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Do chronic diseases increase the likelihood of hospitalization for COVID-19 in the brazilian population? Vigitel survey (2021 AND 2022)

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Research Article

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Abstract

Objective: To analyze whether chronic diseases such as obesity, SAH, and DM are risk factors for hospitalization due to Covid-19 in the Brazilian adult population.

Methods: Cross-sectional time series study, with data from the years 2021 and 2022 from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL). Hospitalization due to Covid-19 was considered as the outcome and Pearson's *chi*-square test was used. The crude and adjusted association between the outcome and the independent variables was performed using Poisson regression with robust variance adjustment.

Results: The prevalence of hospitalization due to Covid-19 was 1.78 (95%CI: 1.62;1.93) The probability of hospitalization due to Covid-19 was 2.14 (95%CI: 1.43;3.21) for those with obesity, 2.76 (95%CI: 2.12;3.60) for those with SAH, and 3.12 (95%CI: 2.63;3.70) for those with DM.

Conclusions: The VIGITEL survey proved to be efficient in demonstrating that chronic diseases act as a risk factor for hospitalizations due to Covid-19.

INTRODUCTION

The SARS-CoV-2 virus is responsible for Coronavirus disease (Covid-19). This virus led the World Health Organization (WHO) to declare a new pandemic due to high rates of interpersonal contamination.[1]The first sign of contagion was in the city of Wuhan, Hubei province, China, in December 2019 and, in March 2020, this disease reached several countries, affecting the health of the global population.[2]

In Brazil, the first case of Covid-19 was registered on February 26, 2020, with the first death on March 17[3]and, because of the easy transmission of the disease, by January 2023 the country had recorded 36.6 million confirmed cases.[4]Pre-existing chronic diseases are known to worsen coronavirus-related complications, such as obesity,[5]Systemic Arterial Hypertension (SAH)[6], and Diabetes Mellitus (DM), [7]which are characterized as Chronic Non-Communicable Diseases.[5, 8]

The incidence of these diseases in the world population represents a public health problem, as they present the main burden of diseases and deaths in the population.[9]In Brazil, according to VIGITEL, between 2006 and 2021, the prevalence of obesity increased by 93%, from 11.6% to 22.4%, in line with the prevalence of diabetes which increased from 5.5% to 9.1% and the prevalence of hypertension which increased from 22.6% to 26.3%.[9]In addition to their high prevalences, these chronic non-communicable diseases are considered the main primary causes for the occurrence of kidney disease, coronary heart disease, stroke, and heart failure, leading to a decrease in the population's life quality and expectancy.[1; 5–6)

During the Covid-19 pandemic, several studies were developed to evaluate the relationship between obesity, diabetes mellitus, and SAH and susceptibility to SARS-CoV-2 infection, as well as their role in

worsening the disease.[10–11]In the integrative review prepared by Andrade et al (2021), it was shown that uncontrolled diabetes mellitus and obesity act as risk factors for the severe form of Covid-19, associated with both a worse prognosis and the need for intensive treatment.[12]The study by Dona et al (2022),including 3,337 patients hospitalized with a diagnosis of SARS-Cov-2 infection, found that 61.73% of individuals had one or more comorbidities, such as high blood pressure, diabetes, and obesity. [13]However, it is worth highlighting that although Brazilian studies have analyzed the association between chronic diseases and worsening and hospitalization due to Covid-19, specific data for the entire Brazilian population have not been identified.

Considering the impact of Covid-19 on global health and the need to expand the analysis of the relationship between chronic non-communicable diseases and hospitalization for Covid-19 in the Brazilian adult population, the objective of the current study was to analyze whether chronic diseases such as obesity, SAH, and DM were risk factors for hospitalization due to Covid-19 in the Brazilian adult population, using data from VIGITEL between September 2021 and February 2022.

