

## REVIEW ARTICLE

# The impact of SARS-CoV-2 on the mental health of healthcare workers in a hospital setting—A Systematic Review

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## Abstract

**Objectives:** The SARS-CoV-2 global pandemic has subjected healthcare workers (HCWs) to high risk of infection through direct workplace exposure, coupled with increased workload and psychological stress. This review aims to determine the impact of SARS-CoV-2 on mental health outcomes of hospital-based HCWs and formulate recommendations for future action.

**Methods:** A systematic review was performed between 31st December 2019 and 17th June 2020 through Ovid Medline and Embase databases (PROSPERO ID CRD42020181204). Studies were included for review if they investigated the impact of SARS-CoV-2 on mental health outcomes of hospital-based HCWs and used validated psychiatric scoring tools. Prevalence of ICD-10 classified psychiatric disorders was the primary outcome measure.

**Results:** The initial search returned 436 articles. Forty-four studies were included in final analysis, with a total of 69,499 subjects. Prevalence ranges of six mental health outcomes were identified: depression 13.5%-44.7%; anxiety 12.3%-35.6%; acute stress reaction 5.2%-32.9%; post-traumatic stress disorder 7.4%-37.4%; insomnia 33.8%-36.1%; and occupational burnout 3.1%-43.0%. Direct exposure to SARS-CoV-2 patients was the most common risk factor identified for all mental health outcomes except occupational burnout. Nurses, frontline HCWs, and HCWs with low social support and fewer years of working experience reported the worst outcomes.

**Conclusion:** The SARS-CoV-2 pandemic has significantly impacted the mental health of HCWs. Frontline staff demonstrate worse mental health outcomes. Hospitals should be staffed to meet service provision requirements and to mitigate the impact on mental health. This can be improved with access to rapid-response psychiatric teams and should be continually monitored throughout the pandemic and beyond its conclusion.

Guarantor: Mr Joshua R. Burke.

Jaspinder Sanghera and Nikhil Pattani Joint 1st Authorship.

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**KEYWORDS**

anxiety, burnout, depression, insomnia, SARS-CoV-2, stress

## 1 | INTRODUCTION

The Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) pandemic originated from Wuhan city, Hubei Province, China, in December 2019. It continues to challenge healthcare services globally and has resulted in significant morbidity and mortality.<sup>1</sup> The World Health Organisation declared the outbreak an international public health emergency on January 30th 2020 and by June 24th 2020, the death toll worldwide stood at 479,496, with 9,343,448 confirmed cases.<sup>2,3</sup> Due to its high reproductive number ( $R_0$ ), cases spread beyond Wuhan within 2 months to more than 25 countries.<sup>4</sup> The number of cases continue to rise with significant impact on healthcare workers (HCWs) and healthcare systems. Limited availability of personal protective equipment and increased workload increases the risk of both contracting and transmitting the disease.<sup>5</sup> Hence, HCWs are at risk of significant psychological distress.

SARS-CoV, the predecessor to SARS-CoV-2, originated in Guangdong province, China, in November 2002. It became an epidemic that affected more than 8000 people across 26 countries, of which 20% of positive cases were HCWs.<sup>6</sup> There was evidence of considerable psychological burden on HCWs, including post-traumatic stress disorder (PTSD) and depression. Chong et al reported that 75% of its HCWs in Taiwan experienced negative psychological effects.<sup>7</sup> Reconciling the fear of contagion, infecting patients, co-workers, and family members, was commonplace, with associated stigmatization.<sup>8</sup> Given the deleterious effects of SARS-CoV-2 on HCWs currently, robust and rapidly available research on mental health outcomes is urgently required.

An understanding of SARS-CoV-2 impact on HCW mental health will inform an appropriate response as the pandemic continues. Support can be targeted to those at greatest risk of psychiatric decline. A previous review by Brooks et al identified key risk factors affecting HCW mental health outcomes during the SAR-CoV pandemic: direct contact with infected patients, inadequate psychological support from employers, impacted social/family life, and working in the nursing profession (specifically for acute stress and PTSD).<sup>9</sup> Greater family support and strong belief in infection control procedures were protective for mental health outcomes. A meta-analysis by Pappa et al on the prevalence of depression, anxiety, and insomnia in HCWs during the pandemic was recently published in May 2020.<sup>10</sup> This meta-analysis limited its investigation to pooled prevalences of three mental health conditions from 13 studies, of which 12 were based in China. Included studies had substantial heterogeneity with varying disease-specific outcome scales and diagnostic cut-off

scores. This systematic review investigates the prevalence of mental health conditions in HCWs during SARS-CoV2. In addition it investigates the impact of mental health outcomes in hospital HCWs during SARS-CoV-2 and aims to identify outcomes and risk factors to inform future interventions.

