Original Article

Prevalence of Long COVID-19 among Home-treated COVID-19 Patients in Baghdad, Iraq 2023

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Abstract

Background: The term "long-COVID-19" describes the condition of individuals who have either recovered from the acute phase of COVID-19 but are still reporting persistent effects of the infection, have had recurrence of the initial clinical symptoms, or have new symptoms other than the initial symptoms. The prolonged course of the COVID-19 illness is a problem that is becoming more widely noticed, affecting both health and economic systems. **Aim of the Study:** To establish base-line data for health policy makers to prevent and control this important public health problem. **Methodology:** A cross-sectional study design was adopted for this study. The study was conducted in 39 health-care centers selected randomly in Baghdad from ten health districts. In the first stage, ten health districts were chosen by a simple random sampling method. Then, in the second stage, a simple random sampling method selected 50% of primary health-care centers from each district. A convenient sample of 600 participants was involved in the study. The collection of the data was completed within 10 months (from January 2nd to the end of October 2023). A level of $P < 0.05$ considered significant in both univariate and multivariable analysis performed in this research. **Results:** The current study revealed that 231 out of 600 (38.5%) participants had persistent symptoms for more than 4 weeks after the onset of illness. The symptoms that had persisted for more than 4 weeks were: fatigue in 145 out of 600 (24.1%), cough in 98 out of 600 (16.3%), and loss of smell or taste in 93 out of 600 (15.5%). By Chi-square test analysis, statistically significant association was found between the duration of illness and: age, sex, smoking history, presence of chronic diseases, COVID-19 vaccination before infection, reinfection with severe acute respiratory syndrome coronavirus 2 and obesity. On logistic regression analysis only increasing age (odds ratio [OR] 1.678, 95% confidence interval [CI] 1.089–2.586), female sex (OR 2.676, 95% CI 1.829–3.916), smoking (OR 2.878, 95% CI 1.964–4.216), and COVID-19 vaccination before infection (OR 0.560, 95% CI 0.387–0.811) were significant factors. **Conclusions:** More than one-third of participants (38.5%) had long COVID. The most frequent symptoms that persisted for more than 4 weeks in this study were fatigue, followed by cough, and loss of smell or taste, respectively. The increasing age, female sex, smoking were significant risk factors, in contrast to COVID-19 vaccination before infection was significant protective factor.

Keywords: Baghdad, COVID-19, home-treated, long COVID-19

Introduction

In December 2019, cohorts of patients presented to the local hospitals in Wuhan, China, with symptoms of pneumonia without known causes. Many of them visited the fish and wild animal market days before.[1] At the end of the month, the Chinese Centre for Disease Control and Prevention reported this health event to the World Health Organisation (WHO). On January 7, 2020, a new virus was isolated from patients' throat swabs in China[2] and named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses.[3]

On February 11, 2020, the WHO named the virus COVID-19,[3] which is distributed rapidly by direct contact transmission from person to person. Therefore, the WHO declared COVID-19 a pandemic on March 11, 2020.[4] Globally, confirmed cases were rising to reach more than 775 million in March 2024,

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with more than 7 million deaths.[5] According to the most recent epidemiological reports from the Ministry of Health/Public Health Directorate in mid-2023, the total confirmed cases in Iraq reached more than 2.4 million, with more than 25,000 deaths.[6] Clinical manifestations of COVID-19 range from asymptomatic or mild to severe, and an average full recovery period occurs from 3 to 4 weeks of disease.[7] Approximately 80% of patients with COVID-19 are mild to moderate, while 10%–15% develop severe illness and 5% become critically ill.[8]

After recovery from the acute phase of COVID-19 (3–4 weeks), some patients still suffer from continued previous symptoms or experience new multisystematic symptoms; these symptoms collectively form the condition called long COVID-19.[9] These symptoms vary in duration in patients, ranging from 4 to 12 weeks after the onset of the disease, and may continue for months (>12 weeks).[10] In long COVID-19, there is no specific mechanism that explains the pathophysiology of these ongoing and new symptoms. However, some studies suggest that a persistent virus in certain tissues leads to immune system destabilization, which in turn contributes to the development of long COVID-19.[11] The WHO webinar discussed the subject on February 9, 2021, and established three theories at the end of the meeting to be responsible for this problem.[12]

- Residual damage to the angiotensin-converting enzyme 2 (ACE-2) receptors in different tissues
- Ongoing immune stimulation
- Autoimmune response.

