ORIGINAL ARTICLE

# Prevalence of mental health problems and associated factors of Thai healthcare workers during the first wave of COVID-19 pandemic

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## ABSTRACT

The purpose of this cross-sectional, national online survey was to assess the magnitude of mental health problems and to identify job task and organizational factors associated with mental health outcomes during the COVID-19 pandemic among healthcare workers in Thailand. The data were collected during the first wave of the COVID-19 pandemic (May 1-15, 2020). Study participants were 417 healthcare workers in public health care facilities of all 12 health regions in Thailand. Demographic data, job task and organizational factors, and mental health outcomes were collected. The mental health outcome was assessed by the Thai version of the Depression, Anxiety, and Stress Scale - 21 Items (DASS-21). Multivariate logistic regression was performed to identify factors associated with mental health outcomes. The results found that most participants were women (77.7%). The largest proportion of participants were nurses (40.5%), followed by public health officers (20.9%). The average age of participants was 41.82 years (SD=10.06). We identified 21.1%, 22.5%, and 15.3% of all respondents had mild to extremely severe depression, anxiety and stress, respectively. Caring for inpatients with COVID-19 was associated with anxiety (aOR=3.41; 95% CI= 1.34, 8.68) and stress (aOR =2.96; 95% CI= 1.11, 7.95). Lack of readiness among management to reduce infection risk, inadequate PPE, working with the fear of being infected and transmitting infection when returning home, and having patients who did not strictly adhere to guidelines were identified as risk factors for all mental health outcomes, after adjustment for confounding. Organizational approaches, such as effective management can help reduce infection of both patients and healthcare providers. These strategies may also protect the mental health of health care workers in a "new, emerging phase" or a future wave of COVID-19 cases.

**Key words:** mental health problems, covid-19, pandemic, healthcare workers, health personnel

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## INTRODUCTION

After the novel Coronavirus Disease 2019 (COVID-19) spread rapidly both locally and globally, the World Health Organization (WHO) declared that COVID-19 was a pandemic disease in March 2020.[1] At the initial phase of the outbreak, an immediate negative impact on mental health was reported among the general population. In a population-based survey conducted in China, approximately 29% and 16% of respondents reported moderate-to-severe anxiety and depression, respectively.[2] A study encompassing seven middle-income countries in Asia identified the mental health problems of Asians and revealed that Thailand had the highest stress, anxiety, and depression scores.[3] The potential hazardous impacts of COVID-19 on mental health have now been reported globally.[4,5] Governments that enacted timely stringent policies during this unprecedented crisis had a benefited impact on mental health, particularly depressive symptoms.[6] The COVID-19 pandemic has brought an unprecedented crisis and has the potential to place great strain on healthcare delivery systems. Each country was faced with the challenge of controlling the increasing rate of new COVID-19 cases. Suppressing a surge of new infections and preserving the limited capacity of the health care system, especially ICU beds, was regarded to be of paramount importance.[7,8] The healthcare delivery system in each country often responded to increasing numbers of cases by securing hospital beds, preparing intensive care units and medical equipment, and designing health care facilities to provide care in the safest way for both patients and healthcare providers. Sometimes, the health care delivery system was redesigned by postponing and delaying elective care for non-COVID-19 patients.[8–10]

