IOSR Journal Of Humanities And Social Science (IOSR-JHSS)
Volume 30, Issue 5, Series 1 (May, 2025) 01-08
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

Mortality From Acute Myocardial Infarction In Brazil In The Pre And Post Pandemic Periods

Gustavo Anthony Pereira De Toledo[1], Bárbara Freitas De Brito[1], Mariana De Sousa Nunes Vieira[2], Heloísa Silva Guerra[2]
[1](Medical Student, University Of Rio Verde, Brazil)
[2](Faculty Member, School Medicine, University Of Rio Verde, Brazil)

Abstract:
Background*: Acute myocardial infarction (AMI) remains a leading cause of death worldwide, representing a major public health concern. The coronavirus disease 2019 (COVID-19) pandemic had a profound impact on global health, characterized by high mortality and morbidity rates. Although COVID-19 primarily affects the pulmonary system, cardiovascular complications are frequently observed and are strong predictors of adverse outcomes.*
Materials and Methods*: Data were retrieved from the Brazilian Mortality Information System and included sociodemographic and clinical variables. A descriptive analysis was conducted.*
Results*: Findings revealed that the Southeast region accounted for the highest absolute number of deaths, whereas the North region exhibited lower mortality rates, potentially due to underreporting and limited healthcare infrastructure. Married and widowed individuals were disproportionately affected, indicating underlying social and economic vulnerabilities. The greater prevalence of mortality among older age groups underscores the need for targeted interventions to address this high-risk population.*
Conclusion: *It is concluded that mortality from AMI in Brazil shows significant regional and demographic disparities, which were intensified after the COVID-19 pandemic. The findings reinforce the need for public policies aimed at strengthening cardiovascular care, especially among the elderly and vulnerable populations.*
Key Word*: Acute Myocardial Infarction, Mortality, Epidemiology.*
Date of Submission: 22-04-2025 Date of Acceptance: 02-05-2025

I. Introduction

Acute myocardial infarction (AMI) has been identified by the World Health Organization (WHO)[1] as one of the leading causes of death worldwide. In 2019, it was surpassed only by coronary artery disease (CAD), whose first clinical manifestation is often AMI[2]. These conditions reflect not only individual risk factors but also structural inequalities within healthcare systems[3,4].

On March 11, 2020, the WHO officially declared the outbreak of the novel coronavirus (SARS-CoV-2) a pandemic, marking the global spread of COVID-19, a severe acute respiratory syndrome[5]. Since then, several studies have sought to establish the relationship between SARS-CoV-2 infection and AMI. Early investigations highlighted a higher incidence of AMI in patients actively infected with COVID-19 or with a history of previous infection. In this context, results revealed a high prevalence of AMI and other forms of myocardial injury among COVID-19 patients. Through the use of diagnostic tools such as cardiac troponin testing and heart imaging, myocardial damage was detected in a significant proportion of cases. These findings suggest that SARS-CoV-2 infection may trigger inflammatory and thrombotic processes that contribute to the development of AMI in affected patients[6].

A study conducted in Ecuador, comparing pre-pandemic data (2005–2019) to data collected after March 2020, demonstrated a 243.6% increase in AMI cases—an unprecedented rise within the country's public health context[7].

In the Brazilian context, a similar study revealed a significant incidence of myocardial injury among COVID-19 patients admitted to intensive care units (ICUs). The research involved a retrospective analysis of data from consecutive patients admitted to the ICU with a confirmed diagnosis of COVID-19. Myocardial injury was assessed through serum measurements of cardiac biomarkers, such as troponin and creatine kinase-MB (CK-MB), in addition to electrocardiographic and clinical evaluations[8].

The results showed that a substantial proportion of COVID-19 patients exhibited myocardial injury, with elevated levels of cardiac biomarkers detected in 36% of the evaluated group. Furthermore, an association was observed between the presence of myocardial injury and an increased risk of in-hospital mortality, as patients with myocardial injury exhibited a higher mortality rate compared to those without this cardiac complication[8].

Brazil's healthcare system faces historical challenges, including regional inequalities, limited resources, and barriers to access[3,4]. These factors make AMI an important indicator for evaluating the effectiveness of public policies and identifying priority areas for intervention. Moreover, understanding the specifics of these disparities can contribute to the development of targeted and sustainable strategies.

