

# Effect of COVID-19 on Cardiovascular Disease Mortality in a Medium-Sized City

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## SUMMARY

**Introduction:** Patients hospitalized for COVID-19 have a high prevalence of cardiovascular risk factors, such as hypertension and diabetes mellitus, in addition to chronic cardiovascular conditions, such as ischemic heart disease and heart failure. Other fatal events have also occurred, and are somehow indirectly associated with the pandemic, such as deaths from neglected or inadequately treated diseases due to an overburdened health system or fear of leaving home at the height of the COVID-19 pandemic. The present study aims to evaluate the impact of COVID-19 on CVD statistics in a medium-sized city.

**Methods:** A retrospective observational study with 546 patients who died due to cardiovascular diseases, between January 1, 2019 and December 31, 2020. Regarding the year of death, continuous variables were compared using the unpaired t-test and categorical variables using Pearson's chi-square or Fisher's exact test. Considering a significance level of 0.05 in the two-tailed test.

**Results:** A total of 545 deaths due to cardiovascular diseases were evaluated, 272 in 2019 and 274 cases in 2020. There was no difference in age and sex ratios between the years evaluated. There was a higher frequency of deaths at home in 2020 compared to 2019; a reduction in the frequency of deaths occurring in hospitals.

**Conclusion:** The results indicate an increase in the number of deaths at home due to CVD reported by SIM in 2020 compared to the same period in the previous year, in a medium-sized Brazilian city.

**Keywords:** Covid 19; Cardiovascular Diseases; Death; Myocardial infarction; Cardiac events.

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## INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared the public health situation involving the disease named COVID-19, caused by the novel coronavirus SARS-CoV-2, a pandemic [1]. It causes a severe acute respiratory syndrome, which invades cells via the angiotensin-converting enzyme 2 [2] and has been responsible for approximately 713,000 deaths in Brazil [3].

Patients hospitalized due to COVID-19 exhibit a high prevalence of cardiovascular risk factors, such as hypertension and diabetes mellitus, as well as chronic cardiovascular conditions, such as ischemic heart disease and heart failure [4-8], contributing

to a significant increase in COVID-19-related mortality [9]. Additionally, other fatal events have occurred, indirectly associated with the pandemic, such as deaths from acute myocardial infarction and stroke due to neglected or inadequately treated hypertension, dyslipidemia, and diabetes because of the overwhelmed healthcare system or fear of leaving home at the height of the COVID-19 pandemic [9, 10].

Considering that cardiovascular diseases (CVD) are the leading cause of death in Brazil [11], this study aims to evaluate the impact of COVID-19 on CVD mortality statistics in a medium-sized city.

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## METHODS

### Study Type and Location

This is an observational, retrospective study conducted in the city of Rio Verde, Goiás, Brazil, a medium-sized city with an estimated population of nearly 248,000 [12].

### Population, Sample, and Sampling

The study comprised 546 patients who died from cardiovascular diseases between January 1, 2019 (pre-COVID-19 pandemic) and December 31, 2020 (during the COVID-19 pandemic). Deaths where the primary cause was not cardiovascular disease were excluded.

### Data

The analysis was based on secondary ordinary administrative data from the SUS Mortality Information System (SIM). The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) codes were used to identify the underlying causes of death due to ischemic heart disease (I20-I25), heart failure (I50), hypertensive diseases (I10-I15), arrhythmias (I49), and other conditions. To examine the potential indirect effect of the pandemic, deaths with COVID-19 as the underlying cause were excluded from the analysis.

### Statistical Analysis

Categorical variables were summarized using

absolute (n) and relative (%) frequencies, while continuous variables were summarized using means and standard deviations (SD). An outlier in age (13 years) was removed due to the non-cardiac cause of death but did not compromise the statistical analysis.

Regarding the year of death, continuous variables were compared using the unpaired t-test, and categorical variables were compared using Pearson's chi-square or Fisher's exact test. All analyses were performed using R software version 4.3.2 (R Core Team, Vienna, Austria), with a significance level of 0.05 for two-tailed tests.

### Ethical Considerations

Approval from a Human Research Ethics Committee was not required due to the use of non-identified, publicly available data.

## RESULTS

A total of 545 deaths due to cardiovascular diseases were evaluated, with 272 cases in 2019 (pre-pandemic) and 274 cases in 2020 (during the pandemic). There were no differences in age and sex proportions between the years evaluated (Table 1).

An increased frequency of deaths at home was observed in 2020 compared to 2019. In this regard, there was a reduction in the frequency of deaths occurring in hospitals or other healthcare institutions ( $p < 0.001$ ). For other diseases, groups, and subgroups of diseases, no differences in proportions were observed.

