Coronavirus Pandemic

Ongoing post-COVID-19 symptoms and complaints among healthcare professionals

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Abstract

Introduction: Post-COVID-19 syndrome refers to the occurrence of symptoms lasting more than 4 weeks in individuals who have recovered from COVID-19. This study aims to investigate the post-COVID-19 symptoms in healthcare professionals.
Methodology: This descriptive study included 166 healthcare professionals who had tested positive for COVID-19 via PCR at least four weeks prior and subsequently presented to the Family Medicine Clinic at Pamukkale University Training and Research Hospital. Participants' demographic data, medical history, COVID-19 history and ongoing or newly emerged complaints and symptoms were evaluated, and physical examinations were carried out and recorded on a patient information form. Blood tests were conducted, and the results were analyzed.
Results: The most common post-COVID-19 symptoms and complaints observed in our study were difficulty in performing daily activities (32.5%; n = 54), fatigue (26.5%; n = 44), forgetfulness (25.9%; n = 43) and weakness (24.1%; n = 40), respectively. Smoking, alcohol use, hospitalization, the need for oxygen support and having comorbidities such as asthma, diabetes, hypertension and rheumatism were found to be associated with various post-acute symptoms. Post-acute symptoms were most frequently observed in individuals vaccinated with Sinovac (38.5%), followed by those who were unvaccinated (35.7%). Least symptoms were seen in individuals vaccinated with only Biontech (15.4%).
Conclusions: The most common post-COVID-19 symptoms observed in our study were difficulty in performing daily activities, fatigue, forgetfulness and weakness. Having comorbidities was found to be associated with various post-COVID-19 symptoms.

Key words: Long COVID; post-acute COVID-19; chronic COVID; long-term effects of COVID; healthcare professional.

Introduction

Coronavirus disease 2019 (COVID-19) has emerged as a result of the new coronavirus (SARS-CoV-2) infection, infecting millions of people worldwide and causing the deaths of hundreds of thousands of individuals. The disease duration varies widely, from approximately two weeks in mild cases to three to six weeks in more severe cases [1]. Post-COVID-19 symptoms have been observed in approximately 90% of patients [1]. In patients who have recovered from the infection, various symptoms affecting different body systems have been reported [2,3]. Although risk factors such as high blood pressure, obesity, and poor mental health have been associated with persistent post-COVID symptoms, studies indicate that even young individuals without chronic conditions—and those with mild cases—may struggle to fully regain their pre-illness health for weeks post-infection [4]. Both the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) characterize prolonged COVID-19 as a condition that persists for at least four weeks following the initial infection. Irrespective of the acute infection's severity, symptoms can continue for at least five weeks in approximately one in five patients and for at least twelve weeks in about one in ten patients [5]. A study conducted in Italy reported that within 60 days of recovery and discharge, at least one symptom persisted in 87% of patients and at least three symptoms persisted in over 55% of patients [6]. In a prospective cohort study conducted in China, it was reported that at least one symptom continued six months after symptom onset in 76% of discharged patients [7]. In a study in which COVID-19 patients were followed up for 9 months, 30% of patients reported ongoing complaints [8]. Prolonged COVID-19 symptoms include nausea, extreme fatigue, muscle weakness, dyspnea, cough, chest pain, brain fog, short-term memory loss, palpitations, skin discoloration especially in the form of pernio-like papulosquamous eruptions, joint pain, light and sound sensitivity, sleep disturbances, anxiety, depression, coagulation, neurological, gastrointestinal,

gynecological issues and difficulty in performing daily activities such as walking, climbing stairs, bathing and dressing [6,9]. This study investigates the post-acute period symptoms and complaints of healthcare professionals, who represent the professional group with the highest exposure to SARS-CoV-2.

Methodology
Design
This descriptive study was conducted on 166 hospital staff who presented to the Family Medicine Clinic of Pamukkale University Training and Research Hospital between June 1, 2021, and June 1, 2022. All participants had a confirmed COVID-19 diagnosis via positive PCR test, with a minimum of four weeks having passed since diagnosis. All participants were informed about the study and their consent was obtained. The study was conducted in accordance with the Declaration of Helsinki and approved by the Pamukkale University Ethics Committee.

