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Article

Mental Health Outcomes Among Healthcare Workers During and After the First COVID-19 Outbreak at a Thai Tertiary Hospital

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Abstract

Background: Healthcare workers (HCWs) caring for patients with coronavirus disease 2019 (COVID-19) face substantial psychological stress during pandemic outbreaks. While global evidence documents high rates of anxiety, depression, and burnout among HCWs, data from Thailand remain limited, particularly regarding temporal changes in mental health across outbreak phases. This study assessed the prevalence of anxiety, depression, and burnout among HCWs caring for COVID-19 patients at a Thai tertiary hospital and examined factors associated with these outcomes. **Methods:** A cross-sectional study was conducted between July and September 2020 at Rajavithi Hospital, Bangkok, Thailand. Healthcare workers (n=86) who provided direct care to confirmed COVID-19 patients were recruited using stratified random sampling. Participants retrospectively reported mental health symptoms during the peak outbreak period (January–April 2020) and completed assessments of current symptoms. Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS), and burnout was assessed using the Maslach Burnout Inventory (MBI). Paired t-tests compared mental health scores between time periods, and multivariable logistic regression identified factors associated with depression, anxiety, and burnout. **Results:** Among 86 healthcare workers (mean age 35.2±8.4 years; 73.3% female; 44.2% nurses), mean anxiety scores were significantly higher during the peak outbreak compared with the post-outbreak period (8.2±4.1 vs. 6.5±3.8, p<0.001, Cohen's d=0.43). The prevalence of clinically significant anxiety (HADS-A ≥8) decreased from 45.3% during the outbreak to 29.1% post-outbreak (p=0.012). Similarly, clinically significant depression (HADS-D ≥8) declined from 38.4% to 22.1% (p=0.008), with mean depression scores decreasing from 7.6±3.9 to 5.8±3.5 (p<0.001, Cohen's d=0.48). Emotional exhaustion scores decreased from 24.8±12.3 during the outbreak to 19.7±11.5 post-outbreak (p<0.001), while depersonalization scores declined from 8.9±5.6 to 6.4±4.8 (p<0.001). However, 29.1% of participants continued to experience anxiety and 22.1% experienced depression after the outbreak subsided. In multivariable analysis, short sleep duration (<6 hours/night; adjusted OR=3.84, 95% CI: 1.52–9.71, p=0.004), use of sleeping medication (adjusted OR=4.21, 95% CI: 1.38–12.85, p=0.012), and caring for critically ill COVID-19 patients (adjusted OR=2.67, 95% CI: 1.08–6.59, p=0.033) were significantly associated with depression. **Conclusions:** Healthcare workers caring for COVID-19 patients experienced substantial psychological distress during the peak outbreak period, with nearly half reporting clinically significant anxiety and over one-third reporting depression. Although mental health indicators improved significantly after the outbreak subsided, persistent symptoms remained in approximately one-quarter to one-third of staff. Sleep disturbance, caring for critically ill patients, and working in high-intensity COVID-19 care settings emerged as key risk factors. These findings underscore the need for sustained organizational support, targeted mental health screening for high-risk groups, and evidence-based interventions to protect HCW wellbeing during and beyond public health emergencies.

Keywords: COVID-19; healthcare workers; burnout; anxiety; depression; mental health; Thailand; pandemic

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in Wuhan, China, in December 2019 and rapidly evolved into an unprecedented global health crisis [1]. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, marking one of the most significant public health emergencies in modern history [2]. By March 31, 2020, Thailand had reported 1,651 confirmed cases with multiple deaths, prompting the government to implement emergency public health measures including lockdowns, travel restrictions, and enhanced infection control protocols [3].

Healthcare workers (HCWs) have been at the forefront of the pandemic response, providing essential care to infected patients while facing unprecedented challenges. Global evidence rapidly accumulated documenting substantial mental health burdens among HCWs during COVID-19. Large-scale meta-analyses synthesizing data from over 250 studies across multiple countries have reported pooled prevalence estimates of approximately 38% for anxiety, 34% for depression, and 37–47% for burnout among HCWs during the pandemic [4,5]. These rates substantially exceed pre-pandemic baseline levels and highlight the profound psychological toll of pandemic healthcare delivery.

Healthcare workers caring for COVID-19 patients face multiple, compounding psychological stressors. These include excessive workloads and extended working hours due to staff shortages and surges in patient volumes, constant fear of infection and transmitting the virus to family members, inadequate personal protective equipment (PPE) in many settings, moral distress from resource allocation decisions and witnessing high mortality rates, social isolation and stigmatization, and rapidly evolving clinical protocols creating uncertainty [6,7]. The cumulative effect of these stressors places HCWs at elevated risk for anxiety, depression, post-traumatic stress disorder (PTSD), and burnout [8,9].

Burnout, characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment, represents a particularly concerning outcome given its associations with reduced quality of care, medical errors, and workforce attrition [10]. The limbic brain structures involved in stress response and emotional regulation are implicated in burnout pathophysiology, suggesting neurobiological underpinnings of this occupational syndrome [11]. During the COVID-19 pandemic, burnout rates among frontline HCWs have been alarmingly high, with some studies reporting prevalence exceeding 70% [12].

Historical evidence from previous infectious disease outbreaks provides important context for understanding HCW mental health during COVID-19. Studies following the 2003 SARS outbreak documented long-term psychological and occupational effects among HCWs who provided hospital care during the epidemic [13]. Healthcare workers exposed to SARS patients experienced elevated rates of PTSD, depression, and anxiety that persisted for years after the outbreak ended. Similarly, research following the 2015 Middle East Respiratory Syndrome (MERS) outbreak in South Korea found significant psychological distress among exposed HCWs [14]. These findings underscore that mental health impacts may extend well beyond the acute outbreak period, necessitating sustained support and monitoring.

While international evidence on HCW mental health during COVID-19 has accumulated rapidly, data from Southeast Asian contexts, including Thailand, have been more limited. Understanding mental health outcomes in diverse cultural and healthcare system contexts is essential for developing culturally appropriate interventions and informing regional policy responses.

Recent Thai studies have begun to document the mental health burden among HCWs during COVID-19. A national online survey of 417 Thai HCWs during the first wave (March–April 2020) using the Depression Anxiety Stress Scale (DASS-21) found that 21.1% reported mild to extremely

severe depression, 22.5% reported anxiety, and 15.3% reported stress [15]. Direct care of COVID-19 inpatients was associated with significantly higher odds of anxiety (adjusted OR=3.41, 95% CI: 1.58–7.35) and stress (adjusted OR=2.96, 95% CI: 1.30–6.73). Inadequate PPE, poor management readiness, and fear of infecting family members emerged as key organizational risk factors.

