Prevalence of Post-Acute COVID-19 Persistent Symptoms and Associated Risk Factors in Previously Hospitalized Patients: Prospective Cohort Study

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Abstract

Background: The recovery process post-COVID-19 gained widespread recognition among social support groups and later in the scientific and medical communities. Long-term or post-acute COVID-19 persistent symptoms are challenging health problems that persist for< 2–3 months post-infection and may not resolve spontaneously. Until now, information regarding post-COVID-19 persistent symptoms, associated risk factors, and recovery duration has been varied. Aim: So, the current study aimed to investigate the prevalence of post-acute COVID-19 persistent symptoms and associated risk factors in previously hospitalized patients. **Methods:** A prospective cohort research design with a 2-month follow-up post-COVID-19 infection was used. A convenience sample of an eligible two hundred forty-six (246) survivors with confirmed COVID-19 who had previously been hospitalized in an isolation unit at Mansoura University Hospital was purposefully recruited to participate in the study. The data pertinent to the study was collected using two tools: demographic characteristics and health-related data, and a post-COVID-19 recovery symptoms questionnaire. **Results**: The follow-up analysis for COVID-19 survivors revealed that a high percentage (74.0%) experienced at least one post-acute COVID-19 persistent symptom for two months post-infection. The most prevalent symptoms among the participants were fatigue (72.5%), shortness of breath (68.1%), joint pain (66.5%), loss of smell (64.3%), and psychiatric disturbance (59.9%). Multivariate logistic regression analysis found that several factors were associated with an increased risk for post-acute COVID-19 persistent symptoms: increase in age 50–60 years AOR = 0.648 (CI = 0.132–3.181), P = 0.009*; current smoker AOR = 6.898 (CI = 1.303–36.521), P = 0.023*; overweight AOR =1.62 (CI = 1.15–4.28), P = 0.029*; and chronic disease AOR = 1.08 (CI = 0.96–1.39), P = 0.041*. **Conclusion**: The recovery process post-coronavirus infection is long-lasting; post-acute symptoms can persist for ≥ 2 months. The overwhelming persistent symptoms were fatigue, shortness of breath, joint pain, loss of smell, and psychological disturbances. High-risk groups for post-acute COVID-19 persistent symptoms were old age, smoker, overweight, and chronic diseases. **Recommendation:** We recommend that healthcare institutions plan for long-term follow-up for COVID-19 survivors, especially high-risk groups, to assess their health care needs and to implement early management, taking into consideration their psychological concerns.

Keywords: Post-acute COVID-19 persistent symptoms; COVID-19 associated risk factors; Long COVID-19 syndrome.

Introduction

The novel coronavirus disease 2019 (COVID-19) is one of the most serious infectious diseases the humanity has known and currently leads to significant morbidity and mortality across the world. At the outset, it was reported in China in December 2019 and quickly spread around the world (**Tizaoui et al., 2020**). The World Health Organization (WHO) declared the COVID-19 outbreak a global pandemic on March 11, 2020 (**Cucinotta, & Vanelli, 2020**). Globally, there have been 144,358,956 confirmed cases of COVID-19 and 3,066,113 deaths reported to the WHO on April 23, 2021. In Egypt, from January 3, 2020, to April 23, 2021, there have been 220,658 confirmed cases of COVID-19, with 12,959 deaths reported to the WHO (**WHO, 2021)**.

Coronavirus pneumonia, or COVID-19, is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), which is a new member of the coronavirus family and the third type following respiratory syndrome coronavirus (SARS-COV) and the Middle East Respiratory

Syndrome Coronavirus (MERS-COV) that have caused infections worldwide in the past 20 years. SARS-CoV-2 is mainly an infectious disease that targets the respiratory system, is transmitted through air droplets, and pulmonary symptoms constitute the main presentations of this disease. However, COVID-19 demonstrates a clinically diverse manifestation ranging from a symptomatic presentation to a critical illness with severe pneumonia, acute respiratory distress syndrome, respiratory failure, or multiple organ failure (**Fan, Zhang, Li, Li, Zhang, & Zhao, 2020**).