## 2 | METHODS

The protocol for this review (CRD42020181204) was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

### 2.1 | Eligibility criteria

Inclusion:

1. Studies which examined the impact of SARS-CoV-2 on healthcare professionals.
2. Studies which investigated at least one International Classification of Diseases-10th Revision (ICD-10) defined psychiatric condition.
3. Use of at least one validated quantitative scoring scale to measure mental health outcomes, or a self-designed one based on a pre-existing, validated scale
4. Available in English Language
5. Hospital based
6. Conducted from 31st December 2019 (when China reported the first case of SARS-CoV-2 in Wuhan) to 17th June 2020

Exclusion:

1. Studies investigating non-hospital-based HCWs exclusively
2. Written in non-English language
3. Studies with fewer than 20 participants

### 2.2 | Information sources and search

MEDLINE and Embase electronic databases were interrogated for studies published between 31st December 2019 and 17th June 2020. Due to the rapid production of publications during the current pandemic, pre-print papers were also searched for using Medrxiv. Reference lists of selected studies were searched to identify further papers. The full list of search terms used is provided in Figure S1.

## 2.3 | Study selection

Two authors (YH and JS) screened the total list of identified records to determine eligibility in a blinded, standardized manner. Screening was initially via title and then abstract. Disagreements between the two reviewers were resolved by a third author (NP). NP also searched the full reference lists of selected studies and identified pre-print papers on Medrx. Correspondences with primary data and preprint studies were included in this review.

## 2.4 | Data collection process

NP and JS completed an outcome extraction database for the review (Microsoft Excel, 2018). NP extracted the following data from the included studies: participant uptake; participant demographics (including age, occupation, exposure to SARS-CoV-2, and others); date of study; location of study; and outcome measure(s) used. JS checked the extracted data and any disagreements were reviewed by the third author YH. The authors of selected studies were contacted for clarification of data sets.

## 2.5 | Data items

The primary outcome measure was the prevalence of ICD-10 defined psychiatric conditions. The secondary outcome measures were the use of validated psychiatric scoring tools, differences in prevalence between sub-groups of HCWs and independent risk factors associated with these conditions. Studies which used the same scoring tool but different diagnostic 'cut-off' scores to calculate prevalence were highlighted. In these studies, the raw data were used to calculate standardized prevalence using the following cut-off scores: DASS-21 > 14, PHQ-9  $\geq$  10, GAD-7  $\geq$  10, IES-R > 24/25, ISI  $\geq$  8, and MBI EE > 27 & DP > 10 using pre-defined standards.<sup>11-16</sup>

## 2.6 | Risk of bias in individual studies

The methodology of each study was individually analyzed. With substantial study heterogeneity and large variation in study methodology, the use of a single bias scoring tool was inappropriate. Instead, differences between sampling methods in studies were identified (Table 1), compared, and limitations highlighted in the discussion.

## 2.7 | Synthesis of results

A narrative synthesis approach was used to summarize the diverse range of selected studies in a structured manner,

following the European Social Research Council Guidance on the Conduct of Narrative Synthesis in Systematic Reviews.<sup>17</sup> Outcome measures on each condition were collected from all studies and prevalences calculated. The studies were screened for independent risk factors associated with each condition, provided they were derived through regression analyses and were significant ( $P \leq .05$ ) (Tables S1-S6). Comparisons between different sub-groups were analyzed: frontline vs non-frontline, doctors/nurses vs other HCWs, HCWs vs general public, doctors vs nurses, and further participant characteristics (eg, years of working experience and social support).

## 3 | RESULTS

This systematic review demonstrates the prevalence of six mental health conditions in HCWs during SARS-CoV-2 with associated factors, incorporating 44 studies across 15 countries (Figure 1). The databases MEDLINE and Embase initially yielded 418 articles. A further 18 were identified through Google Scholar, Medrx, and reference lists of included studies. Following the removal of duplicates, 378 results remained and were compiled into a database for screening. A total of 305 articles were excluded in-line with pre-defined inclusion and exclusion criteria, leaving 73 for full-text assessment. A further 29 were removed following assessment, leaving a total of 44 primary studies.

### 3.1 | Study characteristics

Of the 44 identified studies, 38 included nurses and 42 included doctors. Six studies also included members of the general population. 27 studies were conducted in China. The remaining were conducted in Thailand, Oman, Italy, India, Singapore, UK, Romania, Turkey, Spain, Iran, Jordan, Italy, Pakistan, and America. Seven of the China-based studies recruited HCWs from Wuhan alone. The remaining China-based studies had a varied participant demographic. The total number of participants across all studies was 69 499 (ranging from 37 to 14 285). All studies used a cross-sectional design relying on self-reported questionnaires. The characteristics of the studies are summarized in Table 1. A total of 23 studies investigated independent risk factors for mental health outcomes.

