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Haley Putnam Date

Acute Mental Health Impacts of COVID-19 on Frontline Healthcare Workers during the Beginning of the COVID-19 Pandemic: A Systematic Review

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By

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Bachelor of Arts
Brevard College
2019

Thesis Committee Chair: Dr. Jessica Fairley, MD, MPH

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in the Hubert Department of Global Health
2022

Abstract

Acute Mental Health Impacts of COVID-19 on Frontline Healthcare Workers during the Beginning of the COVID-19 Pandemic: A Systematic Review

By: Haley Putnam

Introduction: In December of 2019, there were reports of various cases of pneumonia with an unknown etiology in the Wuhan province in China. Later, through genetic sequencing it was determined that these cases of pneumonia were caused by a virus now known as SARS-CoV-2, now referred to commonly as COVID-19. As the pandemic progressed, it put a strain on the healthcare system, and particularly the mental health of healthcare workers and those working directly on the frontlines. **Objectives:** The purpose of this review was to explore the potential acute mental health effects during the beginning stages of the COVID-19 pandemic on frontline healthcare workers, or those who have constant exposure due to their occupation. The review also aimed to synthesize all eligible studies that have been conducted on the topic. **Methods:** The primary goal of this systematic review was to synthesize existing literature regarding the potential acute mental health impacts of COVID-19 on healthcare workers during the beginning stages of the COVID-19 pandemic. A search of the literature was conducted using PubMed and Embase. Studies were limited to those in English, consisting of primary research, and were published between December 2019 and October 9, 2020. **Results:** Out of 1,970 initial studies, 23 were included in the final extraction and were included in this review. The primary outcomes for the selected studies included depression, anxiety, stress, psychological distress, burnout, fear, suicidality or suicidal ideation, and post-traumatic stress disorder symptoms. Oher outcomes included resiliency, coping, general health, quality-of-life, and overall well-being. **Conclusion:** The 23 studies included in this review revealed that the COVID-19 pandemic has led to significant psychological impacts on frontline workers. Factors such as increased workload, sex/gender, age, fear of infection and lack of sleep are just a few of the many contributors to conditions such as anxiety, depression, post-traumatic stress disorder, and burnout among frontline healthcare workers. The information learned from these studies could potentially inform public health preparedness in the future.

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Acknowledgements

I would like to personally thank my thesis advisor, Dr. Jessica Fairley for taking the time to mentor and guide me throughout the thesis writing process. She put in a lot of time and effort reading, proofing, and commenting on my thesis and for that I am truly thankful.

In addition to Dr. Fairley, I would also like to thank my ADAP Theresa Nash. Theresa has been there for me since the very beginning of my journey at Rollins School of Public Health in 2019. She is the one who encouraged me to finish my degree, and for that I am deeply and truly thankful.

Lastly, I would like to thank my dear friends and family for pushing me to finish my degree and to strive for greatness. They, along with Theresa and Dr. Fairley have made all of this possible.

Sincerely,
Haley Putnam

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Introduction

In December of 2019, there were reports of various cases of pneumonia with an unknown etiology in the Wuhan province in China. Later, through genetic sequencing it was determined that these cases of pneumonia were caused by a virus now known as SARS-CoV-2, now referred to commonly as COVID-19. In January of 2020, the World Health Organization (WHO) deemed COVID-19 a Public Health Emergency of International Concern (PHEIC) and later declared a pandemic in March of 2020 (WHO, 2020). As of May 2022, there have been 513,499,465 total cases and 6,235,665 deaths worldwide (Johns Hopkins University, 2022). As the pandemic has progressed, it has put a strain on the healthcare system, particularly healthcare workers and those working directly on the frontlines.

Previous instances of disease outbreak have been shown to increase stress and negatively impact mental health of healthcare professionals. For instance, after the Severe Acute Respiratory Syndrome (SARS) pandemic of 2003, healthcare workers had increased incidence of depression (Liu, Kakade, Fuller, et al., 2012). In particular, those who had the most contact with patients infected or potentially infected with SARS had the highest levels of reported depression (Liu, Kakade, Fuller, et al., 2012). The CDC reports that some factors that can lead to stress among healthcare workers include exposure to potentially harmful pathogens, longer or irregular work hours, and sleep deprivation (CDC, 2008; Cheng & Cheng, 2017). Many of these factors have been exacerbated throughout the course of the COVID-19 pandemic, and this has led to an increase and/or progression in psychological disturbances, such as anxiety, depression, burnout, stress, and insomnia (Mayo Clinic, 2021).

The purpose of this review is to explore the potential acute mental health effects during the beginning stages of the COVID-19 pandemic on frontline healthcare workers, such as nurses and doctors working directly with COVID-19 patients, or those who have constant exposure to

COVID-19 due to their occupation. The review will also aim to synthesize all eligible studies that have been conducted on the topic and the findings from the selected studies will be reported within the results and discussion sections of this thesis. While this review is aimed at looking at the acute mental health impacts of the COVID-19 pandemic, more research on this topic is expected to follow in the coming months and years after this review was originally conducted.

Literature Review

Occupational Stress and Mental Health

Occupational stress is known to be a widespread issue within the healthcare industry, particularly among nurses and physicians (CDC, 2008). The term "occupational stress" is defined by the National Institute for Occupational Safety and Health (NIOSH) as "the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources or needs of the worker" (NIOSH, 1999; CDC, 2008). Workplace factors that can result in occupational stress include job tasks, interpersonal conflict at home or work, poor organizational climate, financial or economic issues, or the demands of the job itself. Some common stressors in healthcare settings include inadequate personnel, long or irregular work hours, ambiguity of job roles, and exposure to infectious diseases and/or hazardous substances (CDC, 2008).

While the stressors are similar among all healthcare personnel, the differing roles within the healthcare system may also bring different stressors. For instance, among nurses, the most common stressors include exposure to infectious agents, needlestick injury, exposure to work-related violence, sleep deprivation and understaffing. However, among physicians, the most common stressors include interpersonal conflict with other staff, navigation of patient expectations, and dealing with the threat of malpractice litigation (CDC, 2008). While the effects of occupational stress differ from person to person, there are a number of common psychological, behavioral, and physical effects that have been reported. Some of the most common adverse effects on psychological health of occupational stress include irritability, job dissatisfaction and depression. Common behavioral issues include trouble sleeping and absenteeism. The physical effects that are commonly reported include headache, gastrointestinal

issues, and changes in blood pressure. When faced with an acute traumatic event, post-traumatic stress disorder (PTSD) may result, however not every person who is involved in a traumatic event develops PTSD, as symptoms can vary based on the combination of the trauma that occurred and individual factors (CDC, 2008).

Mental Health Context Prior to COVID-19

Psychosocial Work Conditions

A study by Cheng, W., and Cheng, Y. (2017) investigated the psychosocial work factors that impact mental health among Taiwanese healthcare workers. Out of 19,641 eligible healthcare workers, 349 of them were chosen and participated in a national cross-sectional survey in Taiwan with an interval between 3-5 years since 1988. To assess mental health, a five-item symptom rating scale was used. The scale contained dimensions for anxiety, depression, hostility, and interpersonal sensitivity. Participants responded to items using a Likert-type scale ranging from 0 (not at all) to 4 (extremely). A total score of six or above identified a minor mental health disorder, such as anxiety or depression (Cheng & Cheng, 2017).

