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Prevalence and characteristics of long COVID among COVID-19 survivors in Saudi Arabia: A cross-sectional study

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ABSTRACT

Objectives: This study explores the prevalence, risk factors, and impact of long COVID among COVID-19 survivors in Saudi Arabia.
Methods: A cross-sectional study involving 486 COVID-19 survivors was conducted. Participants were confirmed via polymerase chain reaction testing and enrolled from November 2020 to December 2020.
Results: The study found a high prevalence of long COVID symptoms, with 61% of participants reporting persistent symptoms. The prevalence was similar across demographic factors: 43% were aged 18-30 years, 71% were female, and 30% had comorbidities. The most common symptoms included fatigue (56%), breathlessness (47%), loss of smell (44%), and muscle aches (40%), alongside digestive issues, chest pain, headaches, tachycardia, joint pain, and skin problems.
Conclusions: This study underscores the significance of understanding long COVID's impact on individuals' health and quality of life. It highlights the necessity for further research to guide health care strategies and support COVID-19 survivors in Saudi Arabia.

Introduction

COVID-19 was initially identified in Wuhan, China, toward the end of December 2019. In Saudi Arabia, its first confirmed case was reported in early March 2020. The World Health Organization (WHO) declared COVID-19 a pandemic in March 2020. By mid-April 2021, worldwide, 135 million confirmed cases of COVID-19 were reported, resulting in 2,917,830 reported deaths [1].

COVID-19 manifests a spectrum of symptoms, ranging from common signs such as cough, fever, and fatigue to more severe and potentially life-threatening conditions such as severe pneumonia. Although most patients with COVID-19 recover and regain their health, some patients have symptoms that persist for weeks or months after recovery. This condition, characterized by prolonged COVID-19 symptoms after recovery, is commonly referred to as "long COVID" or "post–COVID-19 condition" [2].

Long COVID manifests as a broad spectrum of symptoms, including but not limited to headache, anosmia, alopecia, and various other manifestations; the occurrence and severity of which may vary based on individual risk factors; and the timing of symptom onset after infection [3,4]. Numerous studies have been published worldwide, shedding light on the diverse symptoms of long COVID, which provide valuable insights into the post-infection conditions experienced by various patients. One study that followed up 143 patients for 7 weeks after discharge revealed that 53% of the patients had fatigue, 43% had breathlessness, and 27% had joint pain [5]. In another study, 30% of the patients surveyed had persistent symptoms after 9 months, with fatigue and a loss of sense of smell being the most common symptoms [6]. Multiple studies have documented a range of long COVID symptoms, with varying manifestations and different durations of persistence [3,4]. These studies revealed significant variations in the type and frequency of symptoms, suggesting potential correlations with various risk factors that need to be further explored [7–9]. Furthermore, the documented impact of long COVID symptoms on patients' quality of life, as indicated by multiple studies, necessitates further investigation of the prevalence, risk factors, and impact of long COVID symptoms [7,10].

The potential risk factors for developing persistent symptoms of long COVID include older age, severe COVID-19, female sex, the presence of

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other comorbidities, and other characteristics that require further investigation [11].

Despite the extensive global research on long COVID, there is a notable gap in studies focusing on this condition within specific regional contexts, such as Saudi Arabia. The cultural, genetic, environmental, and health care differences in Saudi Arabia may influence the prevalence and characteristics of long COVID. Understanding the prevalence, risk factors, and impact of long COVID in the Saudi Arabian population is crucial for developing targeted public health strategies and interventions for the specific needs of this population. This study aims to address this gap by conducting a cross-sectional study to examine the prevalence, risk factors, and impact of long COVID among COVID-19 survivors in Saudi Arabia. The findings of this study will provide valuable insights that can inform health care policies and improve the management and support of patients with long COVID in Saudi Arabia.

Methods

This was an observational, analytical, cross-sectional study, with a planned duration of 24 months. The study was conducted within the local community, focusing on COVID-19 survivors in Saudi Arabia. Participants were enrolled from November 2020 to December 2020. The target population for this study included individuals aged 18 years or older who had a confirmed diagnosis of COVID-19 via polymerase chain reaction testing.