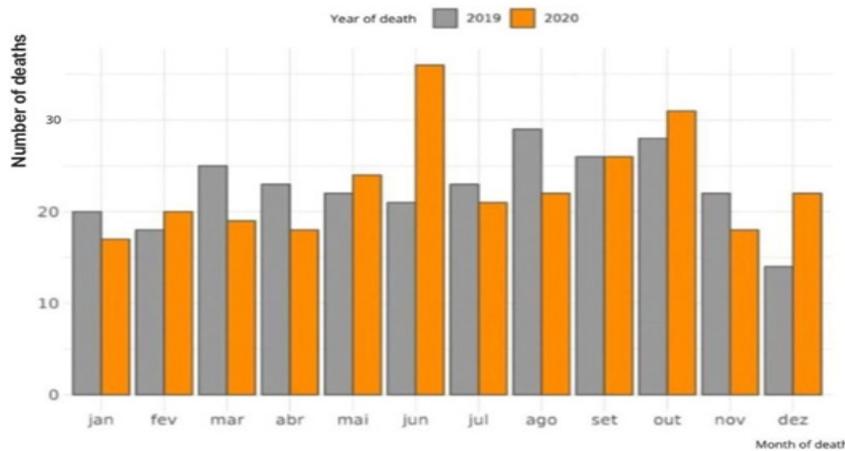
Table 1. Epidemiological Profile of Cardiovascular Disease Deaths in Rio Verde/GO: January 2019 to December 2020

Variables	2019, N = 271	2020, N = 274	p
<b>Age (years)</b>	69.88 (15.24)	70.88 (14.98)	<b>0.54</b>
<b>Age Range</b>			<b>0.48</b>
21-59 years	64 (23.62%)	54 (19.71%)	
60-75 years	94 (34.69%)	105 (38.32%)	
76-102 years	113 (41.70%)	115 (41.97%)	
<b>Sex</b>			<b>0.36</b>
Female	113 (41.70%)	125 (45.62%)	
Male	158 (58.30%)	149 (54.38%)	
<b>Place of Death</b>			<b>&lt;0.001</b>
Home	48 (17.71%)	89 (32.48%)	
Hospital	145 (53.51%)	133 (48.54%)	
Others	6 (2.21%)	5 (1.82%)	
Other Health Institutions	71 (26.20%)	45 (16.42%)	
Public Place	1 (0.37%)	2 (0.73%)	
<b>MI</b>			<b>0.52</b>

No	189 (69.74%)	184 (67.15%)	
Yes	82 (30.26%)	90 (32.85%)	
<b>DM</b>			<b>0.13</b>
No	237 (87.45%)	227 (82.85%)	
Yes	34 (12.55%)	47 (17.15%)	
<b>HT</b>			<b>0.75</b>
No	204 (75.28%)	203 (74.09%)	
Yes	67 (24.72%)	71 (25.91%)	
<b>Dyslipidemia</b>			<b>&gt;0.99</b>
No	267 (98.52%)	270 (98.54%)	
Yes	4 (1.48%)	4 (1.46%)	
<b>Obesity</b>			<b>0.070</b>
No	267 (98.52%)	263 (95.99%)	
Yes	4 (1.48%)	11 (4.01%)	
<b>Heart Disease</b>			<b>&gt;0.99</b>
No	266 (98.15%)	269 (98.18%)	
Yes	5 (1.85%)	5 (1.82%)	
HF			0.37
No	270 (99.63%)	270 (98.54%)	
Yes	1 (0.37%)	4 (1.46%)	
<b>Arrhythmia</b>			<b>&gt;0.99</b>
No	267 (98.52%)	270 (98.54%)	
Yes	4 (1.48%)	4 (1.46%)	
<b>Mental Disorder (Abusive Smoking)</b>			<b>0.45</b>
No	253 (93.36%)	260 (94.89%)	
Yes	18 (6.64%)	14 (5.11%)	
<b>Mental Disorder (Abusive Alcohol)</b>			<b>0.75</b>
No	266 (98.15%)	270 (98.54%)	
Yes	5 (1.85%)	4 (1.46%)	
<b>Nephropathy</b>			<b>&gt;0.99</b>
No	266 (98.15%)	269 (98.18%)	
Yes	5 (1.85%)	5 (1.82%)	
<b>Respiratory Tract Diseases</b>			<b>0.37</b>
No	258 (95.20%)	265 (96.72%)	
Yes	13 (4.80%)	9 (3.28%)	
<b>Endocrine-Metabolic Diseases</b>			<b>0.22</b>
No	264 (97.42%)	271 (98.91%)	
Yes	7 (2.58%)	3 (1.09%)	
<b>Depressive Episode</b>			<b>&gt;0.99</b>
No	271 (100.00%)	273 (99.64%)	
Yes	0 (0.00%)	1 (0.36%)	
<b>Senility</b>			<b>0.76</b>
No	264 (97.42%)	268 (97.81%)	
Yes	7 (2.58%)	6 (2.19%)	

MI: myocardial infarction; DM: diabetes mellitus; HT: hypertension; HF: heart failure. Pearson's chi-square test.

