ISSN-e [2675-5602]

Global Academic Nursing Journal

ORIGINAL ARTICLE

Analysis of COVID-19 death profile between 2020-2021 in a city in Northwest Paraná

Análisis del perfil de fallecimientos por COVID-19 entre 2020-2021 en una ciudad del Noroeste de Paraná

Análise do perfil de óbitos por COVID-19 entre 2020-2021 em uma cidade no Noroeste do Paraná

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How to cite this article:
Ferraz BH, Moretto ADB, Cavalini GR, Charlo PB, Buzzo LS, Henrique CRP, Ogatha BH, Lorencete DV, Silva LEM, Gomedi JGM. Analysis of COVID-19 death profile between 2020-2021 in a city in Northwest Paraná. Glob Acad Nurs. 2025;6(2):e388. https://dx.doi.org/10.5935/2675-5602.20200388

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Submission: 04-28-2023
Approval: 02-10-2024

Abstract

The presence of risk factors is intrinsically related to unfavorable prognoses and deaths from COVID-19. In this context, this study aims to descriptively analyze the sociodemographic profile related to risk factors for death from COVID-19 in 2020 and 2021 in a city in northwestern Paraná. This is a cross-sectional, descriptive, quantitative, and documentary study using official data obtained by the Health Department of a municipality in northwestern Paraná. The following variables were analyzed in COVID-19 deaths: sex, age, and education. Statistical analysis of the variables used absolute frequency and percentages for categorical variables, using Excel, SPSS, and the R environment. A predominance of deaths among males and individuals aged 60 or older was observed. Regarding education, most data were missing or not reported.

Descriptors: SARS-CoV-2; Epidemiologic Factors; Risck Factors; Level of Education; Public Health.

Resumén

La presencia de factores de riesgo está intrínsecamente relacionada con pronósticos desfavorables y muertes por COVID-19. En este contexto, este estudio tiene como objetivo analizar descriptivamente el perfil sociodemográfico relacionado con los factores de riesgo de muerte por COVID-19 en 2020 y 2021 en una ciudad del noroeste de Paraná. Se trata de un estudio transversal, descriptivo, cuantitativo y documental con datos oficiales obtenidos por la Secretaría de Salud de un municipio del noroeste de Paraná. Se analizaron las siguientes variables en las muertes por COVID-19: sexo, edad y educación. El análisis estadístico de las variables utilizó frecuencia absoluta y porcentajes para las variables categóricas, utilizando Excel, SPSS y el entorno R. Se observó un predominio de muertes en hombres y personas de 60 años o más. En cuanto a la educación, la mayoría de los datos faltaban o no se reportaban.

Descriptores: SARS-CoV-2; Factores Epidemiológicos; Factores de Riesgo; Nivel de Educación; Salud Pública.

Resumo

A presença de fatores de risco está intrinsecamente relacionada com prognósticos desfavoráveis e óbitos por COVID-19. Nesse contexto, o presente trabalho tem por objetivo analisar descritivamente o perfil sociodemográfico relacionado a fatores de risco de óbito por COVID-19 nos anos de 2020 e 2021 em uma cidade no noroeste do Paraná. Trata-se de um estudo transversal de caráter descritivo, quantitativo e documental, com dados oficiais obtidos pela Secretaria de Saúde de um município do noroeste do Paraná. Foram analisadas as seguintes as variáveis, sexo, idade e escolaridade nos óbitos por COVID-19. Para a análise estatística das variáveis foram utilizadas a frequência absoluta e a porcentagem para as variáveis categóricas, com auxílio dos *softwares Excel, SPSS* e ambiente R. Foi observado um predomínio nos óbitos pelo sexo masculino e indivíduos com 60 anos ou mais. Quanto ao fator escolaridade a maioria dos dados não constava ou não foi informado.

Descritores: SARS-CoV-2; Fatores Epidemiológicos; Fatores de Risco; Grau de Escolaridade; Saúde Pública.

Introduction

In recent years, global health has been facing a pandemic caused by the SARS-CoV-2 virus, which causes the acute respiratory syndrome known as COVID-19[1]. According to data from the World Health Organization (WHO), as of February 21, 2022, COVID-19 had 424,822,073 confirmed cases and 5,890,312 deaths worldwide[2]. In Brazil, there were 28,208,212 confirmed cases and 644,286 deaths, and in the state of Paraná, according to the Department of Health, there were 2,266,965 confirmed cases and 41,845 deaths[2,3].