Long COVID-19 is not limited for severe or hospitalized cases it occurs with mild-to-moderate home-treated patients.[13-17] Patients with long COVID-19 seem dividing into three groups:[18]

1. Hospitalized patients who suffered from severe respiratory distress syndrome and still experiencing long term of respiratory symptoms
2. Individuals who were not hospitalized but now present with complications of end organ damage
3. Patients experienced mild to moderate illness without hospitalization and now present with persisting symptoms without evidence of end organ damage. Patients of the third group experienced symptoms which may include: fever, shortness of breath (SOB), fatigue, cough, chest pain, headache, muscle pain, and mental and cognitive conditions.[19]

Risk factors are not well understood yet, but previous follow-up showed some factors may be associated with long COVID-19, such as female gender, increasing age, previous comorbidities, and not having taken COVID-19 vaccines.[20,21] Until now, there have not been enough studies estimating the percentage of long COVID-19 or its associated risk factors, creating an epidemiological gap regarding this important health condition.[22] In addition, the diagnosis and assessment of long COVID-19 is difficult if we know that the polymerase chain reaction (PCR) and radiological tests were negative in patients who experienced it at the time of symptoms continuing.[23,24]

On December 18, 2020, the National Institute for Health and Care Excellence (NICE) published a rapid guideline for long-term effects of COVID-19, which helps all health-care personnel in different sectors, identify, assess, and manage long COVID-19 conditions by classifying cases according to the duration of symptoms into categories:[25]

1. Acute COVID-19: Signs and symptoms of COVID-19 for up to 4 weeks
2. Ongoing symptomatic COVID-19: Signs and symptoms of COVID-19 from 4 weeks up to 12 weeks
3. Post-COVID-19 syndrome: Signs and symptoms that develop during or after COVID-19 and continue for >12 weeks are not explained by an alternative diagnosis.

The term "long COVID" is commonly used to describe signs and symptoms that continue or develop after acute COVID-19. It includes both ongoing symptomatic COVID-19 (from 4 to 12 weeks) and post-COVID-19 syndrome (12 weeks or more).

Justification of the study

- The incidence rate of COVID-19 in Iraq is increasing each year by different mutations, along with the prevalence of long COVID-19, which is considered a local public health problem
- We need more studies determining the percentage and estimating any possible risk factors that may lead to a successful diagnosis, treatment, and prevention of long COVID-19
- Long COVID-19 symptoms negatively affect coping with daily activity and reduce the quality of life.

Aim of the study

This study aims to establish base-line data for health policy makers to prevent and control this important public health problem by estimating the prevalence of long COVID-19 among home-treated COVID-19 patients in Baghdad, 2023 and to determine any possible associated risk factors for long COVID-19.

Methodology

A cross-sectional study with an analytic element was conducted in 39 primary health-care centers of Al-Rusafa and Al-Karkh in Baghdad. The data were collected over a period of 10 months. A convenient sample of previously home-treated COVID-19 patients attending primary health-care centers of Al-Rusafa and Al-Karkh health directorates in Baghdad for any cause from the general population.

Inclusion criteria

- Patients attending primary health-care centers
- Previously had symptoms of COVID-19
- Diagnosed by positive PCR test
- Three months or more from the onset of infection
- Treated at home without the need for hospitalization.

