying responsiveness to therapeutic interventions and different clinical outcomes, leading to heterogeneity in cardiogenic shock study populations.[8]

From this perspective, epidemiological studies are important for deepening the understanding of diseases through the analysis of available data on incidence, prevalence, and mortality in a thorough, up-to-date, global, regional, and national manner.[9] Therefore, it is understood that knowing the pathological conditions and the disease

pattern of the population, through surveys in databases, can serve as a basis for the correct planning and development of health measures to reduce the high rates of cardiovascular diseases and deaths from cardiogenic shock.

The objective of this study was to investigate the hospital mortality profile of cardiogenic shock in Brazil from 2011 to 2020.

Methodology

This is an ecological, descriptive, and retrospective study of cardiogenic shock in Brazil from 2011 to 2020, analyzed using data from the Department of Informatics of the Brazilian Unified Health System (DATASUS).[10] Data were collected through a DATASUS database query following these steps: "Health Information (TABNET)", "Vital Statistics", Mortality – since 1996 by ICD-10, and deaths from less useful causes. Subsequently, in the available selections under the "Detailed Useful Causes" option, the cause chosen was: cardiogenic shock (ICD 10 - R57.0), and the other available variables were: year, sex, race/color, and age group.

The data were collected in January 2023 and tabulated using Microsoft® Excel Professional Plus 2019, through which descriptive analysis was performed, representing them in a frequency distribution and in tables/graphs to identify the general characteristics of the studied population. The BioEstat 5.3 program was used for statistical analysis.

The results were expressed as absolute values (n), percentage, mean, standard deviation (SD), and coefficient of variation (CV). The mortality rate was calculated from the ratio between the number of deaths per year and the inhabitants of Brazil and its regions per 100,000 inhabitants. Population data were obtained according to the Population Projections of the Federative Units by sex and age groups: 2000-2030 (2013 edition) available in DATASUS under the following tabs: "Demographic and Socioeconomic" and "resident population".

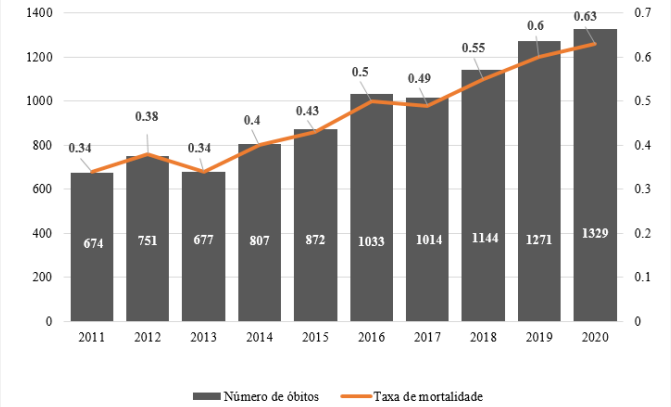
Furthermore, the information used in this study was collected from a secondary database, which eliminated the need for submission to a research ethics committee. Thus, the ethical aspects are in accordance with Resolution 466/12 of the Brazilian National Health Council, as well as international health research resolutions, which do not require approval or submission to a research ethics committee when there is no possibility of individual participant identification and only population data is accessed, preserving privacy and all required ethical precepts.

Results

According to the data obtained in the study, n=9572 deaths due to cardiogenic shock (CS) occurred in Brazil from 2011 to 2020. The average number of deaths was average=957.2 ± 238.42 and the coefficient of variation (CV) = 24.91% during this decade.

Regarding the distribution by year, the number of deaths in the study period was as follows: 2011 (n=674), 2012 (n=751), 2013 (n=677), 2014 (n=807), 2015 (n=872), 2016 (n=1033), 2017 (n=1014), 2018 (n=1144), 2019 (n=1271), and 2020 (n=1329) (Figure 1). In this decade, a substantial increase in deaths from this pathology is observed, with a growing trend, although slightly fluctuating, with small decreases in 2013 and 2017. In relation to the other years, a percentage increase of 97.18% of the total is observed when comparing the years 2011 and 2020.

Regarding the mortality rate in the country, it is observed that there was a similar behavior in the number of deaths with an increasing trend and fluctuations over the years despite the decreasing peaks in 2013 (0.34) and 2017 (0.49) (Graph 1).

