


# Depression and related factors among patients with post-COVID-19 conditions: Cross-sectional, hospital-based study

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## Abstract

**Background and Aims:** The COVID-19 crisis has significantly impacted public health, particularly mental health. This study aims to determine the prevalence of depression and related factors among patients with post-COVID-19 conditions in an outpatient clinic at a tertiary referral hospital in Southern Vietnam.

**Methods:** A cross-sectional survey was conducted among 410 patients with post-COVID-19 conditions in an outpatient clinic at the University Medical Center Ho Chi Minh City. A convenience sampling method was used to screen for depression using the Patient Health Questionnaire-9 (PHQ-9).

**Results:** A total of 410 patients participated in the study. Depression was observed in 23.7% of respondents, categorized as mild (80.4%), moderate (16.5%), or severe (3.1%) based on PHQ-9 scores. Factors influencing depression included age 50 years or older, religion, education level, full-time employment, marital status, family contact, use of anti-inflammatory drugs, hospital admission due to COVID-19, chronic diseases, hypertension, and post-COVID-19 symptoms (shortness of breath, palpitations, fatigue, headache, abdominal pain, brain fog, insomnia, and loss of appetite). The most common symptoms reported were cough, dyspnea, shortness of breath, fatigue, and loss of appetite. A *p*-value of less than 0.05 indicated statistical significance.

**Conclusion:** The prevalence of depression among patients with post-COVID-19 conditions in the outpatient clinic was high. Improving mental health and quality of life, alongside the prevention and treatment of COVID-19, should remain public health priorities.

## KEYWORDS

cross-sectional, depression, hospital-based, PHQ-9, post-COVID-19 condition

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## 1 | INTRODUCTION

On March 31, 2021, the SARS-CoV-2 pandemic remained a public health challenge to the economy and society, impacting the mental health of the general population.<sup>1</sup> Those who recover and are discharged from hospitals show persistent symptoms following acute infection, and even more are later readmitted to the hospital. Indeed, long-term quarantine, fear of infection, lack of information, stigma, and the loss of financial resources may increase susceptibility to mental illness and the risk factors that may contribute to anxiety and depression.<sup>2,3</sup>

According to the World Health Organization (WHO), depression is a common mental disorder that negatively affects social psychology and quality of life, with an estimated 300 million people in the population. Depression can start at any time in life and can affect anyone. Major depressive disorder was ranked as the third cause of the burden of disease worldwide in 2008 by the WHO, and depression is predicted to be the leading cause of disease burden globally by 2030. A previous study reported that the prevalence of depressive symptoms in the US was more than three times higher during COVID-19 than before the COVID-19 pandemic levels.<sup>4</sup>

In Vietnam, the first COVID-19 case was reported on January 25, 2020, and by May 31, 2023, there were 11,612,608 confirmed cases and 43,206 deaths. The Vietnamese government implemented extensive public health measures, including lockdowns, quarantine protocols, and widespread testing. By May 31, 2023, approximately 266 million vaccine doses had been administered, covering a substantial portion of the population.<sup>5</sup> A systematic review and meta-analysis conducted in Vietnam reported that the pooled prevalence of depression during the pandemic was 14.636%, with healthcare workers experiencing a higher prevalence than non-healthcare workers (17.3% vs. 12.04%).<sup>6</sup> This highlights the strain on Vietnam's mental health system, which struggles to meet the increased demand for services, particularly in remote areas.<sup>6</sup>

In this circumstance, it is crucial to understand the prevalence and related factors of depression among patients with post-COVID-19 conditions. This study aims to analyze the prevalence and associated factors of depression in patients attending the post-COVID-19 outpatient clinic at the University Medical Center Ho Chi Minh City. Understanding these factors is essential for developing effective interventions and public health strategies to support the mental health of those affected by the pandemic.

## 2 | MATERIALS AND METHODS

### 2.1 | Study settings and design

A descriptive cross-sectional study was conducted on all patients who visited the post-COVID-19 outpatient clinic of the University Medical Center Ho Chi Minh City between April and June 2022. Participants were thoroughly informed and signed the consent form before joining the study. The study was conducted in accordance with the Declaration of Helsinki and was approved and monitored by

the Research Ethics Committee of the University of Medicine and Pharmacy, Ho Chi Minh City under Decision No. 358/HDDD-DHYD, issued on March 30th, 2022, Research ID 22215-DHYD.

