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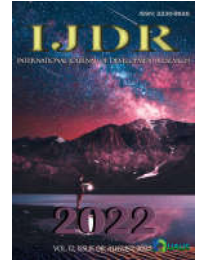
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RESEARCH ARTICLE

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MAIN RISK FACTORS IDENTIFIED IN HOSPITALIZED CASES FOR COVID-19 IN THE STATE OF PARANÁ – BRAZIL

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ABSTRACT

Objectives: To investigate the main risk factors in cases hospitalized for COVID-19 in the state of Paraná. **Methodology:** This is an analytical, cross-sectional study of secondary data. The search was carried out through the website of the secretary of health of the state of Paraná (www.saude.pr.gov.br) through the “Coronavirus - COVID 19” platform that allows free access to information related to new cases, deaths and COVID vaccination in the state. Access was used to “Boletim – Informe Epidemiológico Coronavirus” with data published by the website on 01/06/2022. The source of these data was provided by the Influenza Epidemiological Surveillance Information System (SIVEP-flu). **Results and Discussion:** Until the period investigated, 140,984 cases of hospitalization were registered in Paraná. It is observed that the most prevalent risk factors for hospitalization were: being elderly (36.17%), having some chronic cardiovascular disease (24.01%), having Diabetes Mellitus (16.31%) and being obese (8.26%). It is noteworthy that the same case may have more than one comorbidity. The risk factors that presented the lowest prevalence were: Women in the puerperium period (up to 42 days after delivery) (0.17%), children under six years of age (0.8%) and being in the gestation period (0.86%). Chronic non-communicable diseases are the leading causes of mortality globally, and lead to greater chances of complications from infection, especially at older ages, resulting in a greater need for hospitalization. The lower prevalence of deaths in children, adolescents and adults can be explained by the fact that they respond better to the virus infection, presenting mild and moderate symptoms without the need for hospital care. **Final considerations:** As strategies to minimize the complications of COVID-19, the importance of controlling modifiable risk factors as well as adherence to vaccination to contain new cases and complications of infection is highlighted.

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INTRODUCTION

On January 30, 2020, the World Health Organization (WHO) announced the outbreak of the new strain of coronavirus, hitherto unidentified in humans. Thus, on February 11, 2020, this variant was named SARS-CoV-2, the virus responsible for causing COVID-19. Faced with this reality, authorities, and specialists worldwide sought to investigate ways to contain and reduce injuries caused by the infection, which was little known until then (Beldarrain Chaple et al., 2021). The rapid spread of the virus, accompanied by health consequences and the increasing number of deaths caused by the new

disease in several countries worldwide, made this event a public health emergency. On March 11, 2020, the WHO declared COVID-19 a pandemic. The main preventive measures adopted were social distancing, masks, and gel alcohol. The symptoms of infection vary from individual to individual and also in intensity. In less complex cases, the main symptoms include sneezing, runny nose, fever, and headaches, while in more severe cases, difficulty breathing, chest pressure, blood oxygen saturation, and cyanosis are noted. When analyzing the incidence of deaths from COVID-19 in Brazil and the world, it is noted that some groups were more susceptible to the aggravations of the infection, while others showed better immune responses to exposure to the virus (Servo; Santos; Vieira, 2021).

Several studies (Malta *et al.*, 2021; Borges *et al.*, 2021; Antunes *et al.*, 2020; do Monte *et al.*, 2020) have shown that, among the leading causes of worsening of COVID-19, resulting in cases of hospitalization or evolution to death occur due to the association of other pre-existing diseases added to the damages arising from the virus (dos Santos Caló *et al.*, 2020; Arruda *et al.*, 2020). In this sense, individual health conditions seem to be determining factors for the immune responses to the infection caused by SARS-CoV-2. The epidemiological situation of the pandemic is alarming. Until the period in which this study was developed, according to information made available by the WHO through the website (<https://covid19.who.int/>), 527,211,631 cases of COVID-19 were reported worldwide, of which 6,289,371 died. In the Brazilian scenario, the country registers 31,019,038 cases and 666,676 deaths according to data made available by the Coronavirus Brazil portal <https://covid.saude.gov.br/> updated on 05/31/2022. In comparison, the Paraná totals 2,522,675 cases and 43,114 deaths according to data from the CVIE/DAV/SESA daily case monitoring worksheet on 06/01/2022. The state of Paraná is located in the southern region of Brazil, with an estimated population of 11,597,484 according to IBGE in 2021, being the second most populous state in the southern region. The economy has a good Human Development Index (HDI) [2010] of 0.749, the fifth-best state in Brazil evaluated by this indicator. In addition, the state has good access to health services through democratic actions and strategic planning involving primary, secondary, and tertiary care levels, especially in the context of the COVID-19 pandemic. Because of this, this study aims to analyze the epidemiological situation in the pandemic scenario in Paraná, as well as to investigate the main risk factors identified in patients who required hospitalization for infection in the state between March 2020 and June 2022.