The sample size was calculated to ensure adequate power to detect significant differences between groups with and without comorbidities assess the prevalence of long COVID symptoms. Assuming a confidence level of 95%, a margin of error of 5, and an anticipated prevalence of cough of 40%, as reported in Wang et al. [4], the minimum required sample size was determined to be 369 participants using (Calculator.Net). Specifically, the inclusion criteria required participants to have recovered for more than 30 days after experiencing mild, moderate, or severe COVID-19 and reside in Saudi Arabia. The exclusion criteria included being under 18 years of age and illiterate. A total of 486 COVID-19 survivors who responded were included.

The study variables encompassed three main categories. The first category included demographic information, such as age, sex, comorbidities, and smoking status. The second category included infection-related variables, capturing information on the severity and duration of the infection, as well as the occurrence of pregnancy during the infection. The third category focused on persisting symptoms, aiming to describe and evaluate long COVID symptoms.

Informed consent was obtained from all participants after the purpose of the study was clearly explained. No personal information was needed, ensuring participant confidentiality. The study posed no harm to the participants and may have provided indirect benefits. All data were securely stored and accessible only to the research investigators, with data preserved for 2 years. This study was conducted following the principles of the Declaration of Helsinki and approved by the Health Sciences Colleges Research on Human Subjects Institutional Review Board committee of King Saud University, under Institutional Review Board Approval of Research Project No. E-21-6269.

Data were collected primarily via the Arabic version of a well-structured online questionnaire. The questionnaire was distributed through various social media platforms, including Twitter and WhatsApp. Informed consent was obtained from the participants who were provided all necessary information about their rights and the purpose of the study. The questionnaire took approximately 10 minutes to complete. The researchers' contact information was made available for participants to ask any questions they may have about the study.

The questionnaire used in this study consisted of 12 multiple-choice questions, divided into three parts. Part 1 focused on demographic information, including age, sex, smoking status, and comorbidities. The questions in parts 2 and 3 of the questionnaire were obtained and modified from the study by Carvalho-Schneider et al. [12]. Part 2 collected infection-related data, such as infection severity and duration of recovery from the acute phase, and part 3 addressed persisting symptoms describing long COVID. The total score for each domain in the questionnaire was calculated based on the responses: infection-related data ranged from 0 to 10 and persisting symptoms ranged from 0 to 30. Cut-off points were established to categorize the severity and persistence of symptoms: infection-related data (mild: 0-3, moderate: 4-6, and severe: 7-10) and persisting symptoms (mild: 0-10, moderate: 11-20, and severe: 21-30). To ensure inclusivity and reach a larger population in Saudi Arabia, the questionnaire was translated into Arabic.

Data analysis was performed using statistical software to evaluate the characteristics and outcomes of the study participants. Descriptive statistics summarized demographic information, infection-related variables, and persisting symptoms. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized using mean values.

Chi-square tests were used to assess the associations between categorical variables, particularly, focusing on the presence of comorbidities and the occurrence of specific post–COVID-19 symptoms. Statistical significance was determined at $P < 0.05$. Participants were stratified by the presence or absence of comorbidities to compare demographic characteristics, hospitalization rates, and the prevalence of long COVID symptoms. These analyses aimed to identify significant differences between groups and provide insights into the impact of long COVID among COVID-19 survivors in Saudi Arabia. The Kaiser-Meyer-Olkin test for sampling adequacy value was 0.567, indicating measurable factors. Thus, a confirmatory factor analysis of symptoms survey was performed.

Results

Most were female (71%), aged 18-30 years (43%), and nonsmokers (only 9% of the participants were smokers). A total of 30% of the participants had comorbidities: 8% had hypertension, 8% had diabetes or dyslipidemia, 6% had asthma or thyroid dysfunction, and 6% had other comorbidities. A small percentage of the patients were pregnant at the time of infection with COVID-19 (2%), and some were hospitalized due to infection (3%). Most participants had mild to moderate COVID-19 symptoms (93%). The time to complete recovery from COVID-19 was mostly more than 1 year (37%) (Table 1).

When the participants were stratified according to the presence or absence of comorbidities, multiple factors were significantly different between the two groups. Participants with comorbidities were older (50-60 years old; 76%) than those without comorbidities (10-30 years old; 89%) ($P < 0.001$). In addition, participants with comorbidities were significantly more likely to be hospitalized due to COVID-19 (31 vs 69%, $P < 0.001$). Other demographic and COVID-19–related information was not significantly different between the two groups (Table 2).