A larger cross-sectional survey of 986 HCWs at a Bangkok tertiary hospital assessed burnout using the Maslach Burnout Inventory-General Survey (MBI-GS) alongside anxiety (GAD-7) and depression (PHQ-9) [16]. The study found that 16.3% experienced high emotional exhaustion, 16.0% high depersonalization, and 53.5% diminished personal achievement. Anxiety prevalence was 33.1% and depression 13.8%. Working in COVID-19 inpatient or intensive care units was associated with substantially elevated odds of emotional exhaustion (adjusted OR≈3.00), and preexisting mental illness strongly predicted anxiety (adjusted OR=2.89), depression (adjusted OR=3.47), and PTSD (adjusted OR=4.06).

A nationwide study examining burnout across two periods in 2021 (May–June and September–October) among over 3,000 Thai HCWs found persistently high burnout prevalence of 73.0% and 73.5% respectively, with no significant change between periods [17]. Risk factors included low salary (≤40,000 THB), high patient load (>20 patients per shift), excessive after-hours shifts (>6 per month), and insufficient rest days (≤1 per week).

Despite these important contributions, several gaps remain in understanding HCW mental health during COVID-19 in Thailand. First, most existing studies assessed mental health at a single time point, limiting understanding of temporal changes across outbreak phases. Second, few studies have examined the full spectrum of mental health outcomes anxiety, depression, and burnout simultaneously in the same population. Third, data on mental health trajectories from peak outbreak periods to post-outbreak recovery phases are limited, particularly from tertiary hospitals managing high volumes of critically ill COVID-19 patients.

Understanding temporal patterns of mental health symptoms is crucial for several reasons. It can identify whether symptoms are resolved naturally as outbreak intensity decreases or persist, requiring ongoing intervention. It can reveal critical periods when HCWs are most vulnerable and may benefit from intensified support. It can inform the timing and duration of mental health interventions and resource allocation. Additionally, examining factors associated with adverse mental health outcomes can identify high-risk groups requiring targeted screening and support.

Study Objectives

This study aimed to address these gaps by assessing the prevalence of anxiety, depression, and burnout among HCWs caring for COVID-19 patients at a major Thai tertiary hospital, comparing mental health outcomes during the first peak outbreak period (January–April 2020) with the post-outbreak period (July–September 2020), and identifying demographic, occupational, and clinical factors associated with depression, anxiety, and burnout. We hypothesized that mental health indicators would be significantly worse during the peak outbreak compared with the post-outbreak period, but that a substantial proportion of HCWs would continue to experience persistent symptoms. We further hypothesized that factors such as direct care of critically ill patients, sleep disturbance, and inadequate rest would be associated with adverse mental health outcomes.

Methods

Study Design and Setting

This cross-sectional study with retrospective assessment was conducted at Rajavithi Hospital, a 1,000-bed tertiary care teaching hospital in Bangkok, Thailand, serving as a designated COVID-19 treatment center. The hospital managed both moderate and severe COVID-19 cases, including patients requiring intensive care and mechanical ventilation. Data collection occurred between July 1 and September 30, 2020, corresponding to the post-outbreak period after Thailand's first wave of COVID-19 had substantially subsided. During this period, participants completed assessments of

their current mental health status and retrospectively reported their mental health symptoms during the peak outbreak period (January–April 2020), when Thailand experienced its first major surge in COVID-19 cases.

Participants and Sampling

The study population comprised HCWs who provided direct care to patients with laboratory-confirmed COVID-19 at Rajavithi Hospital between January and September 2020. Eligible participants included physicians, nurses, nursing assistants, and other clinical staff (e.g., respiratory therapists, radiologic technologists) who had direct patient contact in COVID-19 designated areas including emergency departments, inpatient wards, and intensive care units.

Stratified random sampling was employed to ensure representation across professional groups and clinical areas. The sampling frame was constructed from hospital human resources records identifying all staff assigned to COVID-19 care areas. Participants were stratified by profession (physicians, nurses, nursing assistants, other clinical staff) and work area (emergency department, general COVID-19 ward, intensive care unit). Random selection within each stratum was performed using computer-generated random numbers.

Sample size was calculated based on the primary outcome of depression prevalence. Assuming an expected depression prevalence of 35% based on early international reports [18], with a precision of $\pm 10\%$ and 95% confidence level, the required sample size was 87 participants. The calculation used the formula for single proportion: $n = Z^2 P(1-P)/d^2$, where $Z=1.96$, $P=0.35$, and $d=0.10$ [19]. This calculation was performed using the n4Studies application [20].

Data Collection Procedures

Data were collected through self-administered questionnaires distributed to eligible participants during July–September 2020. Research assistants approached potential participants during work breaks or shift changes, explained the study purpose and procedures, obtained written informed consent, and distributed questionnaire packets. Participants completed questionnaires privately and returned them in sealed envelopes to maintain confidentiality. The questionnaire required approximately 20–25 minutes to complete.

For the retrospective assessment of mental health during the peak outbreak period (January–April 2020), participants were asked to recall and rate their symptoms during that specific timeframe using the same validated instruments. Clear instructions emphasized recalling symptoms experienced during the peak outbreak months. While retrospective recall introduces potential for recall bias, this approach was necessitated by the rapid onset of the pandemic, which precluded prospective baseline data collection.

Measures

Demographic and Occupational Characteristics

A structured questionnaire collected information on age, sex, marital status, profession (physician, nurse, nursing assistant, other), years of clinical experience, work area (emergency department, general COVID-19 ward, intensive care unit), involvement in care of critically ill COVID-19 patients, average hours worked per week, and sleep patterns (average hours per night, use of sleeping medication).

Anxiety and Depression

Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS), a widely used 14-item self-report instrument comprising two 7-item subscales measuring anxiety (HADS-A) and depression (HADS-D) [21]. Each item is rated on a 4-point scale (0–3), yielding subscale scores ranging from 0 to 21. Scores of 0–7 indicate normal, 8–10 indicate borderline abnormal

(mild), and 11–21 indicate abnormal (moderate to severe) symptoms. For this study, we used a cutoff score of ≥ 8 to define clinically significant anxiety or depression, consistent with established guidelines and previous research.

The Thai version of the HADS has been validated in Thai populations, demonstrating good internal consistency (Cronbach's $\alpha=0.85$ for HADS-A and 0.82 for HADS-D) and acceptable sensitivity and specificity for detecting anxiety and depressive disorders [22]. The HADS was selected because it excludes somatic symptoms that may overlap with physical illness or fatigue, making it particularly suitable for use in medical populations.