METHODS

This article is a cross-sectional time series study, with data from the Risk and Protection Factor Surveillance System for Chronic Diseases by Telephone Survey (VIGITEL, 2021), linked to the Ministry of Health, for the years 2021 and 2022.[9]

The telephone interview system takes place annually in the capitals of the 26 Brazilian states and the Federal District, with the aim of monitoring the frequency and distribution of risk and protective factors for Chronic Non-Communicable Diseases (NCDs).[9]The sample includes individuals aged 18 or over, living in private homes with landlines. The data collection is segmented into two stages: in the first stage, 10 thousand telephone lines are drawn per city, systematically and stratified by ZIP code, and in the second stage, one of the adults (≥ 18 years of age) residing in the selected household is drawn. In 2020 and 2021, the minimum sample size was one thousand individuals in each city, allowing us to estimate the frequency of any risk and protective factor in the adult population, with a confidence coefficient of 95% and a maximum error of four percentage points.[9]

In 2021, across the 26 capitals and the Federal District, VIGITEL made calls to 319,400 telephone lines, with 1,597 replicates, identifying 44,457 eligible lines. In the end, 27,093 interviews were completed, indicating a system success rate of 61%. Thus, the total number of telephone calls made by VIGITEL in 2021 was 811,646, which corresponds to approximately 29.9 calls per complete interview, with an average interview duration of approximately 14 minutes[9].

The VIGITEL project was approved by the National Research Ethics Committee for Human Beings of the Ministry of Health (opinion no. 2.100.213 – CAAE: 65610017.1.0000.0008).

Independent variables, participants and outcome

The independent variables analyzed were: Sex (male or female); Age (18–39 / 40–59 / 60- ∞); Skin color (white / black / yellow / indigenous); Schooling (0–8 / 9–11 / 12-∞); Marital status (single / married / in a stable relationship / widowed / separated or divorced / declined to provide information); People living in the house (Alone or Not Alone); Medical diagnosis of Obesity (No/Yes); Medical diagnosis of Systemic Arterial Hypertension (No/Yes); Medical diagnosis of Diabetes Mellitus (No/Yes); and Regions (North, Northeast, Central-West, Southeast, and South).

To obtain information about obesity, the following question was asked: “Do you know your weight (even if it is an approximate value)?” and “Do you know your height?” An individual with a body mass index (BMI) ≥ 30 kg/m^2, calculated from weight in kilograms (Kg) divided by the square of height in meters, both self-reported, was considered obese.The BMI was calculated from this information, meeting the criteria given by the ratio between the number of individuals with obesity and the number of individuals interviewed.

For SAH, individuals were asked: “Has a doctor ever told you that you have high blood pressure?” The percentage of adults who reported a medical diagnosis of high blood pressure was calculated, given by the ratio between the number of adults who reported a medical diagnosis of high blood pressure and the number of individuals interviewed, according to the reported response.

For DM, individuals were asked: “Has a doctor ever told you that you have diabetes?” The percentage of adults who reported a medical diagnosis of diabetes was calculated, given by the ratio between the number of adults who reported a medical diagnosis of diabetes and the number of individuals interviewed.

Finally, the number of confirmed cases that were hospitalized for Covid-19 within the sample was obtained, according to the answer given to the question: “Did you have Covid-19, confirmed by a laboratory test or medical diagnostic?" and “Did you need hospitalization during treatment?”. Based on the positive response to Covid-19, the outcome was obtained, which was characterized by hospitalization due to Covid-19.

Statistical analysis

Data analysis was performed using the *Stata*® statistical package, version 14.0. The prevalence of the outcome was calculated according to the independent variables using Pearson's *chi*-square test.For the association between the outcome and obesity, SAH, and DM, a crude and adjusted analysis was performed, using Poisson regression with robust variance adjustment. Thus, the prevalence ratios, 95% confidence interval, and p-value were obtained, adopting a significance level of 5%.

The intervening variable used to adjust possible confounding factors between the outcome and the independent variables was a *cluster* with 27 cities, in addition to sex, age, skin color, education, marital status, housing, and region.

"Pesorake" was used, which considers the sample weights in VIGITEL. All analyses used weights from the *Rake*method, through the command [*aw=pesorake*].

RESULTS

Using the VIGITEL survey, 27,093 adults over the age of 18 were interviewed in the 26 capitals and the Federal District, between 2021 and 2022 (Table 1). Hospitalizations due to Covid-19 represented 1.78% (95%CI 1.62 to 1.93) of the total number of respondents.The most affected individuals were male (1.89%), aged 60 or over (2.71%), black (1.80%), with 0 to 8 years of schooling (1.90%), separated or divorced (4.54%), living alone (1.83%), who reported obesity (3.09%), SAH (3.43%), and DM (5.18%), and residing in the central-west region (2.05%).Of those who had not been diagnosed with obesity, SAH, or diabetes mellitus, the prevalence of hospitalization for Covid-19 was 1%; among those with any one of these conditions, the prevalence was 2.7%; and among those with all three conditions, it was 5.8%.

