



Depression, anxiety, insomnia, and quality of life in hospitalized COVID-19 patients

Papan Thaipsisuttikul^{a,*}, Tantawan Awirutworakul^b, Manusporn Manatsathit^b,
Winitra Kaewpila^b, Saratcha Tiensuntisook^b, Pratana Cheeveewat^b

^a Department of Psychiatry, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

^b Chakrinabodindra Medical Institute, Faculty of Medicine Ramathibodi Hospital, Samutprakarn, Thailand

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ABSTRACT

Objectives: This study aimed to estimate the prevalence of anxiety, depression, and insomnia among hospitalized COVID-19 patients and explore factors associated with these conditions.

Methods: This cross-sectional study was conducted in a COVID-19 cohort ward between July 2020 and December 2022. Patients completed a questionnaire via telephone interview or Google Forms during their admission period.

Results: From 2020 to 2022, 270 patients who were hospitalized with COVID-19 consented to participate. The prevalence rates of depression, anxiety, and insomnia were 19.8%, 7%, and 6.7%. Preexisting psychiatric illness was associated with depression, anxiety, and insomnia. Patients with preexisting psychiatric illnesses tended to report low subjective depression scores. Factors associated with high subjective anxiety scores were hospitalization during the high disease prevalence period, a high level of education, and preexisting psychiatric illness. Patients with a substance abuse history tended to report low anxiety scores subjectively.

Conclusions: The rates of depression, anxiety, and insomnia among patients with COVID-19 in our study were lower than those in previous studies from the first year of the pandemic. Preexisting psychiatric illness was the major significant risk for depression, anxiety, and insomnia. Therefore, regular monitoring and early care for these patients are very important.

1. Introduction

COVID-19 became a major concern worldwide after the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic in March 2020. Government policies to combat the spread of COVID-19 impacted patients, medical professionals, and everyone in the community (Kordi et al., 2023; Kubota et al., 2023; Liu et al., 2021; Mazza et al., 2020; Wu et al., 2021). During the period when the prevalence of COVID-19 was high, depression, anxiety, and insomnia were common among affected patients, partly because of the need for isolation and resulting reduced social interaction. Concerns about the possibility of developing severe disease among older people and those with multiple comorbidities were prominent, especially at the beginning of the pandemic when there was no standard treatment and the overall prognosis was poor. Stigmatization from being labeled as “infected” and fear of spreading infection among family members could also affect patients' psychological well-being. Furthermore, social distancing

policies impacted everyone in various ways. Communication with people outside the hospital was difficult for patients, especially for older people who did not have smartphones or other electronic devices. A meta-analysis of studies conducted in 2020 reported pooled prevalence rates of depression, anxiety, and insomnia among patients with COVID-19 of 38%, 38%, and 48%, respectively (Liu et al., 2021). The prevalence of these psychological problems was slightly higher in patients with COVID-19 compared with the general population (pooled prevalence rates of 31.4%, 31.9%, 41.1%, and 37.9% for depression, anxiety, distress, and insomnia, respectively) as reported in another meta-analysis involving studies conducted in the same year (Wu et al., 2021). These common psychological problems could continue to impact patients even after the acute phase of the disease, which were referred to as “long COVID psychological symptoms” (Kubota et al., 2023; Mazza et al., 2020). Another study found higher anxiety among patients with COVID-19 compared with those without COVID-19 and healthy participants, although depression was not higher (Kordi et al., 2023).

* Corresponding author.

E-mail addresses: papan.jar@mahidol.edu, papanthai@gmail.com (P. Thaipsisuttikul).

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However, during the pandemic period, more became known about the disease, and vaccines were developed to prevent severe illness.

A meta-analysis reported factors associated with depression, anxiety, and insomnia in patients with COVID-19 were female sex, physical or psychiatric disorders, COVID-19 infection, infected colleagues or family members, being a frontline worker, a history of close contact with patients, high exposure risk, quarantine experience, and having serious concerns about the pandemic (Yuan et al., 2022). Female sex was also associated with long COVID syndrome in a prospective cohort study (Bai et al., 2022). A cross-sectional study from Morocco found age, oxygen saturation level, hospital stay, and family infection with COVID-19 were associated with both anxiety and depression; however, gender was only associated with depression (Saidi et al., 2021). A study involving quarantined patients with COVID-19 found a positive correlation between the level of C-reactive protein, and Patient Health Questionnaire-9 (PHQ-9) total score (Guo et al., 2020).