Accordingly, this study aimed to analyze AMI mortality between 2013 and 2022, highlighting regional differences and the most relevant demographic characteristics, and comparing the pre-pandemic (2013–2019) and post-pandemic (2020–2022) periods. By examining patterns related to age, marital status, and gender, the study seeks to provide a foundation for interventions that address observed disparities and promote equity in cardiovascular health.

II. Material And Methods

This descriptive, retrospective, and quantitative study utilized secondary data obtained from official sources, specifically the Mortality Information System (Sistema de Informações sobre Mortalidade – SIM) of the Department of Informatics of the Unified Health System (DATASUS), under the Brazilian Ministry of Health. The research covered the period from 2013 to 2022, focusing on identifying the epidemiological profile of deaths due to acute myocardial infarction (AMI) in the Brazilian population before, during, and after the onset of the COVID-19 pandemic.

The variables analyzed included geographic location, time period (2013–2022), sex, age group, race/ethnicity, educational level, marital status, and cause of death specifically identified as AMI. Data collection was conducted through the TABNET platform, a public domain generic tabulator developed to organize and generate information from the databases of the Unified Health System (SUS). After collection, the data were organized into spreadsheets using Microsoft Excel® and analyzed through descriptive statistics, with calculations of absolute and relative frequencies for each variable.

The results were compared between the pre-pandemic period (2013–2019) and the pandemic period (2020–2022) in order to identify changes in the epidemiological patterns related to AMI, particularly concerning AMI-related mortality. The analyses focused on identifying the occurrence patterns of AMI considering sociodemographic variables and the trends in AMI mortality over the years, with special attention to the pandemic period. To compare AMI-related mortality between the pre-pandemic (2012–2019) and post-pandemic (2020–2022) periods, the mean annual number of deaths was calculated for each period. A two-sample t-test for independent groups was applied to assess differences between the means. A p-value <0.05 was considered indicative of statistical significance.

To assess the temporal trend in AMI-related deaths between 2012 and 2022, a simple linear regression analysis was performed, considering the year as the independent variable and the number of deaths as the dependent variable. The coefficient of determination (R^2) and the slope of the regression line were used to evaluate the direction and magnitude of the trend.

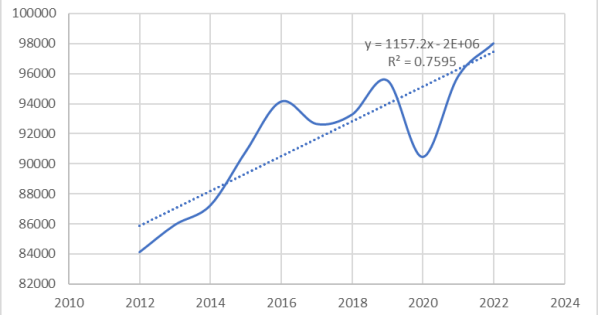
As this study involved the analysis of secondary public domain data, without the identification of individual subjects, it was exempt from approval by a Research Ethics Committee (CEP), in accordance with Resolution No. 510, dated April 7, 2016, of the Brazilian National Health Council.

III. Results

During the period from 2012 to 2022, a total of 1,008,035 deaths due to acute myocardial infarction (AMI) were recorded in Brazil, with an annual average of approximately 91,640 deaths. An increase of 16.5% in the number of deaths was observed between the first and the last year of the historical series.

The linear regression analysis revealed a significant upward trend in AMI-related deaths during the study period (Figure 1). The trend line equation ($y = 1157.2x - 2{,}000{,}000$) indicated an average annual increase of approximately 1,157 deaths. The coefficient of determination ($R^2 = 0.7595$) showed that 75.95% of the variation in mortality during the period could be explained by the year.

Figure 1: Temporal trend of acute myocardial infarction (AMI) deaths in Brazil, 2012–2022.



When comparing the pre-pandemic (2012–2019) and post-pandemic (2020–2022) periods, an increase in the annual average number of AMI-related deaths was observed (from 90,467.4 to 94,765.3 deaths). However, this difference was not statistically significant ($p = 0.1588$).

Regional Inequalities

When analyzing the data on deaths and mortality rates from acute myocardial infarction (AMI) in Brazil between 2013 and 2022, a slow and progressive increase in both the number of deaths and the mortality rate was initially observed during the pre-pandemic period (2012–2019). During the COVID-19 pandemic (2020), there was a decline in both the absolute number of deaths and the mortality rate, which may indicate underdiagnosis, reduced access to healthcare services, or competition with other causes of death. After the peak of the pandemic (2021–2022), both the number of deaths and the mortality rate increased again, with 2022 standing out proportionally, suggesting a possible delayed impact of the pandemic on cardiovascular diseases (Table 1).