Recent evidence has demonstrated that COVID-19 has extrapulmonary involvement, including neurological, psychological, cardiovascular, digestive, hepatobiliary, renal, endocrinologic, dermatologic systems, and others that need integrated care (**Tsai et al., 2021; Salamanna, Veronesi, Martini, Landini, & Fini, 2021**). The care for patients with COVID-19 goes through three phases: (1) the acute phase involves the care of patients in the intensive care units (ICU) or critical care units (CCU); (2) the post-acute phase includes the care of patients who were recovered from the acute phase or patients who were diagnosed with moderate COVID-19 in the inpatient departments; and (3) the long-term phase is the final stage of recovery after hospital discharge carried out at the outpatient units or at the community level (**Kiekens et al., 2020**).

A significant number of survivors who have recovered from acute coronavirus infection continue to report long-lasting symptoms that interfere with daily living activities. Post-SARS-CoV-2 reported symptoms are a phenomenon known as "post-acute COVID-19 syndrome, or chronic or long-lasting symptoms". These long-term or post-acute symptoms are not only present in severe infections but also in mild and moderate patients, which need a unified definition for use in clinical practice and research (**Nalbandian et al., 2021; Augustin et al., 2021**).

In this regard, the National Institute for Health and Care Excellence (NICE) defines post-COVID-19 syndrome as "signs and symptoms that continue for more than 12 weeks post-infection and are not explained by an alternative diagnosis." NICE guidelines advise referral to post-Covid syndrome assessment clinics if symptoms persist for 6–12 weeks (**Sivan, &**

Taylor, 2020). Reputedly, post-COVID-19 syndrome is classified as post-acute symptoms, which persist for 4–12 weeks after COVID-19 infection, and chronic or long-term symptoms, which persist for >12 weeks post-infection. In fact, the reason behind persistent symptoms post-Covid-19 is the impact of the virus on many organ systems, which can lead to a diverse range of persistent symptoms (**Ayoubkhani, & Pawelek, 2021; Huang et al., 2021**).

There is strong evidence from across the world confirming that about 87% of the recovered patients from COVID-19 experienced persisting symptoms following the acute phase of infection for 1 to 3 months after disease onset. A wide spectrum of reported symptoms not only affected patients physically (e.g., dyspnea or shortness of breath, cough, chest pain, tachycardia, palpitations, generalized pain, headache, muscle aches, fatigue, persisting high temperature), but also had negative effects on their psychological and neurological health (e.g., loss of concentration and memory dysfunction, lethargy, confusion, sleep disturbance, anxiety, and depression) (**Carfi, Bernabei, & Landi, 2020; Banda, Singh, Alser,& Prieto-Alhambra, 2020; Weerahandi, et al., 2021; McCorkell, Assaf, Davis, Wei, & Akrami, 2021; Michelen, et al., 2020; Davis et al., 2020; Greenhalgh, Knight, Buxton, & Husain, 2021; Carod-Artal, 2021**).

This wide range of manifestations and the unpredictable course of the illness have put significant pressure on health care systems worldwide. As a result, researchers have extensively analyzed the characteristics, clinical presentation, and risk factors for SARS-CoV-2 infection (**Abdel-Massih et al., 2020**). In this prospect, recent studies illustrated that the risk factors for sustained post-COVID-19 symptoms, longer recovery time, and not returning to "usual health" after infection were patients who were old (≥ 60 years) and who had co-morbid conditions such as diabetes, cardiovascular diseases, hypertension, obesity, psychiatric conditions, and immunosuppressive conditions (**Tenforde et al., 2020; Del Rio, Collins, & Malani, 2020; Galal et al., 2021**).

Nurses are at the front line and play a crucial role in patient care during the COVID-19 pandemic, providing personalized, high-quality services regardless of infectious condition. The

global pandemic of COVID-19 needs strong nursing staff equipped with recent knowledge and awareness of infectious disease-related risk factors, short- and long-term sequels, and the recovery process to be able to engage in clinical management, offer screening information, and be actively involved in evaluation and monitoring in the community (**Fawaz, Anshasi, & Samaha, 2020**).