Quality of life (QoL) is another important issue for patients with COVID-19, as many health and social policies could impact QoL during the pandemic (e.g., social isolation and difficulty accessing medical services). One study found COVID-19 substantially impacted health-related QoL among patients with acute and long COVID (Poudel et al., 2021). Other factors may affect patients' health-related QoL, such as age, comorbidities, and severity of illness. Studies on long-term COVID related to QoL have not yet been fully developed.

The objective of this study was to estimate the prevalence of anxiety, depression, and insomnia and clarify changes in QoL among hospitalized COVID-19 patients at Chakrinaruebodindra Medical Institute (CNMI) cohort ward. We also aimed to explore factors associated with these conditions.

2. Methods

2.1. Study design, setting, and participants

This cross-sectional study was conducted between July 2020 and December 2022. The inclusion criterion was patients with COVID-19 who were admitted to the CNMI cohort ward. All patients received an explanation about this study. Patients who agreed to participate in the study gave either written consent via Google Forms or verbal consent for a telephone interview. After consenting, patients completed the questionnaire upon admission in a telephone interview or using Google Forms. Patients were excluded from this study if they were considered medically unstable, transferred to the intensive care unit, had severe psychiatric symptoms (e.g., psychosis, severe depression, severe anxiety), or were unable to communicate in the Thai language (Fig. 1). This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand (COA.MURA 2020/1029). All participants were informed about the study objectives and their freedom to participate in or withdraw from the study. Sample size calculation was performed based on the prevalence of depression, anxiety, and insomnia from the previous meta-analysis (30%–48%) allowing for a prevalence error of 20%. The study should include at least 225 participants ($p = 0.3$, $d = 0.06$).

Admission criteria were changed over time due to government policy and the availability of vaccines and medication. In the first year of the pandemic, 2020, during Wuhan and G strain, without vaccine and effective anti-viral available, every COVID-19 case was admitted to the hospital. After the availability of vaccine in Thailand for the general population in 2021, the admission criteria were changed to clinical

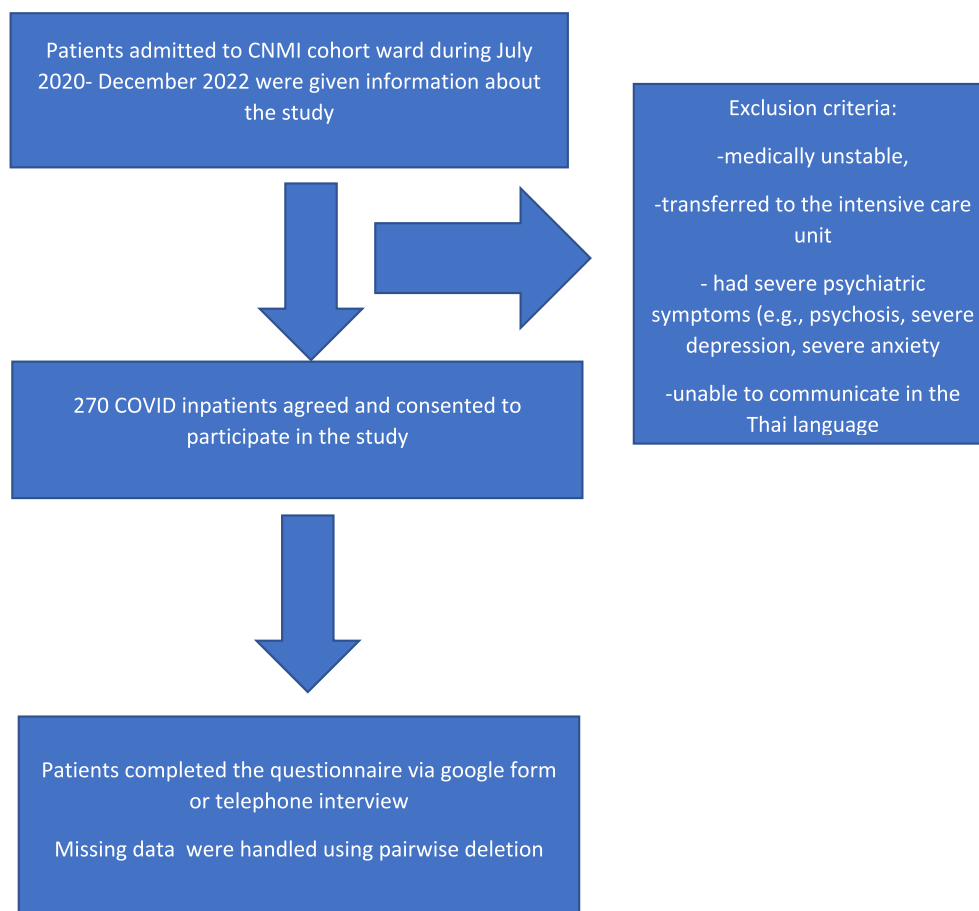


Fig. 1. Study flow chart.

symptoms of the patients, including; (1) fever of 39 degrees Celsius or over, (2) oxygen saturation <94%, (3) showing complications on previous underlying diseases, (4) at risk for severe illness, for example, elderly or having multiple medical conditions and no caregiver taking care off at home. The duration of admission was also changed over time. In 2020, the duration of admission was 14 days, then decreased to 7 days in 2021 and up to patients' clinical symptoms later on.