Table 1. Distribution of deaths and mortality rates from acute myocardial infarction (AMI) in Brazil according to the year of occurrence, 2012–2022.

Year	Population Estimates (IBGE)	AMI Deaths	Mortality rate per 100 mil inhabitants
2012	193946886	84121	43,4
2013	201032714	85939	42,7
2014	202768562	87234	43,0
2015	204450649	90811	44,4
2016	206081432	94148	45,7
2017	207660929	92657	44,6
2018	208494900	93272	44,7
2019	210147125	95557	45,5
2020	211755692	90465	42,7
2021	213317639	95812	44,9
2022	203080756	98019	48,3

Between 2012 and 2022, the distribution of deaths from acute myocardial infarction (AMI) in Brazil remained predominantly concentrated in the Southeast region, which accounted for approximately 45–47% of the deaths recorded during the period. The Northeast consistently ranked as the second region with the highest number of deaths, followed by the South, Central-West, and North regions (Table 2).

Despite the dominance of the Southeast, a slight increase was observed in the proportion of deaths in the North and Central-West regions over the years, which may reflect demographic changes, variations in access to healthcare services, or improvements in the quality of death records in these areas.

Table 2. Proportion of deaths from acute myocardial infarction (AMI) in Brazil by region, 2012–2022.

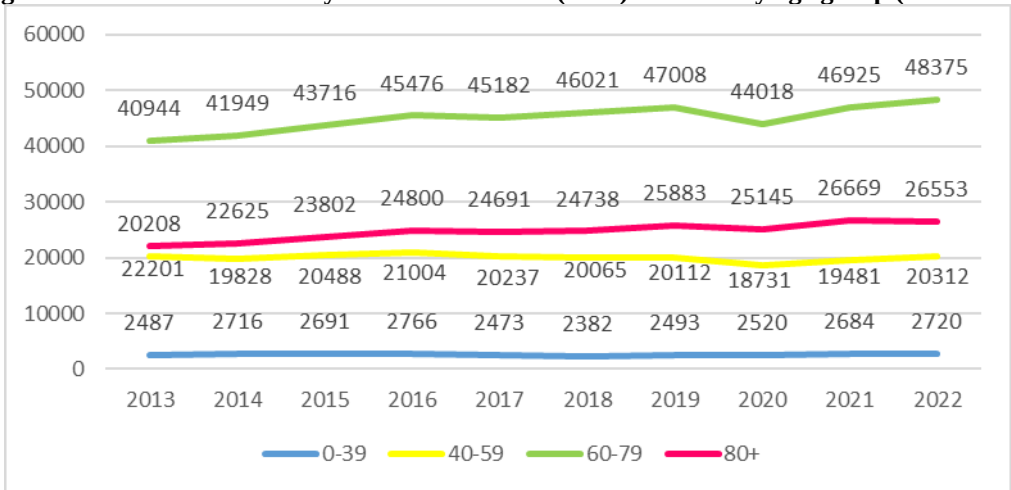
Year	North	Northeast	Southeast	South	Central-West	Total
2012	4.8	27.1	46.7	15.0	6.4	84121
2013	4.7	26.8	47.0	15.4	6.3	85939
2014	5.0	27.2	46.3	14.9	6.5	87234
2015	5.1	27.8	46.1	14.7	6.3	90811
2016	5.1	27.3	46.6	14.6	6.4	94148
2017	5.6	28.4	45.9	13.5	6.6	92657
2018	5.7	28.2	45.7	13.6	6.7	93272
2019	5.7	28.3	46.4	13.1	6.5	95557
2020	6.1	27.7	46.1	13.1	7.0	90465
2021	6.3	26.8	46.3	13.2	7.3	95812
2022	5.9	27.3	46.1	13.4	7.2	98019

Age Groups

The data showed that individuals aged between 60 and 79 years were the most affected, accounting for the majority of AMI-related deaths throughout the entire period across all major Brazilian regions. Mortality among individuals aged 80 years and older showed a steady increase, accompanying the aging of the Brazilian population, and represented the second most prevalent age group for AMI deaths in almost all regions.

An exception was observed in the Central-West region, where the adult age group (40–59 years) consistently surpassed the 80 years and older group in terms of mortality throughout the period. Conversely, younger age groups (0–39 years) showed stable and relatively low numbers, with a low incidence of AMI-related deaths (Figure 2).