### 2.2 | Participants, sample size, and sampling

The study's inclusion criteria were patients aged 18 years or older with a confirmed diagnosis of COVID-19 and proof of recovery. Participants were needed to have the ability to communicate and respond to the interview survey. Patients with physical or mental health issues who were unable to complete the survey (e.g., unconsciousness, cognitive impairment, or psychotic disorders) and respondents who did not complete the PHQ-9 questionnaire were excluded.

This work used a formula to calculate the sample size to estimate one ratio with  $p = 0.268$ , based on a study undertaken by Mendez et al.<sup>7</sup> We calculated the sample size  $n = 392$ . During the data collection period, we recruited all 410 patients from April to June 2022. The study sample conveniently selected all patients who met the sampling criteria during the study period.

### 2.3 | Data collection and tools

The participants were interviewed face-to-face in the outpatient clinic. The questionnaire included three subscales: (1) sociodemographic and economic characteristics, (2) clinical characteristics post-COVID-19, and (3) Patient Health Questionnaire-9 (PHQ-9), which is a 9-item self-administered instrument that evaluates depression symptoms experienced over the previous 2 weeks. The instrument used in this part of the survey was the 4-point answer option scale: *not at all* (0), *over several days* (1), *on more than half the days* (2), or *nearly every day* (3). The questionnaire consists of nine questions regarding depression; the total possible score ranged from 0 to 27, with a higher score corresponding to a greater level of depression. In this study, Cronbach's alpha was 0.86, indicating a high degree of internal consistency.<sup>8</sup>

### 2.4 | Study variables

Risk factors for depression were defined using a binary variable (yes/no). A higher risk of depression with a score  $\geq 10$ , and low risk with a score  $< 10$ . The severity of depression was as follows: 10–14 = moderate, 15–19 = moderately severe, and 20–27 = severe.

Sociodemographic and economic variables were collected, including the following:

- gender
- age ( $< 50$ ,  $\geq 50$  years old)
- ethnic group (Kinh, others)
- religious affiliation (religion, nonreligion)
- education degree (elementary or lower, secondary education, high school, higher education)

- employment status (full-time, others)
- monthly income (>2.25 million Vietnam Dong, ≤2.25 million Vietnam Dong)
- living arrangements (living with family members, others)
- marital status (married, single)
- family communication (engagement, conflicts)
- family connection (regular, irregular)
- occurrence of an unexpected event within the last 6 months (yes, no).

Post-COVID-19 symptom variables were collected, including the following:

- vaccination status (≤1 dose, 2 doses, ≥3 doses)
- duration of COVID-19 infection (>3 months, ≤3 months)
- reinfection (≥1 time, no)
- oral treatments for COVID-19 (yes, no)
- drugs and supplements (antibiotics, anti-inflammatory, antiviral drugs, antipyretics, cough medicines, antidiarrheals, medication for chronic illness, nasal sprays, vitamin supplements, water and water ionizers)
- hospital admission (yes, no)
- intrafamilial transmission of the disease (yes, no)
- chronic diseases (yes, no)
- comorbidities (hypertension, diabetes mellitus, musculoskeletal disorders, cardiovascular diseases, respiratory diseases)
- post-COVID-19 symptoms and present symptoms in patients at the clinic (fever, cough, dyspnea, shortness of breath, palpitations, fatigue,

- headache, myalgia, arthralgia, abdominal pain, brain fog, memory loss, insomnia, hair loss, anorexia, ageusia, anosmia, nausea, diarrhea)
- frequency of long-term COVID-19 check-up (initial, ≥2 times)
- condition improved on initial treatment (yes, no).