Symptoms that were noted after COVID-19 infection are reported in Tables 3 and 4 when stratified by the presence or absence of comorbidities; responders without comorbidities were more likely to experience chest pain post–COVID-19 (62% vs 38%, $P = 0.049$) and more likely to have experienced a recent change in their heart rate (80% vs 20%, $P < 0.001$). People with comorbidities were also more likely to have experienced recent muscle pain than those without comorbidities (73% vs 27%, $P < 0.001$). However, no responders without comorbidities experienced joint pain (79% vs 21%, $P < 0.001$). Responders without comorbidities had fewer skin problems (73% vs 27%, $P = 0.002$). Other symptoms were not significantly different between the groups.

The responders reported breathing problems mostly while running or walking on flat surfaces (n = 43), followed by breathing difficulty after strenuous exercise (n = 27), breathing difficulty while walking slowly on flat ground (n = 11), severe shortness of breath (n = 7), and breathing difficulty after walking on a flat surface for 3 minutes (n = 6) (Figure 1). About the loss of sense of smell after COVID-19 infection, most respondents had complete recovery, with no loss of sense of smell (n = 211),

Table 1
Demographics, comorbidities, and COVID-19–related information of the participants.

N = 486		N	%
Sex	Male	141	29.0
	Female	345	71.0
Age (years)	18-30	211	43.4
	31-40	108	22.2
	41-50	88	18.1
	51-60	53	10.9
	>60	26	5.3
Smoking	Yes	43	8.8
Comorbidities	Yes	145	29.8
Hypertension	Yes	40	8.2
Diabetes mellitus	Yes	38	7.8
Dyslipidemia	Yes	38	7.8
Asthma or respiratory symptoms post–COVID-19 infection	Yes	31	6.4
Thyroid dysfunction	Yes	31	6.4
Other comorbidities	Yes	29	6.0
Pregnancy during COVID-19 infection	Yes	10	2.4
Hospitalized due to COVID-19	Yes	16	3.3
Severity of COVID-19 symptoms	Mild to moderate	454	93.4
	Severe to life-threatening	32	6.6
Duration of recovery from COVID-19	3-5 months	108	25.5
	6-8 months	83	19.6
	9-11 months	78	18.4
	>1 year	155	36.6

Table 2
Demographic characteristics and COVID-19–related information of participants stratified by the presence or absence of comorbidities (chi-square test).

N = 486		Without co-morbidities	%	With comor-bidities	%	Total	%	*P*-value
Demographics								
Age (years)	18-30	187	88.6	24	11.4	211	43.4	<0.001[a]
	31-40	83	76.9	25	23.1	108	22.2	
	41-50	49	55.7	39	44.3	88	18.1	
	51-60	13	24.5	40	75.5	53	10.9	
	>60	9	34.6	17	65.4	26	5.3	
Sex	Male	99	70.2	42	29.8	141	29.0	0.988
	Female	242	70.1	103	29.9	345	71.0	
Smoking	Yes	34	79.1	10.0	9	20.9	6.2	0.181
Pregnancy during COVID-19 infection	Yes	6	60.0	4	40.0	10	2.4	0.489
Hospitalized due to COVID-19	Yes	5	31.3	11	68.8	16	3.3	0.001[a]
Severity of COVID-19 symptoms	Mild to moderate	329	72.5	125	27.5	454	93.4	
	Severe to life-threatening	12	37.5	20	62.5	32	6.6	
Duration of recovery from COVID-19	3-5 months	68	63.0	40	37.0	108	25.5	0.283
	6-8 months	63	75.9	20	24.1	83	19.6	
	9-11 months	55	70.5	23	29.5	78	18.4	
	>1 year	108	69.7	47	30.3	155	36.6	

[a] Cutoff for significant value <0.050.

followed by partial loss (n = 74), complete loss (n = 33), and temporary loss (n = 2).

For factor analysis, five components with an Eigenvalue >1 emerged. Therefore, based on factor loading in each item, the survey covers five domains: respiratory, gastrointestinal, headache, cardiovascular, and others (fatigue, skin, and joints).

Discussion

Since the first COVID-19 case reported by the Saudi government to the WHO, from January 3, 2020 through December 6, 2023, there have been 841,469 confirmed cases of COVID-19 and 9646 deaths [1]. The Saudi government implemented several measures to limit the transmission of the disease. The preventive measures taken by the Saudi government included implementing lockdowns, enforcing social distancing measures, stopping public transportation, closing schools, preventing large religious gatherings, and conducting contact tracing for travelers displaying signs of COVID-19 infection. Moreover, the Ministry of Health established walk-in respiratory clinics to enhance COVID-19 detection and management capacity [13]. Furthermore, the Ministry of Health approved approximately 45 scientific instruction protocols and guidelines for health care providers on how to address and manage COVID-19 [14,15]. However, there is no long-term follow-up data concerning COVID-19 survival. Many international studies have reported

Table 3
Symptoms experienced after COVID-19, stratified by the presence or absence of comorbidities (chi-square test).