Figure 2. Deaths from acute myocardial infarction (AMI) in Brazil by age group (2013–2022).



Marital Status and Gender

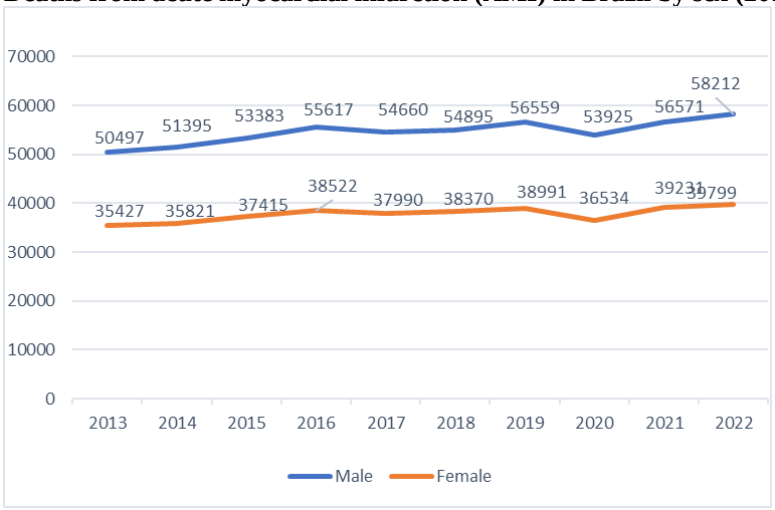
Married individuals led mortality statistics across all regions throughout the study period (Table 3). Widowed individuals were also significantly affected, particularly in the Southeast and South regions. In contrast, the North and Central-West regions showed a higher predominance of single individuals compared to widowed individuals, while the Northeast exhibited a more stable and alternating pattern in this regard.

Table 3. Distribution of AMI deaths in Brazil according to marital status, 2012–2022.

Year	Single	Married	Others
2012	15507	35461	33153
2013	16159	35073	34707
2014	16441	35362	35431
2015	17595	36669	36547
2016	18475	37643	38030
2017	18644	36512	37501
2018	18946	36750	37576
2019	19862	37091	38604
2020	18092	35040	37333
2021	19657	36087	40068
2022	21324	36190	40505

Regarding sex, men were consistently more affected by AMI than women throughout all the years analyzed (Figure 3). This difference appeared to become more pronounced during the pandemic period, with a slightly greater increase (2% higher compared to women) in male deaths in 2021 and 2022, possibly related to exacerbated comorbidities and risk factors. Although less affected, women also showed an increase in deaths in 2021, following a decline observed in 2020.

Figure 3. Deaths from acute myocardial infarction (AMI) in Brazil by sex (2013–2022).



Race/Ethnicity and Educational Level

During the period from 2012 to 2022, a gradual increase in the absolute number of deaths from acute myocardial infarction (AMI) was observed across almost all race/ethnicity categories in Brazil, although with varying magnitudes (Table 4). Individuals self-identified as White consistently represented the majority of deaths throughout the entire period. However, their relative share showed a slight downward trend, while the number of deaths among individuals identified as Pardo (mixed race) and Black increased consistently.

Pardo individuals constituted the second-largest group in terms of the number of deaths, exhibiting continuous growth, which highlights the increasing burden of mortality in this segment of the population. Similarly, deaths among Black individuals also increased proportionally, although in absolute numbers they remained lower than those observed among White and Pardo individuals. In contrast, the Yellow (Asian) and Indigenous categories maintained low numbers of deaths throughout the period, with minor annual fluctuations.

Table 4. Distribution of AMI deaths in Brazil according to race/ethnicity, 2012–2022.

Year	White	Black	Yellow (Asian)	Mixed Race	Indigenous	Ignored	Total
2012	45824	6427	479	27779	112	3500	84121
2013	46704	6663	486	28414	152	3520	85939
2014	47059	6562	531	29623	133	3326	87234
2015	48669	6736	556	31682	156	3012	90811
2016	50011	7001	542	33613	183	2798	94148
2017	48491	6939	522	34210	209	2286	92657
2018	48580	7038	538	34731	194	2191	93272
2019	49451	7439	491	36039	174	1963	95557
2020	45710	7441	522	34636	217	1939	90465
2021	48352	8141	557	36623	219	1920	95812
2022	49685	8233	623	37640	249	1589	98019

It was observed that the highest proportion of deaths continued to occur among individuals with low educational attainment, particularly those with 1 to 3 years of schooling, although there was a gradual downward trend in this group over the study period (Table 5). In contrast, there was a progressive increase both in the absolute number and in the proportion of deaths among individuals with 8 to 11 years and 12 or more years of schooling. The number of deaths among individuals with no schooling or with 4 to 7 years of education showed a decreasing trend throughout the historical series. Additionally, an increase was observed in the category of deaths with unreported educational level, highlighting persistent challenges in the quality of information recorded on death certificates.