## 2.5 | Statistical method

Data processing was performed with Epidata 4.6 and analyzed using STATA version 16 (StataCorp 2015, Stata Statistical Software: Release 16, College Station, TX: StataCorp LP). Second, we conducted a bivariable chi-square or Fisher's exact test analysis to assess the association between general characteristics and depression. Categorical variables are presented as frequencies and percentages using descriptive statistics. A multivariable logistic regression analysis was performed to calculate the adjusted prevalence ratio with 95% confidence intervals (95% CI) for all variables with a  $p < 0.2$  in the univariate analyzes. A  $p$  value of less than 0.05 was considered statistically significant.

## 3 | RESULTS

A total of 410 outpatients with post-COVID-19 were interviewed at the University Medical Center Hospital in Ho Chi Minh City. Those who agreed to participate in this study were provided with the survey. The demographic, socioeconomic, and cultural factors of the participants were presented in Table 1.

**TABLE 1** The demographic, socioeconomic, and cultural factors of the participants ( $n = 410$ ).

Characteristics	$n$ (%)
Age in years, median (interquartile range), mean $\pm$ standard deviation	34 (27–46), 37.6 $\pm$ 13.6
Age categories (<50 years)	328 (80.0)
Gender (women)	272 (66.3)
Ethnicity (Kinh)	399 (97.3)
Religious affiliation (no religion)	290 (70.7)
Education degree	
Elementary or lower	19 (4.6)
Secondary education	54 (13.2)
High school	96 (23.4)
Higher education	241 (58.8)
Employment status (full-time)	188 (45.9)
Disposable income of the respondent (>2.25 million Vietnam Dong)	386 (94.1)
Living arrangements (living)	350 (85.4)
Marital status (single)	132 (32.2)
Family relationship (engagement)	389 (94.9)
Frequency of communication with family members (regular)	361 (88.0)
An unexpected event within the last 6 months (yes)	114 (27.8)

**TABLE 2** The characteristics of post-COVID-19 conditions.

Characteristics	n (%)
Vaccination status	
≤1 dose	12 (2.9)
2 doses	111 (27.1)
≥3 doses	287 (70.0)
Infection rate of COVID-19 (>3 months)	252 (61.5)
Reinfection (≥1 times)	50 (12.2)
Oral treatments for COVID-19 (Yes)	383 (93.4)
Drugs and supplements (n = 383) (Yes)	
Vitamin C, Zinc, herbs for cold and flu	356 (93.0)
Water and water ionizers	331 (86.4)
Cough medicines	296 (77.3)
Antipyretics	270 (70.5)
Nasal sprays	249 (65.0)
Anti-inflammatory	190 (49.6)
Antibiotics	87 (22.7)
Antiviral drugs	47 (12.3)
Antidiarrheals	38 (9.9)
Medication for chronic illness	6 (1.6)
Hospital admission due to COVID-19 (yes)	16 (3.9)
A household member has tested positive for COVID-19 (yes)	348 (84.9)
Chronic diseases (yes)	95 (23.2)
Chronic diseases (n = 95)	
Hypertension	35 (36.8)
Respiratory diseases	23 (24.2)
Type II diabetes mellitus	20 (21.1)
Musculoskeletal disorders	14 (14.7)
Cardiovascular diseases	10 (10.5)
Characterization of post-COVID-19 symptoms	
Fatigue	266 (64.9)
Cough	234 (57.1)
Dyspnea	218 (53.2)
Shortness of breath	217 (52.9)
Headache	140 (34.2)
Insomnia	109 (26.6)
Palpitations	106 (25.9)
Myalgia	98 (23.9)
Difficulty thinking or concentrating (brain fog)	85 (20.7)
Memory loss	79 (19.3)
Hair loss	65 (15.9)
Anorexia	52 (12.7)

**TABLE 2** (Continued)

Characteristics	n (%)
Joint pains	42 (10.2)
Abdominal pain	29 (7.1)
Anosmia	25 (6.1)
Ageusia	24 (5.9)
Nausea	15 (3.7)
Fever	12 (2.9)
Diarrhea	11 (2.7)
Symptoms at presentation to outpatient clinic with COVID-19	
Cough	170 (41.5)
Fatigue	150 (36.6)
Dyspnea	134 (32.7)
Shortness of breath	121 (29.5)
Headache	55 (13.4)
Palpitations	52 (12.7)
Myalgia	41 (10.0)
Difficulty thinking or concentrating (brain fog)	24 (5.9)
Insomnia	23 (5.6)
Loss of memory	12 (2.9)
Arthralgia	10 (2.4)
Abdominal pain	9 (2.2)
Anorexia	8 (2.0)
Hyposmia	8 (2.0)
Hair loss	7 (1.7)
Ageusia	6 (1.5)
Others	6 (1.5)
Diarrhea	3 (0.7)
Nausea	2 (0.5)
Fever	2 (0.5)
Frequency of long-term COVID examinations (initial time)	353 (86.1)
Condition improved on treatment (yes) (n = 57)	40 (70.2)

