ORIGINAL ARTICLE

Older adults, males, and sedentary individuals had a higher number of hospitalizations for COVID-19: prevalence and associated factors in Barbacena-MG, Brazil, 2021-2022

Idosos, homens e sedentários tiveram maior número de hospitalizações por COVID-19: prevalência e fatores associados em Barbacena-MG, Brasil, 2021-2022

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ABSTRACT

Objective: To estimate the prevalence of hospitalizations due to COVID-19 and to investigate associated factors in adult patients in the city of Barbacena, Minas Gerais, Brazil. **Method:** This cross-sectional study included a sample of 248 community participants (≥18 years old) with post-COVID-19 complaints treated at an outpatient clinic of the Unified Health System. Data were collected between September 2021 and January 2022. The dependent variable was hospitalization due to COVID-19 (no/yes). The independent variables were operationalized as: age group (18-59/≥60 years), sex (female/male), race (white/other), education (higher/secondary/elementary education+illiterate), marital status (no/with partner), physical activity (active/sedentary), comorbidities (no/yes), systemic arterial hypertension (no/yes), diabetes mellitus (no/yes), use of medication as a treatment for COVID-19 (no/yes), and doses of COVID-19 vaccine (none or one/≥two or three). The prevalence of hospitalization was presented as a percentage. The association between the dependent and independent variables was assessed using binary logistic regression and expressed as odds ratio (OR). **Result:** The prevalence of hospitalizations due to COVID-19 was 41.5% (36.0% in women and 50.0% in men). Multivariate association analysis showed that age ≥60 years (OR=2.58 [1.41-4.73]), male sex (OR=1.98 [1.10-3.55]), physical inactivity (OR=2.24 [1.38-4.40]), presence of comorbidities (OR=3.15 [1.61-6.17]), and use of medication as a treatment for COVID-19 (OR=3.68 [1.78-7.59]) remained significantly and positively associated with greater odds of hospitalization. **Conclusion:** Four of 10 patients were hospitalized due to COVID-19. The burden of hospitalization was especially high among older patients, males, sedentary individuals, those with comorbidities, and those who used medication to treat COVID-19.

RESUMO

Objetivo: Estimar a prevalência de hospitalizações por COVID-19 e investigar os fatores associados em pacientes adultos do município de Barbacena-MG. **Método:** Estudo transversal que incluiu uma amostra de 248 participantes comunitários (≥18 anos) com queixas pós-COVID-19 atendidos em um ambulatório do Sistema Único de Saúde. Os dados foram coletados entre setembro/2021 e janeiro/2022.

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A variável dependente foi a hospitalização por COVID-19 (não/sim). As variáveis independentes foram operacionalizadas como: faixa etária (18-59/≥60 anos), sexo (feminino/masculino), raça (branca/outras), escolaridade (ensino superior/médio/fundamental+analfabeto), estado civil (sem/com companheiro), atividade física (ativo/sedentário), comorbidades (não/sim), hipertensão arterial sistêmica (não/sim), diabetes mellitus (não/sim), uso de medicamentos como tratamento para a COVID-19 (não/sim) e doses de vacina contra a COVID-19 (nenhuma ou uma/≥duas ou três). A prevalência de hospitalizações foi fornecida em porcentagem. A associação entre as variáveis dependente e independentes foi avaliada por meio de regressão logística binária e expressa como odds ratio-OR. **Resultado:** A prevalência de hospitalizações por COVID-19 foi de 41,5% (36,0% em mulheres e 50,0% em homens). A análise de associação multivariada evidenciou que idade ≥60 anos (OR=2,58 [1,41-4,73]), sexo masculino (OR=1,98 [1,10-3,55]), sedentarismo (OR=2,24 [1,38-4,40]), presença de comorbidades (OR=3,15 [1,61-6,17]) e uso de medicamentos como tratamento para a COVID-19 (OR=3,68 [1,78-7,59]) mantiveram-se significativa e positivamente associadas com maior chance de hospitalização. **Conclusão:** Quatro em cada 10 pacientes avaliados foram hospitalizados devido à COVID-19. A carga de internações demonstrou-se especialmente elevada em indivíduos idosos, do sexo masculino, sedentários, com comorbidades e que usaram algum medicamento para tratar a COVID-19.