Table 5. Proportion of AMI deaths in Brazil according to educational level, 2012–2022.

Year	None	1-3 years	4-7 years	8-11 years	12+ years	Ignored	Total
2012	18.2	27.4	20.3	11.1	4.2	18.9	84121
2013	18.1	26.7	20.3	12.0	4.3	18.7	85939
2014	17.9	26.6	19.4	12.1	4.5	19.5	87534
2015	18.0	26.3	18.4	12.6	4.8	19.9	90811
2016	16.9	25.6	18.0	13.6	4.8	21.1	94148
2017	16.1	24.8	18.2	14.3	5.1	21.5	92657
2018	15.3	23.7	18.1	15.0	5.3	22.5	93272
2019	14.9	23.3	17.9	14.7	5.6	23.6	93869
2020	15.5	23.4	18.1	15.0	6.0	22.1	89024
2021	14.1	21.8	17.0	17.0	6.2	23.9	94138
2022	16.7	20.7	24.1	18.9	6.3	13.3	98019

IV. Discussion

The analysis of deaths from acute myocardial infarction (AMI) in Brazil showed that the annual average of deaths increased during the post-pandemic period (2021–2022) compared to the pre-pandemic period (2012–2019). This increase may be attributed to the impact of the COVID-19 pandemic on cardiovascular care, including delays in diagnosis and treatment, an increase in risk factors, and possible direct effects of SARS-CoV-2 infection on the cardiovascular system[9,10].

The observed upward trend in AMI-related deaths, as demonstrated by the linear regression analysis, highlights a persistent increase in cardiovascular mortality in Brazil over the past decade. This rise may be explained both by population aging—one of the main risk factors for cardiovascular diseases—and by the persistence of high rates of risk factors within the population, such as hypertension, diabetes, obesity, and sedentary behavior[11]. Additionally, improvements in the coverage and quality of death records may also have contributed to the greater detection of fatal AMI cases over the past decade[12].

Although the comparison between the pre-pandemic and post-pandemic periods did not reveal a statistically significant difference in the annual average number of AMI-related deaths, an increase of

approximately 4,300 deaths per year was observed. Despite the lack of statistical significance, this trend is epidemiologically relevant, suggesting a possible delayed impact of the COVID-19 pandemic on cardiovascular health. Even modest changes in mortality patterns warrant attention in public health planning and reinforce the need for continuous surveillance and the strengthening of cardiovascular care services.

The decline in the number of deaths observed in 2020 may be related to the underreporting of AMI deaths, as hospital overload and the prioritization of COVID-19 cases made appropriate triage and accurate cause-of-death reporting more difficult during the pandemic period[13]. The subsequent increase in 2021 and the significant rise in 2022, in turn, should be interpreted with caution, especially considering that, in the latter year, an important revision of the national population database was conducted through the IBGE Demographic Census[14], which reduced the estimated number of inhabitants and, therefore, directly impacted the calculation of mortality rates.

The relative stability in the regional distribution of AMI-related deaths suggests the persistence of regional inequalities in cardiovascular health in Brazil. These regional patterns should be taken into account in the planning and implementation of public policies aimed at the prevention and control of cardiovascular diseases.

Regional inequalities become evident when observing the continuous upward trend in AMI rates in historically vulnerable regions such as the North, Northeast, and Central-West, even prior to the pandemic. Moreover, the lower number of recorded deaths in these regions likely reflects not only smaller populations but also structural limitations, such as underreporting and diagnostic difficulties, particularly during the COVID-19 pandemic, when there was a shortage of diagnostic tests such as RT-PCR[13]. This pattern may reflect chronic failures in the access to and quality of healthcare services[3,4]. Meanwhile, the Southeast's leading position in AMI mortality rates can be attributed to its high population density and the greater absolute number of cardiovascular events.

The persistence of these inequalities reinforces the need for strategic investments in public health, with an emphasis on strengthening primary care, training healthcare professionals, and expanding the coverage of specialized services[15].