Data Collection and Variables
To obtain the data to be used in the research, a patient information form was created based on a literature review, whereby patients' medical histories and physical examination findings were recorded. Participants' age, gender, marital status, number of household members, education level, occupation, department, height, weight, waist circumference, body mass index, medical history and comorbidities, regularly used medications, allergies and past surgeries were queried to investigate the possible effects of demographic features and medical history on post-COVID-19 symptoms. Furthermore, the participants were also queried about their smoking and alcohol consumption status and quantities. Smoking status was recorded as a non-smoker, social smoker (occasionally smoking) and smoker. For smokers, the quantity of cigarettes was evaluated in packs per year and categorized as up to 10 packs/year, 10-20 packs/year and more than 20 packs/year. Regarding alcohol consumption, they were grouped as non-drinkers, social drinkers and drinkers based on the amount and frequency of alcohol consumed. The participants' immunization status against COVID-19 and their COVID-19 history were queried and recorded. Regarding the COVID-19 history, the time of diagnosis, location of virus exposure, symptoms and complaints during the acute illness, treatments received, supportive products used, the course of illness (hospitalized/outpatient) and the need for intensive care and oxygen support were queried. All known post-acute COVID-19 symptoms mentioned in the literature that were ongoing despite a minimum of 4 weeks since the initial diagnosis were individually queried and in addition to those, any reported symptoms and complaints by the participants were recorded. Skin, hair, head, neck, chest, lungs, heart, abdomen, musculoskeletal and neurologic system examinations were performed for the patients and their vital signs were measured. Biochemical, hormonal and hemogram tests were conducted and the results were evaluated. The physical examinations and evaluations of the participants were conducted by a single physician.

Statistical Analysis
The collected data were uploaded to IBM SPSS Statistics Version 26 software for statistical analysis. Continuous variables were reported as mean ± standard deviation and categorical variables were presented as numbers and percentages. Relationships between continuous variables were evaluated using Spearman or Pearson correlation analysis, as appropriate. Differences between categorical variables were assessed with chi-square analysis. A p value of < 0.05 was considered to indicate statistical significance.

Results
The most commonly reported post-COVID-19 symptoms and complaints in our study were difficulty performing daily activities (32.5%; n = 54), fatigue (26.5%; n = 44), forgetfulness (25.9%; n = 43) and weakness (24.1%; n = 40). Headache was reported by 14.5% (24) of participants, muscle pain by 12.7% (21), brain fog by 12.7% (21), palpitations by 11.4% (19), joint pain by 10.2% (17), back pain by 10.2% (17), hair loss by 9.6% (16), shortness of breath by 7.8% (13), loss of concentration by 7.2% (12), anosmia by 6.6% (11), parosmia by 6.6% (11), loss of taste by 5.4% (9), cough by 5.4% (9), tinnitus by 4.8% (8), anxiety by 4.8% (8), chest pain by 4.2% (7), vision problems by 4.2% (7), depression by 4.2% (7), vertigo by 3.6% (6), sleep problems by 3.6% (6), weight loss by 3% (5), loss of appetite by 2.4% (4), feeling of fullness in the ear by 2.4% (4), hoarseness by 2.4% (4), constipation by 2.4% (4), tremor by 1.8% (3), loss of sexual desire by 1.8% (3), various skin findings by 1.8% (3), sore throat by 1.2% (2) and difficulty swallowing by 1.2% (2). Dizziness, nausea, diarrhea, irritability, allergy, hearing loss, hypothyroidism and numbness in the hands and feet were reported by one participant each (0.6%), while no participant reported reflux symptoms. When the most common complaints were grouped according to the time elapsed since COVID-19 diagnosis, activity

limitation, forgetfulness, fatigue and weakness were found to be the most common symptoms in all periods (Figure 1).

The demographic characteristics of the 166 hospital employees participating in the study, along with their smoking and alcohol consumption statuses, are summarized in Table 1. A significant association was observed between smoking and complaints of activity limitation among participants ($p < 0.001$). Specifically, those who smoked 0–9.9 packs/year had higher rates of sleep problems and depression ($p = 0.012$), while those who smoked 10–20 packs/year showed a higher prevalence of skin-related findings ($p < 0.001$). No significant associations were identified between smoking more than 20 packs/year and any specific symptoms (Table 1). A significant relationship was found between alcohol use and complaints of weakness ($p = 0.044$). Tremor was less frequently observed in social drinkers and non-drinkers ($p < 0.001$). Hair loss, on the other hand, was more common in social drinkers and non-drinkers ($p < 0.001$) (Table 1).