To assess participants' psychosocial conditions, the Job Content Questionnaire developed by Karasek and Theorell in 1998 was used. Their model illustrates how high demands and low control can cause high job strain that leads to negative mental health outcomes. The questionnaire consisted of items that assessed demands, skill discretion, authority, and workplace justice. Workplace justice in this context is referring to fairness and equality within the workplace. These factors were also measured on a Likert-type scale ranging from one (strongly disagree) to four (strongly agree). Participants were also asked if they ever experienced

workplace violence, bullying, physical violence or sexual harassment one year prior to the study (Cheng & Cheng, 2017).

When comparing with gender-, age- and education-matched employees, Cheng & Cheng (2017) found that healthcare workers in Taiwan had a higher prevalence of minor mental health disorders, such as depression and anxiety. Healthcare workers were also more likely to have longer work hours, non-standard or unpredictable schedules, higher psychosocial demands and more workplace violence compared to non-healthcare workers. It was also found that lower workplace justice and experience with violence were significantly related to increased risk for mental disorders, such as depression, anxiety, irritability, and sleep.

Further, in 2018, Nena et al. studied effects of shift work on sleep, health, and quality of life among healthcare workers from a tertiary university hospital located in Greece. Employees included in the study were those who worked alternating shifts as well as those who worked exclusively morning shifts. Psychotherapists, health visitors and nurses from various departments were included, however medical doctors were excluded. In addition to basic demographics and history, each participant completed a Shift Work Disorders Screening Questionnaire (SWDSQ), which consists of 26 items and was first used by Barger et al. in 2012. Further, the WHO-5 Well-Being Index (WHO-5) was used to investigate positive mood, vitality, and general interests. Responses are given on a 6-point Likert-type scale ranging from 0 to 25. Total response values can range from 0-25, with lower values indicating lower quality of life among participants (Nena, Katsaouni, Theodorou et al., 2018).

Out of the 389 surveys that were distributed, 312 (80.2%) were returned. Among the 312, 68.6% had irregular shifts more than three times per week, and 71.1% had been doing shift work for more than five years. In terms of the SWDSQ, those who were working irregular shifts were

somewhat or totally dissatisfied with the number of hours they sleep per night. In addition, 37.7% reported experience extreme sleepiness, while 40.2% also reported being slightly dissatisfied with their quality of sleep. Only 9.8% reported being completely dissatisfied with their quality of sleep. In terms of well-being, 47.9% reported that they were somewhat or totally dissatisfied with their sense of well-being. Another 28.3% reported dissatisfaction with their physical and mental health (Nena et al., 2018).

Participants who work irregular shifts exhibited significantly worse WHO-5 scores compared to those who had more consistent work schedules. They reported being less happy, had impaired moods, and felt calm and peaceful less often than non-shift workers. They were also more likely to be less energetic and physically active. Shift-workers also felt that their everyday life was not as full or interesting compared to non-shift workers. These findings were particularly strong among those who were between 36 and 45 years old and in those with children. A significantly negative correlation between SWDSQ and WHO-5 scores was also noted. The study concluded that shift work among healthcare personnel can indeed impair their sleep and overall quality of life, with demographic and family characteristics having a significant effect on these physical and mental impairments (Nena et al., 2018).

A more recent study, published in 2019, investigated the complex relationship between psychosocial factors, burnout, and quality of life among primary healthcare workers in a rural province located in China. The study spanned 108 primary health facilities, which included 36 community health centers. Two cities within the Guandgong province, Qingyuan and Chaozhou were selected purposively, given that they are rural and developing areas within the province. “Rural” in this context refers to the geography, given that most who live in this area work in agriculture. While the geographic locations were purposively sampled, the hospitals and

healthcare centers were selected using a stratified random sampling method (Asante, Li, Liao, Huang, & Hao, 2019).

To evaluate quality of life, the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF) was used. Psychosocial risk factors were assessed using the Copenhagen Psychosocial Questionnaire (COPSOQ). The various quality of life domains were transformed to generate a score that ranged from 0 to 100. The higher the score, the better the quality of life, while lower scores indicated impairment in one's quality of life. It should also be noted that any significant findings were verified using a multiple regression analysis (Asante et al., 2019).

Out of the 1,000 surveys that were distributed, 873 were filled out and submitted, which presented an 87.3% response rate. When evaluating overall health, 70.8% of the respondents rated their state of health as being over 5, on a scale of 0 (worst) to 10 (best). On a scale of 0 to 100, high scores were reported for cognitive stress symptoms (66.69) and burnout (58.47). Lower scores were reported for intention to leave their job (22.34), degree of freedom at work (32.82), and job satisfaction (49.61). Male respondents reported higher scores for quantitative demand, emotional demands, work conflict and burnout. Higher scores are indicators of poorer health and quality of life. In contrast, female workers had higher cognitive stress symptoms when compared to their male counterparts. Further, females reported better quality of life, better social support and higher job satisfaction when compared to males (Asante et al., 2019).

Further, the risk of poor quality of life among workers was higher among those who reported higher levels of burnout, job dissatisfaction, as well as those with job securities. These associations were still significant when controlling for worker sex and age. A poorer quality of life was also significant among those who described their work as being less meaningful, those who had poorer social relationships and those with a poor sense of community. Burnout was also

a risk factor for having poorer physical and psychological health. This risk was stronger among those who were single, had less freedom in the workplace, and those with unclear work roles. While these findings are helpful, a direct causal relationship cannot be established, and can only be generalized to similar populations within China. However, it provides a deeper look into what healthcare workers in rural settings may experience in terms of their occupation and health outcomes (Asante et al., 2019).

The aforementioned studies have been particularly focused on the mental health status of healthcare workers in a general context, which gives an idea as to the challenges that healthcare workers face day-to-day on the job. Healthcare workers regularly experience longer work hours, workplace stress, burnout, disruptions in sleep, and traumatic events, all of which can lead to various mental health outcomes such as anxiety, depression and even Post-traumatic stress disorder (PTSD). These effects can further be heightened in the context of working with highly contagious infectious diseases such as Middle Eastern Respiratory Syndrome (MERS-CoV), Severe Acute Respiratory Syndrome (SARS-CoV), and now currently, COVID-19 (SARS-CoV-2), which will be described below.

Middle Eastern Respiratory Syndrome (MERS-CoV)

In 2016, a study was conducted to investigate the relationship between Middle Eastern Respiratory Syndrome (MERS-CoV) and its impact on healthcare workers who were directly involved with caring for MERS-CoV patients in Saudi Arabia. A cross-sectional survey was conducted at King Faisal Specialist Hospital & Research Center, which is a tertiary care hospital located in Jeddah, Saudi Arabia. The survey was conducted between April and May 2014 and consisted of five sections, which amounted to roughly seventy-two total survey questions. These

indicators were aimed at evaluating the employees' emotions, perceived psychological stressors, chosen coping strategies, as well as potential motivators for working during the outbreak. The types of healthcare workers that were included in this study were nurses, physicians and respiratory therapists, however 89% of those who participated were nurses (Khalid, Khalid, Qabajah, Bernard, & Qushmaq, 2016).