Permission to conduct the study was obtained from the Iraqi Ministry of health, Health Directorates, sectors managers, and primary health center managers. Data collection began on January 2, 2023, and ended on October 31, 2023. And was through a face-to-face interview with health-center visitors from the general population, beginning with a short explanation about the study and the objectives of the study, followed by informed consent and then starting with the assigned questions within the questionnaire form.

The questionnaire

The questionnaire sheet consists of two parts:

- First part: Sociodemographic data that include participant's age, marital status, education level of the participant, smoking history, history of chronic diseases, COVID-19 vaccination history, and number of previous COVID-19 infections
- Second part: Symptoms of COVID-19 and new post-COVID-19 symptoms with their duration (fever, fatigue, SOB, cough, headache, muscle or joint pain, loss of smell or taste, sore throat, depressive symptoms, hair loss, diarrhea, and nausea or vomiting).

Statistical analysis

The description and analysis of the data were carried out using the available statistical package SPSS-27 (SPSS Inc., Chicago, IL, USA). Descriptive data were presented in measures of frequency, percentage, mean, and standard deviation (SD). Analytical statistics using the Pearson Chi-square test were carried out to evaluate the association between independent variables (demographic characteristics) (Comorbidities history) (COVID-19 vaccination history) and dependent variable (long COVID-19). Fisher's exact test was applied whenever applicable; a $P \leq 0.05$ was considered statistically significant. Finally, analysis was performed by binary logistic regression between independent known variables and development of long COVID-19, a level of $P < 0.05$ was considered statistically significant.

Ethical consideration

1. Official research approval of this study was accorded from Iraqi Ministry of health, and from Scientific Council of Community Medicine of the Arabic Board for Health specializations in Iraq
2. Official approval was obtained from the Research Ethical Committee in Iraqi Ministry of Health
3. Official approval was granted from both Al-Rusafa and Al-Karkh health directorates as well as from each primary health sector chosen by sampling
4. The objectives of the study were explained to the participants and informed them that they were allowed to choose to participate or not, and verbal consent was obtained from each participant
5. The collected data were kept confidential in locked computer and will not to be used except for the scientific purpose of this study
6. At the end of each interview, the patient received advices and full explanation about the problem of long COVID-19 symptoms with recommendation for consulting specialist doctor according to his/her symptoms.

Results

A total number of 600 participants were enrolled in the study.

Sociodemographic characteristics of the sample

The mean age of participants was 42.4 ± 15.3 SD with a range of 14–82 years. The most frequent age group ranged between 30 and 39 years with a total of 134 (22.3%) participants. Regarding the sex distribution of the sample, there was a male predominance (51.3%) in sample. Concerning marital status, majority of the study group were married. The most frequent group was people with university (44.3%), as presented in Table 1.

Smoking history

The majority of the participants (322) were nonsmokers, as illustrated in Figure 1.

Regarding the presence of chronic diseases, 249 participants (41.5%) had chronic diseases, with predominance of hypertension (155 participants) and diabetes mellitus (74 participants) as illustrated in Figure 2.

Regarding COVID-19 infections history including last one, 283 participants (47.2%) infected once, 230 participants (38.3%) and 87 participants (14.5%) infected

Table 1: The sociodemographic characteristics of the participants (*n*=600) in Baghdad, Iraq 2023

	n (%)
Age (years)	
<20	27 (4.5)
20–29	121 (20.2)
30–39	134 (22.3)
40–49	122 (20.3)
50–59	97 (16.2)
60–69	75 (12.5)
≥70	24 (4)
Mean±SD (range)	42.4±15.3 (14–82)
Sex	
Male	308 (51.3)
Female	292 (48.7)
Marital status	
Single	154 (25.7)
Married	361 (60.2)
Widowed	54 (9)
Divorced	31 (5.1)
Education	
Postgraduate studies	55 (9.2)
University	266 (44.3)
Institute	92 (15.3)
Secondary school	115 (19.2)
Primary school	43 (7.2)
Illiterate	29 (4.8)

SD: Standard deviation

twice and thrice or more, respectively, as illustrated in Figure 3.