The healthcare professions included under the HCW term varied across studies and are detailed in Table S7. For ease in this review, when doctors and nurses are grouped together in sub-group analysis, 'other HCWs' refers to all other professions within the hospital setting. Frontline HCWs are those working in departments that have direct contact with

**TABLE 1** Study characteristics (n = 44)

Source	Participant no <sup>a</sup>	Dates of study	Location	Methodology	Primary outcomes
Apisarntharak et al <sup>27</sup> (Research brief)	160	Mar 1-31 2020	Bangkok and Pratum, Thailand, 2 private and 2 university hospitals	Participants invited to survey using a 'standardized data collection tool'	GAD-7
Badahdah et al <sup>67</sup>	194	Early Apr 2020	Oman	Web based survey link sent to participants	GAD-7 PSS-10
Barello et al <sup>58</sup>	376	Not disclosed	Italy	HCWs invited to complete an online questionnaire and those who reported direct exposure to SARS-CoV-2 patients were included	MBI
Cao et al <sup>19</sup> (Letter to editor)	37	Jan 20- Feb 10 2020	Peking Union Medical College Hospital, Beijing, China	Self-report questionnaire administered to medical HCWs at end of rotation Qualitative interviews delivered through a 24-hour hotline service	PHQ-9 MBI
Chatterjee et al <sup>30</sup>	152	Mar 28- Apr 6 2020	West Bengal	Link to online questionnaire distributed through email, WhatsApp, social media groups (with only doctors), and to contacts of the investigators	DASS-21
Chen et al <sup>71</sup> (Letter to editor)	105	Not disclosed	Guiyang China	Anonymous questionnaire distributed	SDS SAS
Chew et al <sup>29</sup>	906	Feb 19- Apr 17 2020	Tertiary institutions in Singapore and India	Questionnaire distributed by hand <sup>‡</sup>	DASS-21 IES-R
Choudhury et al <sup>20</sup>	106	Apr 1-7 2020	UK Lancashire Cardiac Centre, Blackpool Victoria Hospital	Two anonymous questionnaires distributed to participants (one consisting of PHQ-9 and PSS-4, and the other GAD-7)	PHQ-9 PSS-4 GAD-7
Chung et al <sup>21</sup> (Letter to editor)	69	Feb 14-24 2020	6 Hospitals in Hong Kong East Cluster	Online questionnaire distributed through COVID-19 newsletter on email and hospital phone calls	PHQ-9
Dimitriu et al <sup>34</sup>	100	Apr 27- May 8 2020	Romania	Survey distributed to participants in front line (Emergency department, radiology, ICU) and other departments (surgery, orthopedics)	MBI
Du et al <sup>66</sup>	310	Feb 13-17 2020	Wuhan, China	Smartphone-based survey	PSS BAI BDI-II

(Continues)

TABLE 1 (Continued)

Source	Participant no. <sup>a</sup>	Dates of study	Location	Methodology	Primary outcomes
Elbay et al <sup>32</sup>	442	Mar 10-15 2020	Istanbul, Turkey	Online survey shared on social network groups of different specialities (convenience sampling)	DASS-21
Garcia-Fernandez et al <sup>60</sup> (Letter to editor)	1787	Mar 29-Apr 5 2020	Spain	National self-reported online questionnaire distributed via social networks (exponential non-discriminative snowball sampling) Patients with current/past psychological disorders excluded	HARS BDI
Guo et al <sup>61</sup>	11,118	Feb 18-20 2020	China	Online survey distributed through WeChat	SDS SAS
Huang et al <sup>28</sup>	7236	Feb 3-17 2020	China	Web-based cross-sectional voluntary survey distributed through WeChat and mainstream media	GAD-7 CES-D PSQI
Jalili et al <sup>59</sup> (preprint)	645	Not disclosed	Tehran, Iran 8 university-affiliated hospitals	Self-reported questionnaire using a survey platform (EPoll), distributed through professional and informal networks	MBI
Kang et al <sup>98</sup>	994	Jan 29-Feb 4, 2020	Wuhan, China	Data collected through Wenjuanxing with anonymous self-report questionnaire	PHQ-9 IES-R GAD-7 ISI
Lai et al <sup>22</sup>	1257	Jan 29-Feb 3 2020	34 hospitals in China: Wuhan (n = 20), other regions in Hubei (n = 7), other provinces (n = 7)	Random selection of one department from each hospital, and everyone in this department asked to participate	PHQ-9 IES-R GAD-7 ISI
Liang et al <sup>72</sup> (Letter to editor)	59	Feb 3-21 2020	Guangdong Province, China	Not disclosed	SDS SAS
Li X et al <sup>99</sup> (Letter to editor)	948	Feb 15-22 2020	Zhejiang province, China Ningbo Kangning Hospital	Self-reported questionnaire No further information provided	AIS SRQ-20
Li Z et al <sup>65</sup>	740	Feb 17-21 2020	China	Anonymous questionnaire built using SoJump and distributed via WeChat	Chinese vicarious traumatization questionnaire (based on IES-R)
Liu C et al <sup>73</sup>	512	Feb 10-22 2020	China	Self-reported questionnaire distributed via WeChat	SAS
Liu Z et al <sup>62</sup> (preprint)	4679	Feb 17-24 2020	China 348 hospitals in 31 provinces	Anonymous voluntary self-reported survey using Questionnaire Star program, distributed via WeChat	SDS SAS
Lu et al <sup>42</sup>	2299	Feb 25-26 2020	Fujian Province, China	Online questionnaire, participants with psychological disorders excluded	HAMA HAM-D

(Continues)

TABLE 1 (Continued)