Out of 150 total participants recruited, 117 (78%) of the surveys were returned for analysis. The mean and standard deviation for each indicator was reported, when appropriate. It was found that the five most common stressors among these workers included seeing their colleagues being intubated ($\overline{x}$ = 2.77, SD = 0.63), the fear of transmitting the infection to family or friends ($\overline{x}$ = 2.69, SD = 0.62), making a mistake or lapse in judgment that could infect themselves or others with MERS-CoV ($\overline{x}$ = 2.66, SD = 0.66), taking care of fellow colleagues ($\overline{x}$=2.54, SD=0.81), and seeing patients die from MERS-CoV infection ($\overline{x}$ = 2.54, SD = 0.73). This led the researchers to conclude that the staff, at least at this hospital, experienced a notable amount of emotional and psychosocial distress associated with responding to this outbreak, however the healthcare workers noted that they felt it was their professional and ethical duty to do so (Khalid et al., 2016).

Severe Acute Respiratory Syndrome (SARS-CoV-1)

In a 2006 study, 549 hospital employees in Beijing were surveyed concerning their exposures to the 2003 SARS outbreak and how the outbreak affected their mental health. The employees were assessed on various sociodemographic factors, types of exposure to the outbreak, and on symptoms of depression and posttraumatic stress disorder (PTSD) (Liu, Kakade, Fuller, et al., 2012). Measures of exposure to the SARS outbreak included work

exposure, having had to quarantine, as well as having a relative or friend contract SARS. Further, other exposure to traumatic events prior to SARS was examined, in addition to perception of SARS-related risks, occupational stress, psychopathology, and other subject demographics (i.e. age, sex, etc). (Liu, Kakade, Fuller, et al., 2012).

During analysis, it was found that 25% worked in locations where contact with SARS patients was common. Approximately 77.2% were considered to have reportedly low depressive symptoms, 14% reported moderate depressive symptoms, and the remaining 8.8% reported high levels of depressive symptoms. Of those with the highest levels of depressive symptoms, 56% had worked in areas where there were high levels of exposure to SARS patients. It was also found that perceived SARS-related risk was significantly associated with level of depressive symptoms among participants (Liu, Kakade, Fuller, et al., 2012).

In 2004, a study was published that investigated the relationship between working during the SARS outbreak in 2003, and stress reactions among healthcare workers (HCWs) (Bai, Lin, Lin, et al., 2004). For this study, a total of 557 staff members (402 healthcare workers, and 155 administrative personnel) were given an anonymous SARS-related stress questionnaire composed of acute stress disorder criteria as described in the DSM-IV, and accounted for emotional and behavioral changes among participants (Bai, Lin, Lin, et al., 2004).

Nearly 5% of hospital staff met the criteria for an acute stress disorder. Quarantine was the most common predictor of acute stress disorder. Additionally, 20% of staff members reported feeling stigmatized and rejected because of their work, and nearly 15% reported they did not want to go home after work during the outbreak out of fear of infecting family members. Further, something that was unique to healthcare workers versus administrative staff was the fact that healthcare workers reported significantly higher rates of insomnia, exhaustion, and uncertainty

about the frequent modification to infection control protocol. Lastly, 9% of healthcare workers reported that they were reluctant to work during the outbreak or had considered resignation from their position (Bai, Lin, Lin, et al., 2004).

The COVID-19 (SARS-CoV-2) Pandemic

In December of 2019, reports of pneumonia with unknown etiology were being reported in the Wuhan province of China. It was soon found out that the pneumonia was being caused by a novel coronavirus strain that is now referred to as SARS-CoV-2 or COVID-19. While the initial cases of the virus were linked to a market in Wuhan, most of the subsequent cases were not. Through genetic sequencing of the virus, it was determined that all the strains are very similar, suggesting that the virus has just recently emerged and possibly just started infecting humans in early December of 2019. In January of 2020, the World Health Organization (WHO) deemed COVID-19 a Public Health Emergency of International Concern (PHEIC) and it was declared a pandemic in March of 2020. (WHO, 2020).

The zoonotic nature of SARS-CoV-2 is currently being investigated. It was found to be genetically similar to two other coronaviruses— SARS-CoV-1 and MERS-CoV. SARS-CoV-1 is the causal agent for Severe Acute Respiratory Syndrome (SARS). Like COVID-19, SARS also caused public health concern when an outbreak began in 2003. The primary origin for the SARS-CoV-1 virus was determined to most likely be bats, however it can also infect other animal species, such as civets. It was hypothesized that a bat infected a civet, and then it entered the human population when an individual was handling the civet (WHO, 2020). MERS-CoV—which causes Middle Eastern Respiratory Syndrome (MERS)—is found naturally in dromedary

camels, which crossed over into humans likely beginning in 2012, which subsequently led to an outbreak (WHO, 2020).

COVID-19— or SARS-CoV-2— is transmitted primarily through contact with infected droplets. This can occur when an individual sneezes, coughs, or sings. The most common symptoms include fever, shortness of breath, cough, fatigue, body and muscle aches, new loss of taste or smell, headache and sore throat. Other symptoms can include nausea and vomiting, diarrhea, runny nose, and nasal congestion. They usually occur within 2-14 days of exposure; however, this can vary (CDC, 2020b).

Given the data regarding the relationship between occupational factors and health—both mental and physical—on healthcare professionals, it is clear that there is an association between the two. A range of factors—such as organizational climate, social support, long work hours and job demands—can lead to symptoms of anxiety, depression, burnout, and low quality of life among healthcare workers. The aim of this systematic review is to take into consideration the findings of this association prior to COVID-19 and to investigate if these findings are similar during the current COVID-19 pandemic. Research has been done in the context of previous pandemics, such as MERS, however, the COVID-19 pandemic could bring new challenges or impose differing impacts on the mental health of healthcare workers in the current context. The information from previous studies—as well as those regarding COVID-19—could highlight current gaps in knowledge, as well as areas for intervention.

Methods

The primary goal of this systematic review is to synthesize existing literature regarding the potential acute mental health impacts of COVID-19 on healthcare workers during the beginning stages of the COVID-19 pandemic in order to determine the extent of the problem, the public health implications of such mental health impacts, as well as potential solutions moving forward. The search strategy for this systematic review included Medical Subject Headings (MeSH) and text words related to COVID-19, mental health, and healthcare workers. These search terms were developed with the assistance from a librarian at Emory University's Woodruff Health Sciences Center Library (WHSCL) (see **Appendix 1 Tables 1 & 2 for PubMed and Embase search strategies**). A search for literature was conducted using PubMed and Embase.