Figure 4 shows the vaccination coverage of the sample, those vaccinated represent 49.5%.

The participants were classified in regards to the total duration of illness (according to the NICE guideline) into: acute COVID-19, ongoing COVID-19 and post-COVID syndrome. Majority of the participants had acute COVID-19 as shown in Figure 5.

Nine symptoms persisted >4 weeks from onset of COVID-19 infection, the most prevalent one was fatigue followed by cough, loss of smell or taste, hair loss, musculoskeletal pain, and depressive symptoms as shown in Table 2.

Association between duration of illness and demographic characteristics

The data analysis was done using Pearson Chi-square test at 0.05 levels to show the association between the factors and the total duration of illness. Regarding the demographic characteristics, only the age and gender showed statistical significance (P = 0.0002 and 0.00001), respectively, as illustrated in Table 3.

Association between smoking and long COVID-19 in the sample

Upon Chi-square test analysis of smoking of the participants by the duration of COVID-19 illness, the finding was there is significant association as illustrated in Table 4.

Association between comorbidities and total duration of illness

There is statistically significant association between the presence of comorbidities and the total duration of COVID-19 illness, as illustrated in Table 5.

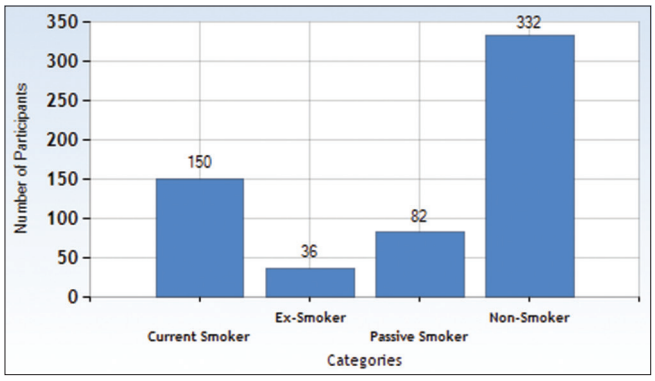

Figure 1: The smoking history of the participants (n = 600) in Baghdad, Iraq 2023

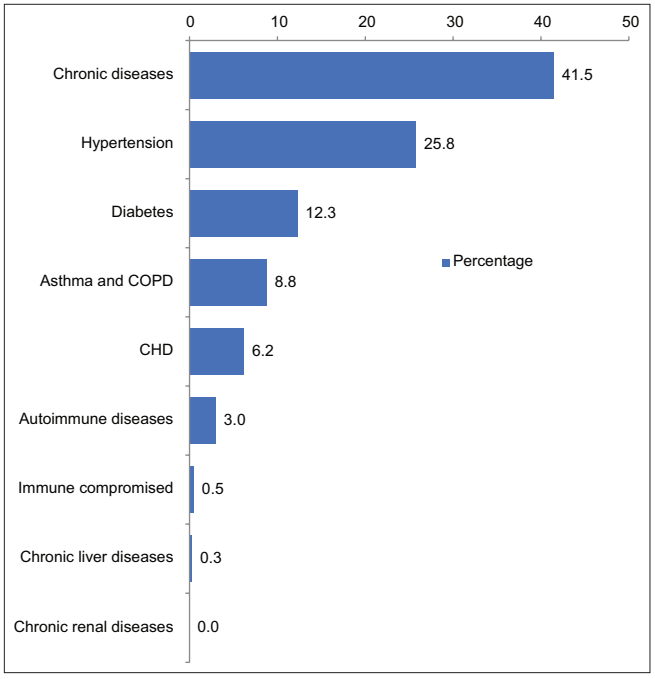

Figure 2: The chronic diseases history of the participants (n = 600) in Baghdad, Iraq 2023