The participants' COVID-19 history was queried and the findings are presented in Table 1. Complaints of cough were significantly higher among those who had contracted the disease twice ($p = 0.015$). Among hospitalized patients, compared to those who recovered from the illness on an outpatient basis, higher frequencies of forgetfulness ($p = 0.016$), brain fog ($p = 0.015$), dyspnea ($p = 0.05$), daily activity limitation ($p = 0.003$), tremor ($p = 0.002$), hair loss ($p = 0.007$) and hearing loss ($p = 0.030$) were observed. Fatigue ($p = 0.044$), brain fog ($p = 0.007$), dyspnea ($p = 0.031$), activity limitation ($p = 0.01$), tremor ($p = 0.001$), hair loss ($p = 0.003$) and hearing loss ($p = 0.024$) were significantly higher among those patients who required oxygen support.

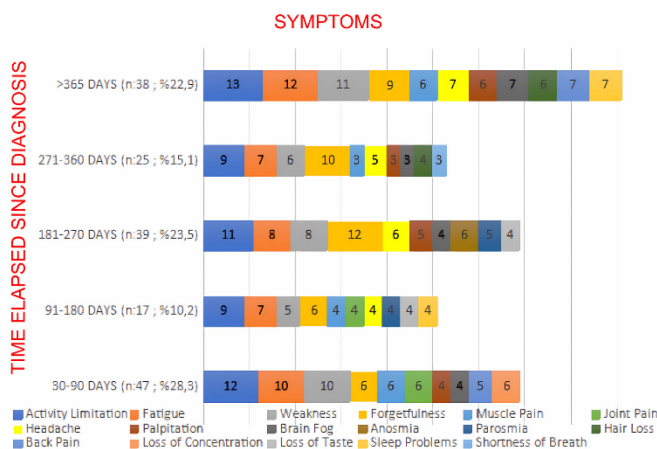**Figure 1.** Symptoms grouped according to the time elapsed since COVID-19 diagnosis.

Table 1. Research Group's Demographic Characteristics.

Characteristics	n (%)
Age (n: 166)	33.76 (± 7.68)
Gender (n: 166)	
Female	127 (76.5 %)
Male	39 (23.5 %)
Marital Status (n: 166)	
Married	111 (66.9 %)
Single	55 (33.1 %)
Educational Background (n: 166)	
Primary	16 (9.6 %)
Secondary	4 (2.4 %)
High	27 (16.3 %)
University	119 (71.7 %)
Profession (n: 166)	
Nurse	53 (31.9 %)
Doctor	39 (23.5 %)
Technician	19 (11.4 %)
Cleaning Staff	17 (10.2 %)
Nursing Staff	16 (9.6 %)
Medical Secretary	15 (9 %)
Kitchen Staff	4 (2.4 %)
Officer	3 (1.8 %)
Smoking (n: 166)	
Non-smoker	125 (75.3 %)
Smoker	35 (21.1 %)
Social Smoker	6 (3.6 %)
Number of Cigarettes Smoked (n: 35)	
< 10 p/y	25 (71.4 %)
10-20 p/y	9 (25.7 %)
> 20 p/y	1 (2.9 %)
Alcohol Consumption Status (n: 166)	
Non-drinker	131 (78.9 %)
Social Drinker	30 (18.1 %)
Drinker	5 (3 %)
Chronic Disease (n: 166)	
Yes	40 (24.1 %)
No	126 (75.9 %)
Medication (n: 166)	
Yes	40 (24.1 %)
No	126 (75.9 %)
Number of COVID Contraction (n: 166)	
Once	155 (93.4 %)
Twice	11 (6.6 %)
Elapsed Time Since Diagnosis (n: 166)	
30-90 Days	47 (28.3 %)
91-180 Days	17 (10.2 %)
181-270 Days	39 (23.5 %)
271-365 Days	25 (15.1 %)
> 365 Days	38 (22.9 %)
Outpatient/Hospitalization (n: 166)	
Outpatient	161 (97 %)
Hospitalized	5 (3 %)
Need of Oxygen Therapy	
Nasal O_2	3 (1.8 %)
High Flow	1 (0.6 %)
Work Unit (n: 166)	
Service	36 (21.7 %)
Polyclinic + Service	35 (21.3 %)
İntensive Care Unit	29 (17.5 %)
Laboratory	29 (17.5 %)
Polyclinic	26 (15.7 %)
Operation Room	4 (2.4 %)
Dining Hall	4 (2.4 %)
Office	3 (1.8 %)

Table 2. Relationships Between Research Group's Comorbidities and Post-COVID-19 Symptoms.