Searches were limited to materials in English, and there were also limitations regarding publication date. Literature included had to have been released from December 2019 to October 9, 2020 to be included in this review. There were no limits regarding geography, given the nature of the COVID-19 pandemic. However, qualitative studies, pre-print literature, studies involving healthcare workers or staff that have no regular contact with known COVID-19 patients (i.e. radiologists, pharmacists and laboratory technicians, dentists), and those involving students, residents or trainees in any health profession were excluded from this review. These were excluded because there may be other factors influencing their exposure to suspected or confirmed COVID-19 cases or their experiences with the chosen outcomes for this review. In addition, this study did not require Institutional Review Board (IRB) approval since human subjects were not involved. A meta-anlaysis was not conducted due to the various outcomes and desire to get a scoping review of the current literature on this novel pathogen.

After the search strategy was applied to all the aforementioned databases, all citations were then exported to EndNote (N = 1,970) and duplicate citations were removed (N = 163). All references were then moved to the systematic review software "Covidence" where a title and abstract screen was conducted. A total of 1,807 studies were put through abstract and title screening. All titles and abstracts were screened by one reviewer (HP) using the following inclusion criteria:

1. Collected primary data;
2. Is published in English;
3. Is published between December 2019 and October 9 2020;
4. Measured the relevant mental health outcomes among healthcare workers, including primary outcomes such as post-traumatic stress disorder (PTSD), anxiety, depression, burnout, and/or psychological distress related to COVID-19; and
5. Included healthcare workers that were involved in direct patient treatment, care or exposure to confirmed or suspected COVID-19 patients (i.e. nurses, doctors) on a regular basis.

A total of 200 articles were chosen for full text review. One reviewer (HP) read each full text to ensure that all inclusion criteria were met. Of the 200 articles included in the full text review, 23 were included for data extraction. A PRISMA flow diagram that depicts the various phases of the search and article inclusion process of the review are shown below (**Figure 1**). The 23 studies included for final extraction were first evaluated for study quality. Quality indicators assessed included study design and potential sources of bias. Relevant data were then extracted by one reviewer (HP) using a standardized extraction technique available in Covidence. Data

extracted included: study setting, study population, sample size, study design and methodology, method of recruitment, and primary outcome measures.

Figure 1. PRISMA Flow Diagram

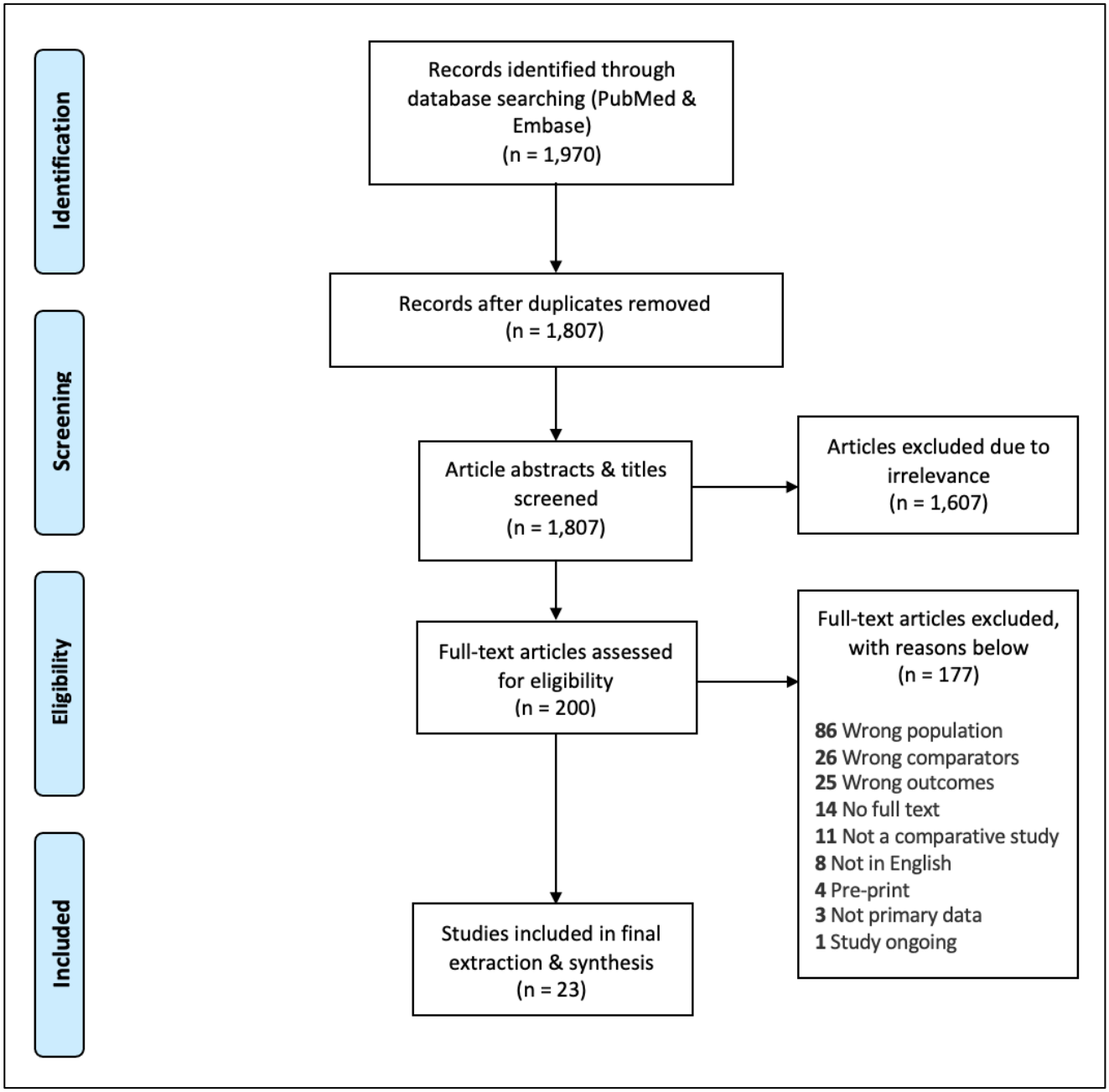

Figure 1. This shows a PRISMA flow diagram depicting the review process from study identification, screening, eligibility determination and final study inclusion.

Results

As a result of this systematic review, a total of 23 studies were extracted in the final phase. Of the 23 studies extracted, 11 (48%) were conducted in China, two were conducted in Egypt, and one study was conducted in Portugal, Turkey, Spain, Saudi Arabia, Oman, Pakistan, Italy, Greece, Poland, and Iran respectively. **Figure 2** below depicts a map that illustrates the geographic distribution of where the 23 eligible studies took place.

Figure 2. This shows map of where the studies took place and how many took place in each country.

The two earliest articles were conducted beginning on February 1, 2020 (Zhu, 2020; Yao, 2020), while the other studies were conducted between February 26, 2020 and April 24, 2020. All studies utilized cross-sectional designs, usually in the form of an online, email or WeChat survey (See **Figure 3**). A detailed table describing the extracted data more in-depth can be found

in **Appendix 2.** The least number of participants included in a study was 165 (Zhu, 2020), and the most participants included in a study was 14,825 (Song, 2020).