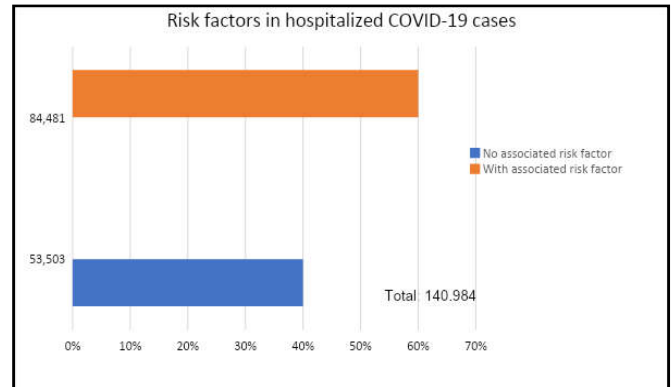
METHODOLOGY

This is an analytical, cross-sectional study of secondary data carried out with information from confirmed cases of COVID-19 in the state of Paraná. Initially, data collection was carried out through online access to the website of the Secretary of Health of the State of Paraná (SES-PR) (www.saude.pr.gov.br), where epidemiological information on COVID-19 from all the 399 municipalities that make up Paraná. All hospitalized cases of COVID-19 in Paraná were analyzed using laboratory tests or clinical-epidemiological diagnostic criteria. The data provided through the website were consulted through the CVIE/DAV/SESA daily case monitoring worksheet. Then, through the “Coronavirus - COVID 19” platform, which allows free access to newsletters about the infection, the “Newsletter – Coronavirus Epidemiological Report (COVID-19)” tab was used, which allows free access to information related to the new cases, deaths and vaccination of the infection in the state. Finally, the “2022” filters were selected, including the period “June”. Thus, the data found added up information since the beginning of the pandemic, dated March 10, 2020, where the first confirmed case of COVID-19 registered by SES-PR was recorded until 06/01/2022, the period in which this study was developed. The source of data regarding risk factors was provided by the Influenza Epidemiological Surveillance Information System (SIVEP-flu). For this reason, only the risk factors that appear in the fields on the SIVEP-flu form were included in this analysis, so morbidities such as hypertension and neoplasms were not included due to the lack of a specific field for this data in this information system. Situations in which the individual presented a comorbidity condition were also investigated and included in the analysis. The information obtained was stored and organized in an Excel spreadsheet of the Office package and the use of the SPSS software version 27.0 through descriptive statistics.

RESULTS

In the world scenario, until the investigated period, 527,211,631 cases were registered (Information made available by the WHO, available at <https://covid19.who.int/> consulted on 06/01/2022). In Brazil, the number of infected is 31,019,038 (Information obtained through the

“Coronavírus Brasil” portal, available at <https://covid.saude.gov.br/> and updated on 05/31/2022), while in Paraná, the number of cases reaches 2,522,675 (Information on confirmed cases of residents in Paraná consulted from the daily case monitoring worksheet of CVIE/DAV/SESA on 06/01/2022). Figure 1 shows the relationship between hospitalization cases according to the presence or absence of risk factors. Until the investigated period, the state of Paraná totaled 140,984 cases of hospitalization for COVID-19 according to the risk factors listed in the SIVEP-flu form.