		Without co-morbidities	%	With comor-bidities	%	Total	%	*P*-value
Do you currently have or experience difficulty breathing?	Yes	63	67.0	31	33.0	94	19.3	0.458
Do you currently have or experience abnormal fatigue?	Yes	132	68.0	62	32.0	194	39.9	0.404
Do you currently have or experience digestive problems?	Yes	79	66.9	39	33.1	118	24.3	0.380
Do you currently have or experience diarrhea or constipation?	Yes	28	68.3	13	31.7	41	8.4	0.784
Do you currently have or experience nausea or vomiting?	Yes	8	80.0	2	20.0	10	2.1	0.492
Do you currently have or experience abdominal pain?	Yes	51	68.9	23	31.1	74	15.2	0.799
Do you currently have or experience other gastrointestinal problems?	Yes	12	66.7	6	33.3	18	3.7	0.741
Do you currently have or experience problems with taste?	No	241	70.3	102	29.7	343	70.6	0.989
	Yes	36	70.6	15	29.4	51	10.5	
	I do not have difficulty tasting food, I only experienced a change in taste	64	69.6	28	30.4	92	18.9	
Do you currently have or experience chest pain?	Yes	52	61.9	32	38.1	84	18.3	0.049[a]
Do you currently have or experience headaches?	No, never	121	72.9	45	27.1	166	36.2	0.485
	Yes, had it temporarily, and now it is gone	117	67.6	56	32.4	173	37.8	
	Yes, constantly	40	67.8	19	32.2	59	12.9	
	Yes, recently	46	76.7	14	23.3	60	13.1	
Do you currently have or experience an abnormal heartbeat (tachycardia)?	No, never	203	74.6	69	25.4	272	60.0	<0.001[a]
	Yes, had it temporarily, and now it is gone	39	51.3	37	48.7	76	16.8	
	Yes, constantly	34	68.0	16	32.0	50	11.0	
	Yes, recently	44	80.0	11	20.0	55	12.1	
Do you currently have or experience muscle pain?	No, never	125	75.8	40	24.2%	165	36.4%	0.041[a]
	Yes, had it temporarily, and now it is gone	83	61.9	51	38.1	134	29.6%	
	Yes, constantly	62	69.7	27	30.3	89	19.6	
	Yes, recently	50	76.9	15	23.1	65	14.3	
Do you currently have or experience joint pain?	No, never	157	79.3	41	20.7	198	43.7	<0.001[a]
	Yes, had it temporarily, and now it is gone	72	62.1	44	37.9	116	25.6	
	Yes, constantly	50	60.2	33	39.8	83	18.3	
	Yes, recently	41	73.2	15	26.8	56	12.4	
Do you currently have or experience any skin problems?	No, never	281	72.6	106	27.4	387	85.4	0.002[a]
	Yes, had it temporarily, and now it is gone	18	78.3	5	21.7	23	5.1	
	Yes, constantly	8	36.4	14	63.6	22	4.9	
	Yes, recently	13	61.9	8	38.1	21	4.6	
Do you currently have or experience increased hair loss?	Yes	147	71.4	59	28.6	206	45.0	0.793
Do you currently have or experience other symptoms?	Yes	84	65.6	44	34.4	128	56.1	0.571
Types of breathing difficulties	After strenuous work	17	63.0	10	37.0	27	28.7	0.343
	After running or walking on a flat surface or mildly elevated surface	29	67.4	14	32.6	43	45.7	
	I cannot breathe after walking on a flat surface for 100 m or 3 minutes	3	50.0	3	50.0	6	6.4	
	I walk slowly on flat ground compared with people my age	7	63.6	4	36.4	11	11.7	
Types of fatigue	Able to do simple, non–heavy-duty work	50	64.1	28	35.9	78	40.2	0.467
	Able to navigate and perform self-care but unable to do any other activities for more than half the awake hours.	17	65.4	9	34.6	26	13.4	
	Able to carry out the usual routine work without restrictions.	39	67.2	19	32.8	58	29.9	
	I have symptoms that force me to sit or lie in bed for more than half my awake hours, but I am not crippled.	24	80.0	6	20.0	30	15.5	
Types of loss of smell	None	147	69.7	64	30.3%	211	65.9	0.667
	Complete	26	78.8	7	21.2%	33	10.3	
	Partial	52	70.3	22	29.7%	74	23.1	
	Temporary	1	50.0	1	50.0%	2	0.6	

[a] Cutoff for significant value <0.050.

