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**Original Article**

**Pulmonary And Extrapulmonary Post COVID Complications: Incidence, Clinical Spectrum And Characterization**

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**ABSTRACT**

**Background:** COVID-19 is a disorder of multiple systems in which cases experience psychological or physical symptoms for weeks or even months following infection, a condition known as post-COVID syndrome. The present work aims to identify post-COVID symptoms and sequelae that occur in patients by following up on these patients for six months after hospital discharge and stabilization of acute symptoms.

**Methods:** This prospective cohort study was performed on 100 cases already diagnosed with COVID-19 in the isolation unit of Zagazig University hospitals from May 2022 to October 2022. Data on acute COVID-19 disease and the severity of patients' conditions were recorded based on the Egyptian Management Protocol for COVID-19.

**Results:** Post covid complications were reported in 72% of participants. The most frequent post-COVID complications were anxiety (49%), persistent dyspnea (36%), fatigue (33%), cough (32%), and olfactory deficit (27%). Regarding CT findings, reticulations, ground glass, and patches were remarkably elevated in cases with post-covid than in cases without post-covid. Comparing CT findings after six months between cases with and without post-covid, reticulations, GGO, and nodules were markedly elevated in cases with post-covid than cases without post-covid ( $p < 0.05$ ).

**Conclusion:** Most of the subjects who recovered from covid 19 experienced several manifestations after recovery from the acute stage of covid 19, including anxiety, fatigue, joint pain, and headache, which were correlated significantly with the symptoms and comorbidities.

**Keywords:** Pulmonary; Extrapulmonary; Post COVID complication

**INTRODUCTION**

In late December 2019, a cluster of instances of pneumonia epidemiologically connected to a wet market in Wuhan, China, gave rise to a novel coronavirus known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since then, COVID-19 has shown a wide range of clinical manifestations, including asymptomatic to progressive viral

pneumonia with breathing problems, multiorgan and systemic disorders in terms of sepsis and septic shock, and death [1-3]. Spring 2020 witnessed the first clinical description of the post-COVID syndrome (PCS), often referred to as long-COVID when COVID-19 cases continued to exhibit symptoms weeks beyond their acute infection and shortly after the initial cases appeared [4].

Many COVID-19 survivors experience long-term psychological, cardiovascular, and pulmonary side effects. Additionally, many patients experience myalgia, exhaustion, and memory loss. Similar to MERS and SARS-CoV1 survivors, some cases may develop post-COVID fibrosis (PCF) in their lungs. Cases with pulmonary fibrosis frequently have worsening dyspnea and require long-term monitoring [5,6]. The most typical symptoms are olfactory and gustatory abnormalities, mental difficulties, fatigue, shortness of breath, and chest pain. One significant and common symptom of PCS is post-infectious olfactory impairment, which may impact more than 60% of those with SARS-CoV-2 infection, including silent infections [4].

It is necessary to pinpoint the precise mechanism causing the symptoms to continue. Consequences of organ damage, differing degrees of injury (organ damage), differing times needed for each organ system to recover, immune response/autoantibody generation, rare persistent viral infections in the body, nonspecific impacts from hospitalization, consequences of critical illness, post-intensive care syndrome, complications from corona infection or complications from comorbidities, or adverse drug interactions can all be reasons for the persistence of symptoms. Re-infection relapse, or chronic viremia in individuals with compromised immunity, can all contribute to the existence of infection [7].

Deconditioning and psychiatric conditions, including post-traumatic stress disorder, further exacerbate symptoms. The social and financial ramifications of the virus also influence psychological problems that arise after contracting COVID-19. When considering public health, it is crucial to distinguish between persistent symptoms and reinfection. Persistently increased inflammatory markers indicate chronic persistence of inflammation. It is useful to

keep in mind that prolonged COVID-19 symptoms in each case might be caused by a variety of processes [8].

The present work aimed to identify post-COVID symptoms, sequelae, and the related factors that occur in patients by following up with these patients for six months after hospital discharge and stabilization of acute symptoms.