INTRODUCTION

The hospitalization of patients with COVID-19 has been the subject of several studies worldwide. These studies have addressed issues related to the need for hospitalization, admission rates, clinical progression, and hospital mortality[1]. Although the World Health Organization (WHO) announced the end of the Public Health Emergency in May 2023 due to the low notification of COVID-19 cases, the post-pandemic period has been marked by the emergence of new variants.This raises the possibility of a further increase in cases and emphasizes the importance of public health protection policies[2].

During Brazil´s first year of the COVID-19 pandemic, prohibitions such as banning public gatherings, quarantine, and closing schools and workplaces had positive and negative effects. These actions helped prevent the spread of the disease but also resulted in delayed medical consultations and examinations, leading to later diagnoses in some cases[3]. This emphasized the importance of Brazil´s public health system (SUS), which is the main healthcare provider in the country and addresses 75% of its population[3]. The response to the pandemic varied among countries because the pandemic affected populations with varying levels of severity. It is crucial to apply the lessons learned from the pandemic to prepare for future waves of COVID-19 and analyze hospitalization data to support future planning[4].

Studies on the severity prediction of COVID-19 began to be published in 2020. One of these studies, conducted by Mount Sinai Hospital medical researchers in New York, involved developing a predictive model of mortality risk among patients with the disease[5]. Another study, conducted by Cleveland Clinic researchers, investigated the probability of a person testing positive for the virus to predict its spread among different populations[6]. Researchers at the University of Chicago developed a predictive model to estimate the weekly count of cases and predict the spread[7]. These studies were important so that hospital and public managers could anticipate and evaluate the effectiveness of the restrictive measures being implemented because many faced resistance from the general population and were targets of conspiracy theories and fake news[8].

Mapping the movement of COVID-19 involves monitoring the number of cases, which enables national and global health organizations to provide appropriate medical assistance based on trends in different geographic locations. An example of this is a study in Sweden published in the European Journal of Epidemiology, which investigated and listed 34 potential risk factors for diagnosis, hospitalization rate, admission to the Intensive Care Unit (ICU), and subsequent death. This study showed that older age was associated with a greater risk of hospitalization, and male sex, which is associated with the presence of comorbidities, was associated with an increased risk of hospitalization both inside and outside the ICU[9].

In this context, it is essential to investigate cases of patients diagnosed with COVID-19 who were more likely to be hospitalized by analyzing factors such as age, sex, educational level, and presence of comorbidities[10]. Based on these data, it will be possible to improve public health policies and optimize hospital administration to obtain a more effective allocation of economic resources. Furthermore, given the vast territorial extension and regional diversity of Brazil, conducting studies that relate risk factors to hospitalizations for COVID-19 is crucial, considering the specific characteristics of each region[11]. Therefore, this study estimated the prevalence of hospitalizations due to COVID-19 and investigated the factors associated with these in adult community patients.

METHODS

Study design and participants

This was a cross-sectional observational and descriptive-analytical substudy in which data from a previous primary study were used, including a convenience sample of 248 adult patients with post-COVID-19 complaints. These patients were referred for medical care and follow-up at

a SUS outpatient clinic, named Medical Specialties Center (CEM), in Barbacena, Minas Gerais, Brazil (South-Center Macroregion, Zona das Vertentes). In the outpatient clinic, several health professionals approached the patients regarding their post-COVID-19 complaints.

Patients were consecutively recruited through active CEM searches. The eligibility criteria were adult individuals aged ≥18 who reported any health complaints after being infected with the COVID-19 virus. The exclusion criteria were pediatric patients, adults without COVID-19 infection, and those with incomplete and missing data. All participants were informed about the objectives of the primary study, and those who agreed to participate signed an informed consent form. The Research Ethics Committee of the Faculdade de Medicina de Barbacena (FAME/FUNJOBE) approved the primary study under decision nº 4.987.009.