Source	Participant no <sup>a</sup>	Dates of study	Location	Methodology	Primary outcomes
Mo et al <sup>68</sup>	180	Feb 2020	Wuhan, China	Online anonymous questionnaires sent to senior nurses and asked to forward onto colleagues	SOS SAS
Naser et al <sup>23</sup> (pre-print)	4216	Mar 22-28 2020	Jordan	Self-reported questionnaire, participants invited through social media (Facebook and WhatsApp)	PHQ-9 GAD-7
Qi et al <sup>74</sup> (pre-print)	1306	Feb 2020	Multiple hospitals in Hubei Province	Online self-report survey distributed via WeChat <sup>b</sup> Participants with psychiatric disorders excluded	PSQI AIS
Rossi et al <sup>33</sup> (Research Letter)	1379	Mar 27-31 2020	Italy	Online questionnaire spread via social networks (snowball sampling) and sponsored social network advertisements	PHQ-9 GPS PSS-10 GAD-7 ISI
Salman et al <sup>24</sup> (pre-print)	398	Apr 15-May 20 2020	Punjab province, Pakistan	Web-based survey distributed via Google Forms (snowball sampling)	PHQ-9 GAD-7
Song et al <sup>63</sup>	14,285	Feb 28-Mar 18 2020	China	Electronic self-reported questionnaire distributed via snowball and convenience sampling	PCL-5 CES-D
Sun et al <sup>100</sup>	442	Jan 31-Feb 4 2020	China	Online survey created using 'Questionnaire Star' platform	IES
Tan et al <sup>31</sup>	470	Feb 9 - Mar 13 2020	Two tertiary hospitals in Singapore	HCWs directly invited in person to participate in a self-administered questionnaire	DASS-21 IES-R
Thomaier et al <sup>69</sup> (pre-print)	374	Mar 27-Apr 10 2020	America	Cross-sectional anonymous online survey, distributed through social media (Twitter, Facebook, LinkedIn)	PHQ-4
Wang et al <sup>64</sup>	123	Jan 30-Feb 7 2020	Children's Healthcare Centre of Renmin Hospital, Wuhan, China	Self-reported, anonymised questionnaire distributed to participants	PSQI SAS SDS
Wu K et al <sup>101</sup>	120	Not disclosed	China 2 undisclosed hospitals	Online self-reported questionnaires completed voluntarily	PSQI SDS SAS PCL-C
Wu Y et al <sup>102</sup>	190	Mar 13-17 2020	Wuhan	Questionnaire distributed to frontline and non-frontline HCWs in 1:1 ratio	MBI
Xiao H et al <sup>103</sup>	180	Jan-Feb 2020	Wuhan, China	Self-reported, anonymous questionnaires	SAS PSQI GSE SSRS SASR

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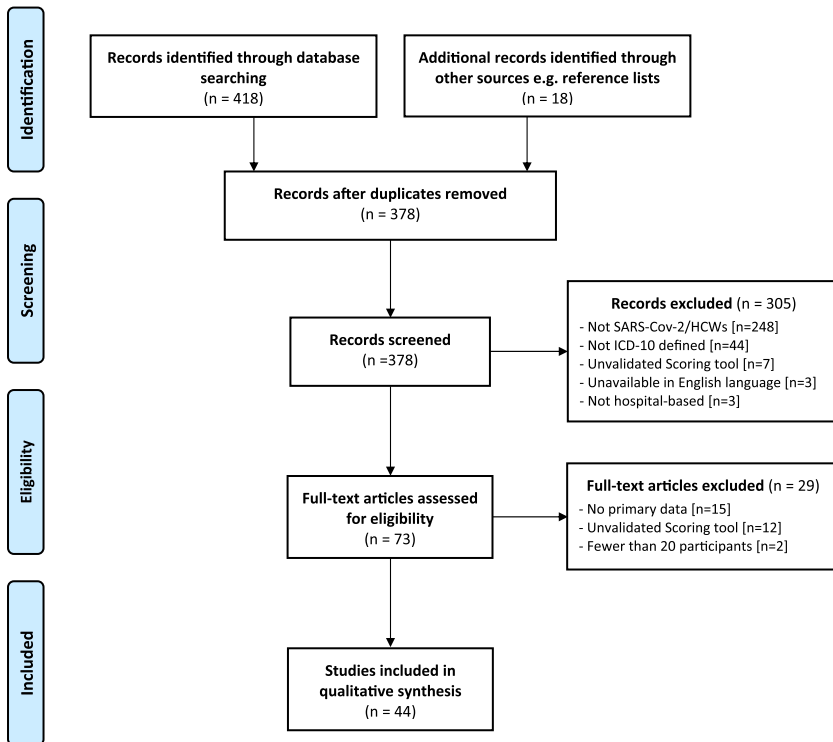
TABLE 1 (Continued)