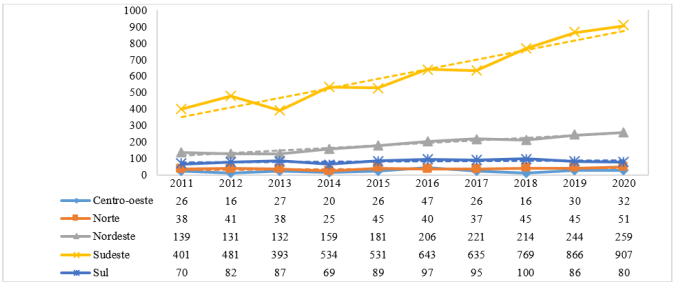


Graph 1 Distribution of deaths from cardiogenic shock in Brazil from 2011 to 2020.

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Regarding deaths from CS in Brazilian regions (Graph 2), the following distribution was observed: Southeast with the highest number (n = 6160), mean = 616 ± 182.52 and CV = 29.63%; followed by the Northeast (n = 1886), mean = 188.6 ± 47.07 and CV = 25.00%; South (n = 855), mean = 85.5 ± 10.55 and CV = 12.34%; North (n = 405), mean = 40.5 ± 7.00 and CV = 17.2%; and Central-West with the lowest number (n = 266), mean = 26.6 ± 9.00 and CV = 33.77%.

In the Southeast region, there was a considerable discrepancy in deaths from this cause compared to other causes, with the highest peak in 2020 (n = 907). In this region, a growing, albeit fluctuating, trend was observed over the years, represented by slight decreasing peaks in 2013 (n = 393), 2015 (n = 531), and 2017 (n = 635). In the Northeast, despite a slightly upward slope, when comparing the years 2011 and 2020, there was an 86.33% increase in the number of deaths from cervical cancer. In the other regions—North, South, and Central-West—even showing variations that sometimes increase and sometimes decrease, a certain stability is noted during the period (Graph 2).



Graph 2 Distribution of deaths from cardiogenic shock in Brazil, by region, from 2011 to 2020.

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Regarding the mortality rate in Brazilian regions (Graph 3), it is observed that the Northeast presented the highest rates, followed by the Southeast, South, North, and Central-West. In the two most populous regions, there was an increasing trend despite the existence of decreasing peaks in the Northeast in 2012 (0.79), 2013 (0.78), 2018 (1.18), and 2020 (1.4), and in the Southeast in 2013 (0.46), 2015 (0.62), and 2017 (0.73). The other regions, despite fluctuations, maintained a linear pattern; however, it is worth highlighting a more significant increasing trend in the Central-West region in 2016 (0.3).

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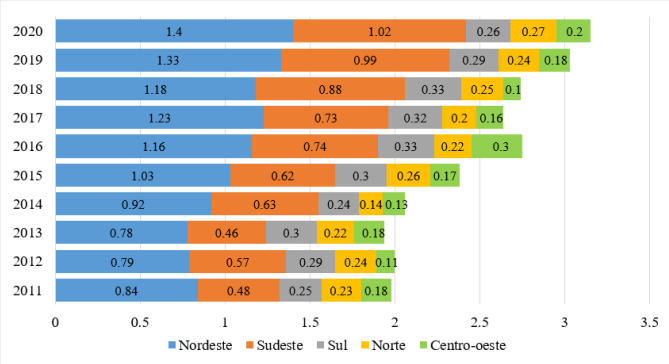
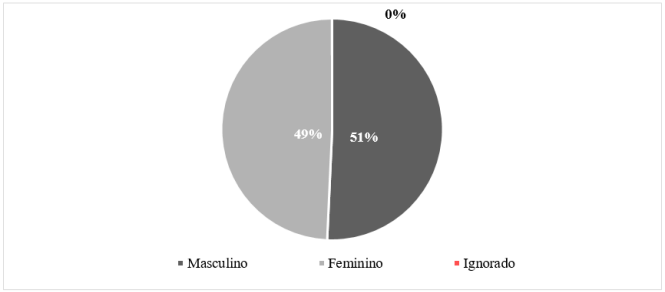


Graph 3 Cardiogenic shock mortality rate by Brazilian region from 2011 to 2020.

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Regarding the distribution by sex, there was a slight preference for male (n = 4855) over female (n = 4715) and unknown (n = 2) (Graph 4).



Graph 4 Distribution of deaths from cardiogenic shock in Brazil by sex from 2011 to 2020.