Participants with underlying psychiatric illnesses can be consulted to see a psychiatrist upon request. Participants with a history of substance use disorder or alcohol use disorder who stopped using within 7 days would be seen by psychiatrists to evaluate for substance/alcohol withdrawal and medications would be prescribed to treat withdrawal symptoms, if needed. Psychological and social support were individualized for the patient's needs.

2.2. Measurements

Demographic data collected were age, sex, education, history of psychiatric illness, and history of substance abuse. History of psychiatric illness was defined as any lifetime episode of psychiatric illness that needed treatment, and history of substance abuse was defined as any lifetime period of substance abuse. Both histories were subjectively reported by participants. Participants were also asked to subjectively rate their mood (e.g., depressed) and anxiety on a scale from 0 to 10. Phases of the pandemic were classified by the timeline of patient infection (Kanchalearnpong & Putthisri, 2023), as classified by the Thai Ministry of Health: Wuhan (January to November 2020), G (December 2020 to March 2021), alpha (April to June 2021), beta (July to December 2021), and omicron (January 2022 to the end of this study).

All questionnaires were in the Thai language. The PHQ-9 (Lotrakul et al., 2008) was used to detect depression, with a cut-off score of ≥ 9 indicating significant moderate depression symptoms. The General Anxiety Disorder-7 (GAD-7) (Spitzer et al., 2006) was used to detect anxiety, with a cut-off score of ≥ 10 indicating significant anxiety symptoms. The Insomnia Severity Index (Gagnon et al., 2013) was used to detect insomnia and a cut-off score of ≥ 15 indicated significant insomnia problems. Finally, QoL was assessed with the WHOQOL-BREF (Mahatnirunkul et al., 1998), which evaluates QoL in four domains: physiological, psychological, social, and environmental. Participants' scores were classified as poor, moderate, or good QoL in each domain.

2.3. Statistical analyses

We performed statistical analysis using SPSS 18.0 for Windows. Data cleaning was done manually by a biostatistician to ensure consistency of information. Missing data were handled using pairwise deletion. Descriptive statistics were used to assess the prevalence rates of depression, anxiety, and insomnia, and the level of QoL in participating patients. Chi-square or Fisher's exact tests were used to compare categorical data. Paired and independent *t*-tests or nonparametric tests were used to compare continuous data. We conducted univariate analyses to compare participants with and without depression, with and without anxiety, with and without insomnia, and with poor vs. moderate vs. good QoL in the four domains (physical, psychological, social, and environmental). A *p*-value ≤ 0.05 was considered statistically significant. Multivariate analyses were performed for risk assessment and adjustment for confounding factors using linear regression for depression, anxiety, and insomnia models.

3. Results

3.1. Basic demographic data, the prevalence of depression, anxiety, insomnia, and quality of life

From 2020 to 2022, 270 patients hospitalized with COVID-19 at CNMI agreed to participate in our study. The majority (60%) of

participants were female. Participants were from different phases of the pandemic: Wuhan (19.6%), G (15.2%), alpha (48.5%), delta (12.6%), and omicron (4.1%). The average age of participants was 36.7 years. Most participants had at least 12 years of education (58.8%). Only 6.5% of participants had a history of psychiatric illness, and 9.5% had a history of substance abuse. About 20% of participants had significant depressive symptoms, 7% had significant anxiety symptoms, and 6.7% had significant insomnia symptoms. The average subjective mood (depression) scores on the scale from 0 to 10 at admission and discharge were 7.44 ± 2.01 and 8.20 ± 1.24 , respectively. The average subjective anxiety scores on the scale from 0 to 10 at admission and discharge were 4.74 ± 3.10 and 2.80 ± 2.40 , respectively. Most participants reported moderate or good QoL in all four domains: physical (99.1%), psychological (98.3%), social (97.9%), and environmental (97.8%). Participants' WHOQOL-BREF scores for the physical, psychological, social, and environmental domains were 234, 233, 236, and 233, respectively (Table 1).