Source	Participant no <sup>a</sup>	Dates of study	Location	Methodology	Primary outcomes
Xiao X et al <sup>70</sup>	958	Jan 28- Not disclosed	China	Online survey created using 'Questionnaire Star' program and distributed to medical personnel in multiple centers across the country via social media (WeChat and Tencent)	PSS HAD
Yin et al <sup>75</sup>	371	Feb 1-5 2020	China	Online survey conducted distributed via e-mail, WeChat and online websites to the contacts of the investigators. Participants with psychiatric disorders excluded	PSQI PCL-5
Zhang. C et al <sup>25</sup>	1563	Jan 29 - Feb 3 2020	China, including Wuhan workers	Questionnaire distributed through WeChat to groups of medical HCWs	ISI IES-R PHQ-9 GAD-7
Zhang S et al <sup>104</sup> (Letter to editor)	304	Apr 5-20 2020	Iran Public and private hospitals	Not disclosed	SF-12 PHQ-4 K6
Zhang. W et al <sup>47</sup>	2182	Feb 9- Mar 6 2020	Chinese provinces: Beijing (n = 888), Hebei (n = 546), Inner Mongolia (n = 126), Hubei (n = 28)	Online survey distributed via Wenjuanxing Chinese citizens over 16 years old were invited if eligible	ISI SCL-90-R PHQ-4
Zhu J et al <sup>105</sup>	165	Feb 1-29 2020	Gansu province, China SARS-CoV2 designated hospitals and fever clinics	Online survey created using 'Questionnaire Star' program and distributed via WeChat	SDS SAS SCSQ
Zhu Z et al <sup>26</sup> (pre-print)	5062	Feb 8-10 2020	Wuhan, China Tongji Hospital	Anonymous online questionnaires distributed via WeChat	PHQ-9 IES-R GAD-7

<sup>a</sup>'Participant No' refers to total number of participants within the study (six included members of the general public).

<sup>b</sup>Authors contacted directly to obtain this information.

FIGURE 1 PRISMA flow diagram



SARS-CoV-2 patients, eg, Intensive Care Unit (ICU) and respiratory wards.

All studies used psychiatric assessment tools as questionnaires to record outcomes, including: Patient Health Questionnaire (PHQ-9), Generalised Anxiety Disorder score (GAD-7), Insomnia Severity Index (ISI), Impact of Events Scale-Revised (IES-R), Pittsburgh Sleep Quality Index (PSQI), Zung's Self-rating Depression Scale (SDS), Zung's Self-rating Anxiety Scale (SAS), Depression Anxiety Stress Scales (DASS-21), General Self-Efficacy scale (GSE), Stanford Acute Stress Reaction Questionnaire (SASR), Social Support Rating Scale (SSRS), Stress Overload Scale (SOS) or Symptom Checklist-90-Revised (SCL-90-R), Maslach Burnout Inventory (MBI), Athens Insomnia Scale (AIS), Hamilton Anxiety Scale (HAMA), Hamilton Depression Scale (HAMD), Beck's Depression Inventory (BDI), Centre for Epidemiologic Studies Depression Scale (CES-D), Hospital Anxiety and Depression Scale (HADS), Beck Anxiety Inventory (BAI), Perceived Stress Scale (PSS), Acute Stress Disorder Scale (ASDS), PTSD Checklist for DSM-5 (PCL-5), Global Psychotrauma Screen (GPS), and Kessler Screening Scale (K6). These are explained in Table S8. The scoring tool utilized in each study along with the key findings are summarized in Tables S9-S14. The time periods during which the studies were conducted in relation to the first reported SARS-CoV-2 case are given in Table S15.

The final analysis identified six self-reported mental health outcomes across 44 studies, with associated ICD-10 codes: depression (F32), anxiety (F41), acute stress reaction

(F43.0), PTSD (F43.1), insomnia (F51), and occupational burnout (Z73).<sup>18</sup> The prevalence ranges of the mental health outcomes were as follows: depression 13.5%–44.7%<sup>19–26</sup>; anxiety 12.3%–35.6%<sup>20,22–25,27,28</sup>; acute stress reaction 5.2%–32.9%<sup>29–32</sup>; PTSD 7.4%–37.4%<sup>22,25,29,31</sup>; insomnia 33.8%–36.1%<sup>22,25,33</sup>; and burnout 3.1%–43%.<sup>19,34</sup>

Direct exposure to SARS-CoV-2 patients was the most common risk factor identified across all mental health outcomes in this review, except occupational burnout (Tables S1–S6). Nurses, frontline HCWs, HCWs with lack of social support, and HCWs with fewer years of work experience reported worse outcomes. Adequate social support was concluded as an important factor in reducing mental health morbidity.

### 3.2 | Depression

Eight validated depression scores were used across 32 studies.<sup>11,15,35–41</sup> The most commonly adopted scoring tool was the Patient Health Questionnaire (PHQ-9), used in 10 studies (Table S9). Using the cut-off score  $\geq 10$ ,<sup>12</sup> eight studies showed depression prevalence ranging from 13.5% to 44.7%.<sup>19–26</sup>

Independent risk factors for depression identified from the studies are shown in Table S1. Five studies identified direct exposure to SARS-CoV-2 patients as a risk factor. Of these, the largest study (Lu et al) reported the odds ratio for direct exposure as 2.016; 95% CI, 1.102–3.685,  $P = .023$ .<sup>42</sup> Four studies reported lack of social support (including



low peer/supervisor support, no family, unmarried or divorced/widowed) as a risk factor. Other risk factors corroborated by at least two studies included: having suspected/confirmed SARS-CoV-2, insufficient personal protection measures, younger age, eg, <35 years, and less working experience, eg, <10 years.