#### **PATIENTS AND METHODS**

This prospective cohort study was carried out on 100 cases already diagnosed with COVID-19 in the isolation unit of Zagazig University hospitals from May 2022 to October 2022. Verbal and written informed consent was obtained from all participants after an explanation of the procedure and medical research. The research was conducted under the World Medical Association's Code of Ethics (Helsinki Declaration) for human research. This study was performed after the approval of the Institutional Review Board (IRB#9486).

Cases with the following criteria were included: All patients attended the hospital with either a positive PCR for COVID-19 or a negative PCR but with established clinical and radiological diagnosis.

Cases with the following characteristics were excluded: Patients who were unable to maintain phone consultation and follow-up, including those with remarkable memory loss, nursing home residents, no phone reply, and patients who refused to participate.

Full clinical assessment, which includes complete history taking and physical examination, and history of COVID symptoms was taken from patients. Data on acute covid disease and severity of patients were recorded as mild, moderate, severe, and critical illness based on the Egyptians Management Protocol for COVID-19 released by the Ministry of Health and Population (January 2022)

Follow up of symptoms were assessed as follows:

General symptoms, respiratory (yes or no: chest pain, cough, wheezing, and dyspnea, which was assessed according to mMRC [9]), cardiovascular (yes or no: palpitation), neuropsychiatric dermatologic (yes or no: hair loss and rash), gastrointestinal, and genitourinary systems.

Patients were telephoned weekly after discharge and followed up in the chest outpatient clinic for a total of six months after hospital discharge and stabilization of acute symptoms. CT of the chest was done at discharge. Follow up CT was done to show if there were any persistent complications. Laboratory investigations were done monthly as total leucocytic count (TLC), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and Liver Function Tests (ALT, AST).

#### STATISTICAL ANALYSIS

Data was analyzed statistically with IBM SPSS, version 23.0 (IBM Corporation, Armonk, New York). Quantitative data were described utilizing the mean, standard deviation, and range, while qualitative data were expressed using the number and percentage. The t-test was used to compare two groups of normally distributed variables. When applicable, the Chi-square test was employed to compare percentages of categorical variables. One-way ANOVA was used to compare quantitative data between the two groups. The Pearson correlation coefficient ( $r$ ) is a method of determining the degree and direction of a linear association between two variables. The ROC curve was utilized in the diagnosis of a health condition to determine the optimal cutoff for a certain quantitative parameter. All of the tests were two-sided. A  $p$ -value  $< 0.05$  is considered significant.

#### RESULTS

There was no substantial difference when comparing basic characteristics in patients with and without PCS. Mild cases were

markedly elevated in cases without PCS, while moderate, severe, and critically ill cases were substantially elevated in cases with PCS, and the higher percentage of cases without PCS had no comorbidities than those with post-covid syndrome ( $p < 0.05$ ) (Table 1).

The most frequent symptoms and signs at the onset of COVID-19 were fever (90%), body ache (88%), cough (83%), SOB (76%), loss of taste (71%), sore throat (70%), loss of smell (68%) (Table 2).

The TLC, neutrophils, IL6, Troponin, ESR, Ferritin, and D Dimer were substantially elevated in patients with the post-COVID syndrome than in patients without PCS. At the same time, albumin was substantially decreased in patients with post-covid syndrome ( $p < 0.05$ ) (Table 3).

Regarding CT findings, reticulations, ground glass, and patches were substantially increased in cases with PCS than in cases without PCS, while effusion and cavities were non-significant findings in CT. When comparing CT findings after six months between cases with and without PCS, reticulations, GGO, and nodules were substantially elevated in cases with PCS than in cases without PCS ( $p < 0.05$ ) (Table 4).

The most frequent post-COVID complications during the 6-month follow-up period were anxiety (49%), persistent dyspnea (36%), fatigue (33%), cough (32%), and olfactory deficit (27%) (Table 5).