Burnout

Burnout was measured using the Maslach Burnout Inventory (MBI), the most widely used instrument for assessing occupational burnout [23]. The MBI comprises three subscales: Emotional Exhaustion (EE; 9 items) measuring feelings of being emotionally overextended and exhausted by work, Depersonalization (DP; 5 items) measuring impersonal response toward recipients of care, and Personal Accomplishment (PA; 8 items) measuring feelings of competence and achievement in work. Items are rated on a 7-point frequency scale (0=never to 6=every day).

Subscale scores are categorized as low, moderate, or high based on established cutoff values. For Emotional Exhaustion: low (≤ 16), moderate (17–26), high (≥ 27). For Depersonalization: low (≤ 6), moderate (7–12), high (≥ 13). For Personal Accomplishment: low (≤ 31), moderate (32–38), high (≥ 39), with low scores indicating greater burnout. High burnout is indicated by high scores on Emotional Exhaustion and/or Depersonalization, and/or low scores on Personal Accomplishment.

The Thai version of the MBI has been validated and used in previous studies of Thai healthcare workers, demonstrating acceptable psychometric properties [24]. For this study, we used the Thai translation that has been employed in prior research at Rajavithi Hospital.

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics summarized participant characteristics, with continuous variables presented as means and standard deviations ($M \pm SD$) and categorical variables as frequencies and percentages.

Paired-samples *t*-tests compared mean anxiety, depression, and burnout subscale scores between the peak outbreak period and post-outbreak period. Effect sizes were calculated using Cohen's *d*, with values of 0.2, 0.5, and 0.8 representing small, medium, and large effects respectively. McNemar's test compared the proportions of participants meeting criteria for clinically significant anxiety and depression between time periods.

Univariable logistic regression analyses examined associations between demographic and occupational variables and three binary outcomes: clinically significant depression (HADS-D ≥ 8), clinically significant anxiety (HADS-A ≥ 8), and high emotional exhaustion (MBI-EE ≥ 27) during the post-outbreak period. Variables with $p < 0.20$ in univariable analyses were entered into multivariable logistic regression models. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test.

Statistical significance was set at $p < 0.05$ (two-tailed). Given the exploratory nature of some analyses and the limited sample size, we did not apply corrections for multiple comparisons, but we interpret findings cautiously and emphasize effect sizes alongside *p*-values.

Ethical Considerations

This study was approved by the Institutional Review Board of Rajavithi Hospital (approval number: 136/2563). All participants provided written informed consent after receiving detailed information about the study purpose, procedures, voluntary nature of participation, confidentiality protections, and their right to withdraw at any time without consequences. No identifying information was recorded on questionnaires, which were assigned unique identification numbers.

Data were stored securely with access limited to the research team. Participants experiencing significant psychological distress were provided with information about available mental health support services at the hospital.

Results

Participant Characteristics

A total of 86 healthcare workers completed the study (response rate: 98.9% of the target sample of 87). Table 1 presents the demographic and occupational characteristics of participants. The mean age was 35.2±8.4 years (range: 24–58 years). The majority were female (73.3%, n=63), married or in a relationship (58.1%, n=50), and had completed bachelor’s degree education (69.8%, n=60).

Regarding professional roles, nurses comprised the largest group (44.2%, n=38), followed by physicians (26.7%, n=23), nursing assistants (17.4%, n=15), and other clinical staff including respiratory therapists and radiologic technologists (11.6%, n=10). Mean clinical experience was 9.7±7.2 years. Work areas included COVID-19 general wards (48.8%, n=42), intensive care units (29.1%, n=25), and emergency departments (22.1%, n=19). Over half of participants (55.8%, n=48) reported direct involvement in caring for critically ill COVID-19 patients requiring intensive care or mechanical ventilation.

Participants reported working an average of 52.3±12.6 hours per week during the peak outbreak period. Regarding sleep patterns during the post-outbreak assessment period, mean sleep duration was 6.2±1.3 hours per night, with 38.4% (n=33) reporting sleeping less than 6 hours per night. Use of sleeping medication was reported by 19.8% (n=17) of participants.

Table 1. Demographic and occupational characteristics of participants (N=86).

Characteristic	n (%) or M±SD
Demographics	
Age (years), M±SD	35.2±8.4
Female sex	63 (73.3%)
Marital status	
Single	36 (41.9%)
Married/partnered	50 (58.1%)
Education level	
Diploma	18 (20.9%)
Bachelor’s degree	60 (69.8%)
Master’s degree or higher	8 (9.3%)
Occupational characteristics	
Profession	
Physician	23 (26.7%)
Nurse	38 (44.2%)
Nursing assistant	15 (17.4%)
Other clinical staff	10 (11.6%)
Years of clinical experience, M±SD	9.7±7.2
Work area	
COVID-19 general ward	42 (48.8%)
Intensive care unit	25 (29.1%)
Emergency department	19 (22.1%)
Care of critically ill COVID-19 patients	48 (55.8%)
Average hours worked per week, M±SD	52.3±12.6
Sleep patterns (post-outbreak period)	
Average sleep duration (hours/night), M±SD	6.2±1.3
Sleep duration <6 hours/night	33 (38.4%)
Use of sleeping medication	17 (19.8%)

Prevalence and Temporal Changes in Anxiety and Depression

Table 2 presents anxiety and depression scores during the peak outbreak period and post-outbreak period. Mean anxiety scores (HADS-A) were significantly higher during the peak outbreak compared with the post-outbreak period (8.2±4.1 vs. 6.5±3.8, $p<0.001$). The effect size was moderate (Cohen’s $d=0.43$), indicating a meaningful clinical difference. Similarly, mean depression scores (HADS-D) were significantly higher during the peak outbreak (7.6±3.9 vs. 5.8±3.5, $p<0.001$, Cohen’s $d=0.48$).

The prevalence of clinically significant anxiety (HADS-A ≥ 8) decreased significantly from 45.3% ($n=39$) during the peak outbreak to 29.1% ($n=25$) in the post-outbreak period (McNemar’s test, $p=0.012$). This represents a 35.8% relative reduction in anxiety prevalence. Similarly, the prevalence of clinically significant depression (HADS-D ≥ 8) declined from 38.4% ($n=33$) to 22.1% ($n=19$) ($p=0.008$), a 42.4% relative reduction.

However, despite these improvements, substantial proportions of HCWs continued to experience clinically significant symptoms in the post-outbreak period. Nearly one-third (29.1%) reported anxiety and over one-fifth (22.1%) reported depression several months after the peak outbreak had subsided. When examining symptom severity categories, 12.8% ($n=11$) of participants reported moderate to severe anxiety (HADS-A ≥ 11) and 9.3% ($n=8$) reported moderate to severe depression (HADS-D ≥ 11) during the post-outbreak period.

Table 2. Anxiety and depression scores during peak outbreak and post-outbreak periods (N=86).

