Prevalence and factors associated with post-covid-19 fatigue in individuals aged 50 years or older

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Abstract

Objective: To investigate the prevalence of and factors associated with post-covid-19 fatigue in a sample predominantly composed of older adults residing in the city of Rio de Janeiro, Brazil. *Method:* This study was conducted between 2022 and 2024 and included 573 participants with a history of covid-19, selected from an electronic survey sent to 9,169 individuals, of whom 1,224 responded. The study used standardized questionnaires, physical performance tests, and mental health assessment instruments to evaluate clinical, functional, and sociodemographic characteristics. *Results:* The prevalence of post-covid-19 fatigue was 32.5%. In the multivariable analysis, hospitalization and non-White skin color were associated with higher odds of post-covid-19 fatigue. Conversely, older age, previous engagement in physical exercise, and better performance on the sit-to-stand test were associated with lower odds of the condition. Sex, handgrip strength, gait speed, and number of covid-19 vaccine doses were not significantly associated with post-covid-19 fatigue. *Conclusion:* Post-covid-19 fatigue remains a condition of clinical and public health relevance, with important functional impacts. The findings highlight the need to consider biological, functional, and social factors when addressing this syndrome, particularly among vulnerable populations, thereby contributing to the planning of care strategies and the reduction of inequities in the post-pandemic context.

Keywords: covid-19. Post-Acute covid-19 Syndrome. Fatigue. Chronic Fatigue Syndrome. Aging.

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INTRODUCTION

Population aging has accelerated markedly in recent decades. In Brazil, according to the Brazilian Institute of Geography and Statistics (IBGE), life expectancy at birth reached 76.8 years in 2025, reflecting the recovery in mortality rates following the pandemic. covid-19 negatively affected this indicator, resulting in an average global reduction of one year between 2019 and 2021, with Brazil being among the most affected countries[1].

Six years after the onset of the pandemic, growing evidence indicates that covid-19 is not limited to the acute phase of infection. Post-covid-19 syndrome, or long covid, was defined by the World Health Organization (WHO) in 2020 as a condition affecting individuals with a history of SARS-CoV-2 infection, characterized by persistent symptoms that generally begin three months after the acute illness and persist for at least two months, with no alternative explanation. These symptoms may include fatigue, respiratory difficulties, cognitive impairment, sleep disturbances, chronic pain, and neuropsychiatric symptoms. Although alternative definitions were subsequently proposed, the WHO definition remains the most widely used[2].

Post-covid-19 fatigue is a debilitating condition that impairs quality of life, affects both physical and mental health, and is associated with reduced functional capacity for activities of daily living[3]. Conceptually, it is characterized by reduced physical and/or mental performance resulting from the interaction between biological factors, such as autonomic dysfunction and persistent inflammation, and psychosocial factors, such as anxiety, depression, apathy, and executive dysfunction[3-8]. Despite its clinical relevance, there is still no consensus regarding its operational definition, which varies among organizations such as the WHO, the Centers for Disease Control and Prevention (CDC), and the National Institute for Health and Care Excellence (NICE), particularly with regard to the interval between infection and symptom onset. This lack of consensus complicates diagnostic standardization and comparisons across studies[7,9-11].

International studies estimate the prevalence of post-covid-19 fatigue to range from 41% to 51%[12,13]. Brazilian studies have reported prevalence rates ranging from 22% to 63%[14]. In the state of Rio de Janeiro, Brazil, prevalence rates ranging from 32% to 71.3% have been reported, with higher rates among hospitalized individuals or those undergoing rehabilitation[14]. Methodological factors, including follow-up duration[15], infection severity[16], study design[17], diagnostic method[14-17], and sample characteristics[15,16], may account for the substantial differences observed.

Post-covid-19 fatigue has been associated with specific clinical and sociodemographic characteristics, including female sex, older age, the presence of comorbidities, greater severity of the acute illness, and hospitalization[17]. Psychosocial factors, such as anxiety and depression, have also been identified as possible contributors to the persistence of this symptom[17]. Despite the growing body of scientific evidence, important gaps remain, including a shortage of long-term longitudinal studies, heterogeneity in the instruments used to measure fatigue, and the underrepresentation of nonhospitalized populations[18].