Asthma n: 11 (6.6%)	Fatigue ($p = 0.001$), muscle pain ($p = 0.004$), joint pain ($p = 0.001$), headache ($p = 0.001$), forgetfulness ($p = 0.001$), anosmia ($p = 0.027$), parosmia ($p = 0.027$), brain fog ($p = 0.035$), feeling of fullness in the ear ($p = 0.001$), tinnitus ($p = 0.01$), cough ($p = 0.015$), shortness of breath ($p = 0.006$), activity limitation ($p < 0.001$), palpitation ($p < 0.001$), sleep problems ($p = 0.001$), depression ($p = 0.007$), loss of concentration ($p = 0.034$), loss of sexual desire ($p = 0.012$), constipation ($p = 0.022$), hair loss ($p = 0.013$) were found more frequently.	
Thyroid n: 11 (6.6%)	Loss of concentration ($p = 0.034$) were found more frequently.	
Insulin Resistance n: 11 (6.6%)	Palpitation ($p = 0.014$), depression ($p = 0.007$), loss of concentration ($p = 0.034$), loss of sexual desire ($p = 0.012$) were found more frequently.	
Coagulation and Vascular Structure Impairment n: 10 (6%)	Forgetfulness ($p = 0.02$), anxiety ($p = 0.008$), loss of concentration ($p = 0.003$) were found more frequently.	
Rheumatologic n: 7 (4.2%)	Muscle pain ($p = 0.044$), forgetfulness ($p = 0.013$), brain fog ($p = 0.005$), anxiety ($p = 0.038$), diarrhea ($p = 0.042$), constipation ($p = 0.009$), numbness in the hands and feet ($p = 0.042$) were found more frequently.	
Hematological n: 7 (4.2%)	No related symptoms were found ($p > 0.05$).	
Diabetes Mellitus n: 6 (3.6%)	Forgetfulness ($p = 0.005$), cough ($p = 0.035$), activity limitation ($p = 0.014$), irritability ($p = 0.036$), numbness in the hands and feet ($p = 0.036$) were found more frequently.	
Hypertension n: 6 (3.6%)	Muscle pain ($p = 0.007$), forgetfulness ($p = 0.004$), dizziness ($p = 0.024$), feeling of fullness in the ear ($p < 0.001$), vision problems ($p = 0.009$), loss of concentration ($p = 0.027$), diarrhea ($p = 0.024$) were found more frequently.	
Hepatic n: 3 (1.8%) **Neurological** n: 3 (1.8%) **Cardiac** n: 3 (1.8%)	No related symptoms were found ($p > 0.05$).	
Psychiatric n: 2 (1.2%)	Headache ($p = 0.020$), tremor ($p = 0.036$), constipation ($p = 0.048$) were found more frequently.	
Obesity	**Under Weight (BMI < 18.5)** *n: 3 (1.9%)*	Feeling of fullness in the ear ($p < 0.001$), cough ($p = 0.004$), palpitation ($p = 0.047$), depression ($p < 0.001$), loss of concentration ($p < 0.001$), hair loss ($p = 0.024$) were found less frequently.
	Healthy Weight (BMI 18.5-24.9) *n: 87 (53.7%)*	Muscle pain ($p = 0.047$), dizziness ($p = 0.002$) were found less frequently.
	Over Weight (BMI 25-29.9) *n: 47 (29%)*	No related symptoms were found ($p > 0.05$).
	Obese Class 1 (BMI 30-34.9) *n: 20 (12.3%)*	Feeling of fullness in the ear ($p < 0.001$) was found more frequently.
	Obese Class 2 (BMI 35-39.9) *n: 4 (2.5%)*	No related symptoms were found ($p > 0.05$).
	Obese Class 3 (BMI > 40) *n: 1 (0.6%)*	Joint pain ($p = 0.035$), tinnitus ($p = 0.001$), vision problems ($p < 0.001$), muscle pain ($p = 0.047$), feeling of fullness in the ear ($p < 0.001$), cough ($p = 0.004$), palpitation ($p = 0.047$), depression ($p < 0.001$), loss of concentration ($p < 0.001$), hair loss ($p = 0.024$) were found more frequently.