Measure	Peak outbreak (Jan–Apr 2020)	Post-outbreak (Jul–Sep 2020)	Mean difference (95% CI)	t- statistic	p-value	Cohen’s d
HADS Anxiety (HADS-A)						
Mean score (SD)	8.2 (4.1)	6.5 (3.8)	1.7 (0.9–2.5)	4.18	<0.001	0.43
Clinically significant (≥ 8), n (%)	39 (45.3%)	25 (29.1%)	—	—	0.012*	—
Moderate-severe (≥ 11), n (%)	22 (25.6%)	11 (12.8%)	—	—	0.021*	—
HADS Depression (HADS-D)						
Mean score (SD)	7.6 (3.9)	5.8 (3.5)	1.8 (1.0–2.6)	4.52	<0.001	0.48
Clinically significant (≥ 8), n (%)	33 (38.4%)	19 (22.1%)	—	—	0.008*	—
Moderate-severe (≥ 11), n (%)	18 (20.9%)	8 (9.3%)	—	—	0.031*	—

*McNemar’s test for paired proportions. HADS = Hospital Anxiety and Depression Scale; SD = standard deviation; CI = confidence interval.

Prevalence and Temporal Changes in Burnout

Table 3 presents burnout subscale scores during the peak outbreak and post-outbreak periods. All three burnout dimensions showed significant changes over time. Emotional Exhaustion scores decreased significantly from 24.8±12.3 during the peak outbreak to 19.7±11.5 in the post-outbreak period ($p<0.001$, Cohen’s $d=0.43$). Depersonalization scores declined from 8.9±5.6 to 6.4±4.8 ($p<0.001$, Cohen’s $d=0.48$). Personal Accomplishment scores increased from 32.4±8.7 to 35.6±8.2 ($p<0.001$, Cohen’s $d=0.38$), indicating reduced burnout on this dimension (recall that lower Personal Accomplishment scores indicate greater burnout).

Examining categorical burnout levels, the prevalence of high Emotional Exhaustion decreased from 44.2% (n=38) during the peak outbreak to 29.1% (n=25) post-outbreak (p=0.015). High Depersonalization declined from 31.4% (n=27) to 18.6% (n=16) (p=0.024). Low Personal Accomplishment (indicating burnout) decreased from 45.3% (n=39) to 30.2% (n=26) (p=0.019).

Despite these improvements, substantial proportions of HCWs continued to experience high levels of burnout dimensions in the post-outbreak period: 29.1% reported high Emotional Exhaustion, 18.6% reported high Depersonalization, and 30.2% reported low Personal Accomplishment. When applying the criterion of high burnout on at least one dimension, 52.3% (n=45) of participants met criteria for burnout during the peak outbreak, declining to 38.4% (n=33) in the post-outbreak period (p=0.028).

Table 3. Burnout subscale scores during peak outbreak and post-outbreak periods (N=86).

MBI Subscale	Peak outbreak (Jan–Apr 2020)	Post-outbreak (Jul–Sep 2020)	Mean difference (95% CI)	t- statistic	p- value	Cohen’s d
Emotional Exhaustion						
Mean score (SD)	24.8 (12.3)	19.7 (11.5)	5.1 (2.8–7.4)	4.41	<0.001	0.43
High (≥27), n (%)	38 (44.2%)	25 (29.1%)	—	—	0.015*	—
Depersonalization						
n						
Mean score (SD)	8.9 (5.6)	6.4 (4.8)	2.5 (1.3–3.7)	4.15	<0.001	0.48
High (≥13), n (%)	27 (31.4%)	16 (18.6%)	—	—	0.024*	—
Personal Accomplishment						
Mean score (SD)	32.4 (8.7)	35.6 (8.2)	-3.2 (-5.1 to -1.3)	-3.35	0.001	0.38
Low (≤31), n (%)	39 (45.3%)	26 (30.2%)	—	—	0.019*	—
Overall burnout						
High on ≥1 dimension, n (%)	45 (52.3%)	33 (38.4%)	—	—	0.028*	—

*McNemar’s test for paired proportions MBI = Maslach Burnout Inventory; SD = standard deviation; CI = confidence interval Note: For Personal Accomplishment, lower scores indicate greater burnout; negative mean difference indicates improvement (increased scores).

Factors Associated with Depression

Table 4 presents results of univariable and multivariable logistic regression analyses examining factors associated with clinically significant depression (HADS-D ≥8) during the post-outbreak period. In univariable analyses, several factors were significantly associated with depression: female sex (OR=2.84, 95% CI: 0.89–9.05, p=0.078), nursing profession compared to physicians (OR=3.12, 95% CI: 0.98–9.94, p=0.054), caring for critically ill COVID-19 patients (OR=3.45, 95% CI: 1.21–9.84, p=0.021), sleep duration <6 hours per night (OR=4.67, 95% CI: 1.68–12.97, p=0.003), and use of sleeping medication (OR=5.23, 95% CI: 1.72–15.89, p=0.004).

In the multivariable model adjusting for all significant univariable predictors, three factors remained independently associated with depression. Short sleep duration (<6 hours/night) was the strongest predictor (adjusted OR=3.84, 95% CI: 1.52–9.71, p=0.004), indicating that HCWs sleeping less than 6 hours per night had nearly four times the odds of depression compared to those sleeping 6 or more hours. Use of sleeping medication was also strongly associated with depression (adjusted OR=4.21, 95% CI: 1.38–12.85, p=0.012). Caring for critically ill COVID-19 patients remained significantly associated with depression after adjustment (adjusted OR=2.67, 95% CI: 1.08–6.59, p=0.033).

The multivariable model demonstrated acceptable fit (Hosmer-Lemeshow test: $\chi^2=6.84$, df=8, p=0.554) and explained 38.2% of variance in depression (Nagelkerke R²=0.382).

Table 4. Factors associated with clinically significant depression (HADS-D ≥8) in post-outbreak period (N=86).

Variable	Univariable analysis		Multivariable analysis	
	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Demographics				
Age (per 5-year increase)	0.89 (0.71–1.12)	0.321	—	—
Female sex	2.84 (0.89–9.05)	0.078	2.18 (0.64–7.42)	0.211
Married/partnered	1.34 (0.51–3.52)	0.552	—	—
Occupational factors				
Profession (ref: Physician)				
Nurse	3.12 (0.98–9.94)	0.054	2.31 (0.68–7.85)	0.179
Nursing assistant	2.45 (0.58–10.35)	0.223	—	—
Other clinical staff	1.87 (0.38–9.21)	0.445	—	—
Years of experience (per 5 years)	0.94 (0.76–1.16)	0.562	—	—
Work area (ref: General ward)				
Intensive care unit	1.89 (0.68–5.24)	0.223	—	—
Emergency department	1.45 (0.46–4.58)	0.526	—	—
Care of critically ill COVID-19 patients	3.45 (1.21–9.84)	0.021	2.67 (1.08–6.59)	0.033
Hours worked per week (per 10-hour increase)	1.23 (0.89–1.70)	0.208	—	—
Sleep factors				
Sleep duration <6 hours/night	4.67 (1.68–12.97)	0.003	3.84 (1.52–9.71)	0.004
Use of sleeping medication	5.23 (1.72–15.89)	0.004	4.21 (1.38–12.85)	0.012

OR = odds ratio; CI = confidence interval; ref = reference category Multivariable model: Hosmer-Lemeshow $\chi^2=6.84$, $df=8$, $p=0.554$; Nagelkerke $R^2=0.382$.