Regarding the relation between PCS and drugs, the need for steroids and antifibrotics was substantially elevated in cases with PCS than without post-syndrome. Ferritin and ESR were significantly higher in patients with post-COVID than patients without PCS (Table 6).

Table (7) shows that the presence of comorbidity and severity of the condition are significant predictors of the occurrence of PCS.

**Table (1):** Basic characteristics, severity of covid 19, and comorbidities in participants with and without post covid syndrome on admission

Variable		Cases				Test	P value
		without covid syndrome (N=28)		with post covid syndrome (N=72)			
		N	%	N	%		
Age	Mean ±SD	52.86±18.07		57.61±17.79		-1.194	0.235
Gender	Male	16	57.1	54	75	3.061	0.080
	Female	12	42.9	18	25		
Smoking	Smokers	7	25	17	23.6	0.021	0.884
	Non- smokers	21	75	55	76.4		
IV addiction	Addict	0	0	3	4.2	1.203	0.273
	Non- addict	28	100	69	95.8		
Severity	Mild	8	28.6	2	2.8	22.769	<0.001*
	Moderate	18	64.3	37	51.4		
	Severe	2	7.1	31	43.1		
	Critical ill	0	0	2	2.8		
comorbidities	<b>No comorbidities</b>	14	50.00	16	22.2	21.228	0.002**
	Diabetes	3	10.7	11	15.3		
	HTN	7	25	10	13.9		
	IHD	1	3.6	3	4.2		
	Stroke	0	0.00	3	4.2		
	Renal disease	0	0.00	1	1.4		
	Malignancy	0	0.00	2	2.8		
	Liver disease	0	0.00	7	9.7		
	ILD	3	10.7	5	6.9		

ILD = Interstitial lung diseases HTN =Hypertension IHD = Ischemic heart diseases.  
(x2) Chi-Square Tests

**Table (2):** Signs and symptoms among studied participants at time of presentation (n=100):

Characteristic	Study group (n=100)		
		No.	%
Fever	Yes	90	90
	No	10	10
Cough	Yes	83	83
	No	17	17
Sore throat	Yes	70	70
	No	30	30
SOB	Yes	76	76
	No	24	24
Body ache	Yes	88	88
	No	12	12
Runny nose	Yes	20	20
	No	80	80
Sneezing	Yes	16	16
	No	84	84
Diarrhea	Yes	18	18
	No	82	82
Headache	Yes	40	40
	No	60	60
Loss of taste	Yes	71	71
	No	29	29
Loss of smell	Yes	68	68
	No	32	32
Eye burn	Yes	15	15
	No	85	85
Rash	Yes	10	10
	No	90	90
Chest pain	Yes	17	17
	No	83	83
Cyanosis	Yes	35	35
	No	65	65
Jaundice	Yes	2	2
	No	98	98
Pallor	Yes	26	26
	No	74	74
LL edema	Yes	33	33
	No	67	67