Table 3. Immunization status against COVID-19, vaccine types, and their relationship with post-COVID-19 symptoms.

UNVACCINATED *n: 28 (16.9%)*		SINOVAC *n: 52 (31.3%)*		BIONTECH *n: 12 (7.2%)*		SINOVAC + BIONTECH *n: 74 (44.6%)*	
Fatigue Forgetfulness Weakness	10 (35.7%)	Activity Limitation	20 (38.5%)	Fatigue		Activity Limitation	24 (32.9%)
		Forgetfulness	14 (26.9%)	Joint Pain		Fatigue	21 (28.8%)
		Weakness	12 (23.1%)	Weight Loss	2 (15.4%)	Forgetfulness	18 (24.7%)
Activity Limitation	9 (32.1%)	Fatigue	11 (21.2%)	Headache		Weakness	17 (23.3%)
Sleep Problems Palpitation Shortness of Breath Headache	4 (14.3%)	Joint Pain Palpitation Headache Parosmia	8 (15.4%) 7 (13.5%)	Back Pain Weakness		Brain Fog	12 (16.4%)
				Muscle Pain Loss of Appetite Forgetfulness		Muscle Pain Headache	11 (15.1%)
Muscle Pain Vision Problems Hair Loss Brain Fog Anxiety	3 (10.7%)	Muscle Pain Anosmia Sleep Problems	6 (11.5%)	Anosmia Parosmia Loss of Taste Brain Fog Vertigo Tinnitus Hoarseness Cough Activity Limitation Palpitation Loss of Concentration	1 (7.7%)	Back Pain	8 (11%)
						Sleep Problems	7 (9.6%)
						Palpitation Loss of Concentration	6 (8.2%)

The relationship between the comorbidities and body mass index (BMI) of the patients in the research group and post-COVID-19 symptoms is shown in Table 2. No significant correlations were identified between participants' waist circumference and post-COVID-19 symptoms ($p < 0.05$).

The participants' immunization status against COVID-19, vaccine types and their relationship with post-COVID-19 symptoms are presented in Table 3 and the relationship between the COVID-19 treatments employed by the research group and post-COVID-19 symptoms is shown in Table 4.

Blood tests were conducted as necessary on the participants and the results were evaluated according to the optimal ranges of our hospital's laboratory. Abnormal laboratory results and associated post-COVID-19 symptoms are presented in Table 5.

Discussion

SARS-CoV-2 has infected millions of people and a significant portion of these individuals have been unable to fully recover their health after overcoming the disease. Healthcare professionals have been the most affected professional group, both physically and mentally, during the pandemic. This study aimed to investigate the persistent complaints and symptoms among healthcare professionals who have completed the acute phase of COVID-19, while also examining the factors influencing post-COVID-19 syndrome.

In the present study, the most frequently reported post-COVID-19 symptoms included difficulty in performing daily activities, fatigue, forgetfulness and weakness. A meta-analysis conducted by Aiyegbusi *et al.* identified fatigue, dyspnea, myalgia, arthralgia and headache as the most common post-COVID-19 symptoms [10]. Peghin *et al.* ranked the most common symptoms as fatigue, anosmia, and neurological disorders, while Bell *et al.* found fatigue, dyspnea, brain fog, stress and anxiety to be the most common symptoms [11,12]. Mahmud *et al.*, Vanichkachorn *et al.* and Kamal *et al.* also found fatigue the most common symptom, while Sykes *et al.* reported dyspnea, myalgia, anxiety and fatigue, respectively [1,13-15].

In the literature, there is a relationship between female gender, smoking, intensive care unit admission during the acute phase of the disease, oxygen support requirement and post-acute phase symptoms [16]. In our study, we also found an association between smoking, alcohol consumption, hospitalization, oxygen support requirement, and post-acute symptoms, while no relationship was observed with respect to gender.