3.2. Factors associated with depression, anxiety, insomnia, and quality of life

Factors that had statistically significant associations with depression were younger age and a preexisting psychiatric illness (Table 2). No factors showed a statistically significant association with anxiety using a GAD-7 score of ≥ 10 (Table 2). However, factors that had a statistically significant association with subjective anxiety score on admission were phase of infection, level of education, history of psychiatric illness, and history of substance abuse. Participants infected during the omicron, alpha, and delta waves reported higher perceived anxiety compared with those infected during the Wuhan and G phases. Factors associated with insomnia were being female and having a preexisting psychiatric illness (Table 3). However, no factors were significantly associated with physical, psychological, social, and environmental QoL (Table 4).

Table 1
Participants' demographic data.

Demographics	Participants (N = 270), n (%)
Female	160 (59.7)
Phase	
Wuhan	53 (19.6)
G	41 (15.2)
Alpha	131 (48.5)
Delta	34 (12.6)
Omicron	11 (4.1)
Age, years	36.72 ± 13.58 (range: 18–88)
Education	
<12 years	106 (41.2)
≥ 12 years	151 (58.8)
History of psychiatric illness	17 (6.5)
History of substance abuse	25 (9.5)
Subjective mood score (0–10) on admission, mean \pm SD	7.44 ± 2.01^a
Subjective mood score (0–10) at discharge, mean \pm SD	8.20 ± 1.24^b
Subjective anxiety score (0–10) on admission, mean \pm SD	4.74 ± 3.10^a
Subjective anxiety score (0–10) at discharge, mean \pm SD	2.80 ± 2.40^b
PHQ-9, ≥ 9 points	53 (19.8) ^a
GAD-7, ≥ 10 points	19 (7.0) ^a
Insomnia Severity Index, ≥ 15 points	18 (6.7) ^c
Quality of life	
Physical, moderate-good	232 (99.1) ^d
Psychological, moderate-good	229 (98.3) ^e
Social, moderate-good	231 (97.9) ^f
Environment, moderate-good	228 (97.8) ^g

Participants: a = 268, b = 33, c = 270, d = 234, e = 233, f = 236, g = 233. PHQ-9 = Patient Health Questionnaire-9, GAD-7 = General Anxiety Disorder-7.

Table 2

Factors associated with depression and anxiety.

	Depression (PHQ-9 ≥ 9 points) n = 53 n (%)	No depression (PHQ-9 < 9 points) n = 215 n (%)	p- Value	Subjective depressed score (0–10) Median (IQR)	p- Value	Anxiety (GAD- 7 ≥ 10 points) n = 19 n (%)	No anxiety (GAD-7 < 10 points) n = 249 n (%)	p- Value	Subjective anxiety score (0–10) Median (IQR)	p- Value
Sex			0.33		0.06			0.76		0.65
Female	35 (21.9)	125 (78.1)		8.0 (3.0)		34 (21.4)	125 (78.6)		5.0 (5.0)	
Male	18 (17.0)	88 (83.0)		8.0 (2.0)		12 (7.5)	147 (92.5)		5.0 (5.0)	
Age, years, mean \pm SD	30.0 \pm 12.0	34.0 \pm 21.0	0.007	7.41 (2.0)	0.54	33.5 \pm 22.0	34.0 \pm 21.0	0.82	5.0 (2.0)	0.49
Phase			0.16		0.14			0.63		0.00*
Wuhan	9 (17.3)	43 (82.7)		8.0 (4.0)		3 (5.7)	99 (93.4)		2.0 (4.0)	
G	3 (7.5)	37 (92.5)		8.0 (1.0)		41 (2.4)	40 (97.6)		3.0 (6.0)	
Alpha	33 (25.2)	98 (74.8)		8.0 (3.0)		12 (9.2)	118 (90.8)		6.0 (3.6)	
Delta	6 (17.6)	28 (82.4)		8.0 (2.0)		2 (6.1)	31 (93.9)		5.0 (6.0)	
Omicron	2 (18.2)	9 (81.8)		8.0 (2.0)		21 (9.1)	10 (90.9)		6.0 (2.0)	
Education			0.66		0.07			0.66		0.02*
<12 years	20 (19.0)	85 (81.0)		8.0 (2.0)		7 (6.6)	99 (93.4)		5.0 (6.0)	
≥ 12 years	32 (21.3)	118 (78.7)		8.0 (3.0)		12 (8.1)	137 (91.9)		5.0 (4.0)	
Psychiatric illness	9 (52.9)	8 (47.1)	0.002	6.0 (4.0)	0.01*	3 (17.6)	14 (82.4)	0.12	6.0 (3.5)	0.04*
Substance use	8 (32)	17 (68.0)	0.13	6.5 (3.0)	0.06	3 (12.0)	22 (88.0)	0.41	2.0 (5.0)	0.003

PHQ-9 = Patient Health Questionnaire-9, GAD-7 Generalized Anxiety Disorder-7, SD = standard deviation, IQR = interquartile range.