Factors Associated with Anxiety

Table 5 presents factors associated with clinically significant anxiety (HADS-A ≥8) during the post-outbreak period. In univariable analyses, significant associations were found for female sex (OR=2.67, 95% CI: 0.91–7.83, $p=0.074$), nursing profession (OR=2.89, 95% CI: 0.96–8.70, $p=0.059$), caring for critically ill COVID-19 patients (OR=2.98, 95% CI: 1.12–7.93, $p=0.029$), sleep duration <6 hours per night (OR=3.45, 95% CI: 1.34–8.88, $p=0.010$), and use of sleeping medication (OR=4.12, 95% CI: 1.42–11.95, $p=0.009$).

In multivariable analysis, sleep duration <6 hours per night (adjusted OR=2.87, 95% CI: 1.09–7.55, $p=0.033$) and use of sleeping medication (adjusted OR=3.56, 95% CI: 1.18–10.74, $p=0.024$) remained significantly associated with anxiety. Caring for critically ill patients showed a trend toward significance (adjusted OR=2.34, 95% CI: 0.86–6.37, $p=0.097$).

Table 5. Factors associated with clinically significant anxiety (HADS-A ≥8) in post-outbreak period (N=86).

Variable	Univariable analysis		Multivariable analysis	
	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Female sex	2.67 (0.91–7.83)	0.074	2.01 (0.64–6.31)	0.234
Nurse (vs. physician)	2.89 (0.96–8.70)	0.059	2.12 (0.66–6.81)	0.206
Care of critically ill COVID-19 patients	2.98 (1.12–7.93)	0.029	2.34 (0.86–6.37)	0.097
Sleep duration <6 hours/night	3.45 (1.34–8.88)	0.010	2.87 (1.09–7.55)	0.033
Use of sleeping medication	4.12 (1.42–11.95)	0.009	3.56 (1.18–10.74)	0.024

OR = odds ratio; CI = confidence interval Multivariable model: Hosmer-Lemeshow $\chi^2=5.92$, $df=8$, $p=0.656$; Nagelkerke $R^2=0.341$.

Factors Associated with Burnout

Table 6 presents factors associated with high emotional exhaustion (MBI-EE ≥ 27) during the post-outbreak period. In univariable analyses, significant associations were found for female sex (OR=2.45, 95% CI: 0.88–6.82, $p=0.087$), nursing profession (OR=3.67, 95% CI: 1.21–11.13, $p=0.022$), working in intensive care units (OR=2.78, 95% CI: 1.04–7.43, $p=0.042$), caring for critically ill COVID-19 patients (OR=3.12, 95% CI: 1.18–8.25, $p=0.022$), hours worked per week (OR per 10-hour increase=1.34, 95% CI: 1.02–1.76, $p=0.037$), and sleep duration <6 hours per night (OR=3.89, 95% CI: 1.51–10.02, $p=0.005$).

In multivariable analysis, nursing profession (adjusted OR=3.24, 95% CI: 1.02–10.29, $p=0.046$), caring for critically ill COVID-19 patients (adjusted OR=2.56, 95% CI: 0.94–6.97, $p=0.066$), and sleep duration <6 hours per night (adjusted OR=3.21, 95% CI: 1.21–8.52, $p=0.019$) were associated with high emotional exhaustion.

Table 6. Factors associated with high emotional exhaustion (MBI-EE ≥ 27) in post-outbreak period (N=86).

Variable	Univariable analysis		Multivariable analysis	
	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Female sex	2.45 (0.88–6.82)	0.087	1.89 (0.63–5.67)	0.256
Nurse (vs. physician)	3.67 (1.21–11.13)	0.022	3.24 (1.02–10.29)	0.046
Work in ICU (vs. general ward)	2.78 (1.04–7.43)	0.042	2.12 (0.76–5.91)	0.151
Care of critically ill COVID-19 patients	3.12 (1.18–8.25)	0.022	2.56 (0.94–6.97)	0.066
Hours worked per week (per 10-hour increase)	1.34 (1.02–1.76)	0.037	1.21 (0.90–1.63)	0.206
Sleep duration <6 hours/night	3.89 (1.51–10.02)	0.005	3.21 (1.21–8.52)	0.019

OR = odds ratio; CI = confidence interval; ICU = intensive care unit Multivariable model: Hosmer-Lemeshow $\chi^2=7.21$, $df=8$, $p=0.515$; Nagelkerke $R^2=0.367$.

Discussion

This study assessed mental health outcomes among healthcare workers caring for COVID-19 patients at a Thai tertiary hospital, comparing the peak outbreak period with the post-outbreak recovery phase. Four principal findings emerged. First, HCWs experienced substantial psychological distress during the peak outbreak, with 45.3% reporting clinically significant anxiety, 38.4% reporting depression, and 52.3% meeting criteria for burnout on at least one dimension. Second, mental health indicators improved significantly after the outbreak subsided, with anxiety prevalence declining by 35.8%, depression by 42.4%, and burnout by 26.6%. Third, despite these improvements, persistent symptoms remained common, with approximately one-quarter to one-third of HCWs continuing to experience clinically significant anxiety (29.1%), depression (22.1%), or burnout (38.4%) several months post-outbreak. Fourth, sleep disturbance (duration <6 hours/night and use of sleeping medication) and caring for critically ill COVID-19 patients emerged as key modifiable risk factors for adverse mental health outcomes.

Our findings align with and extend recent evidence from Thai healthcare settings. The anxiety prevalence we observed during the peak outbreak (45.3%) was higher than the 22.5% reported in a national survey of 417 Thai HCWs during the first wave using DASS-21 [15], but comparable to the 33.1% found in a larger tertiary hospital survey of 986 HCWs using GAD-7 [16]. Our depression prevalence during the peak outbreak (38.4%) was substantially higher than the 13.8% reported in the tertiary hospital survey using PHQ-9 [16] and the 21.1% in the national survey using DASS-21 [15]. These differences likely reflect variations in measurement instruments (HADS vs. GAD-7/PHQ-9 vs. DASS-21), timing of assessment relative to outbreak intensity, hospital characteristics, and sample composition.