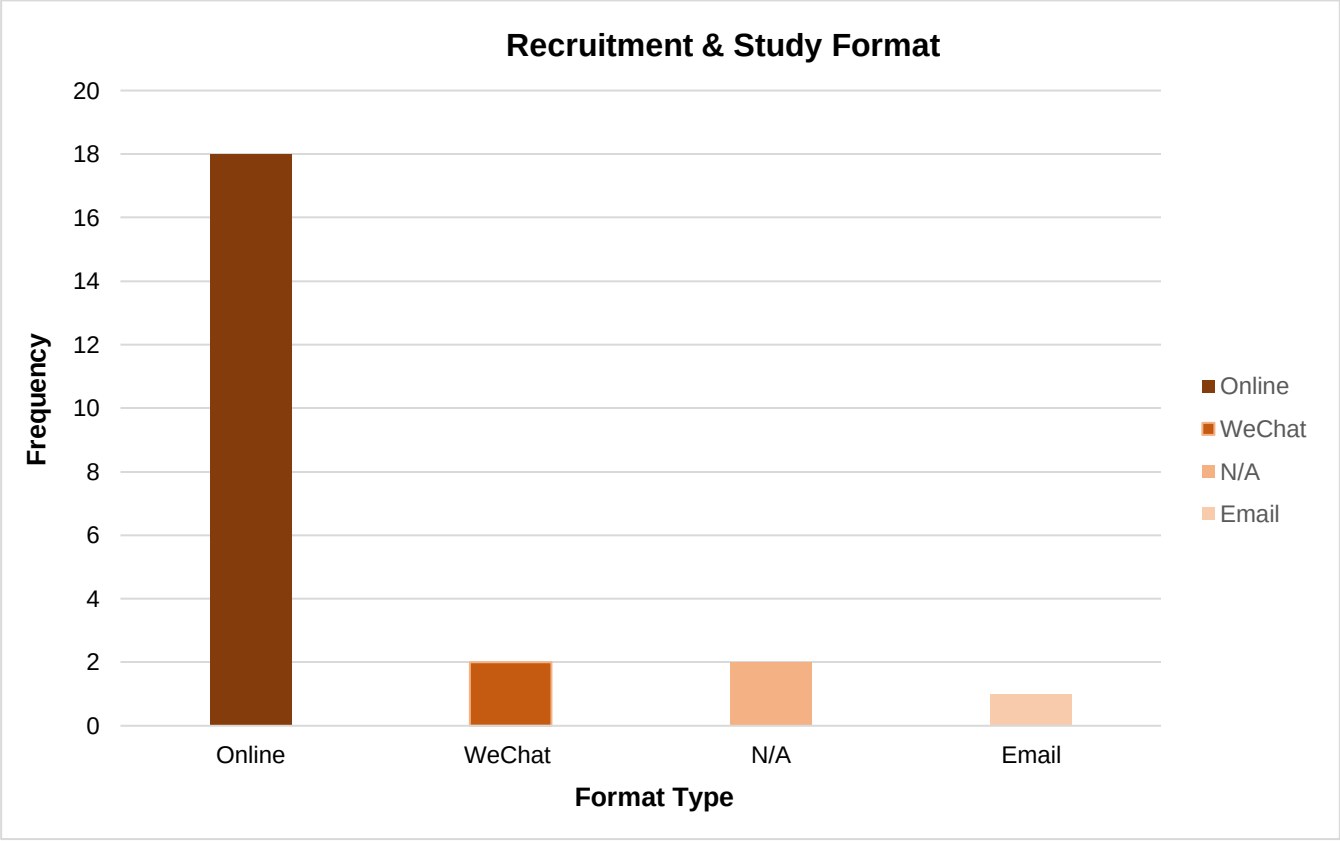

Figure 3. This chart depicts the various types of study recruitment and modes for survey distribution.

The primary outcomes for the studies included depression, anxiety, stress, psychological distress, burnout, fear, suicidality or suicidal ideation, and post-traumatic stress disorder symptoms. Oher outcomes that were studied included resiliency, coping, general health, quality-

of-life, and well-being. **Figure 4** shows the most frequent outcome measures of interest for all 23 studies included in the final review phase as well as data extraction.

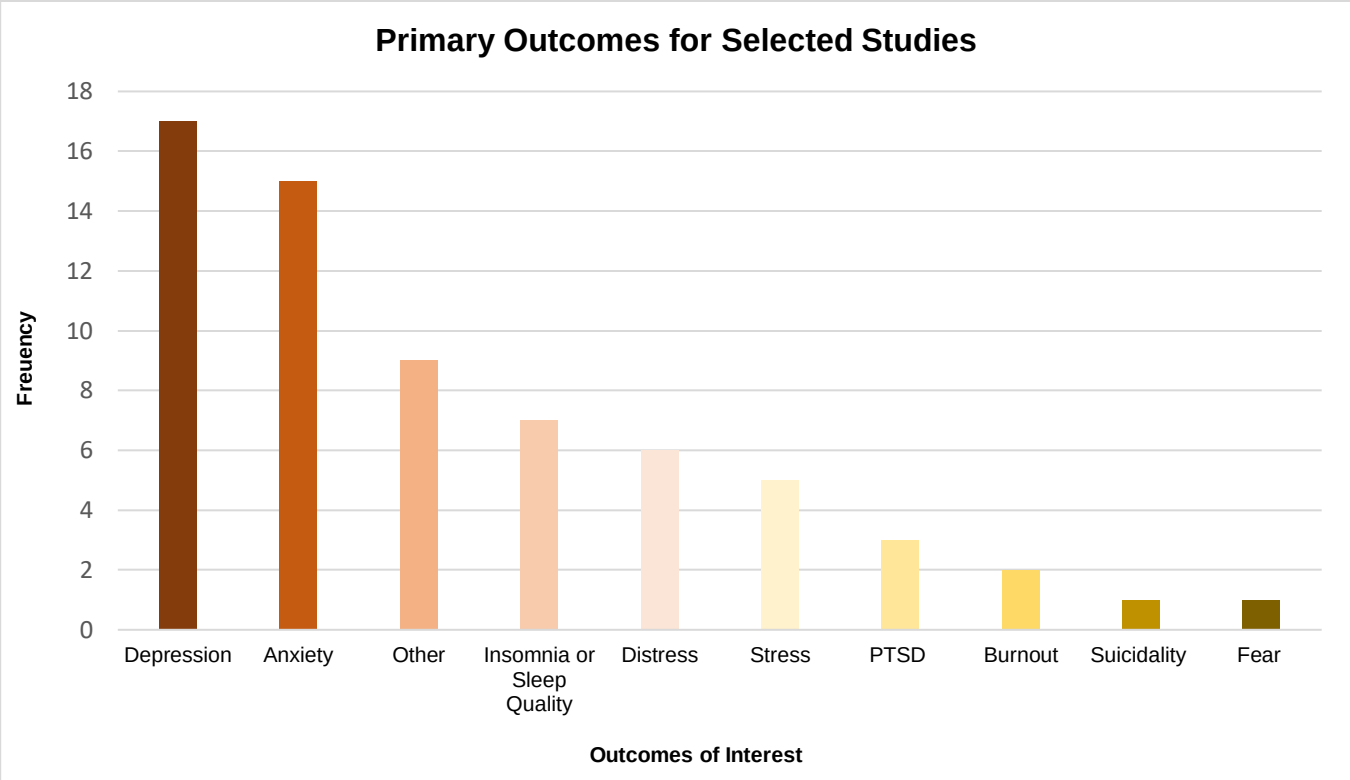

Figure 4. This chart illustrates the primary outcomes of interest for each of the selected studies.