The estimated sample size required for this substudy was 114 participants. This number was obtained by using a sample calculation for prevalence studies: $Z^2 * \frac{P(1-P)}{D^2}$, where Z is the value of the Z-statistic for the range of D2 confidence (95%), D is the acceptable error (5%), and P is the expected prevalence (8%), which was estimated from an average number of hospitalizations for COVID-19 in the adult population of Minas Gerais (≥20 years) reported in a previous study from a Brazilian Health National Database, Sistema de Informação Hospitalar (SIH/SUS)[12].

Data collection and variables

The data were collected between September 2021 and January 2022 using a standardized multidimensional questionnaire prepared by the researchers of the primary study. The dependent variable of this substudy was hospitalization due to COVID-19 (no *vs* yes). The independent variables were operationalized as follows: i) sociodemographic variables: age group (18-59 *vs* ≥60 years), sex (female *vs* male), race (white *vs* other [brown+black]), education level (higher education *vs* high school *vs* elementary education+illiterate), and marital status (without *vs* with partner); and ii) clinicalvariables: physical activity (active *vs* sedentary), comorbidities (no *vs* yes), systemic arterial hypertension (no *vs* yes), diabetes mellitus (no *vs* yes), use of medications as a treatment for COVID-19 (no *vs* yes), and COVID-19 vaccine doses (none or 1 *vs* ≥ 2 or 3).

The variable "comorbidities" included cardiovascular, rheumatological, lung, gastroenterological, and thyroid disorders. The variable "use of medicine as a treatment for COVID-19" considered symptomatic, herbal, and off-label medications used through self-medication or medical prescription, outside of hospitalization.

Data analysis

The mean and standard deviation (±), and the absolute (n) and relative frequencies (%) were used for descriptive characterization of the sample. The prevalence of hospitalization due to COVID-19 was presented as a percentage with a 95% confidence interval (95%CI). The univariate association between hospitalization due to COVID-19 (dependent) and each sociodemographic and clinical variable (independent) was assessed using binary logistic regression and expressed as odds ratio (OR). For each evaluated independent variable stratum, there were at least 10 observations. Associations that presented p<0.20 in the univariate analysis were tested in the multivariate model. The associations with p<0.05 in the multivariate analysis remained in the final multivariate model. The Hosmer-Lemeshow test was used to verify the quality of the final model and Nagelkerke's R^2 was used to estimate the variation explained by the independent variables on the dependent variable. All statistical analysis was performed using the Statistical Package for Social Sciences, version 22 (SPSS Inc., IBM Corporation, Chicago, Illinois, USA).

RESULTS

Data from 248 patients were used in this substudy. The mean age of the sample was 51.6±16.5 (range 18-92) years. The prevalence of hospitalizations due to COVID-19 was 41.5% (95%CI=35.6-47.8%; n=103/248) in total, 36.0% (95%CI=28.8-43 .9%; n=54/150) in females and 50.0% (95%CI=40.3-59.7%; n=49/98) in males. Regarding age group, the prevalence was 12.9% (95%CI=6.4-23.7%; n=8/62) in the 18-39 years age group, 45.0% (95%CI=35.6-54.8%; n=45/100) among 40-59 years, and 58.1% (95%CI=47.6-68.0%; n=50/86) at age ≥60 years.

Most of the participants were young and middle-aged adults, women, white, with a high school education or less, reported having a partner, were sedentary, had comorbidities, used medications as a treatment for COVID-19 outside the period of hospitalization, and reported being vaccinated against COVID-19 with two or three doses. In the univariate analysis, except for race and vaccine doses against COVID-19, all other independent variables were significantly and positively associated with a greater chance of hospitalization due to COVID-19 (Table 1).

In the multivariate analysis, age ≥60 years, male sex, sedentary behavior, presence of comorbidities, and use of medication as treatment for COVID-19 outside hospital stay were significantly and positively associated with a greater chance of hospitalization for COVID-19 (Table 2). The final model presented adequate adjustment using the Hosmer-Lemeshow test (p=0.979), explained 26.5% of the variance in hospitalizations using the Nagelkerke's R^2 and correctly classified 70% of cases after including independent variables in the model.