**Table (3):** Laboratory investigations in participants with and without post covid syndrome on admission

Characteristic	Cases without post covid syndrome (N=28)	Cases with post covid syndrome (N=72)	test	P value
<b>HB level</b> Mean ±SD	10.64±1.72	10.82±1.61	-0.506	0.614
<b>TLC</b> Mean ±SD	9.63±3.44	11.18±3.11	-2.173	0.032*
<b>Lymphocytes</b> Mean ±SD	1.16±0.74	1.17±0.66	-0.039	0.969
<b>Neutrophils</b> Mean ±SD Median (IQR)	2.63±1.93 2.05 (1.6-3.15)	3.21±1.79 2.75 (1.9-3.9)	-1.967	0.049*
<b>Platelets</b> Mean ±SD	236.07±61	222.03±73.05	0.902	0.369
<b>ALT</b> Mean ±SD Median (IQR)	24.68±9.31 23.5 (15.25-33)	23.72±14.24 19 (14.8-28)	-1.287	0.198
<b>AST</b> Mean ±SD Median (IQR)	35.32±7.44 35 (30.25-40)	38.2±14.14 35 (29.5-42)	-0.461	0.645
<b>Creatinine</b> Mean ±SD	0.97±0.39	1.09±0.73	-0.825	0.412
<b>D dimer</b> Mean ±SD Median (IQR)	4.03±24.18 0.8 (0.5-1.27)	5.93±28.24 0.45 (0.3-0.8)	-2.711	0.007*
<b>IL6</b> Mean ±SD Median (IQR)	134.36±354.59 40 (27.5-52)	192.78±403.93 54 (42-115.75)	-3.490	<0.001*
<b>Troponin</b> Mean ±SD Median (IQR)	10.55±17.22 5.15 (1.12-8.05)	144.41±781.89 7.5 (3.4-25)	-2.146	0.032*
<b>Albumin</b> Mean ±SD	3.06±0.32	2.88±0.43	2.044	0.044*
<b>INR</b> Mean ±SD	0.98±0.28	1.02±0.26	-0.722	0.472
<b>CRP</b> Mean ±SD Median (IQR)	18.48±13.32 13.5(9.25-23.5)	22.18±10.69 20 (14-27.75)	-1.447	0.151
<b>Ferritin</b> Mean ±SD Median (IQR)	160.09±85.48 145 (91.25-210)	213.24±122.67 189 (120.75-257.75)	-1.977	0.048*
<b>ESR</b> Mean ±SD Median (IQR)	31.27±21.53 23 (15-43.5)	44.54±27.18 40.5 (22.5-65)	-2.312	0.021*
<b>(Z) Mann-Whitney Test, (t) Independent Samples Test</b>				

**Table (4):** CT findings on admission and after 6 months follow up in participants with and without post covid syndrome.

			Cases without covid	Cases with post covid syndrome (N=72)	Test	P value
			(N=28)			
<b>CT Finding</b>						
<b>Reticulation</b>	No	N	28	50	10.969	0.001*
		%	100.0%	69.4%		
	Yes	N	0	22		
		%	0.0%	30.6%		
<b>GGO</b>	No	N	8	2	14.903	<0.001*
		%	28.6%	2.8%		
	Yes	N	20	70		
		%	71.4%	97.2%		
<b>Patch</b>	No	N	15	12	13.931	<0.001*
		%	53.6%	16.7%		
	Yes	N	13	60		
		%	46.4%	83.3%		
<b>Effusion</b>	No	N	28	70	0.794	0.373
		%	100.0%	97.2%		
	Yes	N	0	2		
		%	0.0%	2.8%		
<b>Cavities</b>	No	N	28	69	1.203	0.273
		%	100.0%	95.8%		
	Yes	N	0	3		
		%	0.0%	4.2%		
<b>CT findings at 6 months follow up</b>						
<b>Reticulation</b>	No	N	28	49	11.616	<b>0.001*</b>
		%	100.0%	68.1%		
	Yes	N	0	23		
		%	0.0%	31.9%		
<b>GGO</b>	No	N	28	58	6.331	<b>0.012*</b>
		%	100.0%	80.6%		
	Yes	N	0	14		
		%	0.0%	19.4%		
<b>Nodules</b>	No	N	28	59	5.811	<b>0.016*</b>
		%	100.0%	81.9%		
	Yes	N	0	13		
		%	0.0%	18.1%		
<b>Effusion</b>	No	N	28	62	4.321	<b>0.038*</b>
		%	100.0%	86.1%		
	Yes	N	0	10		
		%	0.0%	13.9%		
<b>Cavities</b>	No	N	28	65	2.927	0.087
		%	100.0%	90.3%		
	Yes	N	0	7		
		%	0.0%	9.7%		