Table 1
Characteristics of Brazilians hospitalized for Covid-19 between 2021 and 2022 (n = 27,093).

Sex	**N**	**(%)***
Male	235	1.89
Female	245	1.68
Age range		
18–39	166	1.32
40–59	176	1.88
60 or more	138	2.71
Skin color		
White	185	1.78
Black	259	1.80
Yellow	1.88	0.64
Indigenous	1	0.53
Schooling (in years)		
0 to 8 years	137	1.90
9 to 11 years	177	1.64
12 years or more	167	1.85
Marital status		
Single	140	1.11
Married	201	2.30
Stable union	23	0.88
Widower	43	3.19
Separated or divorced	71	4.54
Did not want to respond	2	1.23
Live alone		
No	464	1.78
*Pearson's *Chi*-square test		

Sex	**N**	**(%)***
Yes	17	1.83
Obesity		
No	294	1.40
Yes	187	3.09
SAH		
No	237	1.19
Yes	244	3.43
Diabetes Mellitus		
No	353	1.44
Yes	128	5.18
Obesity, SAH, and diabetes		
None	152	0.98
One	294	2.72
All	35	5.8
Region		
North	57	2.02
Northeast	103	1.51
Central-west	65	2.05
Southeast	221	1.84
South	33	1.56
*Pearson's *Chi*-square test		

**** Table 1 ****

In the adjusted analysis (Table 2), individuals who reported having obesity, SAH, or DM were more likely to be hospitalized due to Covid-19 when compared to those who did not have any of these conditions.Among individuals with the three comorbidities, the probability of hospitalization was 5.83 (95% CI 3.95–8.61) times higher compared to those who did not have any of these chronic conditions.

Table 2
Analysis of the Poisson Regression model among obese, hypertensive, and diabetic patients hospitalized for Covid-19 in the period between 2021 and 2022 (n = 27,093).

Independent variables	Crude Analysis			Adjusted Analysis *		
	Effect Measure PR	95%CI	p-value	Effect Measure PR	95%CI	p-value
Obesity			< 0.001			< 0.001
No	1.00	-		1.00	-	
Yes	2.20	1.46;3.34		2.14	1.43;3.21	
SAH			< 0.001			< 0.001
No	1.00	-		1.00	-	
Yes	2.89	2.11;3.95		2.76	2.12;3.60	
Diabetes			< 0.001			< 0.001
No	1.00	-		1.00	-	
Yes	3.61	2.71;4.81		3.12	2.63;3.70	
Obesity, SAH, and Diabetes			< 0.001			< 0.001
None	1.00	-		1.00		
One	2.79	1.52; 5.11		2.76	1.70; 4.47	
All	5.92	4.51; 7.76		5.83	3.95; 8.61	

*Adjusted for *cluster* 27 cities. Adjusted for confounding factors: sex, age, skin color, education, marital status, living alone, regions.

RP: Prevalence Ratio; 95% CI: 95% Confidence Interval.

**** Table 2****

Among individuals who were hospitalized for Covid-19, the prevalences of diabetes, obesity, and SAH were, respectively, 3, 1.8, and 2 times higher compared to the general sample.

DISCUSSION

The current study found a prevalence of hospitalization for Covid-19 of 1.78. Furthermore, individuals who reported having obesity, SAH, and DM were more likely to be hospitalized due to Covid-19 when

compared to those who did not have these conditions, and the probability of hospitalization was greater for those with all three chronic conditions.

Obesity is one of humanity's most common chronic diseases, affecting around 13% of the world's population by 2016.[14]In the context of Covid-19, which reached pandemic proportions in 2020, obesity contributed to the number of hospitalized patients, with 20% of all those hospitalized being obese with no other chronic disease. [15]Furthermore, the risk of obese people being admitted to Intensive Care Units (ICU) and requiring mechanical ventilation, when compared to people with normal BMI, increased by 73% and 69%, respectively.[16]Obesity is, therefore, considered a risk factor for Covid-19, due both to immunological factors and physical weaknesses.[17]