DISCUSSION

The present study results demonstrated a high prevalence of hospitalization due to COVID-19: for every 10 individuals, 4 were hospitalized. These numbers were even more expressive among males and older age groups (*i.e.,* people ≥60 years).These findings are common to those found in other Brazilian studies[11,13], reinforcing the tendency of older individuals to present more severe forms of the disease, which can be explained by a less effective immune response to the infection in this population compared with younger populations[14]. Males also had a higher prevalence of hospitalizations than females, raising the question of

Table 1 – Descriptive characteristics of participants and univariate association analysis between the variable hospital admission due to COVID-19 and sociodemographic and clinical variables in a sample of adult community patients from Barbacena, Minas Gerais, Brazil, 2021-2022 (N=248).

Variable	Frequency % (n)	OR$_{crude}$ (95%CI)	p
Age group			
18-59 years old	65.3 (162)	1 (ref)	
≥60 years old	34.7 (86)	2.86 (1.67-4.90)	<0.001*
Sex			
Female	60.5 (150)	1 (ref)	
Male	39.5 (98)	1.78 (1.06-2.98)	0.029*
Race			
White	59.3 (147)	1 (ref)	
Others[†]	40.7 (101)	0.94 (0.56-1.57)	0.804
Education level			
Higher education	21.8 (54)	1 (ref)	
High school	39.1 (97)	2.25 (1.05-4.82)	0.036*
Elementary education + illiterate	39.1 (97)	4.22 (1.98-8.98)	<0.001*
Marital status			
Without partner	39.5 (98)	1 (ref)	
With partner	60.5 (150)	1.60 (0.95-2.71)	0.078*
Physical Activity			
Active	29.8 (174)	1 (ref)	
Sedentary	70.2 (74)	2.70 (1.48-4.93)	0.001*
Comorbidities[‡]			
No	33.1 (82)	1 (ref)	
Yes	66.9 (166)	4.11 (2.22-7.60)	<0.001*
Systemic arterial hypertension			
No	52.0 (129)	1 (ref)	
Yes	48.0 (119)	2.34 (1.39-3.91)	0.001*
Type 2 diabetes			
No	83.5 (207)	1 (ref)	
Yes	16.5 (41)	2.93 (1.46-5.87)	0.002*
Use of medications as a treatment for COVID-19[§]			
No	24.2 (60)	1 (ref)	
Yes	75.8 (188)	2.64 (1.38-5.06)	0.003*
COVID-19 vaccine doses			
None or 1	8.5 (21)	1 (ref)	
2 or 3	91.5 (227)	1.17 (0.47-2.93)	0.739

OR: odds ratio; 95%CI: 95% confidence interval. *p<0.20. [†]Brown + black. [‡]Cardiovascular diseases, pneumopathies, gastroenteropathy, thyroid diseases, among others. [§]Considers symptomatic, herbal, and off-label medications used through self-medication or medical prescription, outside the period of hospitalization.

the impact of known differences in behavior related to healthcare between males and females on the potential for worsening diseases and the need for hospitalizations[15].

Univariate analysis showed a significant association between the number of hospitalizations, lower education level, marital status with a partner, physical inactivity, comorbidities, and use of medication as a treatment for COVID-19. Conversely, race and the number of COVID-19 vaccine doses were not associated with the number of hospitalizations. This last finding is significant because it contradicts what was expected and other studies have previously demonstrated[16,17]: a greater

Table 2 – Multivariate association analysis between the variable hospital admission due to COVID-19 and sociodemographic and clinical variables in a sample of adult community patients from Barbacena, Minas Gerais, Brazil, 2021-2022 (n=248).