During the waves of high numbers of COVID-19 cases, health care providers were at high risk of being exposed to COVID-19 from patients undergoing screening, Patients under Investigation (PUI), and confirmed COVID-19 cases. A potential consequence of COVID-19 pandemic was mental health problems amongst front-line healthcare providers. Such problems emerged particularly when the number of infections was still growing and spreading along with increasing deaths. The challenge of mental health problems affecting healthcare workers occurred in the area that first reported the initial confirmed cases in China.[11,12] While they played a key role in responding and controlling the pandemic, they also had a high level of exposure risk perception of being infected and disease transmission.[13] Another important reason for mental health impact among healthcare workers is that healthcare workers are at increased risk for reporting a positive COVID-19 test compared to the general population. In the UK and the USA, the likelihood of a positive COVID-19 test was more than three times higher among frontline healthcare workers when compared to the general community (HR = 3.40; 95% CI, 3.37-3.43).[14] Recent reviews revealed that the pooled prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic was 22.8%, 23.2%, and 38.9%, respectively.[15] During the COVID-19-induced lockdowns, the study of pediatric healthcare workers found a relatively high prevalence of depression, anxiety, and stress.[16] However, a study among healthcare workers in the Asia-Pacific region found that the prevalence of psychological adversity is independent of COVID-19 cases within each country.[17] A later review and global survey found that health professional teams working closely with infected patients showed a higher

prevalence of mental disorders in comparison to professionals working in other areas. [18,19] Moreover, reviews found that profession, place of work, department of work,[11,12] COVID-19 related fear, a low level of resilience, and reduced social support[5,20] were accompanied by increased stress, anxiety, depressive symptoms, and insomnia in healthcare workers.

In Thailand, mental health problems among healthcare providers during the COVID- 19 pandemic are of concern. However, to this date and to our knowledge, the magnitude of mental health problems and factors causing mental health outcomes among healthcare workers in Thailand during the COVID- 19 pandemic has not been comprehensively explored. Thus, the aims of this study were to assess the magnitude of mental health problems and to identify job task and organizational factors that impact mental health outcomes among Thai healthcare workers during the first wave of COVID-19 pandemic.

## METHODS

***Study design, study area, and participants***

This cross-sectional, national online survey was conducted using a convenience sample of 417 health care workers in all 12-health regions. The data were collected during the first wave of infections (May 1-15, 2020) in Thailand, after COVID- 19 began rapidly spreading worldwide. Participants in this study worked specifically in public health care facilities including the hospitals and primary care units, which are organized by the Office of the Permanent Secretary (OPS), Ministry of Public Health (MOPH). This study excluded healthcare workers who work in the private sector, such as private hospitals, drugstores, health volunteers, and internship students (e.g., public health/allied health/nursing/midwifery/medical) who were involved during COVID-19.

***Questionnaire, Main Outcomes and Measures***

Study participants completed a set of questionnaires consisting of three main parts. The first part was about demographic data, including age, gender, profession or occupation, type of health care facilities, and health region. Participants answered questions about their job tasks as health care workers, and whether or not their jobs were on the frontline. Participants answered questions about whether or not they were directly involved in the diagnosing, treating, contacting or caring, screening for confirmed/ probable/ suspected COVID- 19 cases. Those who responded "yes" were defined as "frontline workers." Those who answered "no" were defined as "non-frontline workers." The second part assessed mental health outcomes using the Thai version of the Depression, Anxiety, and Stress Scale- 21 Items (DASS- 21).[21] DASS- 21 was designed to measure three scales related to negative emotional states of depression, anxiety, and stress. This instrument contains 7 items per scale. Participants responded to a statement referring to feelings of depression, anxiety, and stress during the two past weeks using a 4- level rating scale (0 = did not apply to me at all, 1= applied to me to some degree, or some of the time, 2= applied to me to a considerable degree or a good part of the time, and 3= applied to me very much or most of the time). Scores for each scale were calculated from the relevant items and were interpreted into five groups according to the degree of depression, anxiety, and stress. The interpretation of the scores was: depression: 0-4 (normal), 5-6 (mild), 7-10 (moderate), 11-13 (severe), ≥14 (extremely severe), anxiety: 0-3 (normal), 4-5 (mild), 6- 7 (moderate), 8- 9 (severe), ≥10 (extremely severe), stress: 0-7 (normal), 8-9 (mild), 10-12 (moderate), 13-16 (severe), ≥ 17 (extremely severe). DASS-21 was previously used to assess mental health problems among Asians[3,4] and has been validated in different cultures during the

COVID-19 pandemic.[22–25] In this study, Cronbach's alpha coefficients (Internal consistency) of DASS-21 were 0.70, 0.88 and 0.74 for depression, anxiety, and stress subscales, respectively. The final part of the questionnaire asked about organizational factors as well as patient-related factors that could play relevant roles in causing mental health problems. The participants were asked to complete this part if they had felt stress, anxiety, or depression during the *COVID-19* pandemic.