Since the emergence of the virus, numerous studies have correlated the presence of multiple chronic comorbidities with the pathogenesis of COVID-19[4]. Furthermore, social determinants of health such as sex, age, and education are directly related to unfavorable clinical outcomes, such as the need for hospitalization, admission to an intensive care unit, and death[5]. The disease can also be more severe when the factors are concomitant[4]. Therefore, characterizing patients who have a higher risk of hospitalization and death is essential for managing the disease[4,6].

Inequalities in education are factors that can influence the spread and contagion of the new coronavirus, as well as the progression to more severe cases[7]. Education is not limited to analyzing the level of knowledge on the subject in question, but also to factors that accompany the entire context, such as the ability to purchase treatments, exams, medications, as well as other hospital and extra-hospital situations that would assist in the support and treatment of the infected individual[7,8].

Low levels of education may be associated with a lower level of functional health literacy among patients, thus making the patient less able to obtain, process, and understand health information to make appropriate decisions regarding their self-care[7]. It can be concluded, then, that patients with lower levels of education are vulnerable to unfavorable prognoses of the disease[8]. Therefore, by identifying the level of education, it is possible to analyze exposure to vulnerabilities for chronic non-communicable diseases, which is essential for health care[9,10]. Such factors assist in the health-disease process and directly contribute to the prognosis[11].

Given the above, the importance of an epidemiological analysis of COVID-19 deaths is emphasized when correlated with these social determinants of health. Therefore, this study aims to descriptively analyze the epidemiology related to the risk factors of patients who died from COVID-19 in a city in northwestern Paraná.

Methodology

This is a cross-sectional, descriptive, and quantitative documentary study using secondary data on COVID-19 deaths in a city in northwestern Paraná. Cross-sectional studies are a subcategory of observational studies, in which data collection and investigation occur within a single time frame and a well-defined population[12]. As for the descriptive character, the objective is to determine the distribution according to time, place, and/or characteristics of the individuals under debate[13]. Finally, quantitative research involves data quantification in the form of information collection, with statistical analyses ranging from the most basic to the most complex[14].

The data for this study were collected from a city in northwestern Paraná, whose Human Development Index, according to the Brazilian Institute of Geography and Statistics (IBGE), ranks second in the state, with particular emphasis on the functioning and organization of its public health network[15]. During the pandemic, the city under study underwent readjustments to its healthcare network, using Basic Health Units adapted to Emergency Care Units to meet the demand of the population with COVID-19, in addition to social distancing strategies, closing businesses, and the use of masks to combat the spread of the virus.

The sample of this study consisted of patients from the city who died from COVID-19 between March 2020 and March 2021. Data collection analyzed sociodemographic information, including the variables age, sex, and education level. The information collected is found in the data provided by the Maringá Municipal Health Department, generated daily by the city's Strategic Information Center for Health Surveillance (CIEVS). After data collection, the data were organized and analyzed using Microsoft Excel (version 2016) and IBM SPSS (version 21.0), as well as the statistical package R (version 3.3.1). To describe the results, absolute frequencies and percentages were used for categorical variables.

The absolute frequency (n_i) is established by the number of times a given variable assumes a given value/category in question. The percentage (p_i) is the result of the ratio between the absolute frequency and the sample size, multiplied by 100, that is, $100.\frac{n_i}{n}\%$. To assess the difference between the proportion of characteristics of patients who died and the population of the municipality, the test for comparison of proportions was used. The Z-test statistic is given by:

$$T = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n_1} + \frac{\hat{p}(1-\hat{p})}{n_2}}},$$

in which $\hat{p}_1$ and $\hat{p}_2$ are the proportions of companies that meet the requirements of groups 1 and 2, n_1 e n_2 the sample sizes of groups 1 and 2, respectively, and $\hat{p} = \frac{\widehat{n_1 p}_1 + n_2 \hat{p}_2}{n_1 + n_2}$, the weighted average of $\hat{p}_1$ and $\hat{p}_2$.