### 3.3 | Anxiety

Seven validated assessment tools were used across 33 studies.<sup>11,13,36,38,43,44</sup> One of the most commonly adopted tools was GAD-7, used in 11 studies (Table S10). Using the cut-off score  $\geq 10$ ,<sup>13</sup> seven studies showed anxiety prevalence ranging from 12.3% to 35.6%.<sup>20,22-25,27,28</sup>

Independent risk factors for anxiety identified from the studies are shown in Table S2. Five studies identified direct exposure to SARS-CoV-2 patients as a risk factor. Lu et al reported the odds ratio for direct exposure as OR 2.062; 95% CI, 1.349-3.153,  $P = .001$ .<sup>42</sup> Risk factors corroborated by at least two studies included: having suspected/confirmed SARS-CoV-2, insufficient personal protection measures, intermediate job title/responsibility, lack of social support (low peer/supervisor support, no family, or divorced) and insufficient knowledge on SARS-CoV-2. Others included pre-existing medical/psychiatric history and working experience <10 years.

### 3.4 | Insomnia

Three validated assessment tools were used across 12 studies.<sup>45,46</sup> The most commonly used tool was ISI, used in five studies (Table S11). Using the cut-off score  $\geq 8$ ,<sup>14</sup> three studies showed insomnia prevalence ranging from 33.8% to 36.1%.<sup>22,25,33</sup>

Independent risk factors for insomnia identified from the studies are shown in Table S4. Three studies identified direct exposure to SARS-CoV-2 patients as a risk factor for insomnia. Of these, the largest study (Zhang W et al) reported the odds ratio for direct exposure as 2.53; 95% CI, 1.74-3.68,  $P < .01$ .<sup>47</sup> Other risk factors included: fear of self-infection, working in isolation units, uncertainty regarding effective disease control, and lack of faith in psychological support from news/social media.

### 3.5 | Acute stress reaction

Five validated assessment tools were used across 11 studies.<sup>11,48-51</sup> The most commonly used tool was DASS-21, used in four studies (Table S12). Using the cut-off score >14 for the stress subscale,<sup>11</sup> these studies showed acute stress reaction prevalence ranging from 5.2% to 32.9%.<sup>29-32</sup>

Independent risk factors for acute stress reaction identified from the studies are shown in Table S5. These included direct exposure to SARS-CoV-2 patients, longer working hours, being a single child, having colleagues affected by SARS-CoV-2, and pre-existing psychiatric history.

### 3.6 | PTSD

Four validated assessment tools were used across 13 studies.<sup>52-55</sup> The most commonly used tool was IES-R, used in seven studies (Table S13). Using the cut-off score >24/25,<sup>56</sup> four studies showed PTSD prevalence ranging from 7.4% to 37.4%.<sup>22,25,29,31</sup>

Independent risk factors for PTSD identified from the studies are shown in Table S3. Three studies identified direct exposure to SARS-CoV-2 patients as a risk factor. Of these, the largest study (Rossi et al) reported the odds ratio for direct exposure as 1.37; 95% CI 1.05-1.80,  $P = .03$ .<sup>33</sup> Two studies identified the nursing profession as a risk factor. Others included working in isolation wards, being quarantined, working >12 hours/day, having family/friends affected by SARS-CoV-2, and poor sleep quality. Interestingly, Zhu et al identified longer working experience >10 years as a risk factor for PTSD.<sup>26</sup>

### 3.7 | Occupational burnout

The validated MBI assessment tool was used in five studies to evaluate HCW burnout.<sup>57</sup> This scale is divided into three categories: emotional exhaustion (EE), depersonalization (DP), and personal accomplishment (PA).<sup>16</sup> EE refers to the feelings of overextension and loss of motivation in one's work, which can be suspected among HCWs burdened with the SARS-CoV-2 pandemic. Using the cut-off score >27 for EE specifically,<sup>14</sup> two studies showed burnout prevalence ranging from 3.1% to 43.0%.<sup>19,34</sup>

Two studies derived independent risk factors for occupational burnout. Both Barello et al and Jalili et al associated the nursing profession with burnout.<sup>58,59</sup> Jalili et al also found that physicians with intermediate responsibility, ie, residents (OR 6.64; 95% CI, 2.16-20.41,  $P = .001$ ), and being of younger age were risk factors.<sup>59</sup>

## 4 | SUBGROUP ANALYSIS

### 4.1 | Doctors versus nurses

Eight studies investigated differences in mental health outcomes between medical professions.<sup>22,58-64</sup> Six studies show greater prevalence of disorders among nurses.<sup>22,58,60-63</sup> For example nurses in studies by Garcia-Fernandez et al, Guo

et al, and Lai et al scored significantly higher on depression and anxiety scales.<sup>22,60,61</sup> Liu Z et al also corroborated this finding, reporting greater prevalences among nurses compared to physicians.<sup>62</sup> Garcia-Fernandez et al and Lai et al reported higher scores for acute stress and PTSD among nurses, respectively.<sup>22,60</sup> Lai et al also outlined a significantly higher prevalence of insomnia in nurses.<sup>22</sup> Zhang C et al defined being a doctor as a protective factor against insomnia (OR = 0.44; 95%CI 0.24-0.80,  $P = .007$ ).<sup>25</sup> Barello et al demonstrated higher burnout prevalence in nurses.<sup>58</sup>