***Data collection by online surveys***

An online questionnaire was developed via Google Forms, a free online software for creating surveys and questionnaires, and provided free access to download raw data into a CSV file. The research team provided an online link and QR code for the anonymous questionnaire to potential study participants who worked in public health care facilities of OPS, MOPH. We recruited participants by using snowball sampling techniques via personal contacts, healthcare community social media networks, and social media platforms in all health regions of Thailand. The online survey was completely anonymous. Results were uploaded to a Google drive encrypted by a password. No information which could potentially identify any study participants, such as name, residential address, name of workplace or identification number were collected. Only the study management team had access to the data.

***Statistical analysis***

Descriptive statistics were used to summarize the demographic data, job tasks, prevalence of mental health outcomes, and organizational factors as well as patient-related variables. Multivariate logistic regression was conducted to investigate the influence of job tasks of front-line workers and organizational factors as well as patient-related factors on the risk of experiencing a mild or more severe level of depression, anxiety, or stress. We created a dichotomous outcome variable that categorized the level of depression, anxiety, and stress as: 1) normal versus 2) mild to extremely severe. Crude and adjusted odds ratios (aOR) were used to identify the magnitude of association between risk factors and mental health outcomes. Demographic characteristics, including age, gender, type of profession, type of health care setting, and region were included to adjust for confounding. We considered a significance level of $p<0.05$ in this study.

***Ethical considerations***

This research was approved by the Committee of Research Ethics of Sirindhorn College of Public Health, Phitsanulok, Faculty of Public Health and Allied Health Sciences, Praboromarajchanok Institute (No. SCPHPL 2/2020-1). Prior to their participation in the research survey, all survey participants gave written informed consent using the first question of the form. If the participant answered "Yes" to the first question, they gave informed consent and agreed to participate in the survey. If the participant answered "No" to the first question of the form, they declined to give informed consent and the survey ended for those participants.

## RESULTS

***Demographic characteristics***

A total of 417 health care workers participated in this study. Most participants were women (77.7%). A majority of participants (80.6%) were over 30 years old and had an average age of 41.82 years (SD=10.06). The largest proportion of the participants by profession were nurses (40.5%), followed by public health officers (20.9%). Most of the participants (64.2%)

worked in district hospitals and public health centers at the sub-district level. A majority of study participants (82.3%) were frontline health care workers directly involved in screening, diagnosing, treating, or caring for confirmed cases or those suspected to have COVID-19.

**Mental health outcomes; levels of depression, anxiety, and stress**

In our assessment of the mental health impact of the COVID-19 outbreak on health care workers, the mean scores for the depression, anxiety and stress subscales were 2.51 (S.D.=3.12), 2.19 (S.D.=2.95), and 3.98 (S.D.=3.89), respectively. Based on our survey results, 21.1%, 22.5%, 15.3% of all study respondents had mild to extremely severe depression, anxiety and stress, respectively (Table 1).

**Table 1** Self-reported levels of depression, anxiety, and stress based on Thai Depression, Anxiety, and Stress Scale - 21 Items (DASS-21) reported by Thai healthcare workers during the COVID-19 pandemic (n=417)

| Mental health problems levels | Depression | Anxiety | Stress |
|---|---|---|---|
| Mean (±SD.) | 2.51 (3.12) | 2.19 (2.95) | 3.98 (3.89) |
| Normal (n, %) | 329 (78.9) | 323 (77.5) | 353 (84.7) |
| Mild (n, %) | 37 (8.9) | 43 (10.3) | 21 (5.0) |
| Moderate (n, %) | 41 (9.8) | 21 (5.0) | 27 (6.5) |
| Severe (n, %) | 7 (1.7) | 13 (3.1) | 12 (2.9) |
| Extremely severe (n, %) | 3 (0.7) | 17 (4.1) | 4 (1.0) |
| Total respondents with above normal rating (n, %) | 88 (21.1) | 94 (22.5) | 64 (15.3) |