**Table (5):** Post covid complications within the participants during the 6 months follow up period (N=100):

Complications	Study group (n=100)			
	YES		NO	
	n	%	n	%
Fatigue	33	33	67	67
Weight loss	15	15	85	85
Persistent dyspnea	36	36	64	64
Persistent chest pain	15	15	85	85
Persistent cough	32	32	68	68
Wheeze	15	15	85	85
Persistent hypoxia	12	12	88	88
Palpitation	18	18	82	82
Heart failure	12	12	88	88
Arrhythmia	6	6	94	94
Stroke	5	5	95	95
Headache	11	11	89	89
Insomnia	18	18	82	82
Hyper insomnia	5	5	95	95
Nightmare	8	8	92	92
Poor concentration	14	14	86	86
Depression	16	16	84	84
Anxiety	49	49	51	51
Olfactory deficit	27	27	73	73
Gustatory deficit	24	24	76	76
Retinopathy	1	1	99	99
Encephalopathy	1	1	99	99
Tinnitus	4	4	96	96
Abdominal pain	22	22	78	78
Diarrhea	9	9	91	91
Constipation	17	17	83	83
GERD	19	19	81	81
Anorexia	20	20	80	80
Uncontrolled bladder	2	2	98	98
Joint pain	20	20	80	80
Muscle pain	16	16	84	84
Rash	3	3	97	97
Hair loss	2	2	98	98
Renal failure	2	2	98	98
DVT	5	5	95	95
Obesity	1	1	99	99



**Table (6):** Drugs prescribed to participants on admission, duration of hospital stay, and Lab findings after 6 months follow up with and without post covid syndrome.

Drugs						Test (X <sup>2</sup> , t)	P value
		Cases without post covid syndrome (N=28)		Cases with post covid syndrome (N=72)			
		N	%	N	%		
Antiviral	No	28	100	72	100	---	----
	Yes	28	100	72	100		
Steroid	No	25	89.3	48	66.7	5.233	<b>0.022**</b>
	Yes	3	10.7	24	33.3		
Vasopressor	No	28	100	66	91.7	2.482	0.115
	Yes	0	0	6	8.3		
Anti fibrotic	No	28	100	49	68.1	11.616	<b>0.001**</b>
	Yes	0	0	23	31.9		
Duration of hospital stay Mean ±SD		12.64±8.98		16.76±9.57		-1.966	0.05*
TLC Mean ±SD		8.67±2.48		9.57±2.07		-1.839	0.069
CRP Mean ±SD Median (IQR)		18.48±13.32 13.5(9.25-23.5)		22.18±10.69 20 (14-27.75)		-1.447	0.151
Ferritin Mean ±SD Median (IQR)		160.09±85.48 145 (91.25-210)		213.24±122.67 189 (120.75-257.75)		-1.977	<b>0.048*</b>
ESR Mean ±SD Median (IQR)		31.27±21.53 23 (15-43.5)		44.54±27.18 40.5 (22.5-65)		-2.312	<b>0.021*</b>

(x2) Chi-Square Tests, (t) Independent Samples Test

**Table (7):** Multivariate logistic regression analysis of predictors of post covid syndrome

	B	S.E.	Wald	Df	Significance	OR	95% C.I. for OR	
							Lower	Upper
comorbidities	.017	.009	3.679	1	.045*	1.017	1.000	1.036
severity	2.281	.870	6.872	1	.009*	9.791	1.778	53.905
Ferritin	.000	.001	.005	1	.945	1.000	.998	1.002
il6	-.003	.002	2.266	1	.132	.997	.993	1.001
d dimer	.007	.020	.113	1	.737	1.007	.968	1.047
Duration of hospital stay	-.012	.054	.051	1	.821	.988	.889	1.098
steroid	1.494	.871	2.940	1	.086	4.454	.808	24.564

**DISCUSSION**

Globally, the COVID-19 pandemic has caused significant hardship. SARS-CoV-2 infections can range in severity from infection

without symptoms to respiratory disease, multiple organ failure, and even death. While the pathophysiology, complications, and clinical symptoms of COVID-19 cases during

the acute phase have all been clearly documented, the long-term effects of COVID-19 are still mostly unknown [10].

