

# Influence of the COVID-19 pandemic on mortality from cardiovascular diseases, 2010-2020

Influência da pandemia de COVID-19 na mortalidade por doenças cardiovasculares, 2010-2020

Influencia de la pandemia de COVID-19 en la mortalidad por enfermedades cardiovasculares, 2010-2020

## RESUMO

Objetivo: Analisar a influência da pandemia de covid-19 na mortalidade por doenças cardiovasculares e sua distribuição espacial no Brasil, no período de 2010 a 2020. Método: Estudo ecológico de séries temporais com dados secundários sobre óbitos por doenças cardiovasculares no Brasil, ocorridos no período de 2010 a 2020. Os óbitos foram descritos segundo variáveis demográficas, ano de ocorrência e unidade da federação. Empregou-se regressão de Prais-Winsten e o programa QGIS 3.16. Resultado: Houve aumento significativo na taxa de mortalidade por doenças cardiovasculares no ano de 2020 em relação aos anos anteriores, apresentando tendência crescente. A distribuição espacial das mortes por doenças cardiovasculares no Brasil comportou-se de forma crescente no último biênio, 2019 a 2020. Conclusão: Evidenciou-se possível influência da pandemia de covid-19 na mortalidade por doenças cardiovasculares.

**DESCRITORES:** Covid-19; Doenças cardiovasculares; Mortalidade; Estudos ecológicos.

## ABSTRACT

Objective: To analyze the influence of the covid-19 pandemic on cardiovascular disease mortality and its spatial distribution in Brazil from 2010 to 2020. Method: Ecological time series study with secondary data on deaths from cardiovascular diseases in Brazil, occurring in the period from 2010 to 2020. Deaths were described according to demographic variables, year of occurrence and federation unit. Prais-Winsten regression and QGIS 3.16 software were used. Result: There was a significant increase in the mortality rate from cardiovascular disease in 2020 compared to previous years, showing an increasing trend. The spatial distribution of deaths from cardiovascular disease in Brazil behaved increasingly in the last bienium, 2019 to 2020. Conclusion: A possible influence of the covid-19 pandemic on cardiovascular disease mortality was evidenced.

**DESCRIPTORS:** Covid-19; Cardiovascular Diseases; Mortality; Ecological Studies.

## RESUMEN

Objetivo: Analizar la influencia de la pandemia de covid-19 en la mortalidad por enfermedades cardiovasculares y su distribución espacial en Brasil de 2010 a 2020. Método: Estudio ecológico de series temporales con datos secundarios sobre muertes por enfermedades cardiovasculares en Brasil, ocurridas en el período de 2010 a 2020. Las muertes se describieron según variables demográficas, año de ocurrencia y unidad federativa. Se utilizó la regresión de Prais-Winsten y el programa QGIS 3.16. Resultados: Se produjo un aumento significativo de la tasa de mortalidad por enfermedades cardiovasculares en 2020 en relación con los años anteriores, mostrando una tendencia creciente. La distribución espacial de las muertes por enfermedades cardiovasculares en Brasil se comportó cada vez más en el último bienio, 2019 a 2020. Conclusão: Evidenciou-se possível influência da pandemia de covid-19 na mortalidade por doenças cardiovasculares.

**DESCRIPTORES:** Covid-19; Enfermedades cardiovasculares; Mortalidad; Estudios ecológicos.

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## INTRODUÇÃO

Considered a Public Health Emergency of International Concern, the covid-19 pandemic, by early January 2023 globally, had more than 660 million confirmed cases, including more than 6 million deaths notified by the World Health Organization (WHO). Among the countries most affected by the outbreak of the new coronavirus, Brazil is among the first places,<sup>1</sup> with a total of 36,640,787 confirmed cases of the disease, accounting for 695,410 fatalities.<sup>2</sup>

Although COVID-19 can present itself, in many cases, in a mild or asymptomatic way, its presence can lead to the development of severe respiratory syndromes, these forms being more likely to progress in people with previous chronic diseases.<sup>3</sup> A study demonstrates that, among the risk factors for worsening the prognosis, are advanced age and comorbidities such as obesity, diabetes, pulmonary, hypertensive and cardiovascular diseases.<sup>4</sup>

It is important to highlight that cardiovascular diseases (CVD) have been one of the main causes of death in the world.<sup>5</sup> The number of deaths from CVD has increased from more than 2 million since the year 2000 to almost

9 million in 2019, representing 16% of all deaths from all causes in the world.<sup>6</sup> In Brazil, CVDs are considered the main causes of death, representing 31.8% of deaths, when deaths from external causes are excluded.<sup>7</sup>