* p < 0.05.

Table 3

Factors associated with insomnia.

	Insomnia (Insomnia Severity Index ≥ 15 points) n = 18 n (%)	No insomnia (Insomnia Severity Index < 15 points) n = 252 n (%)	p- Value
Sex			
Female	16 (10.0)	144 (90.0)	0.01*
Male	2 (1.9)	106 (98.1)	
Age, years, mean \pm SD	24.5 \pm 23.0	34.0 \pm 19.0	0.07
Phase			
Wuhan	3 (5.7)	50 (94.3)	0.68
G	1 (2.4)	40 (97.6)	
Alpha	11 (8.4)	120 (91.6)	
Delta	2 (5.9)	32 (94.1)	
Omicron	1 (9.1)	10 (90.9)	
Education			
<12 years	4 (3.8)	102 (96.2)	0.09
≥ 12 years	14 (9.3)	137 (90.7)	
Psychiatric illness	5 (29.4)	12 (70.6)	0.003
Substance use	2 (8.0)	23 (92.0)	0.66

SD = standard deviation.

* p < 0.05.

3.3. Multivariate analyses

Results from the multivariate analyses to determine the risk factors for depression, anxiety, and insomnia are presented in Table 5. History of psychiatric illness was the major significant risk for depression, anxiety, and insomnia, while the phase of high prevalence was only marginally significant for insomnia. Participants who had a history of psychiatric illness had increased PHQ-9 by 3.2 scores, GAD-7 by 2.65 scores, and ISI by 4.25 scores compared to those without a psychiatric illness history. However, patients with a history of psychiatric illness reported lower subjective depression scores than patients without a history of psychiatric illness (by 1.19 points). Patients with 1 step higher level of education reported higher subjective anxiety scores than those with less education (by 0.51 points). Patients with a history of psychiatric illness tended to report higher subjective anxiety scores (by 1.55 points), and patients with a history of substance use disorder tended to

report lower subjective anxiety scores (by 1.66 points) compared with those without such histories. Patients who were infected during the high disease prevalence period tended to report higher subjective anxiety scores (by 0.44 points) than those infected during other periods.

4. Discussion

Our participants were recruited during the 3 years of the COVID-19 pandemic, 2020–2022, and included patients who were infected with Wuhan, G, alpha, delta, and omicron variants. The prevalence rates of anxiety and depression as determined by the GAD-7 and PHQ-9 were 7% and 19.8%, respectively, which were lower than rates reported in meta-analyses conducted in the first year of the COVID-19 pandemic (Liu et al., 2021; Wu et al., 2021). The lower total prevalence over time could be attributed to various reasons, such as better knowledge of the disease, availability of vaccines and anti-viral medications, and better policies to manage the spread of the disease.

Furthermore, our study showed that although the subjective anxiety score improved at hospital discharge compared with admission, the subjective depression score did not. This contrasted with data from a previous meta-analysis that showed the prevalence of psychiatric disorders in patients with COVID-19 decreased over time (Kordi et al., 2023). A possible explanation for this finding is that the more complex psychopathology of depression cannot be simply relieved by admission to hospital or psychological support. In contrast, outbreak-related anxiety may be relieved (Chen et al., 2021). Another recent study also supported our finding that anxiety was more related to the COVID-19 infection state compared with depression (Kordi et al., 2023). However, one limitation of our study is that the number of participants reported on the subjective anxiety and depression scale at discharge was relatively lower than those reported on admission.

Our study found preexisting psychiatric illness was associated with depression, which was consistent with previous studies (Bai et al., 2022; Saidi et al., 2021; Yuan et al., 2022). However, participants with a preexisting psychiatric illness tended to report lower subjective depression scores than those without a preexisting condition. This can represent a problem-reported emotional awareness, as previously reported in MDD patients (Dunne et al., 2021), and also supported the difference between depression as determined by a PHQ-9 score and a cross-sectional depressed feeling as determined by a subjective

Table 4

Factors associated with physical, psychological, social and environmental quality of life.