**Job tasks, organizational, and patient-related factors associated with mental health outcomes**

After controlling for confounding, overall, we found that having a frontline health care job was not associated with an increased risk of mental health problems among health care workers in Thailand. However, caring for inpatients infected with COVID-19 was a risk factor associated with anxiety (aOR), 3.41; 95% CI: 1.34, 8.68) and stress (aOR, 2.96; 95% CI: 1.11, 7.95) (Table 2).

**Table 2** Crude and adjusted odds ratios for association between job task risk factor and mental health problems for Thai healthcare workers during the COVID-19 pandemic

| | Depression | | Anxiety | | Stress | |
|---|---|---|---|---|---|---|
| **Risk factor** | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) |
| **Frontline job** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 0.88 (0.48, 1.60) | 0.85 (0.45, 1.59) | 0.97 (0.53, 1.77) | 0.93 (0.50, 1.74) | 0.92 (0.47, 1.83) | 0.99 (0.49, 2.03) |
| **Work includes diagnosis or treatment for confirmed/probable/suspected COVID-19 cases** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 1.17 (0.70, 1.94) | 1.07 (0.63, 1.80) | 0.97 (0.58, 1.60) | 0.85 (0.50, 1.44) | 1.02 (0.57, 1.84) | 1.03 (0.56, 1.88) |

| Risk factor | Depression | | Anxiety | | Stress | |
|---|---|---|---|---|---|---|
| | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) |
| **Caring for inpatients with confirmed infection with COVID-19** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 2.10 (0.81, 5.44) | 1.84 (0.70, 4.84) | 3.73 (1.50, 9.25)* | 3.41 (1.34, 8.68)* | 3.21 (1.23, 8.39)* | 2.96 (1.11, 7.95)* |
| **Contact with patients under investigation (PUI) with suspected COVID-19** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 0.76 (0.40, 1.46) | 0.75 (0.39, 1.44) | 1.13 (0.63, 2.03) | 1.12 (0.61, 2.02) | 0.96 (0.47, 1.93) | 0.98 (0.48, 1.99) |
| **Work for Covid-19 workplace screening unit** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 0.82 (0.51, 1.33) | 0.87 (0.52, 1.44) | 0.76 (0.47, 1.22) | 0.79 (0.48, 1.30) | 0.83 (0.48, 1.44) | 0.94 (0.52, 1.67) |
| **Work at Covid-19 screening checkpoint** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 1.26 (0.76, 2.10) | 1.46 (0.85, 2.53) | 1.19 (0.72, 1.97) | 1.40 (0.82, 2.40) | 1.20 (0.67, 2.14) | 1.35 (0.73, 2.53) |

*Note (s): [a] adjusted for age, gender, professional, type of health care setting, and region; * p<0.05 (Identified by multivariate logistic regression analysis)*

There were statistically significant differences in the organizational and patient-related factors by the subscales of depression, anxiety, and stress. After adjusting for confounders, the odds ratio for the risk of depression, anxiety, and stress was 3.00 times (95% CI: 1.70, 5.31), 3.18 times (95% CI: 1.81, 5.58), and 4.81 times (95% CI; 2.60, 8.88) higher, respectively, for health care workers who reported lack of readiness of managing infection risk at their workplace compared to those who reported readiness. Shortage of PPE ( depression, aOR= 2.20; 95% CI: 1.34, 3.62; anxiety, aOR= 2.45; 95% CI: 1.50, 3.99; stress, aOR= 3.45; 95% CI: 1.97, 6.04) and working with the fear of being infected and transmitting infection when returning home (depression, aOR=1.95; 95% CI: 1.18, 3.24; anxiety, aOR= 2.41; 95% CI: 1.45, 4.00; stress, aOR=1.95; 95% CI: 1.18, 3.24) were risk factors for all three mental health outcomes in our study, after adjustment for confounders. Additionally, having patients that did not cooperate and comply with infection prevention and control recommendations was associated with higher risk of depression ( aOR=2.23; 95% CI: 1.34, 3.70), anxiety (aOR=1.74; 95% CI: 1.05, 2.88), and stress (aOR= 3.06; 95% CI, 1. 74, 5. 39) among healthcare workers (Table 3).