Against this background, the aim of the present study was to investigate the prevalence of post-covid-19 fatigue among individuals aged 50 years or older, most of whom were treated on an outpatient basis, and to identify factors associated with this condition.

METHODS

This was a cross-sectional study conducted as part of the "covid-19 and Human Aging" project. The sample analyzed corresponded to baseline data from the study "Laboratory Profile of covid-19 and Vaccine Response." Individuals aged 50 years or older who resided in the city of Rio de Janeiro, RJ, Brazil, and had a confirmed diagnosis of covid-19 based on RT-PCR tests performed at different laboratories, with results provided by the patients, were included. Individuals who had been diagnosed with covid-19 less than 28 days before the initial assessment were excluded.

The sample size calculation—considering an estimated prevalence of post-covid-19 fatigue of 51%, a 5% margin of error, and a 95% confidence level—resulted in an estimated sample of 384 participants. Data collection was conducted in two stages between April 2022 and June 2024. In the first stage, 1,224 individuals responded to a survey, and 573 met the inclusion criteria and completed the fatigue assessment form. These participants were invited to take part in a second stage involving an in-person assessment. The survey forms were developed by the research team using the Research Electronic Data Capture (REDCap) platform[19] and sent by email. They included sociodemographic information, comorbidities, lifestyle habits, and vaccination history confirmed by the vaccination card issued through the Brazilian Unified Health System (SUS).

In the second stage, data were collected by a team comprising the principal investigator, field coordinator, and data collectors (master's and doctoral students and undergraduate students). Data were recorded using structured forms on the Research Electronic Data Capture (REDCap) platform[19]. To ensure uniformity in data collection, all assessors received prior training and followed standardized protocols for questionnaire administration, anthropometric measurements, and physical performance tests (Figure 1).

All participants signed an informed consent form. The research project was approved by the Research Ethics Committee of Pedro Ernesto University Hospital, in accordance with CNS 196/96 (Resolution No. 466/2012 and Resolution No. 510/2016), under approval No. 5,455,895, CAAE: 58287621.2.0000.5259.