Numerous studies have established a relationship between pre-existing comorbidities and post-COVID-19 complaints among [1,4,17-19]. Among the comorbidities; asthma, hypertension, diabetes and being overweight or obese have been highlighted [1,4,10,18,20]. Consistent with the general opinion in the literature, our study also detected associations between having comorbidities such as asthma, diabetes, hypertension, rheumatism and morbid obesity, and various post-acute symptoms.

Table 4. COVID-19 treatments and post-COVID-19 symptoms.

TREATMENTS	N (%)	SYMPTOMS
COVID-19 Pills (n: 166)		
Favipiravir	84 (50.6%)	-
Chloroquine	9 (5.4%)	-
Chloroquine + Favipiravir	20 (12%)	-
Favipiravir + Azithromycin	1 (0.6%)	Daily activity limitation was found more frequently ($p = 0.01$).
Chloroquine +Azithromycin	1 (0.6%)	Daily activity limitation was found more frequently ($p = 0.01$).
No	51 (30.7%)	Daily activity limitation was found less frequently ($p = 0.01$).
Other Drugs		
Enoxaparin	13 (7.8%)	Fatigue was found more frequently ($p = 0.043$).
Aspirin	38 (22.9%)	Vision problems ($p = 0.049$) and shortness of breath ($p = 0.015$) were found more frequently.
Paracetamol	34 (20.5%)	Joint pain ($p = 0.001$), vision problems ($p = 0.033$) and hoarseness ($p = 0.027$) were found more frequently.
Cortisol	9 (5.4%)	Weakness ($p = 0.038$), muscle pain ($p = 0.016$), joint pain ($p = 0.007$), brain fog ($p = 0.002$), hoarseness ($p = 0.015$), shortness of breath ($p = 0.024$), activity limitation ($p = 0.001$), tremor ($p = 0.008$), hair loss ($p = 0.043$) were found more frequently.
NSAID	2 (1.2%)	-
Supportive Treatments		
Vitamin D	46 (27.7%)	Depression was found more frequently in those who use it. Anxiety was found more frequently in those who do not use it.
Vitamin C	59 (35.5%)	Anxiety was found more frequently ($p = 0.024$).
Magnesium	8 (4.8%)	Forgetfulness was found more frequently ($p = 0.028$).
Zinc	16 (9.6%)	Forgetfulness was found more frequently ($p = 0.044$).
Multivitamin	21 (12.7%)	-
Others	11 (6.6%)	-

In our study, daily activity limitations were more frequently observed in patients receiving the combination of chloroquine + azithromycin and favipiravir + azithromycin. On the other hand, complaints were less frequently reported in patients not using any medication. A study by Akinci *et al.*

Table 5. Abnormal laboratory results and associated post-COVID-19 symptoms.