Table 4
Factors related to COVID-19, stratified by length/duration of infection symptoms (chi-square test).

N = 486		3-5 months		6-8 months		9-11 months		>1 year		*P*-value
		N	%	N	%	N	%	N	%	
Sex	Male	30	24.6	19	15.6	26	21.3	47	38.5	0.489
	Female	78	25.8	64	21.2	52	17.2	108	35.8	
Age (years)	18-30	42	23.1	42	23.1	39	21.4	59	32.4	0.213
	31-40	31	33.3	14	15.1	18	19.4	30	32.3	
	41-50	20	25.0	16	20.0	11	13.8	33	41.3	
	51-60	9	18.8	6	12.5	7	14.6	26	54.2	
	>60	6	28.6	5	23.8	3	14.3	7	33.3	
Smoking	Yes	13	36.1	6	16.7	5	13.9	12	33.3	0.482
Pregnancy during COVID-19 infection	Yes	0	0.0	3	37.5	3	37.5	2	25.0	0.152
Severity	Mild to moderate	102	26.0	77	19.6	73	18.6	141	35.9	0.738
	Severe to life-threatening	6	19.4	6	19.4	5	16.1	14	45.2	
Hospitalization due to COVID-19	yes	3	20.0	1	6.7	3	20.0	8	53.3	0.436

Cutoff for significant value <0.050.

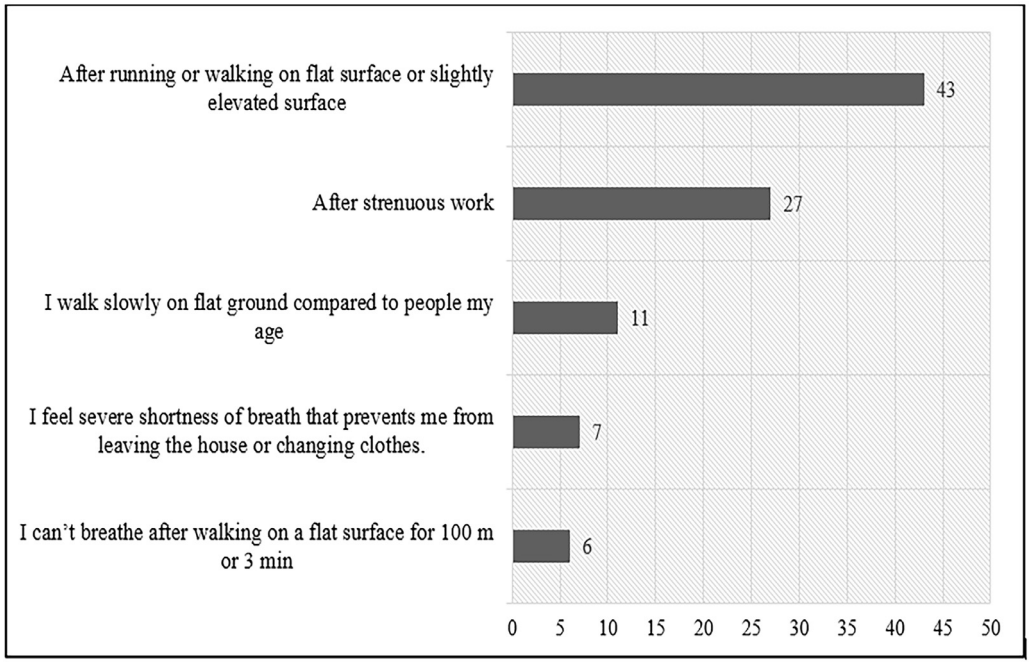

Figure 1. Types of reported breathing difficulties after COVID-19 infection.

cases of long-lasting symptoms, a condition named long COVID. In Saudi Arabia, no study has been conducted to investigate the prevalence of associated risk factors for long COVID.