Currently, the country is undergoing an epidemiological transition process, in which there is a decrease in the incidence of communicable diseases and an increase in chronic non-communicable diseases. However, this process has not occurred homogeneously, in the last three decades (1990, 2000, 2019), among the regions of the country. A negative trend in CVD mortality is observed in the states of the South and Southeast, while the trend has remained positive in the Brazilian Northeast.<sup>8</sup>

Since the beginning of the covid-19 pandemic, CVD has been recognized as a risk factor for morbidity and mortality.<sup>9</sup> A study that analyzed the latent mortality profiles for covid-19 showed that the highest mortality rates were found in groups that had hypertension and heart disease, regardless of the mortality profile.<sup>10</sup>

Before covid-19, the prevalence of CVD in SARS-Cov was 8%, however, the literature shows that when SARS-Cov-2 is associated with other comor-

bidities such as diabetes mellitus and CVD, the risk of death is twelve times higher in patients. This is because the virus binds to the receptor of an enzyme (angiotensin-converting enzyme 2-ACE2) which, in addition to being expressed in the lung, it is highly released in the heart, causing cardiac effects, such as myocardial damage, causing most cases of covid-19 associated with CVD to have a low survival rate in more severe cases.<sup>11</sup>

In this context, the study aimed to analyze the influence of the covid-19 pandemic on CVD mortality and its spatial distribution in Brazil, from 2010 to 2020.

## METHOD

Ecological study of time series, which includes deaths due to CVD in Brazil, which occurred in the period from 2010 to 2020. Ecological studies are those whose unit of analysis corresponds to a group of people instead of individuals.<sup>12</sup> Data referring to the years 2010 to 2019 were collected from the Mortality Information System (SIM) and those for 2020, as they were not available on the Tabnet, were obtained through the mortality monitoring panel of the Department of

Health Analysis and Surveillance of Noncommunicable Diseases (DASNT - Departamento de Análise em Saúde e Vigilância das Doenças Não Transmissíveis), both available at the Department of Informatics of the Unified Health System (DATASUS).<sup>13</sup>

We selected CVD deaths, classified according to the 10th Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10): chronic rheumatic heart diseases (I05-I09), hypertensive diseases (I10-I15), ischemic heart diseases (I05-I09), heart failure (I20-I25), heart failure (I50) and cerebrovascular diseases (I60-I69) according to age group, sex, year of occurrence and states of residence (FU).

Deaths were described according to demographic variables: gender (male, female), age group in years (children/adolescents: 0 to 19 years old; adults: 20 to 59 years old; elderly: 60 years old and over) and race/color (white, black, yellow, brown and indigenous), year of occurrence (2010-2020) and federation unit (FU) of residence. Population estimates were obtained from the Brazilian Institute of Geography and

Statistics (IBGE) according to data from the 2010 Census and population projection by UF, age group, sex and year.

To characterize the study population, a descriptive analysis was performed according to demographic variables. Mortality rates were obtained by dividing the number of deaths from CVD (numerator) by the number of people residing in the country (denominator), multiplying by 100,000 inhabitants. The calculation was performed by age group and for all years of the time series.

For trend analysis, the calendar year in which the death occurred was considered as an independent variable. The outcome variable was the CVD mortality rate for each year included in the analysis. The Average Annual Percent Change (AAPC) and their respective 95% confidence intervals (95%CI) of CVD mortality rates were calculated. Trends were classified as: increasing ( $p < 0.05$  and positive beta), decreasing ( $p < 0.05$  and negative beta) and stationary ( $p > 0.05$ ).

Average CVD mortality rates were calculated for the following periods:

2010-2012, 2013-2015, 2016-2018, 2019-2020. For comparison purposes, the averages were categorized into quartiles in order to verify the evolution of the spatial distribution of the mortality rate according to FU over the period analyzed.

Descriptive analysis and calculation of the mortality rate were performed using the Microsoft Excel Office 2013 program. Trend analysis of the time series was performed using the Prais-Winsten linear regression model in the Stata program version<sup>14</sup> (StataCorp LP, College Station, USA). Maps of mean CVD mortality rates were generated using the QGIS<sup>3,16</sup> program.

Because it is a study with anonymous secondary data and public access, it was not necessary to submit the project to the ethics and research committee.

## RESULTS

In the period from 2010 to 2020, 3,017,591 deaths from CVD were recorded in Brazil. Most deaths occurred in males (53.16%), in those with white color/race (87.35%) followed by brown (10.06%) and elderly (88.54%)

Table 1 – Deaths from cardiovascular diseases according to demographic characteristics by age group, Brazil, 2010-2020.