Song et al. (2020), examined the prevalence of depression among medical staff in emergency departments during the COVID-19 pandemic in China. Song et al. found that out of their 14,825 participants, 41.1% were physicians, while 58.9% were nurses. Further, 25.2% of participants experienced some sort of psychological symptoms, while another 9.1% reported having depressive and post-traumatic stress symptoms (Song et al., 2020). It was also found that there was a relationship between work-related factors, social support and demographics, and psychological symptoms. Comparing men to women, men were more likely to have depressive symptoms (OR: 1.12, 95% CI: 1.01, 1.24). Additionally, working within Hubei province rather than outside of Hubei was associated with more depressive symptoms (OR: 1.70, 95% CI: 1.26,

2.29). Lastly, those with graduate degrees were more likely than others to have depressive symptoms (OR: 1.26, 95% CI: 1.06, 1.50) (Song et al., 2020).

In the study conducted by Hong et al. (2020), the immediate psychological impact on nurses working at 42 government-designated hospitals during the COVID-19 pandemic in China were investigated. Included in the study were data from 4,838 nurses from various government-designated hospitals across China. The overall prevalence of anxiety was 8.1% (n = 379) among the participants. Having education below a baccalaureate degree was found to be a risk factor for symptoms of anxiety (OR = 1.26), while having a family member who was not infected with the virus was protective against symptoms of anxiety (OR = 0.31) (Hong et al., 2020). Further, Hong et al. (2020) investigated the relationship between working in hospitals during the COVID-19 pandemic and suicidal ideation among nurses. Poorer subjective health (poor: OR = 7.56; fair: OR = 3.38), not enough support from family members (OR: 2.05) or hospital authority (OR = 1.54), and less opportunities for reflecting opinions through mass media (OR = 1.47) were found to be risk factors for suicidal ideation, while family members not being infected (OR = 0.15) and lower job-related stress (low: OR = 0.40; medium: OR = 0.61) had protective effects on suicidal ideation (Hong et al., 2020). The studies by Hong et al. and Song et al. were highlighted in more detail because these were two of the largest studies that were selected for final data extraction during this systematic review, however the other 21 studies are also highlighted below.

In addition to the aforementioned studies, while conducting this review, many nuances were found within the data that were collected and included in this review. For instance, in many studies, it was found that females, or those who identified as female, were at a higher risk for experiencing anxiety, depression, stress and disturbances in sleep or insomnia. Further, it was found that being male or identifying as a man could be a protective factor against depression,

anxiety, and stress (Arafa et al., 2020; Blekas et al., 2020; Elkholy et al., 2020; Juan et al., 2020; Lai et al., 2020; Pouralizadeh et al., 2020; Sahin et al., 2020; Yao et al., 2020; & Zhu et al., 2020).

Secondly, results suggested that working directly with suspected or confirmed COVID-19 patients and those working on the frontlines of the pandemic were more at risk for displaying symptoms of depression, anxiety, stress, distress, insomnia. Along those same lines, those who have a higher risk of potentially contracting COVID-19 were at an increased risk for such ailments (An et al., 2020; Badahdah et al., 2020; Lai et al., 2020; Lam et al., 2020; Pouralizadeh et al., 2020; Sahin et al., 2020; & Wankowicz et al., 2020).

Multiple studies found that a lack of or insufficient supply of personal protective equipment (PPE) is linked with an increase in participants' reported levels of anxiety, stress, and depression (Martinez-Lopez et al., 2020; Pouralizadeh et al., 2020; Sampaio et al., 2020; & Sandesh et al., 2020). One study in particular found that a lack of PPE, which was reported by 62.5% of participants, was a significant risk factor for depression and anxiety (Sandesh et al., 2020).

Lastly, there were multiple studies that uncovered findings related to acute stress disorder (ASD), post-traumatic stress disorder (PTSD) symptoms, fear, exhaustion, depersonalization, psychological distress, and anxiety and depression in general. In one Jordan-based study, it was found that 64% of nurses experienced ASD symptoms and were at an increased risk for PTSD as a result. Additionally, 41% suffered from significant psychological distress as a result of the COVID-19 pandemic (Shahrour & Dardas, 2020). In another study conducted by Guisti et al. (2020), 26.8% reported clinical levels of depression, 31.3% of anxiety, 34.3% of stress and 36.7% of PTSD (Guisti et al., 2020). Further, in a Wuhan, China-based study, at least half of

nurses surveyed reported burnout, which was shown in exhaustion (60.5%) and depersonalization (42.3%). 14.3%, 10.7%, and 91.2% of nurses reported moderate and significant levels of anxiety, depression and fear, respectively (Hu et al., 2020). In another China-based study, it was found that the overall prevalence of anxiety, depression and insomnia were 13.9%, 16.1%, and 19.7% respectively. Medical staff in Hubei province had the highest prevalence of anxiety (20%), depression (22%), and insomnia (26%), while staff outside of Hubei province had the lowest prevalence of these conditions (Wang et al., 2020). In another study from Wuhan, China, it was found that among 994 medical staff, 36.9% were below the subthreshold for mental disturbances, 34.4% had mild disturbances, 22.4% had moderate disturbances and 6.2% had severe disturbances (Kang et al., 2020).

Discussion

During the course of this systematic review, it became clear that healthcare workers who were working on the frontlines of the COVID-19 pandemic did, indeed, suffer from drastic mental health impacts, such as depressive symptoms, anxiety, post-traumatic stress symptoms, and even suicidal ideation.

In Song et al. (2020) and across most of the studies in this review, depression was reported among healthcare workers—both nurses and physicians (An et al., 2020; Arafa et al., 2020; Elkholy, 2020; Giusti et al., 2020; Hong et al., 2020; Juan et al., 2020; Lai et al., 2020; Lam et al., 2020; Pouralizadeh et al., 2020; Sahin et al., 2020; Sampaio et al., 2020; Sandesh et al., 2020; Song et al., 2020; Wang et al., 2020; Wankowicz et al., 2020 & Zhu et al., 2020). Song et al. (2020) reported that across 14,825 medical staff that were included in the study, 25.2% reported depressive symptoms during the COVID-19 pandemic in China. Older male medical staff in the Hubei province were more likely to suffer from such symptoms and longer work hours were also associated with increased risk for depressive symptoms (An et al., 2020; Chan, 2003; Song et al., 2020). Lastly, it was found that nurses reported higher rates symptoms than physicians. The increased rate of depression in nurses was hypothesized to be due to the fact that nurses often spend more one-on-one time working with patients compared to physicians, and thus this prolonged patient contact has a stronger effect on the nurses (Chan, 2003; Song et al., 2020).