The study aimed to identify post-COVID symptoms, sequelae, and the related factors that occur in patients by following up with these patients for six months post-COVID after hospital discharge and stabilization of acute symptoms.

Our current findings clearly revealed that the most frequent symptoms among studied participants at time of presentation were fever (90%), body ache (88%), cough (83%), SOB (76%), loss of taste (71%), sore throat (70%), loss of smell (68%), headache (40%), cyanosis (35%), LL edema (33%), pallor (26%), runny nose (20%), Diarrhea (18%), chest pain(17%), sneezing (16%), eye burn (15%), Rash (10%) respectively. The least frequent symptom was Jaundice (2%).

Consistent with our results, Mahmud et al. [11] stated that Sixty-two percent of patients had a cough, and 75 percent of patients had a fever; only 36 percent of patients had indications of ARDS. Additional significant clinical characteristics included lethargy (23%), headache (20%), hypoxia (30%), and anosmia (39%). Compared to patients with other presenting characteristics, those with fever, cough, respiratory distress, and lethargy were more likely to develop PCS. However, the development of PCS was adversely correlated with sore throats. Sathyamurthy et al. [12] reported that In the study population, fever (74.6%), cough (35.8%), dyspnea (24%), exhaustion (21.8%), and myalgia (19.7%) were the most frequently reported presenting symptoms.

The current investigation showed that the most frequent post covid complications during follow-up period were anxiety (49%), persistent dyspnea (36%), fatigue (33%), cough (32%), olfactory deficit (27%), gustatory deficit (24%), abdominal pain(22%), joint pain (20%), GERD (19%), palpitation (18%), insomnia (18%), constipation (17%), depression (16%), muscle pain (16%), wheeze (15%), weight loss (15%), chest pain (15%), poor concentration (14%), persistent hypoxia (12%), anorexia

(12%), headache (11%), diarrhea (9%) respectively. The least frequent complications were stroke (5%), DVT (5%), hyperinsomnia (5%), tinnitus (4%), rash (3%), uncontrolled bladder (2%), hair loss (2%), renal failure (2%), retinopathy (1%), encephalopathy (1%), obesity (1%) respectively.

Our findings of post covid complications were in accordance with Mahmud et al. [11], who reported that There were symptoms of exhaustion, a persistent cough, exertional dyspnea, sleep disturbances, headaches or vertigo, and 18%, 70, 15%, 13%, and 12% of the cases, respectively. Most of the time, it was unclear why weariness predominated. Fatigue could be brought on by immune system changes brought on by viral infections. Chronic chronic lung damage explains cough and respiratory difficulty. Sleep disorders, such as insomnia and circadian rhythm sleep disruptions, affected a sizable fraction of the patients. Previous research with different SARS-CoV infections has demonstrated that the hypothalamus may be involved in these symptoms. Also, a large number of cases with adjustment disorders were found. Adjustment disorders may arise as a result of COVID-19-related mental stress. Also, Vishnu et al. [13] reported that fatigue and breathlessness are the most common symptoms among post-COVID-19 cases, followed by cough, chest pain, and fever. Since SARS-CoV-2 predominantly affects the lungs, persistent symptoms related to the respiratory system are more common. The proportion of cases with breathlessness, fatigue, and chest pain was significantly increased in severe/moderate cases.

Our results were in accordance with Sathyamurthy P. et al. [12], who reported that Ninety days following recovery, weariness remained the most often reported complaint (8.9%). Additional symptoms that were mentioned included cough (4.3%), dyspnea (1.8%), vertigo (1.4%), myalgia (1.1%), taste and smell loss (0.8%), and chest pain (0.7%). Also, Kayaaslan et al. [14] reported that the most common complaints were systemic symptoms, with 24.3% of the patients citing fatigue/easy fatigability as a problem.