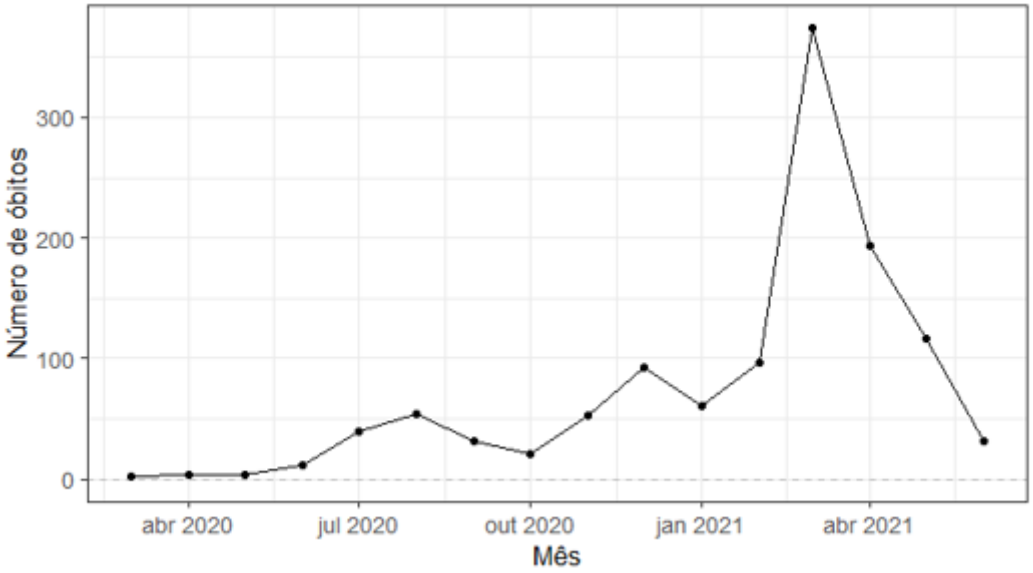
Data collection was then authorized by the Maringá Municipal Health Department through the Center for Permanent Education and Training of Health Workers of Maringá. The study was evaluated by the Permanent Committee on Ethics in Research with Human Beings of UniCesumar, according to substantiated opinion number 4,678,701 and CAAE number 45730621.6.0000.5539. Thus, the ethical precepts of the research were respected, under the guidelines regulated by Resolution No. 466/12 of the National Health Council.

Results

A descriptive temporal analysis of COVID-19 deaths in 2020/2021 reveals that the first death occurred in March

2020, with a gradual and steady increase in the number of deaths in the following months, reaching 54 in August (Graph 1). In September and October, there was a slight decline in the number of deaths; however, the number rose again, reaching approximately 100 in December. The highest peak was observed in March 2021, when the number reached 374 deaths, a period in which the number declined dramatically. According to Table 1, when analyzing the absolute frequency of the sex of patients fatally affected by COVID-19, there is an absolute frequency of 483 deaths (40.76%) of females and 702 deaths (59.24%) of males, totaling 1185 deaths including both sexes.

Graph 1. Monthly series of registered deaths from COVID-19. Maringá, PR, Brazil, 2020-2021



Note: Número de óbitos - Number of deaths. Mês – Month. Abr – Apr. Jul – Jul. Out – Oct. Jan – Jan.

Table 1. Frequency distribution of sociodemographic characteristics of patients who died from COVID-19. Maringá, PR, Brazil, 2020-2021

Variable	AF*	RF* (%)
Sex		
Feminine	483	40.76%
Masculine	702	59.24%
Age		
Up to 29 years old	16	1.35%
30 to 39 years old	49	4.14%
40 to 49 years old	114	9.62%
50 to 59 years old	187	15.78%
60 to 69 years old	292	24.64%
70 to 79 years old	306	25.82%
80 years old or older	221	18.65%
Years of study		
None	58	4.89%
1 to 3 years	207	17.47%
4 to 7 years	197	16.62%
8 to 11 years	254	21.43%
12 years or more	123	10.38%
Ignored	237	20.00%
Not informed	109	9.20%

Note: *FA: Absolute Frequency. FR*: Relative Frequency.

Regarding age, the absolute frequency shows a concentration of deaths in patients between 60 and 80 years of age. The mean and median were 65 and 68 years, respectively, with a standard deviation of 15 years. It is noteworthy that the youngest patient to die was 1 year old, and the oldest, 101 years old. Observing the absolute frequency between age groups, in the age group up to 29 years, the number of deaths was 16 (1.35%). From 30 to 39 years old, there were 49 deaths (4.14%), and from 40 to 49 years old, there were 114 deaths (9.62%). In the 50 to 59 age group, 187 deaths (15.78%), between 60 and 69 years old, 292 deaths (26.64%), between 70 and 79 years old, 306

deaths (25.82%), and in the 80 years or older age group, 221 deaths (18.65%).