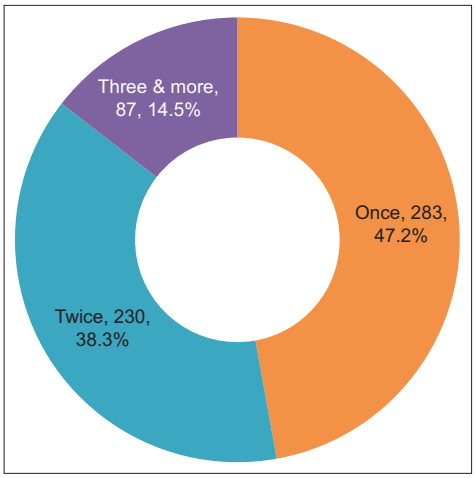

Figure 3: The COVID-19 infections history of the participants (n = 600) in Baghdad, Iraq 2023

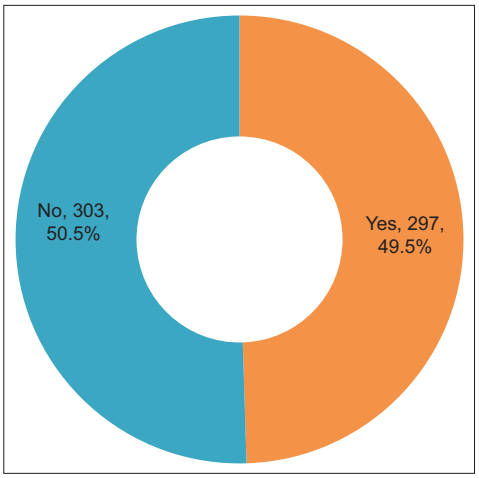

Figure 4: The COVID-19 vaccination history of the participants (n = 600) in Baghdad, Iraq 2023

Association between the COVID-19 reinfection and vaccination on side and development of long COVID-19 on the other side

There is highly significant association between COVID-19 reinfection and vaccination with development of long COVID-19, as illustrated in Table 6.

Logistic regression model

The effect of independent variables on the percentage of developing long COVID-19 as dependent variable was assessed by binary logistic regression model to find adjusted estimated possible risk factors. The explanatory independent variables included in the model were age, sex, and marital status, educational background, smoking history, chronic diseases history in details, COVID-19 infection history, and COVID-19 vaccination before last infection.

Four variables showed significant association with development of long COVID-19 when testing all independent variables by binary logistic regression [Table 7].

Increasing age was a risk factor for long COVID-19, which occurs 1.6 times more in older-aged compared to younger-aged participants.

Long COVID-19 occurs in females 2.6 times more than males.

Smoking was also a risk factor for post-COVID symptoms development with 2.8 times more than those nonsmokers.

Table 2: The frequency of the symptoms persisted for >4 weeks from the onset of COVID-19 infection among total sample (600) participants in Baghdad, Iraq 2023

Symptoms	Symptoms persisted >4 weeks after COVID-19 recovery among total sample, *n* (%)
Fatigue	145 (24.1)
Cough	98 (16.3)
Loss of smell or taste	93 (15.5)
Hair loss	86 (14.3)
Brain fog	65 (10.8)
Musculoskeletal pain	41 (6.8)
Depressive symptoms	34 (5.6)
Insomnia	15 (2.5)
Hearing impairment	1 (0.1)

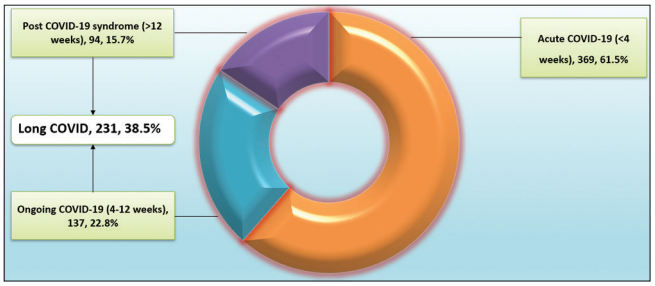

Figure 5: The classification of COVID-19 cases among total sample

Table 3: The association between demographic characteristics of the participants and the duration of COVID-19 illness