Dyspnea, in particular, is a prevalent ailment related to breathing. In COVID-19 patients, cardiac problems are also well-defined illnesses that significantly predict mortality. With 14.3% of all outpatient disease admissions, cardiology was the second outpatient clinic where patients were most frequently admitted. Even 20 weeks after infection, a significant portion of the patients experienced neuropsychiatric issues such as anxiety, headaches, insomnia or hypersomnia, concentration or memory loss, and new-onset depression. 18% of cases reported experiencing hair loss.

Similarly, Garrigues et al. [15] reported that, on average, 24% of subjects reported hair loss 110.9 ( $\pm 11.1$ ) days after admission. Cénat et al. [16] demonstrated that in COVID-19 cases, the incidence of depression, anxiety, and insomnia was reported to be 15.97%, 15.15%, and 23.87%, respectively.

Kamal et al. [17] illustrated that The majority of the documented manifestations were mild, treatable symptoms like headaches and fatigue that might be brought on by COVID-19 symptoms and were alleviated without the need for medical attention. Numerous participants also reported other moderate symptoms, such as soreness in their joints and muscles, which may be categorized as mild manifestations. Numerous symptoms, including persistent headaches, migraines, depression, anxiety, and obsessive-compulsive disorder, have been linked to the central nervous system. A small percentage of participants experienced severe side effects such as myocarditis, stroke, renal failure, and pulmonary fibrosis, which may be reversible and necessitate further research.

A previously reported case by Schwensen et al. [18] that had healed from COVID-19 and had no prior medical history related to lung diseases, yet COVID-19 caused bilateral lung fibrosis, which ultimately resulted in her death. Concerning cardiac involvement, Inciardi et al. [19] reported that myocarditis was a COVID-19 problem that some participants experienced, which was in line with the study's findings.

Our current findings clearly revealed that there was no marked variance when comparing cases with post-COVID syndrome and cases without post-COVID syndrome regarding age and gender. In agreement with our findings, Vishnu et al. [13] showed that gender and BMI did not show any association with persistent fatigue in recovered cases. The proportion of patients with fatigue was elevated in patients with comorbidity, but the association was not statistically significant. Osikomaiya et al. [20] demonstrated that there was no association between age and sex with the presence of COVID-19 persistence-like symptoms among symptomatic COVID-19 cases. On the other hand, Mahmud et al. [11] reported that there was a marked relationship between PCS and female sex. Each age group was equally prone to developing PCS symptoms.

The current study demonstrated that a higher percentage of cases without post-COVID syndrome have no comorbidities than those with post-COVID syndrome. In agreement with our findings, Vishnu et al. [13] showed that patients with comorbidities are more likely to have persistent breathlessness, and it was statistically significant. Kayaaslan et al. [14] reported that The existence of comorbidities independently predicted the progression of symptom persistence.

In contrast to our results, Osikomaiya et al. [20] could not reveal the relationship between PCS and comorbidity. Tenforde et al. [21] illustrated that having more than three comorbidities increases the likelihood of a delayed return to baseline health.

The present study showed that mild cases were substantially increased in cases without PCS, while moderate, severe, and critically ill cases were markedly increased in cases with PCS. The same results were obtained by Kayaaslan et al. [14], who reported that at the time of the questionnaire, the cases who had ongoing symptoms reported having mild to severe symptoms. An independent predictor of the emergence of symptom persistence was severe COVID-19. The primary indicators of PCS seem to be the severity of acute illness and the need for hospitalization. This is to be

expected since severe COVID-19 typically necessitates a lengthy hospital stay, forcing patients to deal with a number of issues such as complication development, physiological abnormalities, and deconditioning.

In agreement with our findings, Osikomaiya et al. [20] demonstrated that compared to individuals with mild illness severity, those with moderate disease severity at the time of initial COVID-19 diagnosis had a higher chance of continuing to experience COVID-19 symptoms. Kamal et al. [17] demonstrated that There was a relationship between the severity of the COVID-19 infection and the intensity of the post-symptom manifestations; individuals with severe instances exhibited more severe symptoms than those with milder conditions. Therefore, the age and comorbidities of the patients involved also have an impact on the severity of the symptoms. This was in agreement with Mahmud et al. [11], who reported that there was a marked relationship between PCS and moderate or severe illness in a presentation.