Age groups (years)	Male		Female		Total	
	N	%	N	%	N	%
0 to 19	4252	60,18	2814	39,82	7066	100
20 to 59	378035	91,92	33223	8,08	411258	100
60 and older	1221922	87,59	173121	12,41	1395043	100
Total	1604209	53,16	1413382	46,84	3017591	100

Age groups (years)	White		Black		Yellow		Brown		Indigenous		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
0 to 19	3028	38,63	625	7,97	15	0,19	4079	52,03	92	1,17	7839	100
20 to 59	268912	82,70	11098	3,41	316	0,10	44511	13,69	312	0,10	325149	100
60 and older	1410826	88,54	34174	2,14	2225	0,14	145269	9,12	977	0,06	1593478	100
Total	1682766	87,35	45897	2,38	2556	0,13	193859	10,06	1381	0,07	1926459	100

Source: SIM, 2010 to 2020.

(Table 1).

Table 2 below shows a significant increase in the mortality rate during the period of the covid-19 pandemic, in 2020, compared to previous years with an increasing trend (AAPC = 1,03% - CI95% 0,04;2,03). The age group from 0 to 19 years showed variation throughout the series with a trend towards stability (AAPC = 0,93% - CI95% -2,42;0,58). In the other age groups, mortality rates showed a stable trend, 20 to 59 years old (AAPC = -0,62% - CI95% -2,02; 0,79), and decreasing, 60 years old and over (AAPC = -1,91% - CI95% -2,65; -1,18).

Figure 1 shows the evolution of the spatial distribution of the three-year averages of CVD mortality rates, according to the 27 FU. In the first three three-year periods (2010-2012, 2013-2015, 2016-2018), 22.22% of the federative units had a mortality rate above 155/100,000 inhab. (Figure 1A, Figure 1B and Figure 1C). The 2019-2020 biennium, in turn, showed a significant increase with 51.85% of the federative units with a CVD mortality rate above 155/100,000 inhab. (Figure 1D).

## DISCUSSION

The present study analyzed the spatial distribution and influence of the covid-19 pandemic on CVD mortality in Brazil over the last decade (2010-2020). A significant increase in the CVD mortality rate was identified in the year 2020, when compared to previous years and in the spatial distribution in the last three years (2018-2020). The mortality rate increased over the course of the series analyzed, predominantly among males, white race/color, aged 60 years or older.

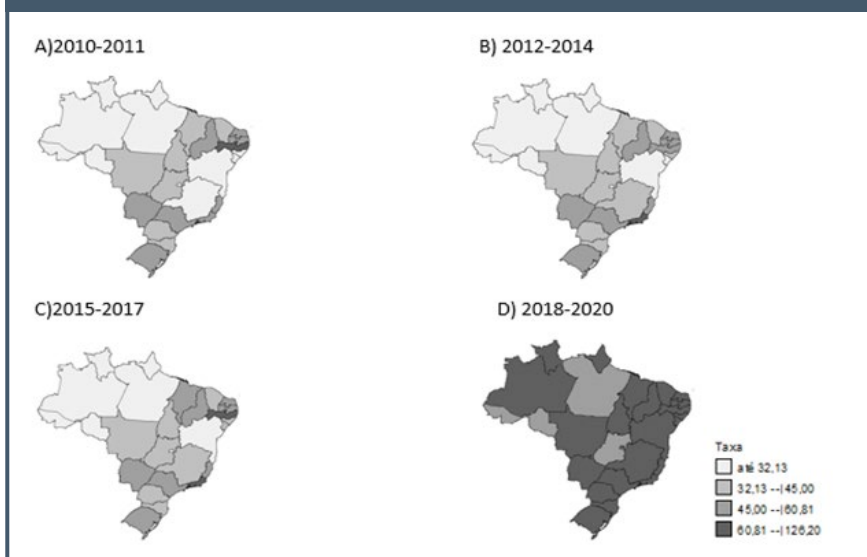
Men are more vulnerable to diseases, especially chronic diseases, and die earlier than women.<sup>14</sup> This greater susceptibility of males, as well as excess mortality, can be explained, in part, by social and cultural factors. This population tends to seek less primary health care services, making screening and disease prevention diffi-

Table 2 - Trend in mortality rate (per 100,000 inhab.) from cardiovascular diseases, according to age group, Brazil, 2010-2020.

Age group (years)	Mortality rate		Average Annual Percent Change (AAPC) (%)	CI 95%*	p-value	Trend
	2010	2020				
0 to 19	1,16	1,20	-0,93	(-2,42; 0,58)	0,194	Estabilidade
20 to 59	53,27	60,58	-0,62	(-2,02; 0,79)	0,343	Estabilidade
60 and older	1098,63	1048,86	-1,91	(-2,65; -1,18)	0,000	Decrescente
Total	140,20	179,95	1,03	(0,04; 2,03)	0,043	Crescente

Source: SIM, 2010 to 2020.

Figure 1 - Evolution of the three-year average mortality rate (per 100,000 inhabitants) from cardiovascular diseases, according to federation units per residence, Brazil, 2010-2020.