To the best of our knowledge, this was the first study to assess the prevalence of long COVID in Saudi Arabia, the associated risk factors, and the impact of long COVID. The present study revealed a high prevalence of long COVID among COVID-19 survivors in Saudi Arabia. In addition, this study showed no statistically significant correlation between the presence of long COVID and various demographic and clinical factors such as age, sex, smoking status, severity of symptoms, comorbidities, pregnancy status, and hospitalization status. However, international research has shown that older age, female sex, increased severity of symptoms during acute infection, an increased number of symptoms during acute infection, intensive care admission, and the presence of preexisting comorbidities are potential factors associated with an increased risk of post–COVID-19 condition symptoms [16–19]. Specifically, comorbidities such as diabetes mellitus, hypertension, obesity, cardiovascular disease, chronic kidney disease, chronic respiratory conditions (e.g. asthma and chronic obstructive pulmonary disease), immunocompromised states (e.g. HIV/AIDS, cancer treatments), and autoimmune diseases have been identified as significant risk factors for developing long COVID symptoms. However, this study revealed a relationship between the presence of comorbidities and more severe symptoms and hospitalization due to COVID-19. Moreover, our findings indicated no significant difference in the duration of recovery from COVID-19 based on the presence of comorbidities.

The most reported symptoms of long COVID were extreme tiredness (fatigue), shortness of breath, loss of smell, and muscle aches [2]. This study identified these symptoms, along with digestive problems, chest pain, headache, tachycardia, joint pain, and skin problems. Notably, although anosmia (loss of smell) was prevalent across our cohort, its occurrence was not statistically associated with the presence of comorbidities, aligning with global recognition of anosmia as a prominent COVID-19 symptom [20]. Furthermore, varying levels of fatigue and breathing difficulties were reported among COVID-19 survivors in our study, with no significant correlation observed with the presence of comorbidities. However, chest pain, changes in heart rate, and muscle pain were more frequently reported among participants without underlying comorbidi-

ties, consistent with recent findings highlighting organ-specific effects of SARS-CoV-2 infection [21].

This study has several limitations that should be acknowledged. First, as a cross-sectional study, it only captures data at a single time point and cannot establish causal relationships between risk factors and long COVID symptoms. Future prospective studies are needed to validate these associations over time. Second, the use of an online questionnaire introduces potential biases, such as self-selection bias, recall bias, and the exclusion of individuals without internet access. This may limit the generalizability of the findings to the broader population. Lastly, the study did not account for COVID-19 vaccination status, which may play a role in the persistence and severity of long COVID symptoms. These data are crucial for understanding whether long-term symptoms are affected by vaccination. Research into COVID-19 vaccination has shown a lower rate of post–COVID-19 symptoms in the highly vaccinated population, with recent data from the UK showing that approximately 4-5% of people who had received three vaccinations reported at least one symptom at 3 months [22,23]. Future research should consider incorporating vaccination history to provide a more comprehensive analysis of long COVID risk factors and outcomes. By addressing these limitations, future studies can build on this research to develop more targeted health care strategies for managing long COVID in Saudi Arabia.

Conclusion

This study provides valuable insights into the prevalence and characteristics of long COVID among COVID-19 survivors in Saudi Arabia. The findings indicate a high prevalence of long COVID symptoms, including fatigue, shortness of breath, and insomnia. However, because this study uses a cross-sectional design, it cannot establish causality between specific risk factors and long COVID symptoms. Future research using longitudinal or prospective study designs is necessary to determine causal relationships and better understand the long-term effects of COVID-19. Furthermore, although this study identified associations between comorbidities and hospitalization rates, these findings should be interpreted cautiously given the study's observational nature. For future research, it is crucial to explore additional variables that may influence the development and persistence of long COVID symptoms. Including variables such as socioeconomic status, duration of hospitalization, specific treatments received during acute infection, and detailed vaccination status could provide deeper insights into the risk factors and outcomes associated with long COVID. Moreover, future research should clarify the COVID-19 vaccination status of participants, incorporating this information into analysis to assess its potential impact on long-term sequelae.

Declarations of competing interest

The authors have no competing interests to declare.

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Ethical approval

This work was approved by the Health Sciences Colleges Research on Human Subjects Institutional Review Board committee under Institutional Review Board Approval of Research Project No. E-21-6269. Informed consent was obtained from all participants after the purpose of the study was clearly explained.

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Author contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave the final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijregi.2025.100616.

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