Figure 1. Monthly Evolution of Cardiovascular Disease Deaths in Rio Verde (GO) by Year



In both years assessed, individuals who died from cardiovascular diseases had a statistically similar average age compared to those who did not die from this cause (Figure 2).

The population aged 60-75 years had the highest

proportion of CVD deaths in both 2019 and 2020 (Figure 3). Additionally, the proportion of CVD deaths was statistically similar between the years, regardless of age group.

Figure 2. Comparison of Average Age of Cardiovascular Disease Deaths in Rio Verde (GO) by Underlying Cause and Year

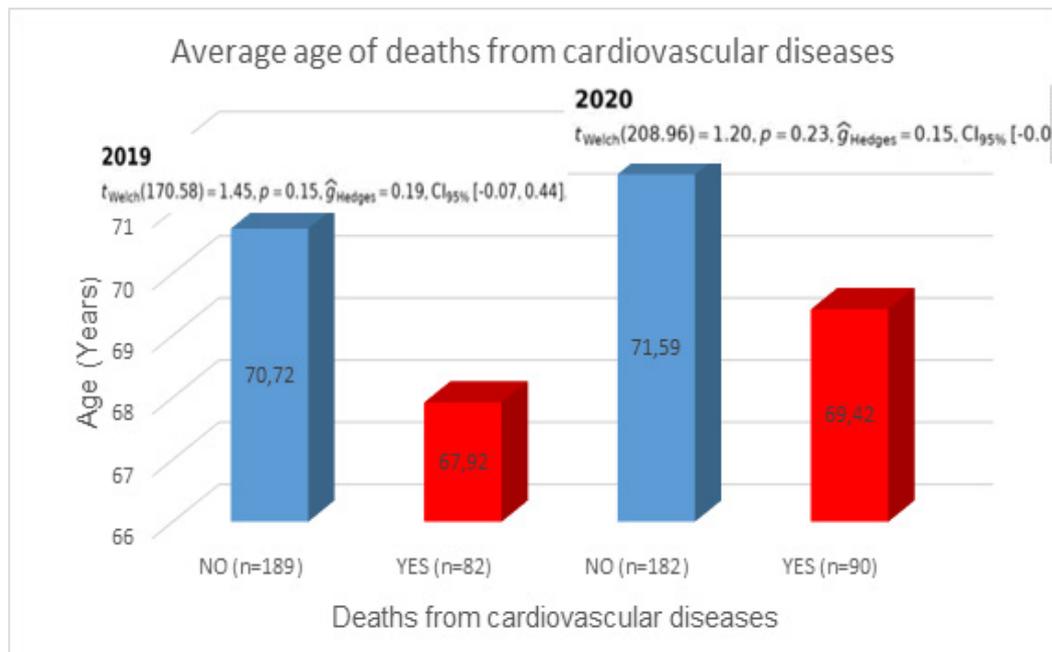
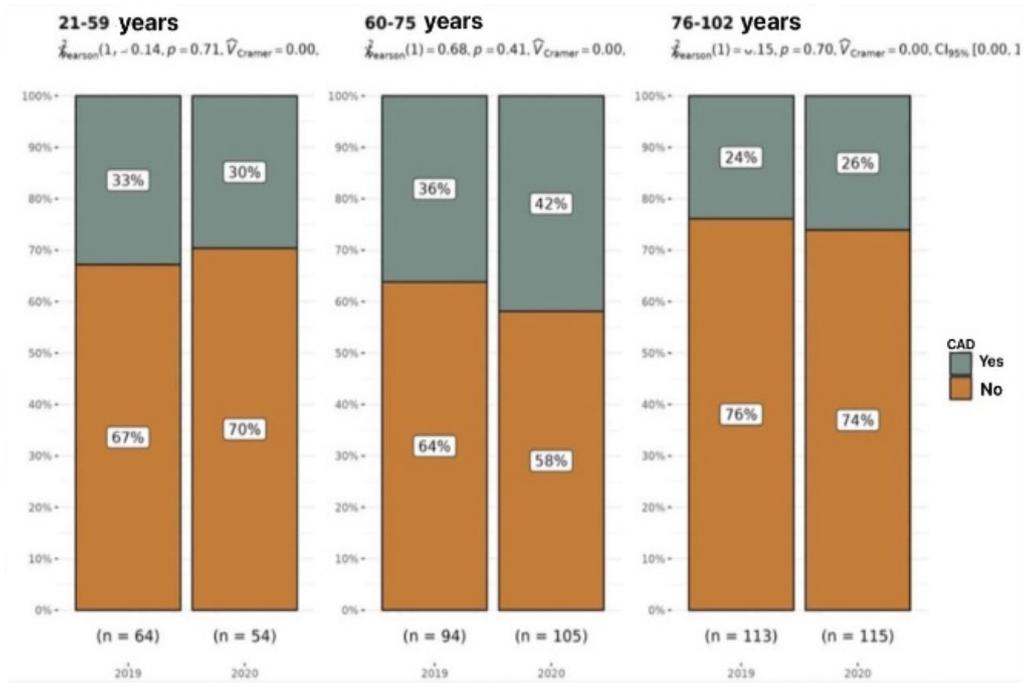
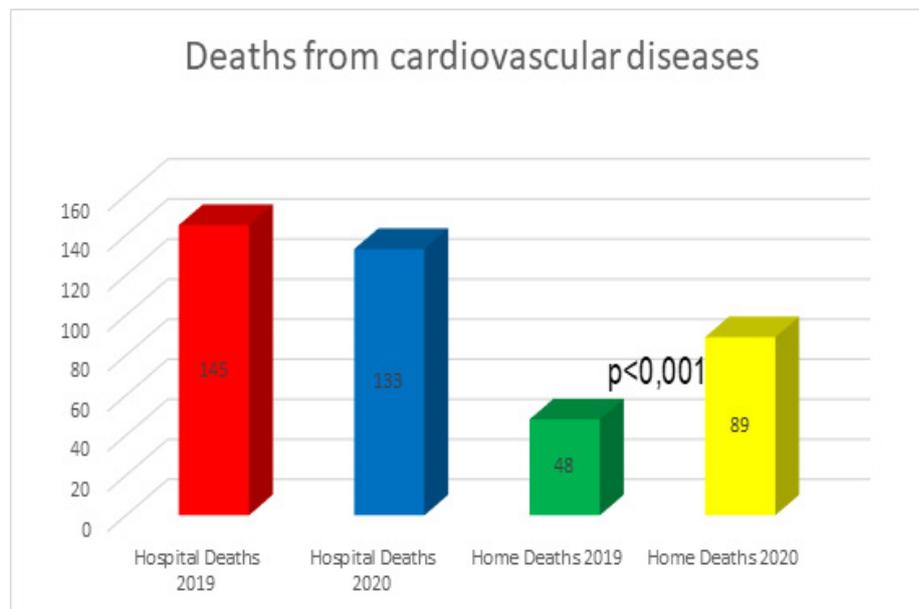