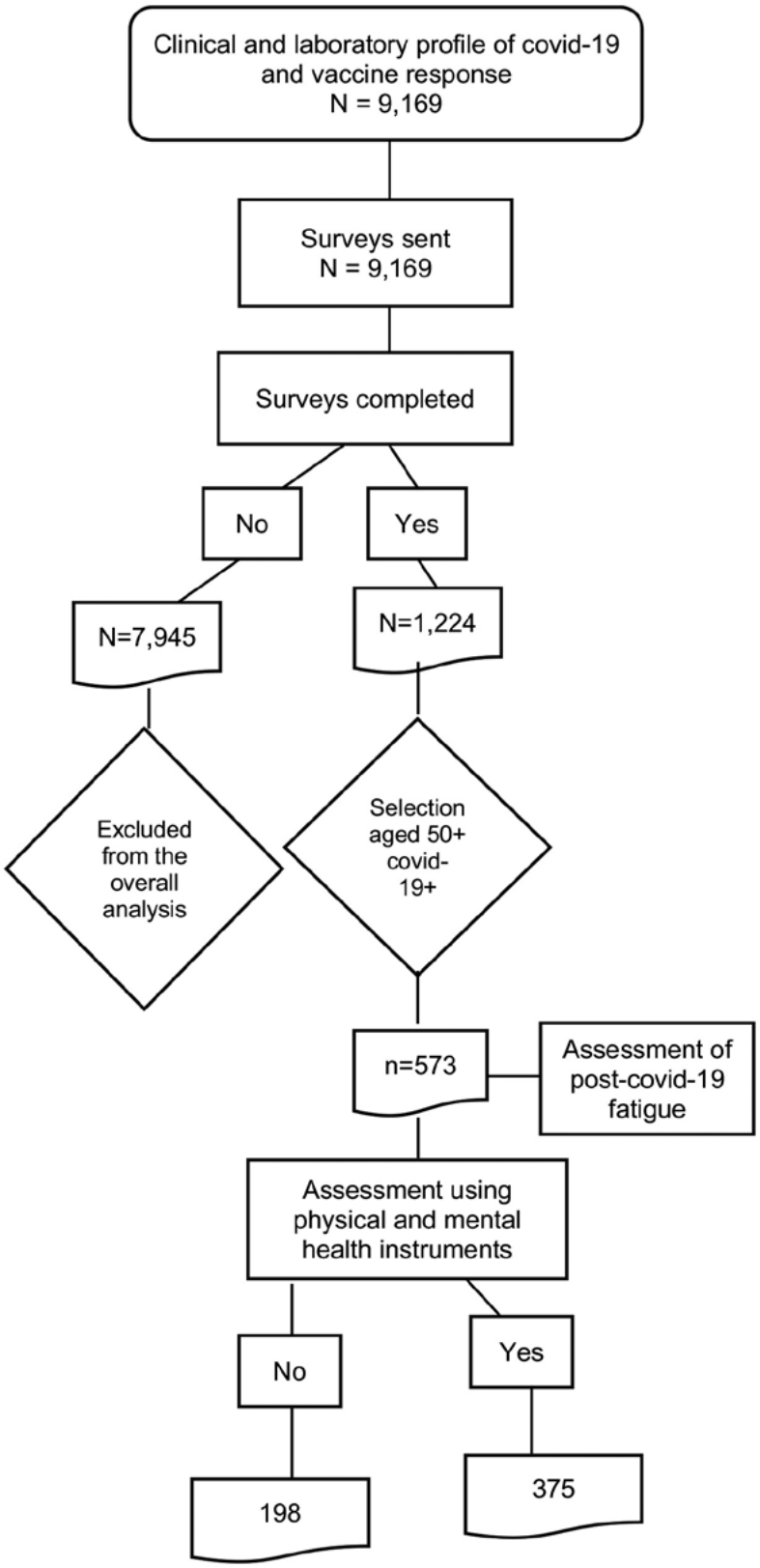


Figure 1. Flowchart of the selection of the study population and sample composition. Rio de Janeiro, RJ, Brazil, 2022–2024.

Source: Prepared by the authors.

The variable of interest, post-covid-19 fatigue, was defined based on a combination of self-reported fatigue during and after covid-19, with symptoms persisting for more than four weeks after diagnosis. The condition was identified using a combination of responses to the following items: A. "Before contracting covid-19, did you feel tired?"; B. "While you had covid-19, did you feel tired?"; C. "After covid-19, did you continue to feel tired?"; and D. "After covid-19, did you begin to feel tired?" Operationally, an individual was considered to have post-covid-19 fatigue if the response pattern was "No" to item A + "Yes" to items B and C, or "No" to item A + "Yes" to items B and D.

For the association analysis, a conceptual model was proposed to guide the selection of independent variables, based on evidence from the literature and variables available in the database. The variables were classified into three categories: risk factors—sex, comorbidities, hospitalization, marital status, and skin color; protective factor—vaccination; and factors with undetermined directionality—mood, cognition, handgrip strength, gait speed, and physical activity.

In the second stage, participants completed a structured assessment form containing sociodemographic, clinical, anthropometric, and functional information. Self-reported comorbidities included heart diseases, respiratory diseases, infectious diseases, and neuropsychiatric disorders. Cognition was assessed using the Mini-Mental State Examination (MMSE)[20]. Functional capacity was assessed using the sit-to-stand test, gait speed test, and handgrip strength test, performed according to standardized protocols[21,22].

The sit-to-stand test was performed using a standardized armless chair with a backrest and a seat height of approximately 43 to 45 cm from the floor, and the time required to complete five consecutive repetitions was recorded. Gait speed was assessed as the mean of two measurements of the time required to walk four meters at the participant's usual pace. Handgrip strength was assessed as the mean of two measurements obtained using a Jamar® hydraulic dynamometer with the dominant hand, with the participant seated and the upper limb appropriately positioned.

A descriptive analysis was initially performed to characterize the sample. The normality of continuous variables was assessed using the Shapiro–Wilk test. For bivariate analysis, the chi-square test was used for categorical variables, or Fisher's exact test when any cell had a frequency <5. For continuous variables, Student's *t* test was used for normally distributed variables, and the Wilcoxon test was used for non-normally distributed variables.