To date, information regarding post-COVID-19 symptoms, associated risk factors, and recovery duration is diverse, and it is not fully understood why some people experience persistent symptoms over a longer period of time than others. Therefore, the current study aimed to investigate the prevalence of post-COVID-19 persistent symptoms and associated risk factors in previously hospitalized patients.

Significance of the study

The rapid prevalence of the COVID-19 pandemic and the higher number of recovered patients have raised global awareness of the long-term impacts of the virus on survivors' health status. Recent evidence has reported that the recovered patients experience persistent symptoms, regardless of the severity of the first episode of infection (**Kim, Kim, Chang, Kwon, Bae, & Hwang, 2021; Nalbandian et al**., **2021**). In addition, the researchers observed from clinical practice and patient reports in the community that the recovery process post-COVID-19 is accompanied by persistent symptoms that vary in intensity and length of time from person to person. The magnitude of this problem is considered the primary engine for the current study to investigate this condition, which will be of relevance to the global community and will be evidence-based research that will help in understanding patient suffering and identify care needs throughout the long-term recovery process of COVID-19 infection.

Aim of the study:

The aim of the current study was to investigate the prevalence of post-acute COVID-19 persistent symptoms and associated risk factors in previously hospitalized patients.

Research questions:

1) What are the most common persisting symptoms post-COVID-19 infections?

2) What are the risk factors associated with an increased risk for post-acute COVID-19 persistent symptoms?

Operational definitions

- Post-acute COVID-19 persistent symptoms are defined as the persistence of at least one health symptom for more than 4-6 weeks after disease onset.
- Risk factors for post-acute COVID-19 Persistent symptoms refer to certain variables (age, comorbid disease, obesity, and smoking) that increase the probability of developing long-term symptoms post-COVID-19.

Subjects and methods:

Research design:

This descriptive study used a prospective cohort research design. In a prospective cohort study design, the individuals who are exposed to certain health problems are selected and then followed for a period to evaluate the occurrence of the outcome of interest (Setia, 2016). The outcomes of interest in the current study included the prevalence of post-acute COVID-19 persistent symptoms and associated risk factors. Therefore, this design works best to accomplish the current study's aim.

Study setting:

This study was conducted at the COVID-19 inpatient department and the post-COVID-19 outpatient' clinics designated for isolation for COVID-19 cases at Mansoura Main University hospital affiliated with Mansoura University, Egypt.

Subjects:

A convenience sample of an eligible two hundred forty-six (246) survivors with confirmed COVID-19 was purposefully recruited to participate in the current study based on the following criteria:

Participants' inclusion criteria:

- Conscious adult patients between the ages of 20 and 60 years of both genders
- Patients who were hospitalized with confirmed positive SARS-CoV-2 by a reverse transcription polymerase chain reaction (RT-PCR) test.

- Patients who were scheduled 6–8 weeks after symptom onset or a positive PCR test.
- Patients who reported persistent symptoms after receiving a negative test result for COVID-19 or after hospital discharge.

Participants' exclusion criteria:

- Patients who did not have a document with a confirmed positive COVID-19 test by a reverse transcription polymerase chain reaction (RT-PCR)
- Patients who had experienced the same symptoms before the onset of COVID-19.
- Patients with mental disorders or a history of psychiatric disorders were excluded from the study.

Tools for data collection:

Tool I: Participants' Demographic Characteristics and Health-Related Data:

This part consisted of eight items, including participants' age, sex, marital status, education, occupation, body mass index (BMI) (kg/m2), smoking, and history of comorbid or chronic disease.