Source: Data from SIVEP-gripe date 01/06/2022 adapted by authors (2022)

Figure 1. Relationship between hospitalized cases of COVID-19 and risk factors

Table 1. Presents the main information regarding the risk factors of cases hospitalized for COVID-19 in the state of Paraná

COVID-19 cases (n=140.984) *		
Risk factors	n	%
Elderly	62.657	36,17%
Chronic Cardiovascular Disease	41.597	24,01%
Diabetes Mellitus	28.252	16,31%
Obesity	14.307	8,26%
Chronic Neurological Disease	5.600	3,23%
Chronic Lung Diseases	4.912	2,84 %
Chronic Kidney Disease	4.275	2,47%
Asthma	3.470	2,00%
Immunodeficiency/Immunodepression	2.653	1,53%
Pregnant	1.486	0,86%
Child under 6 years old	1.380	0,80%
Liver disease	1.121	0,65%
Hematologic Disease	749	0,43%
Down's syndrome	377	0,22%
Puerperium (up to 42 days of delivery)	289	0,17%
Indigenous	109	0,06%
Total	173.234**	-

Data source: SIVEP-gripe date 06/01/2022 adapted by authors (2022)

* Analyze only the risk factors that appear in the fields of the SIVEP-flu form

** The same case may have more than one comorbidity

In most of the reported cases, 60% (n=84,481) had at least one risk factor, while 40% (n=53,503) had no risk factor for complications from the virus infection. When investigating the main risk factors for worse clinical conditions of COVID-19, it is noted that the highest prevalence of risk factors comes from irreversible biological phenomena such as aging and chronic non-communicable diseases (CNCDS) in addition to being related to the environment, physical, social and cultural. Thus, to better understand the magnitude of these risk factors for SARS-CoV-2 infection, more information was gathered about these cases. Table 1 presents the main information regarding the risk factors of cases hospitalized for COVID-19 in the state of Paraná. When investigating the cases of comorbidity, it is observed that the number of hospitalizations increased to 173,234 cases. The most prevalent risk factors for hospitalization were: Being elderly (36.17%, n=62,657), having at least one chronic cardiovascular disease (24.01%, n=41,927), having Diabetes Mellitus (16, 31%, n=28,252) and presenting obesity (8.26%, n=14,307). Considering that risk factors may be involved in the origin of the

same disease, it is noteworthy that the same case may have more than one comorbidity. It is noted that among the main risk factors found, the groups had a lower prevalence of hospitalization (>1%) were:

Pregnant women (0.86%, n=1,486), children under six years of age (0.8 %, n=1,380), individuals with liver diseases (0.65%, n=1,121), individuals with hematological diseases (0.43%, n=749), people with Down syndrome (0.22% n=377), women in the postpartum period (up to 42 days after delivery) (0.17% n=289) and the indigenous population (0.06% and n=109).

DISCUSSION

The high number of confirmed cases of COVID-19 infection in Brazil and the world evidence the high transmissibility of the disease. The rapid spread of the virus mainly justifies the pandemic condition. Faced with the pandemic scenario in the acute phase in 2020, and understanding the nature of viruses to suffer errors during their replication process, new variants of the SARS-CoV-2 virus have emerged until the present day, including the Alpha, Beta, Delta, Gamma, Omicron, Mu, Delta, Lambda variant. Regarding the symptoms of COVID-19, it is observed that the disease presents tremendous variation among individuals. The intensity of symptoms can be mild, moderate, or intense, with fever, cough, runny nose, tiredness, loss of smell and taste, and headaches being more common. Severe symptoms of infection such as breathing difficulties, mental confusion, and chest pain are less observed in the general population. However, they require greater attention and specialized care when present in more exposed groups (Chen *et al.*, 2020). As it is a recent disease, the long-term consequences of infection are not yet known, despite this, cross-sectional studies (Fillis *et al.*, 2021); (Porto *et al.*, 2021) has shown that COVID-19 can cause symptoms that prevail after a month of infection with the coronavirus, especially in more severe clinical cases (Mascarello *et al.*, 2021). The findings of the present study corroborate the results found in studies of Matos *et al.*, 2021 and Duarte *et al.*, 2021 where the elderly population was the group most exposed to clinical complications of infection, as well as a greater need for hospital care, aging is responsible for physiological and irreversible changes that can increase the risk of mortality from all causes and favor the development of CNCDS such as hypertension, diabetes, cardiovascular and immunodepressive diseases. These conditions, combined with the damage caused by the SARS-CoV-2 virus, mainly in the respiratory, cardiac, renal, and nervous tracts, can justify the higher prevalence of hospitalization in this age group (Araujo; Afonso; Apolinário, 2021). Furthermore, changes in the immune system at older ages appear to be a strong indicator of worse responses to infections when compared to younger populations (Geis, 2020); (Zhao *et al.*, 2020).