Source: SIM, 2010 to 2020.

cult, contributing to higher mortality rates.<sup>15</sup>

A similar result was observed by Martins et al.<sup>16</sup>, when analyzing trends in CVD mortality rates between 2000-2015 in the most populous capitals of the five regions of Brazil, they found that mortality rates were higher for men, both in the younger and more advanced age groups.

In the featured series, the group most

victimized by CVD were people of color/white race. Similar results were not found in the literature. A study points out that the most vulnerable groups, with regard to social and biological risks for CVD, are black people.<sup>17</sup> A hypothesis for this finding is the social markers, which often generate inequalities, causing marginalized groups such as blacks to have less access to health services, not faithfully portraying the reality.<sup>18</sup>

In recent years, it has been observed that although CVD mortality rates are decreasing in the country, the total number of deaths has been increasing due to the aging of the population.<sup>19</sup> In a retrospective analysis of the CVD mortality trend in Brazil, in the period 2000-2017, most deaths in the historical series were attributed to increasing age.<sup>20</sup>

Andrade et al.<sup>21</sup>, also observed that the highest number of deaths occurred in the most advanced age groups, corroborating the findings of the present study. The literature points out that advanced age is linked to a greater probability of a cardiovascular event<sup>17</sup>, precisely because this population is more exposed to risk factors for CVD due to increased longevity.<sup>7</sup>

With regard to the mortality rate, the results showed a significant increase in the year 2020 and a growing trend. Studies carried out with periods prior to 2020 showed different results from those found by this study. Martins et al.<sup>16</sup> considering the most populous capitals in Brazil, found a significant and sustained decline in all, with the exception of Manaus from 2000 to 2015. In addition, Malta et al.<sup>20</sup> and Souza et al.<sup>22</sup> identified a decline in the mortality rate from cerebrovascular diseases in the Brazilian population between 2000-2017 and 1996-2015, respectively.

The increase in deaths observed during the pandemic period may be due to the contribution that CVDs play in the severity and mortality of covid-19. Until then, the pathogenesis of acute myocardial injury associated with infection by the new coronavirus is still not fully known, what is known is that the presence of previous cardiovascular metabolic

diseases increases the risk of evolution to the development and prognosis of pneumonia.<sup>23</sup>

Another factor to be considered is that, during the pandemic, access to services, treatments and care for chronic diseases was impacted, thus contributing to the excess of preventable mortality from causes not associated with covid-19.<sup>24</sup> In the southern region of Brazil, people with non-communicable chronic diseases faced problems in controlling their diseases, difficulty in accessing prescribed medications and not seeking medical care.<sup>25</sup> These interruptions are worrying factors, since they can result in immediate and medium and long-term harmful effects.

A study carried out in six Brazilian capitals showed excess cardiovascular mortality during the covid-19 pandemic in most cities, being more expressive in less developed ones, presumably associated with the collapse of health.<sup>26</sup> An increase in the rate of home deaths due to cardiac arrest was described in March 2020 in Belo Horizonte, about 87% of the reported cases had clinical comorbidities, of which 22.9% had hypertension. It was identified that approximately 89% of the cases did not have medical follow-up, given this worrying.<sup>27</sup>

Malta et al.<sup>20</sup>, when comparing historical series of CVD mortality, they observed a significant drop in deaths from heart disease in the FUs of Brazil, except in the North and Northeast. However, these results are in line with those observed in the present study, where all FUs showed an increasing evolution of this distribution, especially in the last biennium (2019-2020).

A hypothesis for this finding is the

current situation that the country is experiencing, the covid-19 pandemic, with high mortality among the regions of the country due to the disease, in particular, for those with pre-existing cardiovascular diseases, which may have contributed to the increase observed in the last year of the studied series, modifying the spatial distribution curve for CVD.<sup>28,29</sup>

Finally, some limitations need to be considered in the present analysis of the presented results. The first concerns the derivation of data from a national database, where it is possible that there are underreporting or erroneous reporting, resulting in underestimated data. The second is that there is no systematic monitoring of national health problems, resulting in insufficient continuous data over the decades. The third, and no less important, is that the pandemic itself makes it difficult to qualify the data, making the scenario dynamic due to the constant updates of deaths.

## CONCLUSION

In conclusion, this study showed that the trend in the mortality rate from CVD over the historical series continued to grow, with a considerable increase in 2020, and the covid-19 pandemic may have influenced the increase in mortality. It was found that the significant increase in the last biennium (2019-2020), evidenced by the spatial distribution of the evolution of mortality rates due to CVD in the country during the pandemic. In view of this, it is important to formulate more effective strategies and actions, aimed at people with chronic diseases, in particular CVD, since this condition is a risk factor for the severity of covid-19.

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