Tool II: Post-COVID-19 Recovery Symptoms Questionnaire

The questionnaire was developed by the researcher after a comprehensive review of relevant literature based on similar objectives **(Kamal, Abo Omirah, Hussein, & Saeed, 2020; Mahmud et al., 2021).** This questionnaire included the following parts:

Part one: Symptoms of the Acute Phase of COVID-19:

This part involved a set of 19 items aimed to assess symptoms of the acute phase of COVID-19 (after symptoms onset), such as the duration of the acute phase, severity of symptoms, need for oxygen therapy, presence of shortness of breath, cough, sore throat, chest pain, palpitations, etc.

Part two: Post-acute COVID-19 persistent symptoms:

This part encompasses a set of fifteen items aimed to assess the persistent symptoms after the recovery from the acute phase of COVID-19 (two months post-symptom onset). It included symptoms like fatigue, persistent cough, loss of smell, loss of taste, shortness of breath, joint pain, psychiatric disturbances such as poor sleep, etc.

Scoring System:

For tool II, the participants were asked to rate their responses for each item by using a 2-point Likert scale as either "yes" (1 point) or "no" (0 point). The severity of COVID-19 was divided into 3 categories: mild (1), moderate (2), and severe (3).

Validity of the study tool:

A panel of five juries with expertise in medical-surgical nursing, critical care nursing, and medical biostatistics reviewed the study tools to estimate the face and content validity of the instrument. The jury revised the clarity, relevance, comprehensiveness, and applicability of the proposed tools. First, an independent tool review was done, followed by a thorough discussion of controversial items until an agreement was reached. All suggested recommendations were considered before the final format of the sheet was designed.

Reliability of the tool:

The internal consistency of the study tool was tested using Cronbach's alpha (Alpha = 0.81), which reflects the good reliability of the designed tool.

A pilot study:

A pilot study was carried out on 10% of the target participants (20 COVID-19-recovered patients) to ensure the clarity and applicability of the study tool and estimate the time needed to fill out the questionnaire. Based on participant feedback, the required refinement and necessary modifications were made prior to data collection. The patients who participated in the pilot study were subsequently excluded from the sample.

Ethical consideration:

Ethical approval was obtained from the Institutional Ethical Committee of Faculty Nursing, Mansoura University, Egypt. Official approval to carry out the study was obtained from the Mansoura University Hospital authorities before conducting the current study after describing the nature and objective of the study. Informed consent (verbal and written) was

obtained from the participants after illustrating the study's nature and aim. Patients' rights to voluntary participation, withdrawal from the study at any time, and refusal to participate in the study were assured. Complete privacy was ensured, data security was protected using data coding, and the researchers verified that the data would be utilized exclusively for research.

Data collection:

Fieldwork for data collection:

The pertinent data for the current study were collected for a period of six months between August 16, 2020, and January 20, 2021, through the following phases:

Phase I: After the researcher was acquainted with the actual dimensions and magnitude of the problem, the study instrument was designed for the collection of data following an extensive review of the relevant literature. The tool's final English version was translated into Arabic, tested for content validity and reliability, and then piloted before data collection.

Phase II: Once the necessary approval was obtained to conduct the proposed study, all subjects with positive PCR for SARS-CoV-2 were identified. Tool (I): Baseline demographics and health-relevant data (age, sex, marital status, education, occupation, body mass index, comorbid or chronic disease, and smoking) were obtained from the medical records at the inpatient department designated for isolation for COVID-19 cases. Afterwards, researchers organized the preparation for follow-up meetings by obtaining the participants' telephone numbers for future contact.

Phase III: After patient discharge, the study outcomes were measured at a single follow-up time. All eligible subjects were interviewed at the post-COVID outpatient follow-up clinic and via telephone video calls. Informed consent was obtained from each participant after clarifying the purpose of the study. Then the researcher conducted a 10- to 15-minute questionnaire-based interview with each patient who agreed to participate in the study after taking safety precautions. Data were collected as follows: The researcher asked the participants to answer the post-COVID-19 recovery symptoms questionnaire (tool II) and rate their responses regarding the symptoms of the acute phase of COVID-19 (the time between symptoms onset and hospital discharge) and the presence of post-acute COVID-19 persistent symptoms two months post-symptom onset (at follow-up or at the time of the interview).