	Acute COVID-19 (<4 weeks) (*n*=369), *n* (%)	Long COVID (>4 weeks) (*n*=231), *n* (%)	Pearson Chi-square test (*n*)	*P*
Age (years)				
<20	23 (6.2)	4 (1.7)	25.8005	0.0002*
20–29	85 (23.0)	36 (15.6)		
30–39	90 (24.4)	44 (19.04)		
40–49	74 (20.1)	48 (20.7)		
50–59	49 (13.3)	48 (20.7)		
60–69	39 (10.6)	36 (15.6)		
≥70	9 (2.4)	15 (6.4)		
Sex				
Male	215 (58.3)	93 (40.3)	18.436	0.00001*
Female	154 (41.7)	138 (59.7)		
Marital status				
Single	105 (28.5)	49 (21.2)	7.669	0.053
Married	215 (58.3)	146 (63.2)		
Widowed	27 (7.3)	27 (11.7)		
Divorced	22 (6.0)	9 (3.9)		
Education				
Postgraduate studies	32 (8.7)	23 (10)	1.141	0.950
University	163 (44.2)	103 (44.6)		
Institute	58 (15.7)	34 (14.7)		
Secondary school	72 (19.5)	43 (18.6)		
Primary school	28 (7.6)	15 (6.5)		
Illiterate	16 (4.3)	13 (5.6)		

*P= 0.0002 (highly significant)

Table 4: The distribution of participant's smoking by the duration of illness

Smoking history	Acute COVID-19 (<4 weeks) (*n*=369), *n* (%)	Long COVID (>4 weeks) (*n*=231), *n* (%)	Chi-square test	*P*
Current smoker	81 (22.0)	69 (29.9)	44.695	0.000001*
Ex-smoker	19 (5.1)	17 (7.4)		
Passive smoker	29 (7.9)	53 (22.9)		
Nonsmoker	240 (65.0)	92 (39.8)		

**P*= 0.000001 (highly significant)

Table 5: The distribution of participant's comorbidities by the duration of illness

	Acute COVID-19 (<4 weeks) (*n*=369), *n* (%)	Long COVID (>4 weeks) (*n*=231), *n* (%)	Chi-square test	*P*
Chronic diseases				
Yes	125 (33.9)	124 (53.7)	22.951	0.000001*
No	244 (66.1)	107 (46.3)		
Hypertension				
Yes	79 (21.4)	76 (32.9)	9.791	0.001*
No	290 (78.6)	155 (67.1)		
Diabetes mellitus				
Yes	35 (9.5)	39 (16.9)	7.191	0.007*
No	334 (90.5)	192 (83.1)		
Chronic renal diseases				
Yes	-	-	-	-
No	369 (100.0)	231 (100.0)		
Coronary heart diseases				
Yes	14 (3.8)	23 (10.0)	9.324	0.002*
No	355 (96.2)	208 (90.0)		
Asthma				
Yes	23 (6.2)	30 (13.0)	9.153	0.002*
No	346 (93.8)	201 (87.0)		
Chronic liver diseases				
Yes	2 (0.5)	-	1.256	0.262
No	367 (99.5)	231 (100.0)		
Immunocompromised conditions (transplantation, cancer, chemotherapy, splenectomy)				
Yes	-	3 (1.3)	4.816	0.028*
No	369 (100.0)	228 (98.7)		
Autoimmune diseases (SLE, thyroid disease, IBD, celiac disease, psoriasis, RA)				
Yes	7 (1.9)	11 (4.8)	4.006	0.045*
No	362 (98.1)	220 (95.2)		

**P*= 0.000001 (highly significant). RA: Rheumatoid arthritis, SLE: Systemic lupus erythematosus, IBD: Irritable bowel syndrome

COVID-19 vaccination before last infection was significantly protective factor; it shows the ability to lower the occurrence of long COVID by 50% compared to those unvaccinated.