The median age of the included patients was 34 years (interquartile range: 27–46). Among the respondents, 80.0% (n = 328/410) belonged to the age group <50 years. The majority (66.3%, n = 272/410) of the respondents were female, mostly from Kinh (97.3%, n = 399) and nonreligious (70.7%). More than half had achieved a higher education (58.8%). Regarding employment status, 45.9% had full-time jobs and monthly incomes greater than 2.25 million Vietnam Dong (94.1%). Most patients were married (62.7%) and living with relatives (85.4%). The level of contact between

patients and their families was high (94.9%). Patients have regular communication with their families (88%). Within the last 6 months, most patients did not experience unexpected events (72.2%). Eighty-five of the patients reported living with family members.

Table 2 shows the characteristics of post-COVID-19 conditions. The vast majority of the patients were vaccinated with three (69.8%) or two (27.1%) doses before being exposed to the coronavirus. A total of 61.5% reported long-term COVID-19 more than 3 months after the initial acute phase. A total of 87.8% of participants did not suffer reinfection (only a single COVID-19 infection).

In response to the infection, 93.4% of patients took medication to support treatment. The most common treatment options were vitamin supplements and zinc (93%). Those treated at the hospital accounted for 3.9% of the sample, and 93.8% remained in the hospital for less than 1 month. Of the participants, 348 (84.9%) reported that a household member had also tested positive for COVID-19. Approximately 23.2% of patients have chronic diseases. Among those who had chronic diseases, 36.8% of patients were identified as having hypertension, respiratory diseases (24.2%), type II diabetes (21.1%), musculoskeletal disorders (14.7%), and cardiovascular diseases (10.5%).

In our sample, we found that in terms of the prevalence of common post-COVID symptoms, fatigue was one of the most common symptoms of the condition (64.9%), and more than half of COVID-19 patients had cough, dyspnea, and shortness of breath (57.1%, 53.2%, 52.9%, respectively). Less typical symptoms included headache (34.2%), insomnia (26.6%), palpitations (25.9%), myalgia (23.9%), difficulty thinking or concentrating (20.7%), memory loss (19.3%), loss of appetite (12.7%), joint pains (10.2%), abdominal pain (7.1%), and altered sense of smell and taste (6.1%; 5.9%).

In particular, a cough was most prevalent among long-term COVID-19 symptoms of visiting patients at the clinic (41.5%), followed by fatigue (36.6%), dyspnea (32.7%), shortness of breath (29.5%), headache (13.4%), and palpitations (12.7%). Among those with long-term COVID-19, 86.1% of participants were visiting the outpatient clinic for the first time, 12% were on their second visit, and 1.5% were visiting for the third time. Among the 57 patients who had undergone a first-time examination, most had a reduced symptom burden of long-term COVID-19 (70.2%).

Table 3 shows the prevalence and severity of depression. Overall, 97 (23.7%) out of 410 patients completed the Vietnamese version of the PHQ-9 and indicated high risk of depression. A total of

80.4% had a moderate form of depression. Moderately severe to severe symptoms of depression were reported by 16.5% and 3.1% of respondents, respectively.

Table 4 shows a statistically significant association between depression and demographic-economic-social characteristics: age group, religious affiliation, education degree, marital status, employment status, and frequency of communication between family members and patients. The difference was statistically significant ( $p < 0.05$ ).

There was a statistically significant association between depression and post-COVID-19 characteristics: hospital admission due to COVID-19, post-COVID-19 symptoms, and the most common symptoms in patients at the clinic. The difference was statistically significant ( $p < 0.05$ ).