Variables with a *p*-value <0.20 in the bivariate analysis were included in the multivariable logistic regression model, with post-covid-19 fatigue as the dependent variable. To guide variable selection and minimize bias, a directed acyclic graph (DAG) was developed[23]. Thus, automatic variable selection based on statistical criteria was not performed. Variables with a *p*-value <0.05 were considered statistically significant.

DATA AVAILABILITY

The complete dataset supporting the findings of this study has been made available in Figshare and can be accessed at: https://doi.org/10.6084/m9.figshare.33117056

USE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence was not used in the preparation of this article.

RESULTS

Of the 573 individuals included, 316 (55.1%) were aged 60 years or older. The mean age of the overall sample was 61 years, compared with 66 years among participants aged 60 years or older and 55 years among those younger than 60 years. Among the participants, 49.9% reported fatigue, and 32.5% met the criteria for post-covid-19 fatigue. Among participants with post-covid-19 fatigue, 79.5% were women, 40.3% self-reported their skin color as non-White, and the mean age was 59 years.

In the bivariate analysis, post-covid-19 fatigue was associated with sex, skin color, hospitalization,

physical exercise, age, handgrip strength, gait speed, number of vaccine doses, and performance on the sit-to-stand test (Tables 1 and 2). No statistically significant associations were observed for comorbidities.

In the final logistic regression model, which included the variables significantly associated in the bivariate analysis, hospitalization for covid-19 was the variable with the greatest impact ($p = 0.02$), significantly increasing the odds of post-covid-19 fatigue. Participants who self-reported their skin color as non-White also had higher odds of post-covid-19 fatigue. Conversely, previous engagement in physical exercise, older age, and better performance on the sit-to-stand test were associated with significantly lower odds of post-covid-19 fatigue. Handgrip strength, number of vaccine doses, gait speed, and sex were not significantly associated with post-covid-19 fatigue (Table 3).

Table 1. Distribution of sociodemographic variables according to the presence or absence of post-covid-19 fatigue (n = 573). Rio de Janeiro, RJ, Brazil, 2022–2024.

Variables	Absent (n = 387) n (%)	Present (n = 186) n (%)	Total (n = 573) n (%)
Age (years)**			
50–59	99 (38.5)	158 (61.5)	257
60 or older	188 (59.5)	128 (40.5)	316
Sex*			
Female	244 (63.0)	148 (79.5)	392 (68.4)
Male	143 (36.9)	38 (20.4)	181 (31.6)
Marital status			
Married	14 (3.6)	72 (38.7)	86 (15.0)
Divorced/Separated	43 (11.1)	27 (14.5)	70 (12.2)
Single	54 (13.9)	34 (18.2)	88 (15.4)
Widowed	24 (6.2)	7 (3.7)	31 (5.4)
Skin color*			
White	255 (65.8)	99 (53.2)	354 (61.8)
Non-White	117 (30.2)	79 (42.4)	196 (34.2)
Hospitalization**			
Hospitalized	2 (0.5)	7 (3.7)	9 (1.6)
Not hospitalized	385 (99.4)	179 (96.2)	564 (98.4)
Physical exercise *			
Active	214 (55.3)	89 (47.8)	303 (52.9)
Sedentary	136 (35.1)	96 (51.6)	232 (40.5)
Smoking			
History of smoking	107 (27.6)	60 (32.2)	167 (29.1)
Never smoked	249 (64.3)	125 (67.2)	374 (65.3)

*p-value < 0.005; **p-value < 0.001.

Source: Prepared by the authors.

Table 2. Distribution of numerical variables according to the presence of post-covid-19 fatigue (n = 573). Rio de Janeiro, RJ, Brazil, 2022–2024.