Discussion

Prevalence of long COVID-19

According to the current study, 231 out of 600 individuals (38.5%) had persistent symptoms for a duration beyond 4 weeks after the initiation of the COVID-19 infection. The findings presented here are consistent with research conducted in Switzerland.[21,22] While a study conducted in Egypt revealed that 89.2% of the participants in the study had persistent symptoms after their initial recovery.[23] Separate research conducted in Jordan found that 71.8% of the participants in the study continued to have symptoms after 3 months following the commencement of their disease.[24] The observed variations in the prevalence of long COVID-19 among the current results and those of previous research may be attributed to differences in sample size, study design, and study population.

Symptoms of long COVID-19

In relation to fatigue, 24.16% of the total sample, reported the persistence of fatigue for more than 4 weeks after the initiation of symptoms and continued up to 21 weeks. This finding is in agreement with studies in other countries.[25-28] The precise mechanism of post-COVID-19 fatigue is

Table 6: The distribution of participant's COVID-19 reinfection and vaccination before last infection by the duration of illness

	Acute COVID-19 (<4 weeks) (*n*=369), *n* (%)	Long COVID (>4 weeks) (*n*=231), *n* (%)	Chi-square test	*P*
COVID-19 infection history				
Once	189 (51.2)	94 (40.69)	11.039	0.004*
Twice	139 (37.7)	91 (39.39)		
Three or more	41 (11.1)	46 (19.91)		
COVID-19 vaccination before recent infection				
Yes	205 (55.6)	92 (39.8)	14.059	0.0001*
No	164 (44.4)	139 (60.2)		

*P= 0.004 (highly significant)

Table 7: Significant independent variables in logistic regression model with development of long COVID as the dependent variable

Variables (reference)	Wald	df	*P*	OR	95% CI for EXP	
					Lower	Upper
Age (increasing age ≥40)	5.515	1	0.019	1.678	1.089	2.586
Sex (female)	25.699	1	0.0001	2.676	1.829	3.916
Smoking (smoker)	29.402	1	0.0001	2.878	1.964	4.216
COVID-19 vaccination (vaccinated before infection)	9.420	1	0.002	0.560	0.387	0.811

OR: Odds ratio, CI: Confidence interval

incompletely understood. One plausible hypothesis is that the infection with COVID-19 induces neuroinflammation inside the brain, therefore stimulating the innate immune system through humoral and retrograde neural signals. The activation of cytokines during this neuroinflammation process may contribute to the experience of fatigue. The cessation of cytokine release occurs subsequent to viral resolution; nevertheless, in some instances, the cytokines may not revert to their baseline levels, resulting in persistent symptoms.[29]

Concerning the cough, 16.3% of the total sample had a persistent cough for more than 4 weeks and up to 1 year. This finding agrees with results from other studies.[30-33] There are many possible explanations for post-COVID-19 cough; one explanation is the damage induced by the virus or the medications given during the illness, such as fibrosis of the lung parenchyma or damage to the airways. Fibrotic abnormalities in the lungs have been seen in around 10%–20% of individuals diagnosed with COVID-19. These fibrotic modifications have the potential to heighten the sensitivity of the cough reflex when subjected to mechanical chest wall stimulation.[34]

Regarding the loss of taste or smell, 15.5% of the total sample reported the persistence of loss of smell or taste for more than 4 weeks after the onset of illness and continued up to 1 year. In comparison with our findings, research conducted in Turkey,[35] Italy,[36] and France.[37] Since the loss of smell and taste is a qualitative disorder and there is an inability to perform olfactory tests to confirm the complete return to a normal state, this could be a possible explanation for the difference in results among the current study and the other studies.[38] The olfactory epithelium is a type of epithelial tissue found inside the nasal cavity. It is a part of the olfactory system and is responsible for detecting odors. The damage to nonneuronal cells of the olfactory epithelium that express ACE2 receptors could be an acceptable cause of smell loss in COVID-19 patients.[39]