Statistical analysis:

Data analysis was performed using the Statistical Package of Social Science (SPSS) version 20. Categorical data were presented as numbers and percentages, while continuous data were reported as means ± standard deviation. Statistical significance was set at $p < 0.05$. Multivariable adjusted logistic regression was used to estimate the odds ratios (ORs) and 95% CIs to identify the association between different independent factors and the development of post-COVID-19 persistent symptoms.

Results:

Table 1: shows that a total of 246 COVID-19 survivors responded to the questionnaire. The mean age of the studied patients was 43.26±10.516, more than half of them were men (52.4%), and the majority were married (72.8%). Moreover, 32.9% & 37.8% of the patients had secondary education, and they worked as employees, respectively. Regarding health-related data, more than half of the participants were overweight or obese (29.7%, 24.8%, respectively), and more than one third of them were current smokers or ex-smokers (25.6%, 11.4%), respectively. In addition, more than one-third of the participants had chronic diseases (37.0%), whereas hypertension was the most common disease among them (37.4%), followed by pulmonary disease, diabetes mellitus, and cardiovascular disease (26.4%, 24.4%, and 12%), respectively.

Table 2: As shown in, the mean duration of the acute phase of COVID-19 was (7.020±2.641). A high percent of the studied patients (97.2%) experienced moderate acute symptoms, and more than one third of them (33.7%) needed oxygen therapy. The most frequent symptoms of the acute phase among participants were shortness of breath, myalgia, cough, fever, loss of smell and taste, and sore throat (86.2%, 75.2%, 71.5%, 65.4%, and 64.6%, respectively).

Table (3): Illustrates that upon analyzing post-acute COVID-19 persistent symptoms after patient discharge, it was found that the majority of the studied patients (74.0%) experienced at least one post-COVID-19 persistent symptom. The most common persistent symptoms among the study participants were fatigue, shortness of breath, joint pain, and loss of smell (72.5%, 68.1%, 66.5%, and 64.3%), respectively. Moreover, nearly two-thirds of the patients (59.9%) had persistent psychiatric symptoms, and

sleep disturbance was the predominant one among them (47.7%).

Table 4: Presents Multivariate logistic regression analysis, which revealed that several factors were associated with an increased risk of post-acute COVID-19 persistent symptoms. Increased age 50–60 years AOR = 0.648 (CI = 0.132–3.181), P = 0.009*; current smoker AOR = 6.898 (CI = 1.303–36.521), P = 0.023*; overweight AOR =1.62 (CI = 1.15–4.28), P = 0.029*; and chronic disease AOR = 1.08 (CI = 0.96–1.39), P = 0.041*.

Table (1): Percentage distribution of demographic and health related data among the studied patients (N = 246)

Items	The studied sample	
	N=246	%
Age (in years)		
18 - 29	31	12.6
30 - 39	76	30.9
40 - 49	71	28.9
50 - 60	68	27.6
Age (Years) (Mean ± SD)	**43.26±10.516**	
Gender		
Male	129	52.4
Female	117	47.6
Marital status		
Married	179	72.8
Single	19	7.7
Widow	42	17.1
Divorced	6	2.4
Educational level		
Read& write	67	27.2
Primary	41	16.7
Secondary	81	32.9
University &above	57	23.2
Occupation		
Manual work	52	21.1
Employee	93	37.8
Housewife	48	19.5
Business	44	17.9
Students	9	3.7
Body mass index (BMI) (kg/m2)		
Normal	112	45.5
Overweight	73	29.7
Obese	61	24.8
Smoking		
Non-smoker	155	63.0
Current smoker	63	25.6
Ex-smoker	28	11.4
History of chronic disease		
Yes	91	37.0
No	155	63.0
Type of chronic disease		
Hypertension	34	37.4
Diabetes Mellitus	22	24.2
Pulmonary disease	24	26.4
Cardiovascular	11	12.0

Table (2): Frequency distribution of the acute symptoms of COVID-19 among the studied patients (N = 246)