Variable	OR$_{adjusted}$ (95%CI)	p
Age group		
18–59 years old	1 (ref)	
≥60 years old	2.58 (1.41-4.73)	0.002*
Sex		
Female	1 (ref)	
Male	1.98 (1.10-3.55)	0.022*
Physical Activity		
Active	1 (ref)	
Sedentary	2.24 (1.38-4.40)	0.020*
Comorbidities†		
No	1 (ref)	
Yes	3.15 (1.61-6.17)	0.001*
Use of medication as a treatment for COVID-19‡		
No	1 (ref)	
Yes	3.68 (1.78-7.59)	<0.001*

OR: odds ratio; 95%CI: 95% confidence interval. *p<0.05. †Cardiovascular diseases, pneumopathies, gastroenteropathy, thyroid diseases, among others. ‡Considers symptomatic, herbal, and off-label medications used through self-medication or medical prescription, outside the period of hospitalization. Hosmer-Lemeshow test, p=0.979; Nagelkerke R^2=26.5%.

number of vaccine doses did not show a significant and inverse association with the number of hospitalizations in the sample evaluated. It may be that other factors related to the host (*e.g.,* age, number of comorbidities, and genetics) and immunizing agent (*e.g.,* type of vaccine, the interval between doses, and the time elapsed between immunization and COVID-19 infection) could interfere with the effectiveness of the body's protective response, as well as in the development of clinical forms of the disease that demand for hospitalization[18,19].

Multivariate analysis revealed that sedentary behavior was associated with a higher number of hospitalizations. Previous studies have found that sedentary patients with reduced muscle strength had a higher prevalence of hospital admissions resulting from COVID-19[4,20]. Regular physical activity is associated with better immune regulation by promoting greater cellular activity, particularly in macrophages, and greater circulation of immunoglobulins and anti-inflammatory cytokines. Therefore, physically active individuals with greater muscular strength are more protected against the clinical outcomes of COVID-19. Regular physical activity is also associated with healthy lifestyle habits and a lower incidence of comorbidities, particularly type 2 diabetes and systemic arterial hypertension, which may favor hospitalizations[20-22].

Another variable that showed a significant and positive association with the number of hospitalizations in the multivariate analysis was the use of medication as treatment for COVID-19. It is important to highlight that this variable included different types of medications, such as symptomatic, herbal, and off-label drugs (*e.g.,* ivermectin and hydroxychloroquine), used by patients outside of hospitalization, whether through self-medication or medical prescription. A plausible explanation for this association concerns the severity of infection itself, which would lead to greater medication use by infected patients. However, it is worth remembering that in the context of the pandemic, several indications for drugs to prevent or treat COVID-19 were circulated, which were not technically and scientifically corroborated in terms of effectiveness against the disease, as well as in the reduction of hospitalization rates[9,23].

Some strengths and weaknesses of this study should be mentioned. This is one of the first studies to investigate the prevalence and factors associated with hospitalizations due to COVID-19, including a range of sociodemographic and clinical variables, among outpatients residing in a medium-sized city in the South Central Macroregion of Minas Gerais. Because this is a substudy, the convenience sample was higher than the minimum estimated for the outcome analyzed and was capable of providing a reliable epidemiological overview of hospitalizations due to COVID-19 in the municipality. The results may serve as a basis for local public health actions and policies, a comparison of the data with those from other municipalities outside of large urban centers, and planning future studies on the topic. On the other hand, the cross-sectional design prevents the inference of causal relationships between the investigated variables, and the association outcomes must be interpreted with caution. Additionally, given that this is a sample of adult outpatients from the SUS, it is impossible to extrapolate the current findings to other contexts and populations.

CONCLUSION

Approximately 4 out of 10 adult patients with COVID-19 who were interviewed at a SUS outpatient clinic in Barbacena-MG were hospitalized due to the disease. The frequency of hospitalizations was high considering the total sample of the study population. It is important to highlight the greater morbidity burden in older adults, males, physically inactive individuals, those with comorbidities, and those who have used medication for COVID-19 treatment. These findings must be compared with those from other cross-sectional studies conducted at different locations and regions to generate sufficient epidemiological data and support the allocation of resources and improvements in health services, especially during critical events involving infectious diseases. Considering the need for more robust evidence, future longitudinal studies should corroborate the associations observed here.

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