Figure 3. Proportion of Cardiovascular Disease Deaths in Rio Verde (GO) by Age Group and Year



Central Figure. Cardiovascular Disease Deaths in Rio Verde (GO) by Location and Year



## DISCUSSION

In this analysis, it was observed that the two evaluated groups (2019 vs. 2020) showed no significant differences concerning age, sex, and other cardiovascular comorbidities such as hypertension, diabetes mellitus, obesity, dyslipidemia, and depression. However, the primary result of this study was an 83% increase in home deaths due to cardiovascular diseases (CVD) in 2020 compared to 2019, with these deaths being more frequent in May, June, October, and December, and myocardial infarction (MI) was the leading cause in almost one-third of the cases. There was no difference in the age range of deaths between the evaluated years, although a higher proportion of CVD deaths was found in the 60-75 year age range. Our results support and extend previous findings [13,14].

Regarding the significant increase in home deaths in 2020, during the period of social isolation due to the pandemic, it is important to note that there was a substantial decline in hospitalizations for acute cardiovascular diseases, such as acute coronary syndrome, stroke, atrial fibrillation, and acute or decompensated heart failure, as well as a considerable proportion of excess deaths not attributed to COVID-19 during the ongoing pandemic [15-25]. Our study showed approximately a 16% reduction in hospitalizations in 2020, with a more pronounced reduction of 25% in May and June, which could be a risk factor for the mismanagement of chronic diseases such as hypertension, dyslipidemia, and diabetes, contributing to adverse cardiovascular outcomes.