TEST	MEAN (± SD)	N %	SYMPTOM
GLUCOSE (N:150)	93.95 (± 19.76)	High: 15 (10%)	loss of appetite ($p = 0.040$), loss of sexual desire ($p = 0.004$), irritability ($p = 0.011$), numbness in the hands and feet ($p = 0.011$), joint pain ($p = 0.024$)
		Low: 4 (2.7%)	hoarseness ($p = 0.010$), joint pain ($p = 0.024$)
GFR (N: 154)	112 (± 11.93)	Low: 6 (3.9%)	
CREATININE (N: 156)	0.72 (± 0.14)	High: 10 (6.4%)	*p > 0.05*
		Low: 3 (1.9%)	
BUN (N: 145)	10.79 (± 2.68)	Low: 1 (0.7%)	
URIC ACID (N: 135)	4.19 (± 1.22)	High: 18 (13.3%)	*p > 0.05*
		Low: 3 (2.2%)	skin findings ($p = 0.001$), irritability ($p < 0.001$)
AST (N: 156)	15.98 (± 5.82)	High: 4 (2.6%)	anosmia ($p = 0.025$), parosmia ($p = 0.025$)
ALT (N: 157)	15.89 (± 12.10)	High: 7 (4.5%)	*p > 0.05*
NA (N: 145)	139.61 (± 2.08)	Low: 5 (3.4%)	
K (N: 143)	4.42 (± 0.34)	High: 5 (3.5%)	fatigue ($p = 0.024$)
CA (N: 147)	9.29 (± 0.41)	High: 1 (0.7%)	*p > 0.05*
		Low: 6 (4.1%)	anosmia ($p = 0.047$), parosmia ($p = 0.030$), difficulty swallowing ($p = 0.004$), tremor ($p = 0.004$), loss of sexual desire ($p = 0.035$), hair loss ($p < 0.001$)
CRP (N: 140)	1.91 (± 2.37)	High: 13 (9.3%)	skin findings ($p = 0.023$)
LDH (N: 137)	163.15 (± 32.58)	High: 11 (8%)	headache ($p = 0.014$)
		Low: 27 (19.7%)	*p > 0.05*
GGT (N: 137)	15.50 (± 10.58)	High: 5 (3.6%)	anosmia ($p = 0.015$), loss of taste ($p = 0.004$), loss of appetite ($p = 0.021$)
		Low: 5 (3.6%)	*p > 0.05*
FERRITIN (N: 147)	49.80 (± 53.87)	High: 10 (6.82%)	*p > 0.05*
		Low: 28 (19%)	vertigo ($p < 0.001$), chest pain ($p = 0.010$)
VITAMIN B12 (N: 136)	366.46 (± 180.86)	High: 1 (0.7%)	*p >0.05*
		Low: 4 (2.9%)	feeling of fullness in the ear ($p = 0.030$), tinnitus ($p < 0.001$), hoarseness ($p = 0.030$), tremor ($p = 0.007$), loss of sexual desire ($p = 0.007$), diarrhea ($p < 0.001$)
FOLIC ACID (N: 142)	7.55 (± 3.05)	Low: 26 (18.3%)	*p > 0.05*
INSULIN (N: 61)	10.74 (± 4.54)	High: 1 (1.6%)	loss of taste ($p = 0.049$)
HOMA-IR (N: 61)	2.49 (± 1.23)	High: 21 (34.4%)	anosmia ($p = 0.011$), anxiety ($p = 0.037$)
T3 (N: 93)	3.14 (± 0.42)	Low: 2 (2.2%)	
T4 (N: 105)	1.29 (± 0.70)	High: 4 (3.8%)	*p > 0.05*
		Low: 3 (2.9%)	
TSH (N: 108)	2.02 (± 1.43)	High: 6 (5.6%)	
LDL (N: 71)	106.45 (± 30.06)	High: 40 (56.3%)	palpitation ($p = 0.032$)
T. CHOLESTEROL (N: 65)	179.66 (± 31.52)	High: 11 (16.9%)	fatigue ($p = 0.010$), cough ($p = 0.026$)
WBC (N: 160)	7.41 (± 1.86)	High: 15 (9.4%)	*p > 0.05*
		Low: 3 (1.9%)	fatigue ($p = 0.011$), weakness ($p = 0.006$), muscle pain ($p = 0.012$), joint pain ($p = 0.001$), brain fog ($p = 0.016$), feeling of fullness in the ear ($p = 0.002$), vision problems ($p < 0.001$), activity limitation ($p = 0.041$), anxiety ($p = 0.008$), loss of concentration ($p < 0.001$), loss of sexual desire ($p < 0.001$)
NEUTROPHIL COUNT (N: 160)	4.43 (± 1.57)	High: 11 (6.9%)	hypothyroidism ($p = 0.001$), allergy ($p = 0.001$), numbness in the hands and feet ($p = 0.001$)
		Low: 1 (0.6%)	palpitation ($p = 0.014$)
LYMPHOCYTE COUNT (N: 160)	2.33 (± 0.68)	High: 1 (0.6%)	*p > 0.05*
EOSINOPHIL COUNT (N: 160)	0.17 (± 0.15)	High: 2 (1.3%)	sore throat ($p < 0.001$), hoarseness ($p = 0.003$), depression ($p = 0.046$), anxiety ($p = 0.046$)
		Low: 2 (1.3%)	anosmia ($p = 0.001$), loss of taste ($p < 0.001$), brain fog ($p = 0.014$), chest pain ($p < 0.001$), back pain ($p = 0.012$), loss of concentration ($p = 0.001$), nausea ($p < 0.001$)
RBC (N: 160)	4.72 (± 0.44)	High: 40 (25%)	*p > 0.05*
HGB (N: 160)	13.65 (± 1.59)	High: 1 (0.6%)	*p > 0.05*
		Low: 7 (4.4%)	loss of appetite ($p = 0.046$)
HCT (N: 160)	40.66 (± 4.01)	High: 6 (3.8%)	fatigue ($p = 0.046$)
		Low: 15 (9.4%)	*p > 0.05*
NLR (N: 157)	2.09 (± 1.15)	High: 15 (9.6%)	*p > 0.05*