Contrary to this, Wang et al reported a significantly greater percentage of doctors with insomnia than nurses.<sup>64</sup> Jalili et al concluded that resident doctors were at a greater risk of burnout than nurses or specialist doctors.<sup>59</sup>

## 4.2 | Doctors/nurses versus other HCWs

The literature comparing doctors/nurses against other HCWs varies. Lu et al reported greater anxiety prevalence in other HCWs (eg, administration staff) which was statistically significant, but not for depression.<sup>42</sup> Tan et al directly compared depression, anxiety, and acute stress in these subgroups, using the DASS-21 scale.<sup>31</sup> Other HCWs (eg, technicians, maintenance workers, and clerical staff) reported more anxiety (adjusted prevalence ratio 1.85; 95%CI, 1.15-2.99,  $P = .011$ ). There were no significant differences for depression and acute stress.

## 4.3 | HCWs versus general public

Six studies included the general public in their samples, in order to compare the impact of SARS-CoV-2 on HCWs to people in other professions.<sup>23,28,47,60,61,65</sup> Zhang W et al reported higher prevalences of depression, anxiety, and insomnia in HCWs, compared to the general public, eg, teachers ( $P = .04$ ,  $P < .01$ , and  $P < .01$ , respectively).<sup>47</sup> Acute stress scores were also higher in HCWs in the study by Garcia-Fernandez et al<sup>60</sup> HCWs in the study by Huang et al reported the highest rate of poor sleep quality compared to other occupational groups (teachers, students, and enterprise workers).<sup>28</sup> Naser et al found that depression and anxiety was most prevalent in undergraduate students, followed by HCWs (61.4% vs 44.8% and 45.9% vs 32.8%, respectively).<sup>23</sup>

## 4.4 | Social support

Social support was often described in the literature as being provided by peers or family.<sup>63</sup> If HCWs lived alone or were unmarried/divorced/widowed, this was deemed as a lack of social support. Du et al reported that depressive and anxiety symptoms were more common among those lacking family support

( $P < .05$ ,  $P < .01$ ).<sup>66</sup> Using a specific scoring scale, Song et al found strong association between low-moderate social support and symptoms of depression and PTSD.<sup>63</sup> Unmarried HCWs were more likely to have depression, but less likely to have PTSD. Badahdah et al found that married doctors reported lower levels of stress than non-married, however, there was no difference in anxiety.<sup>67</sup> Elbay et al reported higher depression, anxiety, and acute stress scores in HCWs living alone.<sup>32</sup> With regards to burnout, Jalili et al showed high emotional exhaustion prevalence in those without children, but no significant difference between married and single participants.<sup>59</sup>

## 4.5 | Working experience

Across eight studies, there was a consensus that fewer years of working experience corresponded to worse mental health outcomes.<sup>30,32,59,60,63,68-70</sup> Chatterjee et al and Elbay et al showed that HCWs reporting depression and anxiety had less experience in their roles.<sup>30,32</sup> Jalili et al reported higher levels of burnout in those with  $\leq 5$  years than  $>5$  years of working experience.<sup>59</sup> Song et al and Thomaier et al attained similar findings regarding depression and PTSD, and anxiety, respectively.<sup>63,69</sup>

## 4.6 | Frontline versus non-frontline

A total of 15 studies compared the mental health outcomes of frontline and non-frontline HCWs.<sup>22,24,32,34,42,60-62,64,67,71-75</sup> Lai et al demonstrated that median GAD-7, PHQ-9, ISI, and IES-R scores were significantly higher in frontline HCWs ( $P < .001$ ).<sup>22</sup> Guo et al, Lu et al, and Liu Z et al all reported higher anxiety and depression scores in frontline HCWs.<sup>42,61,62</sup> However, Liang et al found no significant differences in these disorders despite using the same scoring scales as Guo et al<sup>61,72</sup> Dimitriu et al identified burnout as more frequent in HCWs in normal wards, as opposed to frontline departments (86% vs 66%  $P < .05$ ).<sup>34</sup> Qi et al reported significantly higher scores of PSQI and AIS insomnia scales in frontline HCWs.<sup>74</sup> This is corroborated by Lai et al<sup>22</sup>

Elbay et al derived the following factors which are detrimental to the mental health of frontline HCWs: increased weekly working hours, increased number of SARS-CoV-2 patients, and lack of peer support.<sup>32</sup> Naser et al found that pulmonologists and ENT specialists, who often work on the frontline during this pandemic, had higher depression and anxiety median scores than HCWs.<sup>23</sup>

## 5 | DISCUSSION

This analysis of HCW mental health across 15 countries shows two key findings. Firstly, all six mental health

outcomes were prevalent across the studies which investigated them. Secondly, direct exposure to SARS-CoV-2 patients was the most common risk factor identified for all mental health outcomes except burnout, followed by lack of social support and pre-existing medical and/or psychiatric disorders.