Another aspect confirmed by this study is the higher concentration of AMI-related deaths among older age groups, which reinforces the association between aging and increased susceptibility to cardiovascular diseases such as coronary artery disease (CAD)[16]. Although mortality among individuals aged 80 years and older remains lower than among those aged 60 to 79, it has been growing consistently, reflecting the demographic transition and population aging in Brazil[17]. These findings underscore the need for public policies aimed at preventing and managing chronic comorbidities among the elderly[18], considering that this population presents specific aggravating factors, such as the accumulation of chronic diseases that predispose individuals to coronary events[16,19,20].

The exception observed in the Central-West region, where adults aged 40 to 59 years exhibited higher mortality rates than those aged over 80 years, suggests that specific regional factors warrant further investigation, such as inequalities in access to healthcare, differences in lifestyle, or underreporting among the elderly. On the other hand, the low mortality observed among younger individuals (0–39 years) is consistent with their lower exposure to cardiovascular risk factors, such as less arterial wall stiffening and reduced susceptibility to vascular injury—conditions that tend to worsen with advancing age, particularly in the context of chronic degenerative diseases such as coronary artery disease (CAD)[19,20].

Moreover, a study involving patients infected with COVID-19 provided evidence of an increased risk of cardiovascular diseases even beyond the first 30 days after infection, including cerebrovascular disorders, arrhythmias, myocarditis, ischemic heart disease, heart failure, and thromboembolic disease[21]. Another study following a similar approach demonstrated that older COVID-19 survivors showed an increased risk of developing pulmonary embolism and ischemic heart disease (HR = 1.87)[22].

The predominance of deaths among married individuals may be associated with the concentration of this group within older age ranges, which present a higher cardiovascular risk[23]. The significant mortality among widowed individuals in the Southeast and South regions may reflect the more pronounced population aging in these areas[24], as well as emotional factors such as stress—a modifiable risk factor for cardiovascular diseases—considering that the more industrialized regions of the country carry stressors intrinsic to development[16]. The pattern observed in the North and Central-West regions, with higher mortality among single individuals, may reflect regional sociocultural and demographic differences.

The higher male mortality from AMI, especially during the pandemic, reinforces the hypothesis of greater exposure of men to risk factors, lower healthcare-seeking behavior, and a higher burden of comorbidities[16,18,25]. The discrepancy in the increase in deaths between sexes in 2021 and 2022 suggests that the pandemic may have exacerbated preexisting inequalities. Moreover, data from a retrospective multicenter cohort study that explored the impact of gender, race, and insurance status on invasive treatment and in-hospital mortality among patients with COVID-19 and AMI in the United States indicated that women had a 31% lower likelihood

of receiving invasive treatments and a 32% lower likelihood of undergoing coronary revascularization compared to men[26].

In the present study, the data revealed the persistence of racial and educational inequalities in AMI-related outcomes in Brazil. The increase in deaths among Black individuals, particularly in the North and Northeast regions, suggests a worsening of disparities in access to healthcare services during the pandemic, consistent with studies highlighting the vulnerability of historically marginalized ethno-racial groups[3,4]. This pattern underscores the need for public policies aimed at promoting equity in cardiovascular care, with particular attention to regions with less developed healthcare infrastructure.

The inverse relationship between educational attainment and mortality supports the understanding that education level directly influences the adoption of preventive practices, access to health information, and appropriate use of healthcare services[27]. The 8–11 years schooling group, in particular, showed a significant increase in deaths, reflecting demographic changes in the Brazilian population, with higher educational attainment among younger generations now reaching older ages. The reduction in records with "unknown" educational level suggests an improvement in information systems, which may have contributed to greater data accuracy in more recent years.

Overall, the results suggest that the profile of AMI mortality in Brazil has been evolving in parallel with the increase in population educational attainment. These findings reinforce the need to consider educational level as an important social determinant of health in the formulation of cardiovascular prevention strategies.

This study presents some limitations inherent to the use of secondary data from the Mortality Information System (Sistema de Informação sobre Mortalidade – SIM). The quality of the records depends on the accurate identification of the underlying cause of death, which may be subject to misclassification, underreporting, or improper completion of death certificates, especially in regions with less developed healthcare infrastructure. Despite improvements in data coverage and quality in recent years, there remains the possibility of inconsistencies in the precise definition of deaths due to acute myocardial infarction.

Furthermore, the lack of detailed information on clinical, sociodemographic, and healthcare access factors limits more in-depth analyses of the individual and contextual determinants of mortality. Finally, as this is an ecological study based on aggregated records, it is not possible to establish causal relationships between the variables analyzed.