Items		Studied sample	
		N=246	%
Mean duration of acute phase		7.020±2.641	
Symptoms severity	Moderate	239	97.2
	Severe	7	2.8
Needs for oxygen therapy	Yes	83	33.7
	No	163	66.3
Shortness of breathing	Yes	212	86.2
	No	34	13.8
Cough	Yes	176	71.5
	No	70	28.5
Sore throat	Yes	159	64.6
	No	87	35.4
Chest congestion	Yes	64	26.0
	No	182	74.0
Chest pain	Yes	81	32.9
	No	165	67.1
Palpitation	Yes	71	28.9
	No	175	71.1
Fever	Yes	165	65.4
	No	85	34.6
Myalgia	Yes	185	75.2
	No	61	24.8
Headache	Yes	130	52.8
	No	116	47.2
Fatigue	Yes	127	51.6
	No	119	48.4
Loss of smell and taste	Yes	161	65.4
	No	85	34.6
Hoarse voice	Yes	128	52.0
	No	118	48.0
Nausea & vomiting	Yes	15	6.1
	No	231	93.9
Diarrhea	Yes	15	6.1
	No	231	93.9
Joint pain	Yes	129	52.4
	No	117	47.6
Skin rash	Yes	14	5.7
	No	232	94.3

 # 7 patients admitted to ICU.

Table (3): Frequency distribution of the post-acute COVID-19 persistent symptoms two months post symptoms onset (at follow-up) among the studied patients (N = 246)

Items		The studied sample	
		N=246	**%**
Post- acute COVID persistent symptoms	Yes	182	74.0
	No	64	26.0
Post-acute COVID persistent symptoms #	**N = 182/246**		**%**
Fatigue	Yes	132	72.5
	No	50	27.5
Persistent cough	Yes	79	43.4
	No	103	56.6
Loss of smell	Yes	117	64.3
	No	65	35.7
Loss of taste	Yes	95	52.2
	No	87	47.8
Shortness of breathing	Yes	124	68.1
	No	58	31.9
How shortness of breathing get while	At rest	60	48.4
	After Walking	17	13.7
	After Exertion	47	37.9
Headache	Yes	83	45.6
	No	99	54.4
Joint pain	Yes	121	66.5
	No	61	33.5
Palpitation	Yes	100	54.9
	No	82	45.1
Tachycardia	Yes	69	37.9
	No	113	62.1
Psychiatric symptoms	Yes	109	59.9
	No	73	40.1
Type of psychiatric symptoms	Nervous	17	15.6
	Anxious	17	15.6
	Depressed	23	21.1
	Sleep disturbance	52	47.7
Does symptoms fluctuate in severity	Yes	109	59.9
	No	73	40.1
Symptoms increased by	Physical exertion	73	67.0
	Cognitive task	20	18.3
	Emotional events	16	14.7
Time since recovery	1-2 month	133	73.1
	2-3 month	45	24.7
	More tham3 month	4	2.2

Table 4: Multivariate logistic regression analysis of independent factors of post-acute COVID-19 persistent symptom

Independent Factors		P	AOR (95% CI) [a]
Age (in years)	18-29	-	1(r)
	30-39	0.211	0.211(0.019-2.409)
	40-49	0.593	0.146(0.034-0.618)
	50-60	0.009*	0.648(0.132-3.181)
Sex	Male	-	1(r)
	Female	0.642	0.815(0.344-1.931)
Marital status	Married	-	1(r)
	Single	0.086	0.074(0.004-1.447)
	Widow	0.182	0.072(0.002-3.422)
	Divorced	0.411	0.290(0.015-5.546)
Educational level	No formal education	-	1(r)
	Read& write	0.076	4.366(0.875-22.230)
	Primary	0.056	2.267(0.980-5.244)
	Secondary	0.072	2.736(0.913-8.202)
	University &above	0.157	2.126 (0.748-6.040)
Occupation	Manual work	-	1(r)
	Employee	0.211	0.216(0.020-2.384)
	Housewife	0.971	1.045(0.93-11.802)
	Business	0.193	0.172(0.012-2.436)
	Students	0.196	0.232(0.25-2.128)
Smoking	Non-smoker	-	1(r)
	Current smoker	0.023*	6.898(1.303-36.521)
	Ex-smoker	0.149	0.282(0.051-1.572)
Body mass index	Normal	-	1(r)
	Overweight	0.029*	1.62 (1.15–4.28)
	Obese	0.256	3.54 (1.48–8.48)
Chronic disease	No	-	1(r)
	Yes	0.041*	1.08(0.96-1.39)
AOR=Adjusted odds ratio, CI=Confidence interval.			