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

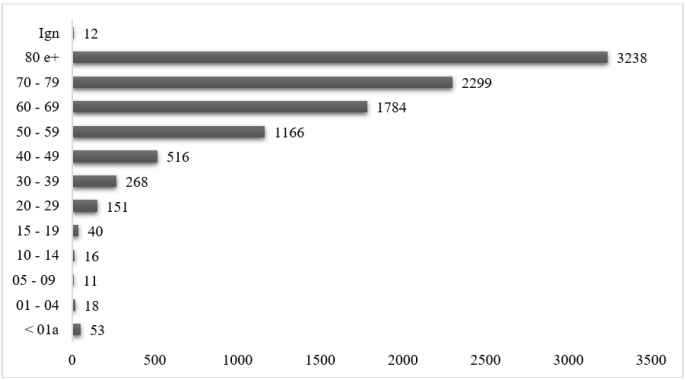
This trend observed in men is seen across all age groups except for the 5-9 year age group (n = 3) and the 80+ year age group (n = 1237) (Table 1).

Table 1 Distribution of deaths due to cardiogenic shock by age group stratified by sex from 2011 to 2020

Age range years	*Sex*		
	Male	*Female*	*Ignored*
< 01	30	23	
01 - 04	11	7	
05 - 09	3	8	
10 - 14	9	7	
15 - 19	30	10	
20 - 29	101	50	
30 - 39	184	84	
40 - 49	339	177	
50 - 59	708	458	
60 - 69	980	804	
70 - 79	1213	1086	
80 e+	1237	2001	
Ignored	10		2
Total	4855	4715	2

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Analyzing the distribution by age groups (Graph 5), it is noted that there was fluctuation in the number of deaths from CS among the younger ones, represented by a decrease in the 01-04 years (n = 18) and 05-09 years (n=11) age groups compared to <01 year (n=53). From then on, a progressive increase in deaths was observed, being more representative from 60 years or more (n = 7321), which corresponds to the elderly age group.[11]



Graph 5 Distribution of deaths from cardiogenic shock by age group from 2011 to 2020.

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Regarding the distribution by race/color (Table 2), there was a higher number of deaths from CS in the white population (n=4693) followed by the mixed-race population (n=3491), which corresponded to 49% and 36.47% respectively. According to the data, the indigenous race showed the lowest representation when compared to the others (n=14), accounting for 0.14% of the total deaths.

Table 2 Distribution of deaths from cardiogenic shock stratified by race and sex from 2011 to 2020

Race/Color	*Male*	*Female*	*Ignored*	*Total*
Not filled in	187	184	1	372
White	2265	2428	0	4693
Black	488	450	0	938
Yellow	29	35	0	64
Brown	1881	1609	1	3491
Indigenous	5	9	0	14

Source: Prepared by the authors, with data from the Ministry of Health/SVS - Mortality Information System – SIM, 2023.

Discussion

Based on the data analysis, it was observed that during the period from 2011 to 2020, 9572 deaths due to cardiogenic shock (CS) occurred in Brazil, with the majority of them in the Southeast region, representing 64.54% of the total deaths. Furthermore, during this decade, despite fluctuations, there was an upward trend and a significant increase in deaths (97.18%) comparing the first and last years of the study. Regarding the mortality rate, the country showed an increasing trend during the decade, despite decreases in 2013 and 2017.

It is known that cardiovascular diseases (CVD) are a public health problem, constituting the leading cause of death in Brazil[12] and worldwide,[13] especially those that can progress to cardiogenic shock (CS), such as acute myocardial infarction (AMI) and acute-on-chronic heart failure.[14]

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Currently, it is observed that most studies available in the literature evaluate the mortality of cardiogenic shock in the context of AMI. The absence of epidemiological studies in Brazil and data in DATASUS that can detail the etiology of CS makes it difficult to correlate with other countries and to assess the pattern of growth or decrease in the country and its regions in recent decades.

However, according to Duceau & Bluglé,[15] the epidemiology of cardiogenic shock follows that of ischemic heart disease. In this sense, although we did not find studies similar to this one that can be used for comparative purposes, the literature provides research that presents epidemiological data on cardiovascular diseases that potentially evolve into cardiogenic shock. It is understood, therefore, that by knowing their behavior, one can infer about the influence of the mortality pattern due to cardiogenic shock in the country.