The frequency distribution of education levels among patients who died from COVID-19 between 2020 and 2021 can be seen in Table 2. Regarding the education level of patients who died from COVID-19 between 2020 and 2021, the following variables were considered: none, 1 to 3 years of study, 4 to 7 years of study, 8 to 11 years of study, 12 or more years of study, unknown, and not reported. It can be observed that the most frequent range of years of study among those fatally affected by the disease was 8 to 11 years of study; however, most patients had unknown or not reported education levels. Regarding the years of study, 4.89% (58) of the patients reported having no years of study, 17.47% (207) reported having 1 to 3 years of study, and 16.62% reported having 4 to 7 years of study. The group of patients who reported having 8 to 11 years of study stood out in absolute frequency, representing 21.43% (254) of the patients who died. Patients with 12 years of study or more represented 10.38% (123) of the deaths. Furthermore, most patients had their level of education in years of study unknown (20%) or not reported (9.20%).

Table 2. Results of each item of the Rosa Neto protocol applied according to age for all patients participating in the study, by group. Maringá, PR, Brazil, 2020-2021

Variable	Deaths from COVID-19		Population		p-value
	n	%	n	%	
Sex					
Feminine	483	40.76%	225213	51.60%	< 0.001*
Masculine	702	59.24%	211259	48.40%	0.002*
Age					
Up to 29 years old	16	1.35%	242262	47.47%	< 0.001*
30 to 39 years old	49	4.14%	73920	14.48%	< 0.001*
40 to 49 years old	114	9.62%	61384	12.03%	< 0.001*
50 to 59 years old	187	15.78%	55918	10.96%	0.003*
60 to 69 years old	292	24.64%	42319	8.29%	< 0.001*
70 to 79 years old	306	25.82%	23762	4.66%	< 0.001*
80 years old or older	221	18.65%	10827	2.12%	< 0.001*
Years of study					
None	265	31.59%	79117	35.06%	0.051
1 to 3 years	197	23.48%	33144	14.69%	< 0.001*
4 to 7 years	254	30.27%	68224	30.23%	0.888
8 to 11 years	123	14.66%	45191	20.02%	< 0.001*

Note: *p-value < 0.05.

For the comparative analyses, we considered data obtained by the IBGE regarding population estimates, by sex and age group, for the municipality in question in 2021, as well as data from the 2010 census to assess the distribution of education (Table 2). To equate the scale used, ignored or unreported records from both sources were disregarded, and the following equivalences were made: none means no education; 1 to 3 years of schooling is equivalent to incomplete elementary school; 4 to 7 years, complete elementary school and incomplete high school; 8 to 11 years, complete high school and incomplete higher education; 12 years and older, complete higher education.

It is noted that the city's general population is slightly predominant among women (51.60%) compared to men (48.40%). The opposite was observed in COVID-19 deaths, where men were predominant (59.24%). Thus, according to the results of the proportion comparison test, the proportions of both women and men differ significantly between deaths and the general population of the municipality (p-values <0.001 and 0.002, respectively), at the 5% significance level.

There is also a significant difference in the proportions of all age groups between individuals who died and the general population of the municipality, highlighting that while almost half of the population is up to 29 years of age, the concentration of deaths occurs among individuals aged 60 or over, who represent almost 70% of cases.

Those aged up to 29 years old account for 47.47% of the city's general population. However, this same age group accounts for only 1.35% of COVID-19 deaths. There is a significant difference between the proportions within this age group (p-value <0.001). The 30- to 39-year-old age group accounted for 4.14% of deaths, representing 14.48% of the general population. The 60- to 69- and 70- to 79-year-old age groups account for 12.95% of the city's general population, but account for 50.46% of COVID-19 deaths.

Discussion

This study analyzed COVID-19 deaths in a city in northwestern Paraná and correlated them with risk factors that predispose to a worse outcome. The results revealed a correlation between the disease and age, sex, and education as factors that influence the context of the COVID-19 pandemic.

The study results showed that advanced age (60 years or older) and male gender were factors associated with

higher mortality from COVID-19, compared to female gender and younger age, which appear to be protective factors. Recent studies have already highlighted the relationship between male gender, advanced age, and comorbidities as aggravating factors and associated with worse prognoses of COVID-19 infection[16,17].

Since the beginning of the pandemic, age has been discussed as a prognostic factor in COVID-19 patients. In China, since the first epidemiological reports, age over 60 has been correlated with high fatality rates[18]. Data from Italy also revealed, during the same period, that individuals over 70 years of age had high mortality rates and those over 80 years of age represented almost triple these rates[19].

The relationship between the physiological aging process, combined with the pathological aging process that can affect elderly individuals, contributes to the susceptibility to infections and complications[20]. Furthermore, the prevalence of cardiovascular disease, hypertension, and diabetes in the elderly weakens the health-disease process, being linked to worse prognoses for COVID-19 infection[21].