**Table 3** Crude and adjusted odds ratios for association between organizational and patient-related risk factors and mental health problems for Thai healthcare workers during the COVID-19 pandemic

| Risk factor | Depression | | Anxiety | | Stress | |
|---|---|---|---|---|---|---|
| | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) | Crude OR (95% CI) | Adjusted OR[a] (95% CI) |
| **Lack of readiness to manage and reduce infection risk such as working from home policy, redesigning health service delivery, etc.** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 2.66 (1.54, 4.60)* | 3.00 (1.70, 5.31)* | 2.76 (1.61, 4.73)* | 3.18 (1.81, 5.58)* | 4.35 (2.42, 7.80)* | 4.81 (2.60, 8.88)* |
| **Shortage of Personal Protective Equipment (PPE) for reducing the risk of COVID-19 infection.** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 2.26 (1.38, 3.70)* | 2.20 (1.34, 3.62)* | 2.51 (1.55, 4.07)* | 2.45 (1.50, 3.99)* | 3.41 (1.97, 5.90) | 3.45 (1.97, 6.04)* |
| **Lack of vital equipment needed to treat COVID-19 patients, such as a ventilator.** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 1.33 (0.60, 2.95) | 1.37 (0.61, 3.08) | 1.42 (0.66, 3.07) | 1.47 (0.68, 3.23) | 1.43 (0.59, 3.42) | 1.44 (0.59, 3.53) |
| **Work with fear of being infected and transmitting infection from work to home** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 1.91 (1.16, 3.14)* | 1.95 (1.18, 3.24)* | 2.32 (1.41, 3.81)* | 2.41 (1.45, 4.00)* | 1.74 (0.99, 3.05) | 1.95 (1.18, 3.24)* |
| **Patients does not cooperate with following infection prevention and control recommendations** | | | | | | |
| No | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Yes | 2.24 (1.36, 3.68)* | 2.23 (1.34, 3.70)* | 1.73 (1.05, 2.84)* | 1.74 (1.05, 2.88)* | 3.01 (1.74, 5.22)* | 3.06 (1.74, 5.39)* |

*Note (s): [a] adjusted for age, gender, professional, type of health care setting, and region; * $p<0.05$ (Identified by multivariate logistic regression analysis)*

## DISCUSSION

Most participants were employed as nurses and public health officers, and worked at the primary care level (district hospital and sub-district public health centers). A majority of study participants also engaged in frontline jobs during the COVID-19 outbreak. At the primary care level, nurses and public health officers are the key staff providing basic healthcare services.[26] Similarly, during the COVID-19 outbreak, nurses and public health officers are the main frontline healthcare workers who worked in partnership with Village Health Volunteers (VHVs) to conduct timely and effective case investigation and contact tracing.[27] Thus, it is not surprising that many of our respondents perform job tasks that put them at risk of exposure to COVID-19 cases. *Their responses may show that COVID-19 had a significant impact on mental health.*