According to WHO data, the leading cause of mortality in the world is CNCDS, especially those of cardiovascular origin. In 2019, data showed that approximately 70% of deaths were from this condition (WHO, 2019) despite the excellent mobilization for prevention and treatment by health services in Brazil and the world. In the retrospective study of Ye *et al.*, 2020 with 112 patients with COVID-19, evidence of myocardial injury was found in patients infected with the virus. When analyzing the data of this study with those of Wu & McGoogan, 2020, it is observed that in addition to a higher prevalence of hospitalization, people with CNCDS are more likely to die, given that the highest incidence of deaths from COVID-19 was observed in people with diabetes (type I or II) (7.5%) and hypertension (6.0%). Thus, it is noteworthy that CNCDS are responsible for thousands of deaths and that, combined with SARS-CoV-2 infection, they can be even more harmful. Investigations into cases of diabetic patients hospitalized for COVID-19 are still scarce in Brazil, however, according to the study carried out in China by Guo *et al.*, 2020 individuals with diabetes are more susceptible to infectious diseases, justified by deregulated immune responses (Chen *et al.*, 2020; Liu *et al.*, 2020). In Italy, the prevalence of diabetes as a risk factor for hospitalization was 8.9%, moderately exceeding the global-local prevalence of diabetes (6.2%), mainly at older ages (55-

75 years), which shows that patients with diabetes were more susceptible to SARS-CoV-2 infection. It is known that obesity is a condition enormously harmful to health in all age groups. In addition to the damage observed in physical fitness components, obesity has significant negative health impacts by representing an increased risk of developing other CNCDS. The retrospective cohort study of Palaodimos, *et al.*, (2020) carried out in New York with 5,700 hospitalized for COVID-19, found that approximately 42% of patients were obese according to BMI. In the United Kingdom, a prospective cohort of 387,109, of which 760 required hospitalization, found that approximately 24% were obese (BMI ≥ 30 kg/m²). The strong association between the worsening of COVID-19 and obesity observed in several countries around the world also highlights the health outcomes in the state of Paraná. On the other hand, women in the gestational and postpartum periods were shown to be the least susceptible group to the complications of coronavirus infection. The results found here corroborate the study by Cardoso *et al.*, 2020 who showed less need for hospital care because they only presented symptoms of mild and moderate intensity. These better responses to contamination are believed to be related to other variables such as gender and age, considering that younger people have a lower chance of clinical worsening due to a better immune response.

The information obtained in this study did not present the gestational trimester in which these hospitalized women found themselves. However, for Ibiapina *et al.*, 2022 the most excellent chances of the clinical worsening of COVID-19 occur in the last trimester of pregnancy due to physiological and system changes in immune, cardiovascular, and blood circulation. Studies carried out with children showed that this population often presents mild to moderate intensity symptoms. (Rocha *et al.*, 2022). Some hypotheses to explain the best responses to exposure to SARS-CoV-2 is that children up to six years of age are still in the cellular and humoral immune development phase, unable to generate more severe inflammatory responses. (de Castro *et al.*, 2020). Furthermore, two other hypotheses have been frequently discussed: The first is that the vaccine "Bacilo Calmette - Guérin" (BCG) used mainly for the prevention of tuberculosis and leprosy taken in the first years of life provides some protection against exposure to the virus, and the second, the ACE2 receptors (receptor for the entry of the viral particle into the cell) are still developing and immature. In childhood, it make it difficult for the virus to invade the cell. Regarding the low numbers of hospitalizations for COVID-19 in indigenous people, it is believed that these data can be partially justified by the low number of indigenous people in Paraná compared to other races/ethnicities, which reflect in lower rates observed in cases of hospitalization for this group. Considering the total population of Paraná of 11,597,484 inhabitants estimated in 2021 by the IBGE, only 13,300 (0.11%) are Indians who live in 23 villages in different regions of the state. The low indigenous population reflects lower rates observed in hospitalization cases and possibly is related to cultural aspects that make access to health services difficult. However, Mondardo, points out that the COVID-19 pandemic has had significant consequences on the health of the indigenous population and cultural heritage.