The results of the analysis using the logistic regression regression model recorded the following variables: chronic illness, post-COVID-19 symptoms, including chest pain, loss of appetite, and symptoms that lead patients to seek medical attention, such as loss of appetite (Table 5).

There is a statistically significant association between depression and patients with chronic illness. The group of individuals with chronic illness had a depression rate 1.87 times higher (95% CI: 1.18–2.97) than the group without chronic illness, with a  $p = 0.008$ .

There was a statistically significant association between depression and post-COVID-19 chest pain symptoms. The group of individuals with chest pain symptoms had a depression rate 2.16 times higher (95% CI: 1.38–3.39) than the group without chest pain symptoms, with a  $p = 0.001$ .

There is a statistically significant association between depression and post-COVID-19 loss of appetite symptoms. The group of individuals with loss of appetite symptoms had a depression rate 1.97 times higher (95% CI: 1.16–3.36) than the group without loss of appetite symptoms, with a  $p = 0.012$ .

There is a statistically significant association between depression and post-COVID-19 symptoms, leading patients to seek medical attention. The group of individuals with loss of appetite symptoms had a depression rate 2.39 times higher (95% CI: 1.07–5.35) than the group without loss of appetite symptoms, with a  $p = 0.035$ .

## 4 | DISCUSSION

This study highlights the prevalence and associated factors of depression among patients with post-COVID-19 conditions, adding valuable insights to the increasing amount of literature on the mental health impact of the pandemic. Our findings indicate that depression is prevalent among post-COVID-19 patients, with a significant portion of the study population experiencing moderate to severe symptoms. This aligns with existing studies that have reported high rates of depression among individuals recovering from COVID-19.<sup>9–11</sup>

Physical activity has been widely recognized as beneficial for mental health, and our study supports this evidence. A substantial

**TABLE 3** The prevalence and severity of depression ( $n = 410$ ).

Characteristics	$n$ (%)
High risk of depression ( $\geq 10$ points) (yes)	97 (23.7)
Classification of depression	
Moderate	78 (80.4)
Moderately severe	16 (16.5)
Severe	3 (3.1)

**TABLE 4** Prevalence ratio (PR) and 95% confidence interval (95% CI) of factors associated with depression ( $n = 410$ ).

Characteristics	Depression		<i>p</i> value	PR (95% CI)
	Yes ( $n = 97$ )	No ( $n = 313$ )		
Age group, years				
≥50	35 (42.7)	47 (57.3)	<0.001	2.26 (1.61–3.16)
<50	62 (18.9)	266 (81.1)		
Religious affiliation				
Religion	39 (32.5)	81 (67.5)	0.007	1.63 (1.15–2.30)
No religion	58 (20.0)	232 (80.0)		
Education degree				
Elementary or less	10 (52.6)	9 (47.4)	<0.001 <sup>b</sup>	1
Secondary school	23 (42.6)	31 (57.4)		
High school	19 (19.8)	77 (80.2)		
Higher education	45 (18.7)	196 (81.3)		
Employment status				
Full-time	34 (18.1)	154 (81.9)	0.015	0.64 (0.44–0.92)
Others	63 (28.4)	159 (71.6)		
Marital status				
Married	76 (27.3)	202 (72.7)	0.011	1.72 (1.11–2.66)
Single	21 (15.9)	111 (84.1)		
Frequency of communication between family members and patients				
Regular	78 (21.6)	283 (78.4)	0.008	0.56 (0.37–0.83)
Irregular	19 (38.8)	30 (61.2)		
Hospital admission due to COVID-19				
Yes	9 (56.3)	7 (43.7)	0.004	2.52 (1.57–4.03)
No	88 (22.3)	306 (77.7)		
Chronic diseases				
Yes	36 (37.9)	59 (62.1)	<0.001	1.96 (1.39–2.76)
No	61 (19.4)	254 (80.6)		
Hypertension				
Yes	20 (57.1)	15 (42.9)	0.003	2.14 (1.29–3.56)
No	16 (26.7)	44 (73.3)		
Post-COVID-19 symptoms				
Shortness of breath				
Yes	63 (29.0)	154 (71.0)	0.007	1.65 (1.14–2.38)
No	34 (17.6)	159 (82.4)		
Palpitations				
Yes	40 (37.7)	66 (62.3)	<0.001	2.01 (1.43–2.82)
No	57 (18.8)	247 (81.2)		
Fatigue				
Yes	78 (29.3)	188 (70.7)	<0.001	2.22 (1.40–3.51)
No	19 (13.2)	125 (86.8)		