In this study, we found that healthcare workers faced depression (21.1%), anxiety (23.5%), or stress (15.3%)

during the COVID-19 pandemic. These findings support a previous review that found that the COVID-19 pandemic brought high levels of mental problems related to the health emergency, such as anxiety, depression, and stress, and that these mental health problems are more likely to affect healthcare professionals.[28] A more recent systematic review also supports our findings. This review found that healthcare workers experienced mental health problems during the COVID-19 pandemic in a higher range than in a non-pandemic period.[11] However, our study observed smaller proportions of healthcare workers with mental health impacts. One previous study had much higher proportions of healthcare workers during the COVID-19 pandemic reporting depression (50.4 %), anxiety (44.6 %), insomnia (34.0 %), and distress (71.5 %)[29] than our study. However, our findings are consistent with recent systematic reviews that found the pooled prevalence of anxiety and depression among healthcare workers during the COVID-19 pandemic of approximately 23-24%, and 21-23%, respectively.[11,15] A possible explanation for the discrepancy may be due to differences in instruments used to assess mental health in each study. When we compared our results using Thai DASS-21 to another previous study assessed by DASS-21, the mean score for anxiety, as well as for depression and stress were aligned between our studies.[30]

During the outbreak period, being a healthcare worker who cared for in-patients with COVID-19 was significantly associated with higher risk of experiencing anxiety and stress compared with those not involved with COVID-19 inpatients. This finding is consistent with previous studies that found that healthcare workers engaged in the direct care of patients with COVID-19 had an increased risk of depression, anxiety, and distress.[29] Such associations have been consistently observed. For example, health professionals or healthcare teams had higher levels of anxiety and depression compared to professionals from other areas or administrative teams during the COVID-19 pandemic.[18] We assume that workers with frontline job tasks, especially those at increased exposure to infected patients, have a greater chance of being infected by COVID-19. In a previous study, frontline healthcare workers were at increased risk by reporting a positive COVID-19 test compared with the general community.[14] Furthermore, workers who were exposed to patients with suspected or documented COVID-19 had an increased risk for COVID-19 infection compared to those not caring for patients with suspected or documented COVID-19.[14] We hypothesize that the strong correlation between closely working with infected inpatients with mental health problems reflects that healthcare workers are afraid that they will become COVID-19 patients themselves.

Our study also found that healthcare providers who fear or worry about getting infected and spreading the infection when returning home were at a higher risk for all subscales of mental health problems compared to those who did not have this fear. Similarly, previous studies also reported the fear of being infected with COVID-19 was positively correlated with an increased score for depression, anxiety, and stress.[31] Our findings are consistent with previous studies that found significant impact of organizational factors on the increased risk of mental health problems, including depression, anxiety, and stress in healthcare workers. For example, a review demonstrated that several organizational factors, including the availability of PPE, influenced mental health outcomes among health workers.[28] In a similar way, Simms and colleagues (2020) indicated that having inadequate equipment at work was

associated with significantly greater odds of reporting common mental health disorders for healthcare workers.[32] We hypothesize that healthcare workers, particularly those involved with COVID-19 patients, perceived their own susceptibility to the virus and the severity of a potential COVID-19 infection. We also suspect that healthcare workers perceive proper PPE as the best way to protect themselves from COVID-19 when working with patients. Previous research findings support this possible explanation that the perception of having insufficient PPE at an individual level was significantly associated with symptoms of mental health disorders.[32] Additionally, healthcare workers who reported reusing PPE or inadequate PPE had an increased risk of a positive COVID-19 test compared with healthcare workers who reported using adequate PPE. Furthermore, healthcare workers with inadequate PPE caring for patients with COVID-19 had the highest increased risk for COVID-19 compared with those with adequate PPE not caring for patients with COVID-19.[14]