Importantly, our study extends previous Thai research by documenting temporal changes in mental health from peak outbreak to post-outbreak periods. While previous Thai studies provided cross-sectional snapshots, our comparative assessment reveals that although symptoms improve significantly as outbreak intensity decreases, substantial residual burden persists. This finding is consistent with a Thai study comparing mental health across COVID-19 waves at Siriraj Hospital, which found significantly higher depression, anxiety, and stress scores during the more severe third wave compared to the second wave [25], suggesting that symptom severity tracks outbreak intensity but may not fully resolve between waves.

Our burnout findings warrant particular attention. The 52.3% prevalence of burnout (high on ≥ 1 MBI dimension) during the peak outbreak and 38.4% post-outbreak are substantially lower than the 73.0–73.5% reported in a nationwide Thai study across two periods in 2021 [17]. This discrepancy may reflect several factors. First, the nationwide study occurred during later, more prolonged phases of the pandemic when cumulative stress and fatigue had accumulated. Second, different MBI versions and scoring criteria may have been used. Third, our study focused on a single tertiary hospital in Bangkok, while the nationwide study included diverse settings with varying resources and support systems. The persistently high burnout rates across multiple Thai studies underscore that burnout represents a particularly intractable problem requiring sustained organizational interventions.

Our identification of caring for critically ill COVID-19 patients as a risk factor for depression (adjusted OR=2.67) and emotional exhaustion (adjusted OR=2.56) is consistent with the Thai tertiary hospital survey finding that working in COVID-19 inpatient or ICU units was associated with substantially elevated odds of emotional exhaustion (adjusted OR $\approx$ 3.00) [16]. Similarly, our finding that direct COVID-19 patient care increases risk aligns with the national survey's report that caring for COVID-19 inpatients was associated with anxiety (adjusted OR=3.41) and stress (adjusted OR=2.96) [15]. These converging findings across multiple Thai studies establish direct COVID-19 care, particularly of critically ill patients, as a robust and consistent risk factor requiring targeted interventions.

Our findings are broadly consistent with global meta-analytic evidence documenting high rates of anxiety, depression, and burnout among HCWs during COVID-19. Large-scale meta-analyses have reported pooled prevalence estimates of approximately 38% for anxiety, 34% for depression, and 37–47% for burnout [4,5]. Our peak outbreak prevalence estimates (45.3% anxiety, 38.4% depression, 52.3% burnout) fall within or slightly above these global ranges, suggesting that Thai HCWs experienced psychological burdens comparable to or exceeding international averages.

Our temporal findings showing improvement from peak outbreak to post-outbreak periods align with longitudinal evidence from other countries. A one-year observational study of 410 HCWs in Quebec, Canada, found that while burnout and anxiety remained stable between 3 and 12 months after pandemic onset (burnout: 52% vs. 51%, $p=0.66$; anxiety: 23% vs. 23%, $p=0.91$), PTSD declined from 23% to 11% ($p<0.0001$) and depression declined from 11% to 6% ($p=0.001$) [26]. This pattern with some acute symptoms declining while burnout persists mirrors our findings and suggests common psychological trajectories across diverse healthcare contexts.

However, important differences exist. The Quebec study found lower baseline anxiety (23%) and depression (11%) compared to our peak outbreak rates (45.3% and 38.4%), possibly reflecting differences in outbreak severity, healthcare system resources, cultural factors affecting symptom reporting, or measurement instruments. The Quebec study also documented that perceived organizational support was protective against burnout longitudinally [26], highlighting the importance of organizational factors that we did not directly measure but that warrant attention in Thai contexts.

Our identification of sleep disturbance as a key risk factor is strongly supported by international evidence. A Bangkok urban community survey of 517 HCWs found that sleeping ≤ 6 hours per day was associated with higher burnout scores [27]. Sleep disturbance has been consistently identified as both a symptom and a risk factor for mental health problems in HCWs during COVID-19 across

multiple countries [28,29]. The bidirectional relationship between sleep and mental health where poor sleep increases risk for depression and anxiety, which in turn further disrupt sleep creates a vicious cycle that may explain the persistence of symptoms we observed.

A key contribution of our study is documenting that while mental health improves significantly as outbreak intensity decreases, substantial residual burden persists. The 29.1% prevalence of anxiety and 22.1% prevalence of depression we observed 3–6 months after the peak outbreak represent concerning levels of ongoing distress. Several mechanisms may explain symptom persistence.

First, cumulative stress and trauma exposure during the peak outbreak may have lasting effects that do not resolve quickly. Healthcare workers witnessed high mortality rates, made difficult triage decisions, and experienced moral distress that may require extended time and active intervention to process [30]. Second, ongoing uncertainty about future waves, fear of infection, and continued disruption to normal life and work patterns may maintain elevated stress levels even when acute outbreak intensity decreases [31]. Third, burnout, once established, tends to be persistent and resistant to spontaneous recovery without targeted interventions [32]. Fourth, sleep disturbance, which we identified as a key risk factor, may perpetuate mental health problems through its effects on emotional regulation, cognitive function, and physiological stress systems [33].

The persistence of symptoms we documented underscores that mental health support for HCWs cannot be limited to acute outbreak periods but must extend into recovery phases. Longitudinal monitoring, sustained access to mental health services, and proactive outreach to high-risk groups are essential components of comprehensive workforce support strategies.

Our multivariable analyses identified three key risk factors for adverse mental health outcomes: sleep disturbance, caring for critically ill COVID-19 patients, and nursing profession. These findings have important implications for developing targeted, evidence-based interventions.

Sleep Disturbance

Short sleep duration (<6 hours/night) was the strongest predictor of depression (adjusted OR=3.84) and was also significantly associated with anxiety (adjusted OR=2.87) and emotional exhaustion (adjusted OR=3.21). Use of sleeping medication was independently associated with depression (adjusted OR=4.21) and anxiety (adjusted OR=3.56), likely indicating more severe sleep problems. These findings suggest that interventions targeting sleep should be a priority.

Evidence-based sleep interventions for healthcare workers include optimizing work schedules to allow adequate recovery time between shifts, providing education on sleep hygiene practices, creating quiet, comfortable rest areas for breaks during shifts, offering cognitive-behavioral therapy for insomnia (CBT-I), which has demonstrated efficacy in healthcare populations [34], and screening for and treating sleep disorders such as insomnia and sleep apnea. A randomized trial of a smartphone-based stress management program for hospital nurses in Vietnam and Thailand during COVID-19 demonstrated feasibility and potential efficacy of digital interventions [35], suggesting that scalable, accessible approaches may be particularly valuable in resource-constrained settings.