Discussion:

The current study presents a prospective follow-up cohort study for previously hospitalized patients with confirmed Crona virus. The findings of the present study confirmed that the recovery from COVID-19 symptoms is a lengthy process that persists for more than 2 months after the onset of symptoms. The most common persistent symptoms among the study participants were fatigue, shortness of breath, joint pain, loss of smell, psychiatric symptoms, and sleep disturbance, which significantly answered question number (1). In addition, the factors that increased the risk of experiencing post-acute COVID-19 persistent symptoms were increased age, smoking, overweight, and chronic disease, which significantly answered question number (2).

When interpreting the demographic characteristics of the study participants, we found that the majority of participants were male and adults. These findings could be related to the fact that Egyptian adult men are more likely than females to be responsible for earning their living and to be active in most outside-the-home tasks, so they may be highly exposed to infection. These findings are comparable to studies conducted by **Mahmud et al. (2021),** and **Augustin et al. (2021), who** reported the same results. On the other hand, a study done by **Galal et al. (2021),** reported that more than two-thirds of participants were adult women, which reveals that a large sample size from different sectors is needed to confirm sex distribution.

Upon analysis of health-related data, the results of this study showed that more than half of

the participants were overweight or obese. Moreover, more than one-third of participants were current smokers and suffered from chronic diseases, of which hypertension was the main disease, followed by pulmonary disease, diabetes mellitus, and cardiovascular disease. This current finding is lie in agreement with the study result done by **Iqbal et al. (2021)**, who reported that approximately more than one third of the study population were overweight or smokers and reported pre-existing comorbidities, of which hypertension was the leading comorbidity, followed by asthma, diabetes mellitus, and cardiovascular diseases. In some extent, the current study is similar to the study conducted by **Augustin et al. (2021)**, found that concomitant conditions prior to the SARS-CoV-2 infection were hypertension, followed by diabetes and autoimmune diseases, respectively.

With reference to the symptoms of the acute phase of COVID-19, the current study revealed that the most common acute symptoms reported by the participants were shortness of breath, myalgia, persistent cough, fever, loss of smell and taste, and sore throats, respectively. These findings are consistent with the study conducted in Egypt by **Galal et al. (2021)**, who reported that the most common presenting symptoms during the acute attack were dyspnea, myalgia, fever, and restriction of daily activities. In the same line, a study in Germany by **Augustin et al. (2021)**, showed that the most common symptoms at disease onset were cough, ageusia, anosmia, body aches, headaches, and fever. Another supporting study done in Bangladesh by **Mahmud et al. (2021)**, found that most patients presented fever and cough, and other important clinical features with a low percentage included anosmia, hypoxia, headaches, and lethargy.

Concerning post-acute COVID-19 symptoms that persist for two months at follow-up, the current study found that most of the studied patients experienced at least one persistent COVID-19 symptom. A high percentage of the patients complained of fatigue, shortness of breath, joint pain, loss of smell, psychiatric disturbances, and sleep disturbances. Previous research revealed a comparable pattern of sustained symptoms for 1-6 months post-infection. The study conducted in Egypt by **Aiash et al. (2021)**, **and Galal et al. (2021)**, reported that the range of long-term symptoms is substantial,

including aching joints, fatigue, tachycardia, dyspnea, prolonged loss of smell, sleeplessness, and several psychological impacts.