V. Conclusion

Between 2012 and 2022, Brazil recorded more than one million deaths due to acute myocardial infarction (AMI), with a trend toward increasing mortality, particularly in certain regions and specific population groups. The highest burden of mortality was concentrated in the Southeast region and among male individuals with lower educational levels, although changes in the educational profile of the victims were observed over the decade.

The findings reinforce the importance of public policies aimed at the prevention of cardiovascular diseases, the strengthening of primary healthcare, the expansion of access to specialized health services, and the addressing of regional and social health inequalities. Furthermore, the study highlights the need for continued investment in the quality of mortality records to support health planning actions.

Given the impact of AMI on national morbidity and mortality, integrated strategies for health promotion, risk factor control, and improvement in the management of cardiovascular emergencies should be priorities to reduce mortality from this cause. The continuation of studies in this area, incorporating more detailed analyses of socioeconomic and environmental factors, will be crucial to deepen understanding and guide more effective public policies. Addressing inequalities based on evidence and ensuring universal access to quality services are fundamental steps toward transforming the landscape of cardiovascular health in Brazil.

VI. Acknowledgments

We thank the Institutional Program for Scientific Initiation Scholarships (PIBIC) at the University of Rio Verde for supporting the development of this study.

References

[1] World Health Organization. The Top 10 Causes Of Death [Internet]. Geneva: WHO; [Cited 2024 Dec 12]. Available From: Https://Www.Who.Int/News-Room/Fact-Sheets/Detail/The-Top-10-Causes-Of-Death

[2] Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, Et Al. Third Universal Definition Of Myocardial Infarction. Eur Heart J. 2012;126:2020–35..

[3] Guedes TA, Silva FS. Gestão De Saúde Pública No Brasil À Luz Da Teoria Da Burocracia: Escassez De Médicos Especialistas E Desigualdade Regional De Acesso. Bol Conjuntura (BOCA). 2023;13(37):111–29.

[4] Viacava F, Oliveira RAD, Carvalho CC, Laguardia J, Bellido JG. Desigualdades Regionais E Sociais Em Saúde Segundo Inquéritos Domiciliares (Brasil, 1998–2013). Cien Saude Colet. 2019;24(7):2745–60.

[5] Cucinotta D, Vanelli M. WHO Declares COVID-19 A Pandemic. Acta Biomed. 2020;91(1):157–60.

[6] Giustino G, Croft LB, Oates CP, Rahman K, Lerakis S, Reddy VY, Et Al. Characterization Of Myocardial Injury In Patients With COVID-19. J Am Coll Cardiol. 2020 Nov;76(18):2043–55.

[7] Fornasini M, Sisa I, Baldeon ME. Increased Cardiovascular Mortality In Ecuador During COVID-19 Pandemic. Ann Glob Health. 2023;89(1):21.

[8] Nascimento JHP, Gomes BFO, Do Nascimento TC, Andrade Júnior DF, Batista KM, Dos Santos TM, Et Al. COVID-19 And Myocardial Injury In A Brazilian ICU: High Incidence And Higher Risk Of In-Hospital Mortality. Arq Bras Cardiol. 2021;116(2):275–82.

[9] Tanaka C, Tarasoutchi F, Montera MW, Et Al. Impacto Da Pandemia De COVID-19 Na Atenção Às Doenças Cardiovasculares No Brasil. Arq Bras Cardiol. 2022;118(6):1040–7. Doi:10.36660/Abc.20210746

[10] Brant LCC, Nascimento BR, Passos VMA, Et Al. Impacto Da Pandemia De COVID-19 Na Mortalidade Por Doenças Cardiovasculares No Brasil: Uma Análise Do Sistema De Informação Sobre Mortalidade. Arq Bras Cardiol. 2021;116(3):543–53. Doi:10.36660/Abc.20200821

[11] Dossena C, Teofilo RNF, Braznik MB, Bergamo FA, Bergamo FMA, Melo ASM, Et Al. Hipertensão Arterial Sistêmica E Fatores De Riscos Associados À Saúde Da População. Braz J Implant Health Sci. 2024;6(9):3568–80. Doi:10.36557/2674-8169.2024v6n9p3568-3580

[12] Brant LCC, Et Al. Variações E Diferenciais Da Mortalidade Por Doença Cardiovascular No Brasil E Em Seus Estados, Em 1990 E 2015: Estimativas Do Estudo Carga Global De Doença. Rev Bras Epidemiol. 2017;20(Suppl 1):116–28

[13] Carvalho TA, Boschiero MN, Marson FAL. COVID-19 In Brazil: 150,000 Deaths And The Brazilian Underreporting. Diagn Microbiol Infect Dis. 2021;99(3):115258.