Caring for Critically Ill COVID-19 Patients

Direct involvement in care of critically ill COVID-19 patients was associated with elevated odds of depression (adjusted OR=2.67), anxiety (adjusted OR=2.34, trend), and emotional exhaustion (adjusted OR=2.56, trend). This finding is consistent with multiple Thai and international studies identifying frontline COVID-19 care as a robust risk factor [15,16,36]. Healthcare workers in these roles face multiple stressors including higher infection risk, witnessing severe suffering and death, making difficult treatment decisions with limited resources, and working with complex, rapidly evolving protocols.

Targeted interventions for HCWs in high-intensity COVID-19 care settings should include enhanced staffing ratios to reduce workload, regular rotation out of high-intensity areas to allow recovery, priority access to mental health support services, peer support programs and psychological debriefing, clear communication about infection control protocols and PPE adequacy, and

recognition and compensation for high-risk work. The Thai tertiary hospital survey found that perceived organizational support and clear communication were protective factors [16], suggesting that organizational interventions addressing these domains may be particularly valuable.

Nursing Profession

Nurses showed elevated odds of depression (adjusted OR=2.31, trend) and emotional exhaustion (adjusted OR=3.24) compared to physicians. This finding aligns with multiple Thai studies documenting higher burnout rates among nurses [16,17,27] and international evidence showing that nurses are at particularly high risk during COVID-19 [37]. Several factors may contribute to nurses' elevated risk including longer direct patient contact hours, greater exposure to distressing patient care situations, less control over work conditions and decision-making, lower compensation relative to workload and risk, and potential gender effects (nursing is predominantly female, and some studies suggest women report higher distress).

Interventions specifically targeting nurses should include workload reduction through improved staffing ratios, enhanced professional recognition and compensation, increased involvement in decision-making and policy development, tailored mental health support programs, and career development and advancement opportunities to enhance sense of professional accomplishment.

Thai Cultural and Contextual Considerations

While our study did not directly assess cultural factors, understanding Thai cultural context is essential for interpreting findings and developing culturally appropriate interventions. Several Thai cultural elements warrant consideration.

Mental health stigma remains substantial in Thai society, potentially leading to underreporting of symptoms and reluctance to seek help [38]. The collectivist orientation of Thai culture, emphasizing group harmony and avoiding burdening others, may discourage HCWs from expressing distress or requesting support [39]. Interventions must address stigma through education, normalize help-seeking, and provide confidential, accessible services.

The Thai cultural value of "kreng jai" (consideration, deference, reluctance to impose) may make HCWs hesitant to report inadequate resources, excessive workload, or need for support to supervisors [40]. Organizational leaders must proactively assess staff needs and create psychologically safe environments where concerns can be raised without fear of negative consequences.

Family and social support are highly valued in Thai culture and may serve as important protective factors. However, fear of transmitting COVID-19 to family members was identified as a major stressor in Thai HCWs [15]. Interventions should support family connections while addressing infection transmission concerns through clear protocols, adequate PPE, and possibly temporary housing options for HCWs who prefer to isolate from family during high-risk periods.

Buddhist principles emphasizing mindfulness, acceptance, and compassion are deeply embedded in Thai culture and may inform culturally resonant interventions. Mindfulness-based stress reduction programs adapted for Thai cultural context may be particularly acceptable and effective [41]. Integration of traditional Thai healing practices with evidence-based psychological interventions warrants exploration.

Hierarchical organizational structures common in Thai healthcare settings may affect communication, decision-making, and support provision. Interventions must work within existing organizational cultures while promoting more open communication and participatory approaches where appropriate.

Our findings have important implications for healthcare organizations and policymakers in Thailand and similar contexts.

Organizational-Level Interventions

Healthcare organizations should implement comprehensive mental health support systems including routine screening for anxiety, depression, and burnout using validated instruments, confidential counseling services with adequate staffing and accessibility, peer support programs connecting HCWs with colleagues who have experienced similar challenges, stress management and resilience training programs, and clear pathways for referral to specialized mental health care when needed.

Organizational policies should address modifiable risk factors identified in our study and previous research including optimizing work schedules to ensure adequate rest and recovery time, reducing patient-to-staff ratios in high-intensity COVID-19 care areas, ensuring adequate PPE and infection control resources, providing clear, consistent communication about policies and protocols, offering financial recognition and compensation for high-risk work, and creating opportunities for staff input into decision-making and policy development.

The Thai tertiary hospital survey found that perceived organizational support was protective [16], and the nationwide burnout study identified low salary, high patient load, excessive after-hours shifts, and insufficient rest days as key risk factors [17]. These findings converge to suggest that organizational interventions addressing workload, compensation, scheduling, and support are essential and likely to have substantial impact.

National Policy Recommendations

At the national level, Thai health authorities should consider developing national guidelines for HCW mental health support during public health emergencies, allocating dedicated funding for mental health services and programs, establishing centralized resources and expertise that can be deployed to support healthcare facilities, implementing workforce planning to ensure adequate staffing during emergencies, and conducting ongoing surveillance of HCW mental health to identify emerging problems and evaluate interventions.

The Thai Ministry of Public Health could establish a national HCW mental health task force to coordinate efforts, disseminate best practices, and provide technical assistance to healthcare facilities. Integration of HCW mental health into pandemic preparedness and response plans is essential to ensure that support systems are in place before future outbreaks occur rather than being developed reactively.

Research Priorities

Our findings highlight several research priorities for Thailand and similar contexts. Prospective longitudinal studies with baseline measurements before or early in outbreaks are needed to more rigorously examine temporal patterns and identify predictors of symptom persistence versus recovery. Intervention studies evaluating the effectiveness of specific programs (e.g., CBT-I for sleep, mindfulness-based stress reduction, peer support, organizational interventions) in Thai healthcare settings are needed to build an evidence base for practice. Mixed-methods research incorporating qualitative interviews can provide deeper understanding of HCWs' experiences, coping strategies, and preferences for support. Studies examining cultural factors, stigma, and barriers to help-seeking can inform culturally appropriate intervention design. Economic evaluations assessing the cost-effectiveness of mental health interventions can inform resource allocation decisions.

Strengths and Limitations

Strengths

This study has several strengths. We assessed multiple mental health outcomes anxiety, depression, and burnout providing a comprehensive picture of psychological distress. We used validated instruments (HADS, MBI) with established psychometric properties in Thai populations.

We compared mental health during peak outbreak and post-outbreak periods, providing insights into temporal patterns. We examined a range of demographic, occupational, and clinical factors to identify risk factors for adverse outcomes. We achieved a high response rate (98.9%), minimizing selection bias. Our sample included diverse professional groups (physicians, nurses, nursing assistants, other clinical staff) and work areas (general wards, ICUs, emergency departments), enhancing representativeness within our hospital setting.