Likewise, similar findings by **Iqbal et al. (2021)**, in Pakistan documented that upon analyzing long-term COVID-19 manifestations, the overwhelming symptoms reported by the majority of the patients were persistent fatigue, dyspnea, poor sleep quality, and anxiety, respectively. Additionally, **Huang et al. (2021),** found that the most common symptoms after discharge were fatigue, muscle weakness, and sleep difficulties, respectively.

In the same direction, the study conducted in Italy by **Townsend et al. (2020)**, documented that fatigue, anosmia, ageusia, and shortness of breath were the most common symptoms following the COVID-19 infection. In agreement, the study done in the United Kingdom by **Halpin et al. (2021)**, **and Greenhalgh et al. (2020)**, in Atlanta by **Del Rio et al. (2020)**, and in Bangladesh by **Mahmud et al. (2021)**, reported that fatigue, cough, exertional dyspnea, respiratory distress, headache, and sleep disorders were observed as the most common symptoms in patients. On the other hand, **Wang et al. (2020)**, stated that an initial report of COVID-19 post-discharge complaints in China summarized that most cases were asymptomatic, while only a small percentage had coughing and breathing difficulties.

In addressing the phenomenon of "why do some COVID-19 survivors experience longer-term or persistent symptoms than others?" and risk factors for that. In the current study, we used multivariate logistic regression analysis to examine the relations between COVID-19 persistent symptoms and several factors, such as the studied patients' personal characteristics and comorbidities. The study findings noted that increased age (50–60 years), smoking, overweight, and chronic disease were associated with an increased risk of post-COVID-19 persistent symptoms. In fact, human immunity decreased with age and with chronic disease. Moreover, obesity and the existence of adipose tissue can impair immune function by altering cell-mediated immune responses. Also, smoking deteriorates lung function. So, the previously mentioned variables can be considered risk factors for long-term recovery.

Similar findings were seen in the study done by **Huang et al. (2021)**, and **Del Rio et al. (2020)**, who reported that post-acute COVID-19 persistent syndrome is commonly observed among those aged 50 years or older. Moreover, **Kamal et al. (2021)**, found that there was a relationship between the presence of comorbidities and the severity of post-COVID-19 manifestations. In addition, **Kim et al. (2021)**, reported that the presence of any comorbid diseases increases the risk for persistent post-COVID-19 manifestations and severity.

On the contrary, **Mahmud et al. (2021)**, found that female sex, respiratory distress, and the long duration of the disease were risk factors for post-COVID-19 syndrome. Another contradictory study done by **Moreno-Pérez et al. (2021)** reported that after multivariate adjustment, no baseline clinical features (age, sex, comorbidity, severity of acute COVID-19 infection, and treatment) are considered independent predictors for post-acute COVID-19 persistent symptoms. This conflict can be attributed to limited sample characteristics and different circumstances. So large sample sizes and cross-sectional studies are needed in the future to confirm these results.

Limitations

There are some limitations that should be considered; the current study was conducted at a single COVID-19 isolation center in Egypt with a relatively small number of patients, so the study findings can't be generalized. Moreover, the current study was made at a single follow-up point (two months), which limited the identification of the time needed for a complete recovery.

Conclusion:

The findings of the afforded study concluded that most of the COVID-19 survivors experienced at least one post-acute COVID-19 persistent symptom such as fatigue, shortness of breath, joint pain, loss of smell, psychological disturbance, and sleep disturbance. The presence of post-acute COVID-19 persistent symptoms is associated with certain risk factors like increased age, smoking, overweight, and chronic diseases.

Recommendation:

Taking the abovementioned limitations into consideration, we recommend that future research use longitudinal cross-sectional studies with longer follow-up periods (3–12 months) on a larger sample size, which would aid further understanding of the progression of symptoms post-COVID-19 and the length of time needed for complete recovery. Based on the study findings, we recommend the implementation of an early rehabilitation program for coronavirus survivors to improve their health outcomes and prevent complications.

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