	Physical quality of life (n = 232)			p-Value	Psychological quality of life (n = 233)			p-Value
	Poor n (%)	Moderate n (%)	Good n (%)		Poor n (%)	Moderate n (%)	Good n (%)	
Sex				0.95				0.62
Female	1 (0.7)	81 (59.1)	55 (40.1)		3 (2.2)	76 (55.5)	58 (42.3)	
Male	1 (1.1)	57 (60.0)	37 (38.9)		1 (1.1)	48 (51.1)	45 (47.9)	
Age, years, mean \pm SD	55 \pm 21.0	34 \pm 19.0	32 \pm 21.0	0.23	43 \pm 35.0	33 \pm 18.0	34 \pm 22.0	0.50
Phase				0.71				0.71
Wuhan	0 (0)	16 (51.6)	15 (48.4)		0 (0)	14 (45.2)	17 (54.8)	
G	0 (0)	19 (52.8)	17 (47.2)		0 (0)	22 (61.1)	14 (38.9)	
Alpha	2 (1.6)	79 (63.2)	44 (35.2)		4 (3.2)	70 (56.0)	51 (40.8)	
Delta	0 (0)	21 (65.6)	11 (34.4)		0 (0)	16 (51.6)	15 (48.4)	
Omicron	0 (0)	5 (50.0)	5 (50.0)		0 (0)	4 (40.0)	6 (60.0)	
Education				0.89				0.42
<12 years	1 (1.1)	54 (58.1)	38 (40.9)		1 (1.1)	55 (59.8)	36 (39.1)	
\geq 12 years	1 (0.7)	81 (60.4)	52 (38.8)		3 (2.2)	68 (50.7)	63 (47.0)	
Psychiatric illness	0 (0)	6 (37.5)	10 (62.5)	0.19	0 (0)	11 (68.8)	5 (31.3)	0.48
Substance abuse	0 (0)	5 (41.7)	7 (58.3)	0.31	0 (0)	10 (83.3)	2 (16.7)	0.13

	Social quality of life (n = 234)			p-Value	Environmental quality of life (n = 233)			p-Value
	Poor n (%)	Moderate n (%)	Good n (%)		Poor n (%)	Moderate n (%)	Good n (%)	
Sex				0.86				0.27
Female	3 (2.2)	71 (51.1)	65 (46.8)		3 (2.2)	83 (60.1)	52 (37.7)	
Male	2 (2.1)	45 (47.4)	48 (50.5)		2 (2.2)	51 (54.8)	40 (43.0)	
Age, years, mean \pm SD	40 \pm 33.0	30 \pm 17.0	35 \pm 22.0	0.19	40 \pm 29.0	30 \pm 17.0	35 \pm 24.0	0.09
Phase				0.85				0.27
Wuhan	0 (0)	13 (41.9)	18 (58.1)		0 (0)	14 (45.2)	17 (54.8)	
G	1 (2.7)	17 (45.9)	19 (51.4)		0 (0)	22 (61.1)	14 (38.9)	
Alpha	4 (3.2)	63 (50.0)	59 (46.8)		4 (3.2)	70 (56.5)	50 (40.3)	
Delta	0 (0)	19 (59.4)	13 (40.6)		0 (0)	22 (68.8)	10 (31.3)	
Omicron	0 (0)	6 (60.0)	4 (40.0)		1 (10.0)	7 (70.0)	2 (20.0)	
Education				0.59				0.34
<12 years	3 (3.2)	48 (51.1)	43 (45.7)		3 (3.2)	58 (62.4)	32 (34.4)	
\geq 12 years	2 (1.5)	66 (48.9)	67 (49.6)		2 (1.5)	74 (55.6)	57 (42.9)	
Psychiatric illness	1 (6.3)	8 (50.0)	7 (43.8)	0.44	0 (0)	10 (62.5)	6 (37.5)	1.00
Substance abuse	0 (0)	3 (25.0)	9 (75.0)	0.16	0 (0)	5 (41.7)	7 (58.3)	0.42

SD = standard deviation.

depression score; therefore, a subjective score alone may not be enough to determine a participant's depression state. Participants with preexisting psychiatric illnesses tended to report higher anxiety scores on GAD-7 compared to participants without preexisting conditions, which was congruent with a previous study (Dai et al., 2022). Many factors were associated with participants' subjective anxiety scores. Those with COVID-19 infection in periods of high disease prevalence (e.g., omicron, alpha, and delta waves) reported higher subjective anxiety scores compared with the early phases with lower disease prevalence (0.44 points), which was consistent with a previous study in young adults (Matic et al., 2022). Participants with a higher education level or a preexisting psychiatric illness tended to report higher subjective anxiety scores than those with a lower education level or no preexisting illness (0.51 and 1.55 points, respectively), which was congruent with a previous study (Yuan et al., 2022). In contrast, participants with a history of substance use disorder tended to report lower subjective anxiety scores (1.66 points) than those without such a history, which differed from a previous study (Yuan et al., 2022). A possible explanation is that substances may be used to reduce anxiety. Our hospital protocol for participants with a history of substance use who stopped using within 7 days or who show any signs of withdrawal would be evaluated by a psychiatrist, and medication would be prescribed if necessary. It is important to note that the history of substance use was solely based on participants' reports.