Although the COVID-19 pandemic has been an unprecedented threat to global health in recent times [26], reports of potential side effects from widespread strategies to prevent the rapid spread of SARS-CoV-2 and relieve the burden on health systems, with reduced attention to non-communicable chronic diseases, as well as the continuous increase in deaths reported by the media, may have led to fear among this population in seeking adequate maintenance of their treatments, resulting in increased home deaths not due to COVID-19 among patients with established cardiovascular comorbidities. Generally, the reduction in hospital visits for patients with non-communicable chronic diseases, especially hypertension, diabetes, dyslipidemia, and myocardial infarction, was expected as the pandemic necessitated a reorganization of the existing human and technological hospital resources focused on combating COVID-19 [27]. In this study, home deaths due to CVD increased by 83% during the COVID-19 lockdown compared to the previous year. The same result was observed in a cross-sectional study with nearly 3.5 million deaths before and during the pandemic [28]. A divergent result was found in a Danish study with nearly 700,000 patients [29].

The present study showed that the leading cause of death in both evaluated years was myocardial

infarction, followed by hypertension and diabetes [11]. Myocardial infarction is the leading cause of death worldwide and requires urgent attention, as does the management of its risk factors such as hypertension and diabetes mellitus. These conditions represent acute events that always require immediate emergency care, even during a public health emergency such as the COVID-19 pandemic. Despite the statistical insignificance of myocardial infarction deaths between the two years evaluated, the significant increase in home deaths due to myocardial infarction in our study may reflect a fear of presenting to the emergency room, having a detrimental impact on patients with myocardial infarction, delaying or avoiding treatment. Similar results were found in other studies that also reported increased mortality from myocardial infarction unrelated to COVID-19 [30,31]. Sometimes, clearer, more frequent, and highly visible communication by healthcare and public health professionals to reinforce the importance of timely medical emergency care and to ensure public safety regarding COVID-19 contamination might have yielded different outcomes.

Another interesting finding from this study was the increase in cardiovascular mortality rates, mainly myocardial infarction, in the months of May, June, October, and December 2020 compared to the same period the previous year. The explanations for this observation are unclear and we can only speculate about this finding, such as the possibility of lower temperatures in the months of May and June increasing the risk of viral infection, which could trigger atherothrombotic processes in patients already suffering from chronic coronary artery disease [32,33]. Additionally, the relaxation of social isolation in October and December, during extended holidays and school vacations, and consequently, an increase in social gatherings and family reunions, might have contributed to the observed increase in deaths. The significant rise in COVID-19 cases in May, June, and October 2020 might also have contributed to the increase in cardiovascular deaths. Given the shortcomings of public cardiovascular prevention policies in the municipality both before and after the pandemic, we might not attribute this variable as a causal factor of the deaths.

Regarding mortality by age group, this study showed a higher proportion of mortality in the 60-75 age group, with no statistically significant difference between the two years evaluated. Although Brazil stands out among the BRICS countries for its successful epidemiological transition, with a rapid reduction in CVD mortality both in cohorts of newborns and in all age groups over time [34], the rapid ageing of the population, the increase in obesity and the decline in healthy diet and physical activity can be major risk factors for cardiovascular death, especially in older and more vulnerable patients [35]. In our study, both groups died of CVD at an average age of 70, which may have contributed to this finding. Excess deaths

make it possible to quickly assess the mortality burden directly attributable to COVID-19, as well as its indirect burden, resulting from interruptions in access, use and provision of health services [26,36].

The limitations of our study that deserve to be highlighted are: The first concerns the coverage of the number of deaths in the civil registry, which may have biased our estimates of excess mortality, even though we revised and updated the database. The second refers to the difficulty of analyzing cardiovascular mortality, given the unavailability of this specific information for the entire period analyzed. The third is due to the reliability of the administrative data presented by the SIM, such as incompleteness and the high rate of deaths from ill-defined causes, reflecting on the quality of the completion and processing of death certificates and making it difficult to carry out a more comprehensive analysis considering the population of health insurance beneficiaries who use private health services. Despite the limitations mentioned above, especially in a context such as the pandemic, which imposes significant challenges on the health system, it is worth emphasizing the importance of having a national database which, in global terms, covers around 75% of the Brazilian population and is available relatively quickly. This study adds to others already published in other countries and contributes by examining in detail the effects of the COVID-19 pandemic on cardiovascular mortality in a medium-sized Brazilian city, considering the universe of deaths from COVID-19 and other conditions covered by the SUS.

## CONCLUSION

The results indicate an increase in at-home CVD deaths reported by SIM in 2020 compared to the previous year in a mid-sized Brazilian city. Our study underscores the need to reform public health policies to prevent cardiovascular deaths during periods of viral infection spread.

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