Furthermore, the addition of comorbidities to elderly individuals presents a serious risk factor for COVID-19[22]. Multimorbidity affected a large part of the population in the south of the country, although the Northeast and Southeast regions had a greater number of comorbidities associated with individuals over 50 years of age[22]. This issue was already a major health problem in Brazil before the pandemic, which negatively impacted the healthcare system.

Furthermore, the relationship between advanced age and education is a risk factor already demonstrated in other studies[5]. Although this study failed to demonstrate a link between education and disability due to data being ignored or underreported, older adults with less education are considered more vulnerable. In addition to health-related vulnerability, there is economic hardship, which becomes a challenge in the face of the pandemic[5].

As for males, several other studies have already linked unfavorable prognoses and greater probabilities of death[23,24]. It is believed, among several theories, that hormonal differences, in relation to the type and varying concentrations between the sexes, help females to have a more protective predisposition to COVID-19 infection, as it has been seen that the adaptive and innate immune responses are influenced by female sex hormones[23-25].

A study that analyzed the relationship between sex and COVID-19 mortality in 63 countries found that male mortality from the novel coronavirus infection was higher than female mortality, and the relationship between male mortality from other causes was also higher and more significant. Thus, life expectancy and health outcomes in men are lower, resulting in a concomitant disadvantage for COVID-19, although this has not yet been fully elucidated[26].

Mortality from COVID-19 in men associated with the main causes of death, such as vascular diseases, cancers, respiratory infections and tuberculosis, was higher, as male gender was significantly linked to these deaths. However, chronic respiratory diseases in many countries have a similar distribution between the sexes, and the difference between the sexes associated with COVID-19 is also approximate[26].

For women, better disease outcomes may also be linked to greater awareness of symptoms, even mild ones, and increased access to healthcare services. Conversely, men seek healthcare more often when they experience more severe disease, where treatments are often limited and, consequently, management is more complicated[27,28].

In short, COVID-19 has revealed the disparity of social inequalities in health regarding morbidity and mortality in relation to individuals with sociodemographic differences and different services available and/or accessible in different places[29]. Social determinants, such as gender, income, and education, are linked to conditions and access to health care, which exposes different populations to vulnerability[30].

These determinants of health are crucial for understanding the current situation and implementing actions and policies to improve health care for the population, particularly within the Unified Health System (SUS), which aims to improve health quality and prevent health problems and morbidity and mortality. Furthermore, understanding regional differences and developing strategies based on socioeconomic heterogeneities and vulnerabilities are crucial in addressing the disease and its implications[29,30].

Thus, the COVID-19 pandemic has highlighted existing social inequalities across the world, in addition to highlighting other sociodemographic factors linked to the disease, as well as impacting the quality of health of individuals in different ways[30,31]. Thus, it can be seen that advanced age and male gender are factors associated with higher mortality, while younger age and female gender appear to be protective factors. Furthermore, the presence of comorbidities worsens the prognosis of the infection.

Furthermore, the interplay between physiological and pathological aging processes contributes to susceptibility to infections and complications, compounded by social inequality, which also constitutes a vulnerability factor for the elderly population with low levels of education and limited access to health services. Finally, COVID-19 has revealed the disparity in social inequalities in health regarding morbidity and mortality among individuals with sociodemographic differences and different services available and/or accessible in different locations. This needs to be analyzed to implement policies and actions aimed at addressing this situation.

Conclusion

There is enormous social inequality worldwide. In Brazil, regional inequalities are also crucial in understanding health vulnerability and the quality of infrastructure in the fight against COVID-19. Several states have a high degree of social and economic vulnerability, which is reflected in their health systems. Factors such as gender, age, and education may be intrinsic to the mortality rate from the novel coronavirus. This study revealed that in a city in northwestern Paraná, whose Human Development Index,

according to the IBGE, ranks second in the state, being over 60 and being male were significant mortality factors.

When analyzing and comparing educational factors with other studies, although not yet fully explained or with clearly elucidated mechanisms, they indicate that there are predisposing factors in unfavorable prognoses, which can lead to higher mortality rates. This entire scenario, when combined with analyses of predisposing determinants and regional socioeconomic infrastructure, helps implement actions and policies for better health care for regional populations, in addition to preventing complications and mortality. Furthermore, it aims to inform the scientific community for future work focusing on the analysis of COVID-19 deaths and the risk factors presented in this study.

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