The findings in this review align with evidence provided by Cheng & Cheng (2017) in that healthcare workers are more likely to have longer work hours, non-standard or unpredictable schedules, higher psychosocial demands and more workplace violence compared to non-healthcare workers— all of which could affect the mental health status of healthcare workers in a

pandemic setting (Cheng & Cheng, 2017). Also, those who had stronger social support systems outside of work reported less symptoms of depression. This aligns with existing literature in that both quantity and quality of social relationships can affect one's mental health, health behavior and physical health and improve one's quality of life (Umberson & Montez, 2011).

An interesting finding from the Song et al. (2020) study was the fact that the rate of depression reported in the study were actually lower than previously reported in the literature, however the authors hypothesized this was the case due to the timing at which the study was conducted. The study was conducted between February 28, 2020 and March 18, 2020, and at this time, the pandemic in China was finally starting to stabilize and the pressure on medical staff was starting to be reduced (Song et al., 2020).

Among the studies that looked at anxiety, symptoms of such were reported among frontline healthcare workers, such as doctors and nurses. In a study by Hong et al. (2020), they found that 8.1% of nurses reported symptoms of anxiety. Overall, within this study, they found that the mental health of nurses was generally poor due to the COVID-19 pandemic. The findings in Hong et al. (2020) align with a previous study that was conducted during the Severe Acute Respiratory Syndrome (SARS) outbreak. Healthcare workers responding to the SARS outbreak were found to experience higher stress, anxiety, depression, and post-traumatic stress symptoms. It was hypothesized that these mental health effects were exacerbated by poor sleep, fatigue, a general sense of worry about health, and fear of contact with the virus (McAlonan et al., 2007).

During the MERS outbreak there was also evidence of this among frontline healthcare workers, such as nurses, physicians, and respiratory therapists. Factors that led to an increase in stress and anxiety included seeing fellow colleagues being intubated, the fear of potentially

transmitting the infection to family members or peers, making a mistake of having a lapse in judgment that could infect themselves of others with MERS, taking care of fellow colleagues, and finally seeing patients die from MERS-CoV infection. These factors led researchers to conclude that frontline workers do experience a significant amount of psychological distress that can lead to conditions such as anxiety (Khalid et al., 2016). Other job-related factors that could potentially impact frontline workers' experience of anxiety include high workload and being put into quarantine (Hong et al., 2020).

As stated in the results section, it was found that females or those identifying as women, were more likely to experience anxiety, stress, depression, and other psychological ailments when compared to men (Arafa et al., 2020; Blekas et al., 2020; Elkholy et al., 2020; Juan et al., 2020; Lai et al., 2020; Pouralizadeh et al., 2020; Sahin et al., 2020; Yao et al., 2020; & Zhu et al., 2020). These findings are in alignment with previous literature. For instance, in one study by Wang et al. (2020), females' anxiety risk was 3.01 times that of males (Wang et al., 2020). It is suspected that women internalize more of their trauma and experiences as opposed to men, who tend to have more externalizing symptoms. These findings could be why there is a higher prevalence of depression and anxiety among women compared to men (Albert, 2015). It is also suggested that the role of sex hormones such as oestradiol and progesterone may play a role in these sex differences to stress and trauma (Li & Graham, 2016).

In addition to sex and gender differences, age was also a factor for psychological disturbance. Younger healthcare workers (HCWs) were more likely to experience moderate to severe anxiety compared to older HCWs (Badahdah et al., 2020). A study by Ahmed et al (2020) also found that younger individuals were more at risk during the COVID-19 pandemic, stating that younger individuals are more vulnerable when under stress (Ahmed et al., 2020). Further, it

was suggested that young people can easily trigger stress since they tend to collect information from social media more readily than older adults (Ahmed et al., 2020; Cheng et al., 2014).

Lastly, excessive workload and fear of infection were also factors for increased psychological disturbances among healthcare workers. This was especially true for frontline healthcare workers (An et al., 2020). These findings align with those of the SARS pandemic. For example, Maunder et al. (2020) also found that fear of infection was a factor that led to negative psychological effects such as stress, anxiety and depression. Another study suggested that increased workload during the SARS pandemic led to increased anxiety among clinical staff, with over half reporting that they have an increased workload due to the pandemic (Koh et al., 2005).

Limitations

While this was a comprehensive review of the literature regarding mental health impacts of COVID-19 on healthcare workers, there were some limitations. First, the studies reviewed were limited by a set of inclusion and exclusion criteria identified in the methods section of this paper and may not be a fully comprehensive due to factors such as article availability, accidental deletion during de-duplication, and the search terms chosen during the initial search of the literature. Second, all of the studies included in this review were cross-sectional studies, and therefore it may be more difficult to establish causality between the exposure and the outcomes of interest— however correlations could be made to drive further research. Lastly, one of the most important limitations in this systematic review is that there was only one reviewer (HP) who was involved in the screening and in-depth review of the literature selected, which could

potentially impose bias if items were not screened consistently against the inclusion and exclusion criteria designated for this review.

Conclusion

Overall, the 23 studies included in this review revealed that the COVID-19 pandemic has led to significant psychological impacts on frontline workers—particularly nurses and physicians working directly with confirmed or suspected COVID-19 patients. Factors such as increased workload, sex/gender, age, fear of infection and lack of sleep are just a few of the many contributors to conditions such as anxiety, depression, post-traumatic stress disorder, and burnout among frontline healthcare workers. Information learned from these studies could potentially inform public health preparedness in the future—in the event of another outbreak or pandemic such as the COVID-19 pandemic.

Public Health Implications

The studies that were included in this review could be a vital source of information when it comes to mental health, healthcare workers, and responding to a global public health emergency such as the COVID-19 pandemic. While these were all cross-sectional studies, and direct causality could not be presumed, these studies are the first stepping-stone to illustrating how the COVID-19 pandemic has influenced the mental health of vital frontline workers, such as nurses and physicians.

Having the information from these studies could help public health and healthcare professionals know where to stage mental health interventions, not only within everyday operations, but especially in the case of a public health crisis like COVID-19. Potential interventions could include having mental health workers on site and available to frontline workers, offering free or low-cost mental health services for frontline workers, and potentially screening for signs of mental health distress on a routine basis—such as during a shift change.

Additionally, with the knowledge that has been acquired regarding mental health and COVID-19, organizations like the Substance Abuse and Mental Health Services Administration (SAMHSA) have acquired grant funding in order to expand current services, such as those related to the pandemic, mental health, and substance use. SAMHSA also provides training and other services to behavioral health providers, educating them on how to deal with mental health afflictions brought on by the COVID-19 pandemic (SAMHSA, 2021). The Centers for Disease Control and Prevention (CDC) now provides mental health resources on their website regarding how to deal with stress and other side-effects of the pandemic, such as grief and loss, resources for healthcare personnel and first responders, information regarding intimate partner violence

and suicide prevention, as well as information for how to help teens and children in coping with the COVID-19 pandemic (CDC, 2021).