[14] Instituto Brasileiro De Geografia E Estatística (IBGE). Censo Demográfico 2022: População E Domicílios: Primeiros Resultados [Internet]. Rio De Janeiro: IBGE; 2023 [Cited 2025 Mar 27]. Available From: Https://Biblioteca.Ibge.Gov.Br/Index.Php/Biblioteca-Catalogo?View=Detalhes&Id=2102011

[15] Tasca R, Massuda A, Carvalho WM, Buchweitz C, Harzheim E. Recomendações Para O Fortalecimento Da Atenção Primária À Saúde No Brasil. Rev Panam Salud Publica. 2020;44:E4. Available From: Https://Iris.Paho.Org/Handle/10665.2/51793

[16] Moreira MADM, Pinto ESJ, Amador AEB, Santos VR, Silva JAS, Farias LCN, Et Al. Perfil Dos Pacientes Atendidos Por Infarto Agudo Do Miocárdio. Rev Soc Bras Clin Med. 2018;16(4):212–6.

[17] Simões CCDS. Relações Entre As Alterações Históricas Na Dinâmica Demográfica Brasileira E Os Impactos Decorrentes Do Processo De Envelhecimento Da População. Rio De Janeiro: Instituto Brasileiro De Geografia E Estatística (IBGE); 2016.

[18] Freitas RB, Padilha JC. Perfil Epidemiológico Do Paciente Com Infarto Agudo Do Miocárdio No Brasil. Rev Saúde Dom Alberto. 2021;8(1):100–27.

[19] Lima AEF, Nascimento EDS, Almeida BLS, Gomes GTR. Perfil Na Mortalidade Do Infarto Agudo Do Miocárdio Por Idade E Sexo No Município De Paulo Afonso No Estado Da Bahia. Rev Rios Saúde. 2018;1(3):26–37.

[20] Santos JD, Medeiros A, Lopes JM, Silva P, Silva RB. Mortalidade Por Infarto Agudo Do Miocárdio No Brasil E Suas Regiões Geográficas: Análise Do Efeito Da Idade-Período-Coorte. Cien Saude Colet. 2018;23(5):1621–34.

[21] Wei JF, Huang FY, Xiong TY, Liu Q, Chen H, Wang H, Et Al. Acute Myocardial Injury Is Common In Patients With COVID-19 And Impairs Their Prognosis. Heart. 2020;106:1154–9. Doi:10.1136/Heartjnl-2020-317007.

[22] Wang W, Wang CY. Long-Term Cardiovascular Outcomes In COVID-19 Survivors Among Non-Vaccinated Population: A Retrospective Cohort Study From The Trinetx US Collaborative Networks. Eclinicalmedicine. 2022;53:101619. Doi:10.1016/J.Eclinm.2022.101619

[23] Mathioni SM, Mendes R, Costa CT, Gomes R, Rosa RA, Oliveira MLF. Prevalência De Fatores De Risco Em Pacientes Com Infarto Agudo Do Miocárdio. Av Enferm. 2016;34(1):30–8.

[24] Santos LOF. Envelhecimento Populacional: Uma Análise Temporal Da Idade Prospectiva, Brasil 1970-2010 [Dissertation]. Belo Horizonte: Universidade Federal De Minas Gerais; 2024.

[25] Nascimento LL, Pereira LG, Silva AR, Santos J, Lima RL, Almeida RF. Perfil De Pacientes Com Infarto Agudo Do Miocárdio Em Um Pronto Socorro Do Distrito Federal. Rev Nursing. 2022;25(287):7515–21.

[26] Patel KN, Selvaraj V, Al-Sadawi M, Muthuri J, Al-Sadawi M, Chalhoub M, Et Al. Impact Of Gender, Race, And Insurance Status On In-Hospital Management And Outcomes In Patients With COVID-19 And ST-Elevation Myocardial Infarction (A Nationwide Analysis). Am J Cardiol. 2023;198:14–25.

[27] Soares LSA. Efeitos Do Nível De Escolaridade Na Procura E Acesso A Serviços De Saúde Preventivos No Brasil: Uma Análise Multinível [Dissertation]. Viçosa: Universidade Federal De Viçosa; 2022.