Independent variables	Post-covid-19 fatigue	
	Absent $\bar{x}$ (95% CI) (n=387)	Present $\bar{x}$ (95% CI) (n=186)
Age (years)**	62.4 (61.7-63.1)	59.0 (58.1-59.9)
Gait speed (m/s)	1.9 (0.9-2.8)	2.1 (0.4- 3.7)
Handgrip strength (kgf)**	29.6 (28.0-31.2)	26.2 (24.0 -28.4)
Vaccine doses**	3.9 (3.9-3.9)	3.8 (3.8-3.8)
Mini-Mental State Examination	28.3 (28.1-28.5)	28.5 (28.3-28.7)
Body mass index (kg/m²)	27.2 (26.4-28.0)	27.2 (25.9-28.5)
Number of medications	3.6 (3.3-3.9)	3.6 (3.3-3.9)
Sit-to-stand test (seconds)*	11.2 (10.8-11.6)	13.1 (12.3-13.9)
Oxygen saturation (%)	97.0 (96.9-97.1)	96.7 (96.3-97.1)

$\bar{x}$ =mean; CI = confidence interval; *p-value < 0.005; **p-value < 0.001.

Source: Prepared by the authors.

Table 3. Multivariable logistic regression analysis of factors associated with post-covid-19 fatigue, including risk factors, protective factors, and variables with undetermined directionality (n = 573). Rio de Janeiro, RJ, Brazil, 2022–2024.

Variables	OR	95% CI	p-value
Male sex	0.38	0.26-1.25	<0.001
Hospitalization*	13.64	2.13-2.70	0.02
Physical exercise – active*	0.53	0.28-0.90	0.04
Age*	0.93	0.89-0.09	0.004
Handgrip strength	0.98	0.96-1.00	0.17
Gait speed	0.99	0.96-1.01	0.61
Number of vaccine doses	0.48	0.17-1.26	0.14
Sit-to-stand test*	1.09	1.02-1.18	0.009
Non-White skin color*	2.36	1.29-4.38	0.005

OR = odds ratio; 95% CI = 95% confidence interval; *p-value < 0.05.

Source: Prepared by the authors.

DISCUSSION

In this study, the prevalence of post-covid-19 fatigue was estimated at 32.5%. The final logistic regression model identified significant associations with hospitalization, physical exercise, age, skin color, and performance on the sit-to-stand test. In contrast, sex, handgrip strength, gait speed, and number of vaccine doses were not significantly associated with post-covid-19 fatigue.

Although the WHO declared in May 2023 that covid-19 no longer constituted a public health emergency of international concern, the virus remains in circulation and continues to be a cause for concern in different contexts. Data from the Brazilian Ministry of Health indicate that, as of March 2, 2026, 36,433 cases of covid-19-related influenza-like illness had been reported in the country, demonstrating the persistence of viral circulation. In this context, late manifestations such

as post-covid-19 fatigue remain clinically relevant, although they have received less attention in recent public and scientific debate, which may contribute to the relative invisibility of the problem.

Although post-covid-19 syndrome, including fatigue, is widely documented in the literature, it remains insufficiently incorporated into clinical practice.

The prevalence observed in this study falls within the range reported in previous investigations[6]. The wide variation reported across previous studies has been attributed mainly to the subjectivity of self-reported symptoms and the lack of standardized assessment methods[7,17,18]. The absence of specific biomarkers further increases the diagnostic challenge.

Recent systematic reviews and meta-analyses have confirmed this heterogeneity[17,23], with reported prevalence rates varying according to the assessment tool used[16]. In the study by Rao et al.,[24] the prevalence based on self-report was 42%, whereas the prevalence obtained using standardized scales—such as the Fatigue Assessment Scale, Borg Perceived Exertion Scale, Brief Fatigue Inventory, Chalder Fatigue Scale (CFQ-11), Fatigue Severity Scale (FSS), and Fatigue Impact Scale (FIS)—was 34.9%. Similarly, Ceban et al.[13] analyzed 43 studies in which the mean prevalence based on self-report was 29%, compared with 45% when assessed using standardized scales. Poole-Wright et al.,[12] in a review of 178 articles, found that prevalence was higher in studies using standardized scales (51%) than in those using nonstandardized instruments (38%).

Standardization of fatigue assessment instruments is essential to ensure comparability across studies and the robustness of findings. However, although widely used, scales such as the FSS, FIS, and CFQ-11 were not originally developed to assess post-covid-19 fatigue and have specific limitations in this context[7,9,25]. Recent studies have identified a ceiling effect in the FSS and limitations in capturing symptoms such as autonomic dysfunction and prolonged functional impairment. In 2023, a Brazilian study using the Manchester Fatigue Scale (MFS) provided adequate evidence of discriminant and convergent validity, indicating that it may be a promising tool for assessing post-covid-19 fatigue[26].