The prevalence of insomnia, as determined by an Insomnia Severity Index score of ≥ 15 (6.7%), was significantly lower than the incidence found in previous studies (Liu et al., 2021; Wu et al., 2021). Previous

studies used lower cut-off scores for the Insomnia Severity Index than our study (e.g., ≥ 8) or other tools like the Pittsburgh Sleep Quality Index (Liu et al., 2021; Wu et al., 2021). However, we used ≥ 15 as the cut-off score to measure significant moderate insomnia because subthreshold mild insomnia could be triggered by being admitted to the hospital, resulting in a lower prevalence. We found participants with a history of psychiatric disorders had a significant risk for insomnia, which was similar to risk factors found in a non-COVID-19 population in a previous study (Morin & Jarrin, 2022) and participants who were admitted during the high prevalence of disease, such as omicron phase, would have slightly increased ISI by 0.67 scores. The previous neuroimaging study proposed a pathophysiology mechanism involved when omicron invades the nervous system and induces various forms of insomnia (Du et al., 2024). Unfortunately, due to the limited data gathering time, especially in the early phase of infection, while standard policy recommends keeping small contact time with COVID-19 patients, subjective details of patients' sleep patterns and concerns were not collected in our study.

Most (97%–99%) of our participants had moderate to good QoL in all four domains (physical, psychological, social, and environmental). Because few participants were in the low QoL group, no factors were associated with low QoL across the four domains.

The preexisting psychiatric illness appeared to be a significant risk factor for depression, anxiety, and insomnia in our study. These underlying conditions can be triggered by the stress caused by COVID-19 infection. On the other hand, studies (Taquet et al., 2021; Toubasi et al., 2021) have shown that psychiatric disorders are a risk factor for

Table 5
Multivariate analyses of factors influencing depression, anxiety, and insomnia.

Variables	B (coefficient)	Standard error	p- Value	95% confidence interval
Linear regression model for depression by PHQ-9 score				
Age	−0.02	0.02	0.24	−0.07–0.02
History of psychiatric illness	3.20	1.12	0.005	0.99–5.41*
Education	0.02	0.57	0.97	−1.10–1.15
Sex	0.55	0.56	0.33	−0.55–1.66
History of substance abuse	1.52	1.02	0.14	−0.48–3.52
Phase of infection with higher prevalence	0.46	0.30	0.12	−0.12–1.04
Linear regression model for anxiety by GAD-7 score				
Age	−0.01	0.02	0.64	−0.04–0.03
History of psychiatric illness	2.65	0.97	0.007	0.74–4.56*
Education	0.34	0.49	0.49	−0.63–1.31
Sex	0.24	0.48	0.62	−0.72–1.19
History of substance abuse	0.40	0.88	0.65	−1.33–2.12
Phase of infection with higher prevalence	0.21	0.25	0.40	−0.29–0.71
Linear regression model for insomnia by ISI score				
Age	−0.01	0.02	0.82	−0.05–0.04
Sex	0.65	0.64	0.31	−0.61–1.91
History of psychiatric illness	4.23	1.29	0.001	1.69–6.77*
Education	1.06	0.65	0.11	−0.23–2.34
History of substance abuse	−0.32	1.16	0.78	−2.61–1.97
Phase of infection with higher prevalence	0.67	0.34	0.05	0.01–1.33*
Linear regression model for depression by subjective depression score				
Age	0.02	0.01	0.1	−0.003, 0.03
Sex	0.31	0.26	0.24	−0.20, −0.81
History of psychiatric illness	−1.19	0.51	0.02	−2.18, −0.2*
Education	−0.11	0.16	0.47	−0.42, 0.19
History of Substance abuse	−0.80	0.46	0.08	−1.7, 0.10
Phase of infection	−0.13	0.13	0.33	−0.39, 0.13
Linear regression model for anxiety by subjective anxiety score				
Age	−0.01	0.01	0.36	−0.04, 0.02
Sex	−0.16	0.38	0.68	−0.92, 0.60
Education	0.51	0.23	0.03	0.05, 0.98*
History of psychiatric illness	1.55	0.77	0.04	0.04, 3.07*
History of substance abuse	−1.66	0.69	0.02	−3.02, −0.29*
Phase of infection with higher prevalence	0.44	0.20	0.03	0.04, −0.83*

PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Disorder-7 ISI = Insomnia Severity Index.