In conclusion, the information gained from the studies in this review—as well as others that did not make it into this review—could also allow employers to notice warning signs of mental health distress early so that vital intervention(s) can take place for healthcare workers on the frontlines of not only the COVID-19 pandemic, but in the event of future public health crises or outbreaks.

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Appendix 1

Table 1: PubMed Search Strategy

Search conducted October 9, 2020

	#	Searches	Results
Mental Health	**1**	(“mental health”[tw] or “mental illness”[tw] or “mental disorder”[tw] or well-being[tw] or wellbeing[tw] or “quality of life”[tw] or burnout[tw] or stress[tw] or PTSD[tw] or resilienc*[tw] or emotion*[tw] or post-traumatic[tw] or psychological[tw] or psychosocial[tw] or fatigue[tw] or coping[tw] or trauma[tw] or suicide[tw] or anxiety[tw] or depression[tw] or psycholog*[tw])	3,286,206
Healthcare Workers	**2**	(healthcare personnel[tw] or health care personnel[tw] or healthcare professional*[tw] or health care professional*[tw] or healthcare worker*[tw] or health care worker*[tw] or doctor*[tw] or nurse*[tw] or physician*[tw] or health worker*[tw] or health personnel[tw] or frontline worker*[tw] or clinician*[tw] or health professional*[tw] or essential worker*[tw])	1,347,814
COVID-19	**3**	("COVID-19"[tw] OR "COVID 19"[tw] OR COVID19[tw] OR 2019nCov[tw] OR "2019-nCoV"[tw] OR "2019 ncov"[tw] OR SARS-CoV-2[tw] OR "COVID-19" [Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2" [Supplementary Concept] OR "pediatric multisystem inflammatory disease, COVID-19 related" [Supplementary Concept] OR "COVID-19 vaccine" [Supplementary Concept] OR "COVID-19 diagnostic testing" [Supplementary Concept] OR "COVID-19 serotherapy" [Supplementary Concept] OR "COVID-19 drug treatment" [Supplementary Concept] OR "LAMP assay" [Supplementary Concept] OR (Wuhan[tw] OR hubei[tw] OR Huanan[tw] AND coronavirus[tw]) OR (new[tw] OR novel[tw] AND coronavirus[tw]))	63,230
	4	#1 AND #2 AND #3	1,734

Table 2: Embase Search Strategy

Search conducted October 9, 2020

	#	Searches	Results
Mental Health	**1**	"mental health" or "mental illness" or "mental disorder" or well-being or wellbeing or "quality of life" or burnout or stress or PTSD or resilienc* or emotion* or post-traumatic or psychological or psychosocial or fatigue or coping or trauma or suicide or anxiety or depression or psycholog*	7,572,011
Healthcare Workers	**2**	healthcare personnel or health care personnel or healthcare professional* or health care professional* or healthcare worker* or health care worker* or doctor* or nurse* or physician* or health worker* or health personnel or frontline worker* or clinician* or health professional* or essential worker*	29.619
COVID-19	**3**	"COVID-19" OR "COVID 19" OR COVID19 OR 2019nCov OR "2019-nCoV" OR "2019 ncov" OR SARS-CoV-2 OR ((Wuhan OR hubei OR Huanan) AND coronavirus) OR ((new OR novel) AND coronavirus) OR (MH "COVID-19") OR 'coronavirus disease 2019'/exp OR 'SARS-CoV-2 vaccine'/exp	63,194
Combined	**4**	#1 AND #2 AND #3	236

Appendix 2

Author	Country in which the study conducted	Primary Outcome Measure(s)	Study design	Start date	End date	Method of recruitment of participants	Total number of participants
Zhu et al.	China	Anxiety, depression	Cross sectional study	1-Feb-20	29-Feb-20	Online	165
Yao et al.	China	Stress, general health	Cross sectional study	1-Feb-20	20-Feb-20	Online	1,002
Wang et al.	China	Anxiety, depression, sleep quality, stress, and resilience	Cross sectional study	26-Feb-20	3-Mar-20	WeChat	274
Badahdah et al.	Oman	Anxiety, stress, and well-being	Cross sectional study	Apr-20	Apr-20	Online	509
Wankowicz et al.	Poland	Anxiety, depression, sleep disorders	Cross sectional study	3-May-20	17-May-20	N/A	441
An et al.	China	Depression, quality of life	Cross sectional study	15-Mar-20	20-Mar-20	WeChat	1,103
Song et al.	China	Depression, PTSD	Cross sectional study	28-Feb-20	18-Mar-20	Online	14,825
Shahrour et al.	Jordan	Stress, distress, coping self-efficacy	Cross sectional study	N/A	N/A	Online	448
Sandesh et al.	Pakistan	Depression, anxiety	Cross sectional study	May-20	May-20	Online	112
Sampaio et al.	Portugal	Depression, stress, anxiety	Cross sectional study	31-Mar-20	7-Apr-20	Online	767
Sahin et al.	Turkey	Depression, anxiety, distress, insomnia	Cross sectional study	23-Apr-20	23-May-20	Online	939
Martinez-Lopez et al.	Spain	Burnout, self-fulfillment, depersonalization	Cross sectional study	6-Apr-20	19-Apr-20	Online	157
Giusti et al.	Italy	Anxiety, psychological distress, post-traumatic symptoms, and burnout	Cross sectional study	16-Apr-20	11-May-20	Online	330
Pouralizadeh et al.	Iran	Anxiety, depression	Cross sectional study	7-Apr-20	12-Apr-20	Online	441
Hu et al.	China	Burnout, anxiety, depression, and fear	Cross sectional study	N/A	N/A	Online	2,101
Hong et al.	China	Depression, anxiety, somatic disorders, and suicidal ideation	Cross sectional study	8-Feb-20	14-Feb-20	Online	4,838

Elkholy et al.	Egypt	Anxiety, insomnia, depression and stress, and potential risk factors	Cross sectional study	Apr-20	May-20	N/A	30-50 per hospital (20 hospitals)
Lam et al.	China	Depression	Cross sectional study	9-Mar-20	9-Apr-20	Online	1,566
Lai et al.	China	Depression, anxiety, insomnia, and distress	Cross sectional study	29-Jan-20	3-Feb-20	Online	1,257
Kang et al.	China	Anxiety, insomnia, depression, distress	Cross sectional study	29-Jan-20	4-Feb-20	Online	994
Juan et al.	China	Psychological stress reactions, anxiety, depression, obsessive-compulsive symptoms, psychological distress.	Cross sectional study	1-Feb-20	14-Feb-20	Online	456
Blekas et al.	Greece	PTSD, insomnia, distress	Cross sectional study	10-Apr-20	13-Apr-20	Online	270
Arafa et al.	Egypt & Saudi Arabia	Depression	Cross sectional study	14-Apr-20	24-Apr-20	Email	426