Although there are variations in reported prevalence rates and the methodologies used, there is consensus regarding the role of younger age, female sex, disease severity, and hospitalization. Female sex is widely recognized as a risk factor for post-covid-19 syndrome, including fatigue, possibly because of hormonal and immunological changes[17]. However, in the present study, the multivariable analysis did not identify a statistically significant association with this variable. This finding may be related to sample-specific factors, such as the predominance of women, which may have reduced the contrast between groups and limited the statistical power to detect differences. The literature suggests that the heterogeneity of post-covid-19 symptoms and their overlap with fatigue of other etiologies contribute to discrepant findings[27,28].

Hospitalization is strongly associated with the occurrence of post-covid-19 fatigue and is considered one of the main predictors of persistent manifestations, regardless of the initial severity of the infection. Several studies have highlighted that hospitalization is associated with a higher prevalence of symptoms such as fatigue, dyspnea, and long-term functional impairment[15,16,29,30]. In the present study, hospitalization showed the strongest statistical association, emerging as an important marker for the development of persistent symptoms following SARS-CoV-2 infection, even in a sample with a small number of hospitalized patients.

In addition, regular physical exercise before infection and better performance on the sit-to-stand test—a measure of lower-limb strength—showed a protective effect[15]. Consistent with these findings, one study concluded that higher levels of physical activity before SARS-CoV-2 infection were associated with a lower odd of fatigue[30]. Similarly, other authors found that lower levels of physical exercise were associated with greater fatigue and lower handgrip strength[31] .

Handgrip strength is widely recognized as an important functional marker and is used to assess muscle function and overall health. In the present study, however, it was not significantly associated with post-covid-19 fatigue. This finding contrasts with part of the literature, which describes an association

between lower muscle strength and higher levels of fatigue, particularly in individuals with low habitual physical activity, highlighting a discrepancy in the evidence regarding this variable. Factors such as the relatively younger age profile of the sample and the low prevalence of previous hospitalization for covid-19 may have influenced the lack of association.

Another relevant finding concerns older age, which showed a protective effect in this study, a result that may appear contradictory given the greater severity of covid-19 observed among older adults. Importantly, 55.1% of the sample consisted of participants aged 60 years or older, reinforcing the relevance of these findings to the field of human aging. Indeed, 2023 data from the covid-19-Associated Hospitalization Surveillance Network (COVID-NET) indicate that adults aged 65 years or older accounted for 62.9% of COVID-19-related hospitalizations[32].

However, when post-covid-19 fatigue is considered specifically, findings in the literature are largely consistent with those observed in the present study. Choudhury et al. (2024), for example, reported a higher prevalence of fatigue among young and middle-aged individuals[33]. Similarly, Tan et al. (2023) reported prevalence rates decreasing from 53.1% to 33.1% over 12 months, with a greater impact among younger individuals and women[34]. Possible explanations for these findings include immunological, neuroinflammatory, and psychosocial factors. According to the same authors[33-34], younger individuals may exhibit a more robust and prolonged inflammatory response to infection, favoring the persistence of the condition. In addition, factors such as social and economic pressures appear to exacerbate the perception and impact of fatigue.

Individuals who self-reported their skin color as non-White had a higher risk of post-covid-19 fatigue. International studies have reported higher prevalence rates among populations of African descent, Latin American populations, and Middle Eastern populations. This finding may be related to structural inequalities, such as limited access to healthcare services, adverse living conditions, and a greater burden of comorbidities, which disproportionately affect different ethnic groups. Although the underlying mechanisms are not fully understood, recent literature suggests that biological, social, and immunological factors may interact to increase this vulnerability[8,32].

In the Brazilian context, these findings are directly related to the principles of the SUS, particularly universality, comprehensiveness, and equity. The principle of equity recognizes that different population groups have distinct needs and therefore require tailored responses to ensure fair and effective access to healthcare services. Thus, the association between skin color and a higher risk of post-covid-19 fatigue reinforces the urgency of public policies aimed at promoting equity, with affirmative measures targeting historically vulnerable populations, such as ethnic and racial minorities, in order to reduce disparities and advance social justice in post-pandemic care[32].