Therefore, according to the latest Global Burden of Disease (GBD), an observational epidemiological study conducted in Brazil in 2019, there was a significant increase in the number of people with coronary heart disease such as myocardial infarction (MI) and ischemic heart failure, rising from 1.48 million in 1990 to more than 4 million in 2019. In parallel, in recent decades there has been an increase in the number of hospitalizations for MI (54%) and for percutaneous coronary intervention (PCI), while surgical procedures, especially for heart failure and acute coronary syndrome, such as coronary artery bypass grafting (CABG), remained stable during the period.[16]

Thus, it is noted that during the study period there was an increase in patients with and hospitalizations due to coronary artery disease, while the number of procedures crucial for the treatment of these patients remained stable in the country. According to Piegas et al.,[4] if patients with congenital heart disease receive only clinical treatment, they have a high mortality rate (60 to 70%). Corroborating this, the findings of the SHOCK study show that early revascularization is the main approach in post-MI congenital heart disease and should be performed urgently. Although it does not reduce mortality at 30 days, the research showed a significant reduction after 6 months, 1 year, and 6 years.[17] Based on this, it is presumed that certain patients may not have received adequate surgical support and thus progressed to cardiogenic shock and negative outcomes.

Furthermore, in addition to performing surgical procedures in the context of the CCU, it is believed that failures in initial care can also contribute to high mortality. According to Warren et al.,[18] factors contributing to lethality include: delays in recognizing shock and in accessing hemodynamically modifying or stabilizing interventions, whether due to heterogeneity of practices in hospitals or logistical factors that hinder or limit transfer to specialized acute cardiac care centers.

In addition, Brazil has been experiencing exponential population aging and an increase in life expectancy. It is known that as age advances, the prevalence of CVD and consequently deaths in this population increase,[16] thus reflecting in the increase in deaths in the general population and in the annual mortality rate.

Regarding the distribution of deaths from cardiovascular disease (CVD) in Brazilian regions, the Southeast showed an increasing trend and a high absolute number compared to the others. As for the mortality rate, heterogeneity is observed among the regions. The Northeast led with the highest rates throughout the time period, with the Southeast in second place. The South, North, and Central-West regions stand out among those least affected by CVD mortality. According to Ribeiro et al.,[19] given the magnitude and continental pattern of Brazil, mortality from cardiovascular disease (CVD) does not occur homogeneously.

In the context of ischemic diseases, corroborating the findings of this study, Silva Júnior, et al.,[20] evaluating the relationship between mortality and cardiovascular risk factors for AMI by Brazilian regions from 2012 to 2022, observed that although the Southeast region presented a higher number of deaths, the Northeast region had the highest mortality rate (12.03%). Although we did not find studies directly linked to CS, it is presumed from the literature that it follows the same parameters as ischemic diseases, such as AMI. It is understood that this is a result of the socioeconomic differences between the two regions. For Baptista and Queiroz,[21] the Northeast region presents a different context compared to the Southeast, with worse socioeconomic indicators and difficult access to healthcare over time, which directly reflects in the increase in mortality from CVD and consequently in CS.

Regarding the lower mortality rate in the Central-West region, similar to this study, Baptista et al.,[22] evaluating the mortality trend from ischemic heart disease in Brazil from 1980 to 2018, observed a lower rate in this region compared to others. According to the authors, this pattern is also observed in developing countries, in regions that proportionally have the lowest share of overall mortality. From another perspective, according to Villela, et al,[23] the lower rate in the Central-West region is a result of the gradual improvement in its epidemiological information and notification at the end of the last century. With this improvement, there was a shift in notifications towards cardiovascular diseases, which likely altered the classification of deaths to a large extent.

Regarding age range, despite fluctuations among younger people, there was a progressive increase from the age of 10 onwards, with the highest representation in the elderly age group (60 years or older), which accounted for 76.48% of total deaths. According to Thiele et al.,[24] the aging of the population in recent decades has led to an increase in the mortality rate from congenital shock. Corroborating this, Kanwar and colleagues,[25] in a multicenter study, evaluated the impact of age on outcomes in patients with congenital shock and concluded that the older the patient, the higher the mortality rate at all stages of shock. It is known that the elderly have increased vulnerability and predisposition to chronic non-communicable diseases (NCDs), including cardiovascular diseases.[26] This is a result of changes in the body, so that as age advances, the arteries lose elasticity and stiffen, becoming more susceptible to injury and the formation of thrombi.[27]