Limitations

Several limitations must be acknowledged. First and most importantly, our assessment of mental health during the peak outbreak period was retrospective, relying on participants' recall of symptoms from 3–6 months earlier. Retrospective recall is subject to memory distortion and may be influenced by current mood states. The HADS and MBI were not designed or validated for retrospective use, and we cannot verify the accuracy of recalled symptoms. This limitation means that our temporal comparisons should be interpreted cautiously, and findings regarding changes over time should be considered preliminary pending confirmation in prospective longitudinal studies with repeated measurements.

Our sample size (n=86) was relatively small, limiting statistical power for detecting modest effects and for conducting subgroup analyses. Confidence intervals around some effect estimates were wide, indicating imprecision. Larger studies are needed to provide more precise estimates and to examine interactions between risk factors.

Our single-center design limits generalizability. Rajavithi Hospital is a large tertiary care teaching hospital in Bangkok with specific characteristics (resources, staffing, patient population, organizational culture) that may not be representative of other Thai hospitals, particularly secondary hospitals, rural hospitals, or private facilities. Multi-center studies are needed to assess generalizability across diverse healthcare settings.

We did not include a control group of HCWs not involved in COVID-19 care, limiting our ability to determine whether observed mental health problems were specifically attributable to COVID-19 care or reflected broader pandemic impacts affecting all HCWs. Comparative studies with control groups would strengthen causal inference.

We did not assess several potentially important variables including specific organizational support measures (e.g., availability of counseling services, quality of communication from leadership), detailed PPE adequacy and infection control concerns, specific coping strategies and resilience factors, family and social support, and prior mental health history. Future studies should assess these factors to provide a more complete understanding of risk and protective factors.

Our cross-sectional design (even with retrospective comparison) cannot establish causality. While we identified associations between sleep disturbance and mental health outcomes, we cannot determine whether poor sleep caused mental health problems, mental health problems caused poor sleep, or bidirectional relationships exist. Longitudinal designs with repeated measurements are needed to examine temporal sequences and causal pathways.

Self-report measures are subject to social desirability bias and may not correspond perfectly with clinical diagnoses. While the HADS and MBI are validated screening instruments, they do not replace comprehensive clinical assessment. Some participants meeting screening criteria may not meet diagnostic criteria for clinical disorders, while others may underreport symptoms due to stigma or other factors.

We did not correct for multiple comparisons in our analyses, increasing the risk of Type I error (false positives). Given the exploratory nature of some analyses and our limited sample size, we chose to report all findings with p-values and confidence intervals, allowing readers to judge the strength of evidence. However, findings should be interpreted cautiously and require replication.

Our study was conducted during Thailand's first COVID-19 wave in 2020. Subsequent waves have differed in terms of viral variants, vaccination availability, treatment options, and cumulative pandemic fatigue. Findings may not generalize to later pandemic phases or future outbreaks.

Future Research Directions

Based on our findings and limitations, we recommend several directions for future research. Prospective longitudinal studies with baseline measurements and repeated follow-ups (e.g., at 3, 6, 12, and 24 months) are needed to rigorously examine temporal patterns of mental health symptoms, identify predictors of symptom persistence versus recovery, and assess long-term outcomes. Such studies should ideally begin before or early in outbreaks to capture true baseline data.

Intervention studies are urgently needed to evaluate the effectiveness of specific programs in Thai healthcare settings. Randomized controlled trials or quasi-experimental designs should assess interventions targeting sleep (e.g., CBT-I, schedule optimization), organizational factors (e.g., workload reduction, enhanced support), and individual-level factors (e.g., mindfulness-based stress reduction, peer support). Economic evaluations should be incorporated to assess cost-effectiveness and inform resource allocation.

Multi-center studies including diverse hospital types (tertiary, secondary, rural, private) and regions of Thailand are needed to assess generalizability and identify setting-specific factors. National surveys with large, representative samples can provide population-level estimates and examine regional variations.

Mixed-methods research incorporating qualitative interviews and focus groups can provide rich, contextual understanding of HCWs' lived experiences, coping strategies, barriers to help-seeking, and preferences for support. Qualitative findings can inform intervention design and implementation strategies.

Studies examining cultural factors, stigma, and help-seeking behaviors in Thai HCWs are needed to develop culturally appropriate interventions. Research should explore how Thai cultural values (e.g., *kreng jai*, collectivism, Buddhist principles) influence mental health experiences and support-seeking, and how interventions can be adapted to align with cultural values.

Research on specific high-risk groups identified in our study (HCWs with sleep disturbance, those caring for critically ill patients, nurses) should examine mechanisms linking risk factors to outcomes and test targeted interventions for these populations.

Studies examining organizational factors (leadership, communication, support systems, resources) and their relationships with HCW mental health can inform organizational interventions. Multilevel analyses examining individual, team, and organizational factors simultaneously can provide insights into leverage points for intervention.

Research on the long-term career impacts of pandemic-related mental health problems, including workforce retention, job satisfaction, and quality of care, can help quantify the broader consequences and make the case for investment in mental health support.

Conclusions

Healthcare workers caring for COVID-19 patients at a Thai tertiary hospital experienced substantial psychological distress during the peak outbreak period, with nearly half reporting clinically significant anxiety (45.3%), over one-third reporting depression (38.4%), and over half meeting criteria for burnout (52.3%). While mental health indicators improved significantly after the outbreak subsided, persistent symptoms remained common, with approximately one-quarter to one-third of HCWs continuing to experience clinically significant anxiety (29.1%), depression (22.1%), or burnout (38.4%) several months later.

Sleep disturbance emerged as the strongest modifiable risk factor, with short sleep duration and use of sleeping medication strongly associated with depression, anxiety, and emotional exhaustion. Caring for critically ill COVID-19 patients and nursing professions were also significant risk factors. These findings underscore the need for comprehensive, sustained mental health support for healthcare workers during and beyond public health emergencies.

Healthcare organizations should implement routine mental health screening, provide accessible counseling services, address modifiable risk factors through workload reduction and schedule

optimization, and offer targeted interventions for high-risk groups. National health authorities should develop guidelines, allocate resources, and integrate HCW mental health into pandemic preparedness plans. Future research should employ prospective longitudinal designs, evaluate intervention effectiveness, and examine cultural factors to inform evidence-based, culturally appropriate support strategies.

The COVID-19 pandemic has highlighted the critical importance of protecting the mental health and wellbeing of healthcare workers who serve on the frontlines of public health emergencies. Investing in comprehensive mental health support is not only an ethical imperative but also essential for maintaining a resilient, effective healthcare workforce capable of responding to current and future health crises.

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Data Availability Statement: The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical restrictions but are available from the corresponding author on reasonable request and with appropriate ethical approval.

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