The study has several important limitations. Because of its cross-sectional design, causal inferences cannot be made. Missing data, particularly for variables related to comorbidities, may have been associated with the length of the survey. Long questionnaires tend to result in incomplete data because of participant fatigue and reduced attention, thereby increasing the number of incomplete or omitted responses. The repetitive nature of some questions may also have contributed to participant disengagement and increased the frequency of incomplete responses. In addition, only 375 of the 573 participants underwent assessment using physical and mental health instruments, which may have introduced selection bias. The inclusion of physical and mental health assessment variables only for this subgroup may also have affected the multivariable analysis by reducing statistical power and potentially limiting the generalizability of the findings. The participants had a mean age of 61 years, indicating that the sample was concentrated toward the younger end of the study age range. This characteristic provides an opportunity to investigate the long-term effects of covid-19 in future studies.

The diagnosis of covid-19, established through positive RT-PCR results obtained from different laboratories, also represents a limitation. Although RT-PCR is considered the

reference method for confirming infection, the lack of standardization across laboratories may have introduced methodological variability into diagnostic confirmation.

The criterion adopted to characterize fatigue was not subjected to formal validation procedures, which represents a methodological limitation that should be considered when interpreting the results. However, in the absence of widely accepted criteria and instruments, an approach based on self-reported fatigue, with emphasis on the temporal dimension and consideration of symptom onset and persistence after covid-19 infection, appeared appropriate.

Another limitation is related to the sample: all participants had received at least one vaccine dose, which may have attenuated the effect of the "vaccination" variable. Although stratification by number of doses suggested a protective association in the bivariate analysis, this relationship should be interpreted with caution. Another consideration is the small number of hospitalized patients (n = 9), which may have underestimated the impact of covid-19 severity on fatigue. Finally, the absence of a control group comprising individuals without a history of covid-19 precluded comparisons with other causes of fatigue, making it difficult to distinguish between manifestations attributable to the disease and factors present in the general population.

Despite these limitations, the study contributes to advancing the understanding of post-covid-19 fatigue by confirming factors previously described in the literature and generating new hypotheses. The inclusion of objective measures of physical and mental capacity enabled a more comprehensive assessment of factors associated with post-covid-19 fatigue, an approach that remains relatively underexplored. The use of the proposed multivariable model, based on a DAG, enabled careful variable selection while accounting for causal assumptions and minimizing confounding bias. This approach allowed the identification of factors associated with the condition, particularly hospitalization as the strongest predictor and physical exercise, older age, and functional performance as protective factors. These findings emphasize the importance of further research, particularly longitudinal studies, to improve understanding of the condition, enhance quality of life, and preserve functioning among individuals affected by SARS-CoV-2 infection.

CONCLUSION

Although covid-19 is no longer considered a public health emergency, new cases continue to occur, and fatigue remains one of the most prevalent symptoms of post-covid-19 syndrome. The present study found a 32.5% prevalence of post-covid-19 fatigue, which, according to the logistic regression model, was significantly associated with hospitalization, sex, physical exercise, age, and performance on the sit-to-stand test.

The findings indicate that potentially modifiable clinical and functional factors may play an important role in the occurrence of the condition, reinforcing the importance of functional assessment and the promotion of physical activity. In addition, the inverse association with older age and the remaining knowledge gaps regarding post-covid-19 fatigue highlight the need for longitudinal studies to inform prevention and management strategies, particularly among older adults.

AUTHOR CONTRIBUTIONS

- Alessandra Ferrarese Barbosa: Formal Analysis; Investigation; Methodology; Visualization; Writing – Original Draft.
- Mariangela Perez: Conceptualization; Formal Analysis; Supervision; Investigation; Writing – Review & Editing.
- Luís Cristovão Porto: Conceptualization; Supervision; Investigation; Data Curation.
- Roberto Alves Lourenço: Conceptualization; Data Curation; Formal Analysis; Funding Acquisition; Resources; Writing – Review & Editing.

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