Furthermore, although age and the presence of comorbidities increase mortality from heart failure, it is understood that the determination of therapeutic approaches also contributes to more negative outcomes in the elderly age group. These patients represent specific challenges in management, as they often have contraindications for antithrombotic or interventional therapies in the case of coronary syndromes, for example, and have limitations in care related to frailty, comorbidities, and advanced care guidelines.[28] According to Harjola et al.,[29] in the context of heart failure, advanced age is frequently an exclusion criterion for advanced therapies, prolonged intensive care, transplantation, or the use of mechanical assistance devices. Regarding the other variables analyzed, a slight predominance in males (51%) was observed. According to Sibai, Bachir, and Sayed,[30] this is due to the higher prevalence of heart disease in men compared to women. It is believed that cultural and social factors influence these statistics. In addition to greater exposure to risks that predispose to the onset of CVD and consequently to mortality,[31] there is commonly a resistance to seeking preventive treatments, which leads to late discovery of the diseases.[27]

Analyzing the distribution by race/color, it was observed that there was a higher number of deaths in the white population (n = 4693)

followed by the mixed-race population (n = 3491), corresponding to 49% and 36.47%, respectively. The lowest prevalence occurred in the indigenous population (0.14%). Despite the scarcity of data reflecting the reality regarding overall mortality from congenital heart disease (CHD) regardless of etiology, the data from this study are consistent with epidemiological studies that assess the pattern of patients admitted to intensive care units. According to a multicenter study by Berg et al.,[7] that evaluated three profiles of patients admitted (CHD related and unrelated to AMI and mixed) to contemporary ICUs, the majority of patients were white. This same characteristic was found by Jentzer et al.,[32] who analyzed a database of adult patients admitted to a cardiac ICU according to the shock stage proposed by the Society for Cardiovascular Angiography and Intervention (SCAI).

Regarding the lower prevalence of cardiovascular disease (CVD) in the indigenous population, the literature lacks studies that portray the epidemiology of CVD in this group. However, the data obtained are consistent with research evaluating mortality from ischemic diseases, such as myocardial infarction (MI). In an ecological study using the DATASUS database, Silva Júnior et al.,[20] concluded that the lowest mortality rate from MI in Brazil between 2012 and 2022 occurred among indigenous people (0.026%). Furthermore, it is known that there is a growing incidence of CVD in this population. Due to Westernization, there has been greater interaction with non-indigenous people, contributing to the incorporation of sedentary habits and diets typical of this civilization, which predispose them to these diseases.[33]

Finally, it is known that data collected from the Mortality Information System (SIM) can contribute to the planning and control processes of health services; however, it is important to address the limitations of this study.

In mortality statistics, cardiogenic shock falls under the category of "less useful causes." These deaths are those whose underlying cause is part of a list of Garbage Codes (GC), also known as "junk codes." This category includes causes of death where the diagnoses are undefined or incomplete and do not indicate the specific cause. Mortality registration systems with a high proportion of GC have compromised quality, which makes it difficult to identify priorities, and are therefore of little use in planning preventive actions.[10]

Currently, deaths registered with GC receive little attention from health professionals and services; however, it is necessary to develop strategies that specify the real reasons for death.[34] According to Ishitani et al.,[35] it is essential that appropriate strategies be drawn up to qualify the causes of death, either by investigating deaths or by training doctors to complete the Death Certificate (DC).[36,37]

Therefore, unreliable epidemiological surveys regarding the causes of death hinder the implementation of public policies for prevention and actions aimed at reducing the morbidity and mortality of cardiogenic shock in the country.

Final considerations

Despite medical advances in cardiology care, congenital shock (CS) is observed in Brazil as a condition with high mortality rates. Delays in etiological diagnosis and therapeutic decisions to treat shock may be the main reasons for the considerable number of deaths. Given the potential severity and lethality of CS, early recognition of this pathology is essential so that an appropriate management plan can be drawn up, as this will impact the prognosis. Investigations into therapies, effective approaches in patients with different phenotypes, trained teams, and multidisciplinary care are fundamental to reducing CS mortality. Since Brazil is a country of continental dimensions, marked by social inequalities, the importance of conducting studies that include less developed regions such as the North and Northeast stands out, so that they become priorities in public health interventions.

Furthermore, knowing that deaths reported as Garbage codes also represent an indicator of the quality of healthcare, it is necessary to improve and train physicians to accurately identify the cause and complete the Death Certificate, so that the quality of information improves and the production of estimates becomes increasingly accurate. Therefore, this epidemiological survey contributes information to support the development of appropriate public policies aimed at reducing deaths from this pathology.

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Conflict of interest

The authors declare that there is no conflict of interest.

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