In this sense, designing interventions and strategies to avoid clinical problems is essential for more exposed populations. Another essential point to be discussed is that the period investigated in this study involves epidemiological information from the period from 2020 to 2022. However, the immunization of COVID-19 began to be carried out in January 2021. Thus, considering that the SES-PR platform provided the data from the Epidemiological Bulletin, there was no information on whether these hospitalized cases had been immunized. For this reason, the total number of hospitalizations was used without further investigations regarding the vaccine. However, according to data from Paraná presented on the Vacinometro-SUS portal, which integrates the Strategic Inputs Information System (SIES) and the National Immunization Program Information System (SI-PNI), available at <https://localizaus.saude.gov.br>, and consulted on 06/01/2022, the state totaled 25,241,583 doses applied, of which 10,018,508 correspond to the first dose, and 9,445,732 to the second, totaling 10,353,714 vaccinated individuals. This work sought to

investigate and discuss the most prevalent risk factors in cases of hospitalization for SARS-CoV-2. As a limitation, this study was developed from secondary data, subject to errors and filling bias, as well as underreporting provided by the municipalities of Paraná. In addition, as this is a cross-sectional study, the outcomes after hospitalization, such as the evolution of cases of death and the conditions of these individuals after hospitalization, were not evidenced, nor were interventions carried out to mitigate the damage caused by the infection. However, it is believed that the study presents valuable explanations for presenting epidemiological evidence of COVID-19 in the state of Paraná. Consequently, investigating the main risk factors for hospitalization seems to be an essential way to develop better interventions, ensuring the integrity of the population during the pandemic period. In addition, the findings of this study make it possible to compare the reality of the pandemic in Paraná with other states in Brazil and other countries. As a suggestion, it is expected that further studies will be carried out on cases hospitalized for COVID-19 so that further clarifications are made available in the literature. The importance of longitudinal intervention studies is highlighted, especially those that seek to investigate aspects of these patients' physical and mental health as a way of monitoring and better intervening in more severe clinical conditions in all groups and ages, especially in those who presented greater vulnerability.

FINAL CONSIDERATIONS

The COVID-19 pandemic has had a significant impact on the health of the population. The high number of cases and deaths from the SARS-CoV-2 virus made health systems adapt to the circumstance in the face of the rapidly imposed demands. Regarding hospitalized cases, most of these patients had at least one associated risk factor, thus, it is evident that belonging to a risk group results in greater exposure to the complications of infection. As expected, the highest prevalences of hospitalization for COVID-19 were observed in elderly people and people with NCDs. When comparing the risk factors to cases of hospitalization for COVID-19, it is noted that the presence of at least one CNCD, in addition to being an aggravating factor of infection, already presented alarming rates before the pandemic being included among the leading causes. Of deaths in the world. Thus, prior to the outbreak of the new coronavirus in 2020, in several countries around the world, mobilization on the part of health systems was already observed, seeking, through public actions and policies, to adopt measures to prevent and control NCDs and their risk factors, aiming at the promotion of population health. To minimize the complications caused by COVID-19, the importance of controlling modifiable risk factors in all groups and age groups is highlighted, especially in old age. Several global health authorities have frequently recommended protective measures such as adopting healthy eating habits and regular physical activity to reduce the risk of developing chronic diseases and more significant complications of infection. Added to this, the importance of adherence to immunization is suggested, considering that in the face of a pandemic situation, the vaccine has proved to be an effective strategy for reducing contamination, worsening, and deaths caused by the SARS-CoV-2 virus and in the emergence of new variants of the coronavirus.

List of abbreviations

WHO - World Health Organization; HDI - Human Development Index; SES-PR - Secretary of Health of the State of Paraná; SIVEP-flu - Influenza Epidemiological Surveillance Information System; CNCDs - Chronic Non-Communicable Diseases; - Ethical Approval and Consent to participate; Not applicable; - Consent for publication All authors claim to agree; - Availability of data and materials; The data is made available openly and online by the Secretary of Health of the State of Paraná at <https://www.saude.pr.gov.br/>. -Competing interests The authors declare that there are no conflicts of interest.

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