Our current findings clearly revealed that TLC, neutrophils, IL6, Troponin, ESR, Ferritin, and D Dimer were remarkably increased in patients with PCS than in cases without PCS. At the same time, albumin was significantly decreased in patients with PCS. These findings were different from those reported by Moreno - Pérez et al. [22], who illustrated that age, sex, COVID-GRAM score, comorbidities, ICU admission, severity of acute COVID-19 infection, inflammatory markers, length of treatment or hospital/ICU stay do not act as independent predictors of PCS after multivariate adjustment.

The current study showed, when comparing CT after six months between cases with and without post-COVID complications, that reticulations, GGO, and nodules were remarkably increased in cases with post-COVID complications. There was a marked decrease in GGO; patches were measured and followed after six months.

Moreno - Pérez et al. [22] assessed 277 cases face-to-face 10–14 weeks after the disease started. They found that while half of the cases had COVID–19 recovery, radiological

alterations were minimal and only present in fewer than 25% of the patients. Fifty-one patients had relevant imaging abnormalities, although 52.9% of them had no respiratory symptoms. On the other hand, 20.7% of the individuals with cough or dyspnea had pertinent results on chest imaging.

Zhao et al. [23] showed that three months after being released from the hospital, 55 individuals reported 64% ongoing symptoms and 71% radiologic abnormalities.

Our current findings clearly revealed that the duration of hospital stay was markedly increased in cases with PCS than in cases without PCS. Sathyamurthy obtained similar findings. P et al. [12] reported that In hospitalized cases, the frequency was as high as 80%, whereas in non-hospitalized cases, it was only 10%. Kayaaslan et al. [14] stated that hospitalization due to an acute independent predictor of the emergence of symptom persistence was COVID-19. 25% of the patients went to emergency rooms or outpatient clinics for symptoms mostly related to their hearts and lungs, but 1.7% of them required hospitalization. This was in line with Mahmud et al. [11], who showed that PCS was significantly correlated with protracted recovery and continuous positive results on RT-PCR beyond day 14 of the first test. Vishnu et al. [13] stated that the duration of hospital stay during active COVID-19 is significantly related to post-COVID persistent breathlessness, fatigue, and abnormal lung function. Unlikely, Ayoubkhani et al. [24] illustrated that In a UK research, one-third of cases were readmitted to the hospital after being discharged, most likely as a result of an early discharge.

The current study showed that the need for steroids and antifibrotics was markedly increased in cases with PCS than without PCS. Similar findings were obtained by Vishnu et al. [13], who stated that steroid therapy received during active COVID-19 is significantly related to post-COVID persistent breathlessness, fatigue, and abnormal lung function. Antiviral therapy and ventilator requirement had no significant association

with the presence of breathlessness, fatigue, or abnormal lung function.

Our study showed that ferritin and ESR were substantially elevated in cases with post-COVID syndrome than in cases without post-COVID syndrome. Menezes et al. [25] stated that their study showed that the group with fewer symptoms consisted of more cases with a shorter duration of COVID-19, leading to an increased incidence of high ferritin concentrations in this group. However, more research is recommended. High ferritin concentrations were related to a poor prognosis of acute COVID-19 and also increased in the post-COVID-19 phase.

The presence of comorbidities and COVID-19 severity are predictors for the occurrence of post-syndrome. Similar findings were obtained by Abdelhafiz AS et al. [26], who stated that The degree of COVID-19 symptoms was also correlated with the duration and intensity of PCS. Another finding was obtained by Taboada et al. [27], stating that hospitalized cases with COVID-19 had a diminution of the functional status, including fatigue, cough, and headache, six months after hospitalization.

### CONCLUSION

Most of the subjects who recovered from covid 19 experienced several manifestations after recovery from the acute stage of covid 19, including anxiety, fatigue, joint pain, and headache, which were correlated significantly with the symptoms and comorbidities.

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