* p < 0.05.

the development of COVID-19 infection and are associated with a poor prognosis. Therefore, regular monitoring and early care for these patients are very important.

The strengths of our study included the long study duration, coverage of several pandemic periods from 2020 to 2022, and the reporting of both scale and subjective scores for depression and anxiety to determine depression and anxiety state and cross-sectional depressive and anxiety feelings. However, our study had some limitations. First,

this study was conducted in a COVID-19 inpatient setting. The results may not be generalizable to patients with COVID-19 in other settings such as those who are treated at outpatient clinics or intensive care units. A previous study (Dai et al., 2022) found the severity of COVID-19 was positively correlated with depression as a result of central nervous system damage due to the disease. However, our long-duration study covering patients with different staging on admission, from very small symptoms in the first phase of COVID to clinically significant symptoms in the late phase of admission, may not be able to confirm this hypothesis at this point. Second, the questionnaire could be completed by telephone interview or Google Forms; patients who completed the questionnaire using Google Forms had more missing data than those completed by phone interview. Some older patients may have had difficulty completing the questionnaire by themselves. Additionally, detailed and lengthy questionnaires, like WHO-QOL-brief may not be the most appropriate tool to measure QoL in the acute phase of COVID-19 infection because the 26 questions require cooperation and a significant amount of concentration to complete. In addition, some questions were not relevant to the inpatient setting, such as questions about the household environment and commuting ability. For further studies, we suggest using other tools that focus on health-related QoL. Finally, our study aimed to cover the duration of the COVID-19 pandemic situation between July 2020 and December 2022; it is important to keep in mind that each stage of the pandemic could have differing psychological impacts on patients with COVID-19.

For future research, advancing survey content with specific questions and tailored questionnaires for COVID-19 patients and developing tools for elderly-friendly or patients with physical limitations during pandemics would be beneficial.

5. Conclusion

The prevalence rates of depression, anxiety, and insomnia in participants hospitalized during 2020–2022 in the COVID-19 cohort ward were 19.8%, 7%, and 6.7%, respectively. A history of psychiatric illness was a major independent risk factor for depression, anxiety, and insomnia. Patients with a history of psychiatric illness also tended to report lower subjective depression scores than those without such a history. Factors associated with higher subjective anxiety scores were hospitalization during the high disease prevalence period, high level of education, and preexisting psychiatric illness. Substance use was associated with a low subjective anxiety score. No factors were associated with QoL, as most patients reported moderate or good QoL. Although the subjective anxiety scores improved between admission and discharge, subjective mood scores did not. This confirms there is a difference between the complex psychopathology of depression and COVID-19 outbreak-related anxiety. The difference we observed for depression and anxiety determined by scale and subjective report scores also supported this hypothesis.

The prevalence rates of depression, anxiety, and insomnia in patients with COVID-19 in our study were not as high as in previous studies conducted in the first year of the pandemic. This may be attributable to better knowledge, better management, and adaptation to the pandemic. However, depression, anxiety, and insomnia remain significant problems among COVID-19 patients. Early detection and management are essential. Subjective depression score alone may not be enough to determine a patient's depression state since patients with preexisting psychiatric illnesses tended to report lower scores than others.

CRedit authorship contribution statement

Papan Thaipisuttikul: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Tantawan Awirutworakul:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Manusorn Manatsathit:** Writing – review & editing,

Methodology, Investigation, Conceptualization. **Winitra Kaewpila:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Saratcha Tiensuntisook:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Pratana Cheeveewat:** Writing – review & editing, Methodology, Investigation, Conceptualization.

Consent for publication

All authors have approved and consented to this submission.

Ethics approval

This study was conducted following the Declaration of Helsinki and approved by the Ethical Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand (COA.MURA 2020/1029).

Ethical approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board and the Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand (COA.MURA 2020/1029). All participants were informed about the study objectives, their freedom to participate in or withdraw from the study. Patients who agreed to participate in the study gave either written consent via Google Forms or verbal consent for a telephone interview, which was witnessed by nursing staff.

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Declaration of competing interest

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

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Data availability

The original contributions presented in this study are included in the article; dataset was available upon reasonable request to corresponding author.

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