Our finding that management efforts to reduce infection risk at health care workplace can improve workers' mental health is consistent with previous reviews that found effective leadership and managerial support for clinicians[33] ~~and,~~ the availability of clear procedures to manage the risk of contagious diseases[28] as well as organizational psychneuroimmunity prevention, which includes significant improvement in workplace hygiene and the company's concerns on the health status of employees after returning to work[34] were highly protective against mental health outcomes and improved workers' well-being and performance. In addition, providing clearer communication about COVID-19 protocol changes was the most cited measure to alleviate stress or anxiety[35] Furthermore, the timely provision of online psychological interventions such as Cognitive Behavioral Therapy (CBT), especially Internet CBT, has the potential for improving psychiatric symptoms.[36,37] In such situations, healthcare professionals, especially those who have contact with COVID-19 patients were often required to work in highly challenging conditions. They likely considered themselves at elevated risk of COVID-19 infection. Effective information and communication between health service providers, including the procedure for managing the risk of contagious disease and effective guidelines for patient care, support health care workers' mental health. While it is not possible to eliminate all risks, risk mitigation of COVID-19 infection is warranted.

In our study, the patient-related risk factor in which health care workers dealing with patients who did not strictly adhere to infection control guidelines was associated with mental health outcomes among healthcare providers. During the COVID-19 outbreak, the state of emergency act and other related regulations was strictly implemented and enforced to control the spread of disease in the community and the health care delivery system in Thailand.[38] During the early period of implementing regulations, infection mitigation measures in healthcare facilities, included having a seating configuration to maintain social distancing, arranging or limiting patients to visit healthcare facilities only as needed, and delivering medicines by VHVs was implemented. Additionally, wearing a mask in public places was essential in order to receive services.[27] A possible explanation for patients not adhering to infection control guidelines may be that the patients may not be familiar with "new normal" of the healthcare system. There also could be an imbalance in information shared between providers and patients regarding infection control guidelines. We assumed that this situation causes health care providers to be concerned and could result in their poor mental health.

# CONCLUSIONS

Our findings suggest that the COVID-19 pandemic had a significant association with the mental health of healthcare workers, particularly those with the frontline job of caring for COVID-19 inpatients. Organizational factors as well as patient-related factors were major risk factors for poor mental health outcomes among healthcare workers. Organizational approaches, such as effective management to reduce infection for both patients and healthcare providers may help protect mental health in a "new-emerging phase" or a future wave of COVID-19 outbreaks.

**Limitations and recommendations**

This research has several limitations. First, it was a cross-sectional study. We do not know the prevalence or severity of mental health problems among our participants before the pandemic period. Thus, it is difficult to establish a causal relationship between work conditions and mental health from this study design. Second, the research was conducted by a voluntary online questionnaire. Therefore, participants in this study only consisted of healthcare workers who were interested in providing responses. Moreover, this group was also relatively small and may not have fully represented the entire study population of healthcare workers in Thailand. With regard to the snowball technique for recruiting the participants, this study was unable to report proper response rates. As a result, our findings have limited generalizability. It is also notable that the COVID-19 pandemic has been found to cause hemodynamic changes in the brain,[39] and the gold standard for establishing psychiatric diagnosis involves a structured clinical interview and functional neuroimaging.[40–42]. However, this study mainly used self-reported questionnaires to measure psychiatric symptoms and did not make any clinical diagnosis for anxiety and depression.

In further research, we plan to explore the prevalence of mental health problems among healthcare workers and identify the impact of work-related factors during the second or third wave of the pandemic. More knowledge of COVID-19 disease and treatment guidelines, clearer, more relevant disease prevention policy, as well as greater availability of effective procedures for managing the risk of contagious diseases in the second/third wave may improve the mental health of healthcare workers. On the other hand, when the "new-emerging phase" or second/third wave outbreak occurs, healthcare workers may be at high risk of being exposed to confirmed COVID-19 patients with new genetic variants or mutant strains of COVID-19. In addition, we anticipate that there may be an increased workload in hospitals or field hospitals due to a new wave of COVID-19 cases. Simultaneously, the workload will increase due to the management of the COVID-19 vaccination program and monitoring. Thus, healthcare workers may still be at increased risk for mental health problems. In terms of the COVID-19 vaccination policy for Thai frontline healthcare workers, future studies should assess the willingness to receive vaccines, evaluate the perceptions of vaccine safety and effectiveness, job insecurity, and explore mental health problem reactions after the vaccination.

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