**TABLE 4** (Continued)

Characteristics	Depression		p value	PR (95% CI)
	Yes (n = 97)	No (n = 313)		
Headache				
Yes	45 (32.1)	95 (67.9)	0.004	1.67 (1.18–2.35)
No	52 (19.3)	218 (80.7)		
Abdominal pain				
Yes	13 (44.8)	16 (55.2)	0.005	2.03 (1.30–3.17)
No	84 (22.1)	297 (77.9)		
Difficulty thinking or concentrating (brain fog)				
Yes	33 (38.8)	52 (61.2)	<0.001	1.97 (1.40–2.79)
No	64 (19.7)	261 (80.3)		
Insomnia				
Yes	40 (36.7)	69 (63.3)	<0.001	1.94 (1.38–2.72)
No	57 (18.9)	244 (81.1)		
Loss of appetite				
Yes	30 (57.7)	22 (42.3)	<0.001	3.08 (2.24–4.23)
No	67 (18.7)	291 (81.3)		
The most common symptoms in patients at the clinic				
Cough				
Yes	31 (18.2)	139 (81.8)	0.030	0.66 (0.45–0.97)
No	66 (27.5)	174 (72.5)		
Dyspnea				
Yes	44 (32.8)	90 (67.2)	0.002	1.70 (1.21–2.40)
No	53 (19.2)	223 (80.8)		
Shortness of breath				
Yes	39 (32.2)	82 (67.8)	0.008	1.60 (1.14–2.27)
No	58 (20.1)	231 (79.9)		
Fatigue				
Yes	49 (32.7)	101 (67.3)	0.001	1.77 (1.25–2.49)
No	48 (18.5)	12 (81.5)		
Loss of appetite				
Yes	7 (87.5)	1 (12.5)	<0.001 <sup>b</sup>	3.91 (2.84–5.38)
No	90 (22.4)	312 (77.6)		

<sup>a</sup>Fisher's exact test.

<sup>b</sup>The chi-square test for trend.

proportion of our participants engaged in regular physical activity, which is crucial for both physical and mental recovery. This finding is consistent with the study by Margarida Rodrigues et al.,<sup>12</sup> which demonstrated significant improvements in physical and mental health parameters following rehabilitation.

Respondents report that 69.8% had their third or fourth booster shot, similar to what was reported in Vietnam on June 20 by the

Ministry of Health.<sup>13</sup> This report describes that the percentages of 1, 2, 3, and 4 COVID-19 messenger RNA vaccine doses among over 18-year-olds were 100%, 100%, 64.5%, and 11.5%, respectively. After initial repeat coronavirus infections, the proportion of re-infected patients was 10.5%. Reinfection with COVID-19 with a low percentage showing the efficiency of the COVID-19 vaccination campaign launched 5K messages (face mask, disinfection, distance,



**TABLE 5** Logistic regression analysis of risk factors.

Characteristics	<i>p</i> value	Unadjusted PR (95% CI)	<i>p</i> value <sup>a</sup>	Adjusted PR (95% CI)
Chronic diseases				
Yes	<0.001	1.96 (1.39–2.76)	0.008	1.87 (1.18–2.97)
No				
Post-COVID-19 symptoms				
Palpitations				
Yes	<0.001	2.01 (1.43–2.82)	0.001	2.16 (1.38–3.39)
No				
Loss of appetite				
Yes	<0.001	3.08 (2.24–4.23)	0.012	1.97 (1.16–3.36)
No				
The most common symptoms in patients at the clinic				
Loss of appetite				
Yes	<0.001	3.91 (2.84–5.38)	0.035	2.39 (1.07–5.35)
No				

Abbreviations: CI, confidence interval; PR, prevalence ratio.