suggested that the combination of favipiravir + hydroxychloroquine was unsafe, while we found that azithromycin-containing combinations were not safe [21]. Although studies indicate the cardiac safety of azithromycin in combination with hydroxychloroquine, there is insufficient evidence regarding its use in COVID-19. Azithromycin may interact with chloroquine and favipiravir, increasing the potential for toxicity and side effects. Patients who had a severe course of the disease during the acute phase may have used combination therapy, leading to an association between medication intake and post-COVID symptoms. Therefore, the significantly lower complaints observed in patients not using medication may be attributed to milder disease course or the absence of medication treatment during the Omicron variant period, in which the disease was generally milder. However, in the study by Galal *et al*. no relationship was found between the treatment received during the acute phase (supportive treatment, hydroxychloroquine, azithromycin, or corticosteroids) and post-COVID-19 symptoms [4].

During the pandemic in Turkey, individuals were offered two vaccine options: Sinovac and Biontech. Initially, only the Sinovac vaccine was available. Thus, a majority of healthcare workers were vaccinated with Sinovac first, and later, with the addition of the Biontech vaccine, different combinations emerged. When examining the relationship between vaccine types and symptoms, post-COVID-19 symptoms were most commonly observed in individuals who were vaccinated solely with Sinovac. In this group, activity limitation was the most frequently reported symptom. The second group with the highest frequency of post-COVID-19 symptoms was those who had not received any vaccine. Individuals with no vaccination reported fatigue, weakness, and forgetfulness to some extent. Activity limitation was observed among those vaccinated with both Sinovac and Biontech, while individuals who received the Biontech vaccine alone had the least number of post-COVID-19 symptoms, which included fatigue, joint pain, weight loss, headache, and back pain, with at least one of these symptoms being present. Analysis of the participants' laboratory values revealed associations between high blood glucose levels, hypocalcemia, low vitamin B12 levels, low white blood cell counts, elevated neutrophil counts, and both high and low eosinophil counts with post-COVID-19 symptoms. Although there are currently no studies directly linking elevated blood glucose levels to post-COVID-19 symptoms, some research has indicated that the impairment of insulin

secretion mechanisms caused by SARS-CoV-2 may persist during the recovery phase potentially leading to the development of insulin resistance in the post-acute period [22,23]. Hypocalcemia is commonly observed in COVID-19 patients and has been associated with hospitalization [24-26]. Increased oxidative stress and prolonged immune response, which are likely mechanisms in the pathogenesis of post-COVID syndrome, can cause the oxidation of vitamin B12 [27]. The exposure of erythrocytes and blood cell precursors in the bone marrow to the effects of SARS-CoV-2 through ACE2, CD147, CD26, GRP78, and other receptors they have, as well as the impact of the virus on the immune system, may lead to impairment in the number and function of immune cells [28–30]. In this regard, our laboratory findings are consistent with the literature. Prognostic indicators widely accepted during the acute and post-acute periods, such as BUN, elevated creatinine, decreased uric acid levels, and neutrophil-to-lymphocyte ratio (NLR), were not found to be associated with any specific symptoms in our study [31-37]. It is possible that the different results obtained in our study compared to these previous studies may be attributed to the fact that the samples in those studies consisted mainly of hospitalized patients, while the majority of our participants experienced the disease in an outpatient setting.

In conclusion, the most frequently reported post-COVID-19 symptoms in our study were difficulty in performing daily activities, fatigue, forgetfulness, and weakness. Additionally, the presence of comorbidities such as asthma, diabetes, hypertension, and obesity was associated with various post-COVID-19 symptoms.

Limitations of the Study

The limitations of this study include a small sample size, the restriction to a single study location, and a low proportion of participants who were hospitalized. Additionally, since all participants were healthcare professionals, these factors collectively limit the generalizability of our findings to the broader population.

Authors' Contributions

A.Ö., Y.K.Ç. Administrative, technical, or material support: All authors. Supervision: A.Ö., T.E.

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