In line with our findings, an international multicenter study developed in Greece[18]with 90 patients found that both grade 1 obesity and morbid obesity were associated with ICU admission. Another study carried out in Mexico[19]with 23,593 patients found that, compared to patients without obesity, those with obesity are 1.43 times more likely to develop severe Covid-19 after testing positive. Furthermore, obesity was also more common (42%) among those who died from Covid-19 compared to survivors (26.7%). In a retrospective cohort study of 124 patients in France, a high prevalence of obesity was observed among patients admitted to the ICU.[20]These findings were also confirmed in a meta-analysis study. [21]

Regarding the physical limitations that contribute to a worse prognosis in the case of Covid-19 in obese patients, it is important to consider the increased intrathoracic pressure and the deficiency in respiratory muscle function. [15]Regarding intrathoracic pressure, it is estimated that in a person with a BMI greater than 35 kg/m², the pressure in the airways is approximately 1.3 cm H_2O higher compared to people with a normal BMI, signaling a decrease in lung compliance in obese individuals. [17]Therefore, the respiratory muscles need to make more effort to elevate the chest wall and expand the lungs, considering that the exaggerated deposit of fat, as well as the increase in intrathoracic pressure, cause a force opposite to that exerted by the respiratory muscles.[17]

Due to the high global prevalence of SAH, it was predictable that people affected by the new coronavirus would have a high incidence of this pathology. Thus, high blood pressure was one of the most common comorbidities among patients with Covid-19. [22]In line with our findings, a survey carried out in the United States with 1,492 patients who required hospitalization for the treatment of coronavirus, demonstrated that 49.7% of these individuals had a previous diagnosis of systemic arterial hypertension. [23]A meta-analysis study found that stage I systemic arterial hypertension was present in 37% of those hospitalized for Covid-19, while the prevalences for stages II and III hypertension were significantly higher (61% and 70%, respectively). [24]From this perspective, several reports have demonstrated that SAH may be associated with the risk of SARS-CoV-2 infection, as well as with the development of a worse prognosis. [25]

Regarding DM, its direct relationship with complications and prolonged hospital stays in patients infected by Covid-19 became clear. [7]In this context, the prevalence of diabetes among individuals admitted to ICUs is two to three times higher, and the mortality rate two times higher than that of non-diabetic patients. [23]This is further corroborated when analyzing what happened in the United Kingdom, where a representative number of those hospitalized with Covid-19 were diabetic patients (31%), while the national prevalence was only 7% and hospital bed occupancy for type 2 DM was 18% before the pandemic. [26]An observational study, which covered more than 1,000 patients admitted to US hospitals with Covid-19, reported that 40% of people had uncontrolled diabetes or hyperglycemia upon admission, and hospital mortality was four times higher for diabetic patients. [27]

Among the limitations of the study, it can be highlighted that although obesity was widely correlated with Covid-19 during the pandemic, the BMI calculation did not take into account the individuals' body composition, that is, there was no differentiation between lean mass and fat mass. Furthermore, studies demonstrate that insufficient blood pressure control is associated with adverse outcomes in patients with Covid-19 and hypertensive patients, however, the impact of SAH on the clinical evolution of these patients portrays an important limitation related to the age of these patients, since advanced age is associated with a greater presence of other comorbidities that may justify the susceptibility of these patients to Covid-19. In addition, although the existence of a direct association between DM and a higher risk of hospitalization was evidenced, this situation can be explained by numerous pathophysiological mechanisms, such as endothelial dysfunction, a chronic pro-inflammatory state, and hyperglycemia, inherent to the diabetic individual, these are enhanced by SARS-CoV-2, creating a vicious cycle that worsens the health status of patients, to the point that, in many cases, hospitalization becomes essential.Since VIGITEL is a telephone survey, it must be considered that this information is subject to bias, as it depends on the respondent's knowledge of the information of interest, their ability to remember the information, and their desire to report it. Furthermore, the disease may not have been diagnosed, i.e., the prevalence of the morbidity or chronic condition investigated may be underestimated.

Among its strengths, it stands out that VIGITEL has national coverage and, although it only reported data from capital cities and individuals who have a landline telephone, it has a representative sample.Furthermore, estimates of chronic diseases based on self-reported morbidity demonstrate the advantages of agility in obtaining information and low cost, especially when obtained by telephone surveys, which makes their use viable in large populations.

According to the results obtained, during the pandemic, people with SAH, obesity, and DM were more likely to be hospitalized due to COVID-19. These findings emphasize the importance of adopting preventive strategies and specific instructions aimed at more vulnerable groups in times of health crisis.

Declarations

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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