Associations

In terms of demographic parameters, the present findings indicate a statistically significant correlation between age and the length of COVID-19 symptoms in both Chi-square test and logistic regression analysis. Consistent with the present result, research conducted in China and France has shown a correlation between age and the persistence of COVID-19 symptoms.[36,40] Unlike the present findings, a study conducted in the United States did not observe any correlation between age and the continuation of COVID-19 symptoms.[41]

The association between age and long COVID-19 could be explained by the age-related decline and dysregulation of the immune system. Vaccination or prior exposure to the same pathogen may provide partial immune protection (adaptive immunity) in many diseases. Due to its new nature, SARS-CoV2 lacks prior exposure or herd immunity, rendering the whole population vulnerable. The lack of adaptive immunity in older individuals necessitates reliance on their innate immunity, which has already undergone remodeling and loss as a result of aging. This phenomenon will have implications for the length and prognosis of the COVID-19 illness.[22]

In relation to sex, the current study found a statistically meaningful correlation between sex and the duration of

symptoms in logistic regression analysis. The present investigation, along with two other studies conducted in Jordan and the United States, yielded results indicating a significant correlation between female sex and the duration of COVID-19.[24,42] Hormones may play a role in perpetuating the hyperinflammatory status of the acute phase even after recovery.[43]

With respect to the existence of chronic illnesses, the present findings indicate a statistically significant correlation between the prevalence of chronic diseases and the length of symptoms associated with COVID-19. Analogs to our findings, research conducted in Egypt and India has shown a correlation between the existence of chronic illnesses and the extended duration of symptoms associated with COVID-19.[23,44]

The activation of the Renin–Angiotensin–Aldosterone System by hypertension could be a possible illustration of the association between preexisting hypertension and the duration and outcome of COVID-19 illness.[45] Regarding the role of diabetes mellitus, it can give rise to a persistent state of low-grade inflammation, leading to disruption of the immune response and impairment of micro vascular function. Consequently, this mechanism may potentially contribute to an elevated susceptibility to long-term COVID-19 in diabetic patients.[45]

Regarding smoking, the present findings indicate a statistically significant correlation with the duration of symptoms associated with COVID-19 even in logistic regression analysis. This conclusion aligns with a systematic review conducted in China, which included five studies on the relationship between smoking and COVID-19. The analysis indicated that smoking had a detrimental impact on the development and unfavorable consequences of COVID-19.[46] Further research conducted in the United Kingdom has also shown empirical support for a correlation between present smoking habits and the length of disease in individuals with COVID-19.[47] The association between smoking and the duration of COVID-19 symptoms may be attributed to the upregulation and increased gene expression of ACE2 receptors in current smokers compared to ex-smokers and nonsmokers, as these receptors serve as the primary entry points for SARS-CoV2 into host cells.[48]

Regarding the COVID-19 vaccination, our study results show that there is a significant association between not receiving the COVID-19 vaccination before the last infection and the development of long COVID in binary logistic regression. Similar to the result of a study conducted in the UK in March 2024, which estimated that COVID-19 vaccination lowers the risk of developing of COVID-19 by 30%–50%.[49] Another study conducted at Harvard University on data from 2019 to 2022 stated that the COVID-19 vaccination played a protective role in long COVID-19 occurrences.[50] While research conducted in South Korea found that there is no benefit from the COVID-19 vaccination for the prevention of long COVID-19.[51] This variation in studies is due to different types of COVID-19 vaccinations, times of vaccination, and populations from which samples were taken from.

Conclusions

- More than one-third (38.5%) of participants had long COVID-19
- The most prevalent long COVID-19 symptom in our study was fatigue followed by cough and loss of smell or taste, respectively
- Increasing age, female sex, and smoking were significant risk factors
- COVID-19 vaccination before infection was significant protective factor.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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