<sup>a</sup>Variables with  $p \leq 0.2$  were excluded from the model.

no gathering, and health declaration) and citizen compliance with government recommendations.

Common comorbidities among our participants included hypertension, respiratory diseases, and diabetes mellitus. The study conducted by Marwa Kamal et al.<sup>14</sup> showed that most (83.3%) of the moderate-severe patients had comorbidities (type II diabetes, asthma, and hypertension). These comorbidities have been frequently reported in other studies as well, highlighting the need for comprehensive care strategies that address both physical and mental health in post-COVID-19 patients

The most prevalent post-COVID-19 symptoms in our study were fatigue, cough, dyspnea, and shortness of breath, which significantly impact daily activities and quality of life. These symptoms are consistent with findings from other studies.<sup>14–17</sup> Fatigue was the most frequent symptom in patients, and other studies have also reported this along with dyspnea and cough as common post-COVID-19 symptoms.<sup>18</sup> Goertz et al.<sup>19</sup> also reported that a significant number of patients continued to experience respiratory symptoms 3 months post-infection.

The study revealed that 23.7% of all respondents identified depression as a score of  $\geq 10$  on the PHQ-9. In particular, of depressive patients, 80.4% of respondents reported moderate, 16.5% moderately severe, and 3.1% severe. The difference in post-COVID-19 depression between studies is likely due to studies conducted over different times and differing criteria for the evaluation of long-term COVID-19 patients.<sup>10,11,14</sup> In addition, a study by Zhang et al.<sup>20</sup> showed that the most commonly included depression instruments were used, with DASS-21 being the most popular (50%), along with the PHQ-9 (31.8%), for a total of 82,890 respondents. As in postacute COVID-19 patients, patients may

experience a decline in psychological and cognitive functioning after a mean follow-up of 13 weeks.<sup>21</sup> Factors influencing depression included age categories, religion, education degree, employment status, marital status, levels of family care, hospital admission due to COVID-19, chronic diseases, hypertension, and post-COVID-19 symptoms (shortness of breath, palpitations, fatigue, headache, abdominal pain, insomnia, brain fog, and loss of appetite).<sup>21</sup>

From a management perspective, the high prevalence of depression and its associated factors among post-COVID-19 patients underscore the need for integrated mental health services within the healthcare system. Health authorities should prioritize mental health screening for post-COVID-19 patients and provide accessible mental health support services. Additionally, policies promoting regular physical activity and comprehensive care for those with chronic diseases could mitigate the long-term mental health impacts of COVID-19. Training healthcare providers to recognize and address mental health issues in post-COVID-19 care is also crucial for improving patient outcomes and quality of life.

This study has several limitations. First, the cross-sectional design limits the ability to establish causality. Second, the use of self-reported measures for depression may introduce response bias. Additionally, the sample was drawn from a single outpatient clinic, which may limit the generalizability of the findings to other settings or populations. Future studies should aim to include a more diverse sample and consider longitudinal designs to better understand the long-term impacts of post-COVID-19 conditions.

In conclusion, our study highlights the significant prevalence of depression among patients with post-COVID-19 conditions. The findings



emphasize the need for targeted mental health interventions and policies to support those affected by the pandemic. Understanding the factors associated with depression in this population is crucial for developing effective strategies to mitigate the long-term mental health impacts of COVID-19.

### AUTHOR CONTRIBUTIONS

**Nguyen Thanh Binh:** Conceptualization; investigation; methodology; writing—original draft. **Tran Thien Thuan:** Conceptualization; writing—review and editing; supervision. **Nguyen Hoang Tan Luc:** Investigation; formal analysis; data curation; writing—review and editing. **Ho Tat Bang:** Conceptualization; methodology; software; investigation; writing—review and editing. **Le Thi Diem Trinh:** Supervision; project administration; writing—review and editing.

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The authors have nothing to report.

### CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### ETHICS STATEMENT

This study was reviewed and approved by the Institute Ethics Committee of the University of Medicine and Pharmacy at Ho Chi Minh City (Ref. No.: 358/HDDD-DHYD/30.03.2022).

### TRANSPARENCY STATEMENT

The lead author Ho Tat Bang affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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