In the majority of studies comparing HCWs to the general public during this pandemic, HCWs suffered worse mental health outcomes. Furthermore, the 'China Mental Health Survey' prior to SARS-CoV-2 found that in the general public, the weighted 12-month prevalences of anxiety and depression were 5.0% and 3.6%, respectively.<sup>76</sup> In this review, the prevalence ranges of anxiety and depression in HCWs are substantially higher at 12.3%-35.6% and 13.5%-44.7%, respectively.

During the SARS-CoV 2003 pandemic, Chong et al demonstrated that fear and anxiety amongst HCWs appeared early, but depression and PTSD symptoms arose later in the 'repair phase' as the virus was brought under control.<sup>7</sup> As the included studies were conducted in different countries and at different time points in relation to their case trajectory curves (Table S15), similar conclusions cannot be made. However, the high insomnia prevalences in this review may suggest its importance as a precursor of HCW mental health deterioration. This is supported by a recent meta-analysis, which identified chronic insomnia as a risk factor for depression.<sup>77</sup> However, this relationship is likely bidirectional.<sup>78</sup>

HCW mental health is clearly multifaceted. A range of interlinking factors should be addressed when devising psychological interventions, including external factors such as social support and demographic risk factors.<sup>79</sup> Maunder *et al* demonstrated that high levels of HCW post-traumatic stress and burnout were sustained up to 12-26 months after the SARS-CoV pandemic.<sup>80</sup> As SARS-CoV-2 has arguably impacted healthcare services on a greater scale, it is likely that HCW mental health will be affected in a similar way. Hence, longitudinal follow-up studies are required to investigate and inform treatment of these disorders.

## 5.1 | Frontline versus non-frontline HCWs

Frontline HCWs worked in high-risk departments such as ICU, respiratory wards, and 24-hour fever clinics. Direct exposure to SARS-CoV-2 patients was the most consistent risk factor identified. The reasons for this may be three-fold. Firstly, frontline workers have the most exposure risk and having seen first-hand the effects of SARS-CoV-2 on patients, fear being infected themselves and transmitting to others. This includes their colleagues, other patients, friends, and family. Much like SARS-CoV-2, during the SARS-CoV pandemic, a greater disease exposure was associated with higher stress levels.<sup>81</sup> Secondly, Personal Protective Equipment

(PPE) is often double layered and uncomfortable. They must be worn by staff for several hours on end without eating, drinking, or using the toilet. Many become dehydrated from excessive sweating and develop skin conditions from excessive hand cleaning.<sup>82</sup> In the case of PPE shortages, their risk of infection increases dramatically.<sup>83</sup> Thirdly, due to the high morbidity and mortality associated with the disease, in addition to the reported unpredictable nature of deterioration, medical workers experience feelings of helplessness.<sup>84,85</sup>

## 5.2 | HCW medical/psychiatric health

Due to the added strain of SARS-CoV-2 on HCWs with pre-existing medical and/or psychiatric comorbidity, their symptoms may become exacerbated with a decline in overall function. HCWs with chronic medical conditions may experience anxiety over self-infection and the potential increase in mortality risk. Added stress and reduced sleep may worsen existing depression or trigger mood episodes in bipolar disorder.<sup>86</sup>

The presence of respiratory-related symptoms such as sore throat, breathlessness, or cough, as well as other systemic symptoms of myalgia and lethargy may raise HCWs' fear of SARS-CoV-2 infection. HCWs may feel conflicted between self-isolating for further testing or continuing to work alongside their colleagues, especially if they are under-staffed. This dilemma could result in anxiety, distress, and burnout.<sup>87</sup>

## 5.3 | Working hours

In order to provide 24-hour care, hospitals organize staff rotas in shifts and HCWs must often work during unsocial hours. Before the pandemic, shift work had been independently associated with burnout among nurses.<sup>88</sup> Dyrbye et al reported 3%-9% increased odds of physician burnout for each additional night or weekend on call.<sup>89</sup> SARS-CoV-2 has brought a surplus of patients with complex management needs, placing an even greater strain on healthcare systems and HCW workload.<sup>90</sup> A recent survey by Zhang et al identified that frontline HCWs were working longer hours than preferred during the SARS-CoV-2 pandemic.<sup>91</sup> This was particularly the case in fever clinics and isolation wards. Longer working hours on the frontline not only increases exposure to SARS-CoV-2 patients but also their risk of acute stress reaction/PTSD.<sup>63,68</sup>

## 5.4 | Variability in HCWs

The SARS-CoV pandemic has demonstrated similarly higher rates of mental health outcomes in nurses, compared to

doctors.<sup>92</sup> The reasoning behind this may be multifactorial. Nursing staff may have increased contact with infected patients compared to other HCWs.<sup>93</sup> For example they are responsible for monitoring vital signs, administering oxygen, and attending to patient needs. Given the morbidity associated with the disease, all HCWs are likely to experience increased ‘Emotional Labour’. This refers to the mental effort of suppressing emotions such as fear and concern, while displaying optimism and empathy.<sup>93</sup> There has been no research comparing this phenomenon between different HCWs. However, this has been linked to occupational burnout in the nursing profession.<sup>93</sup> The observed increased strain on all healthcare sectors may exacerbate inadequate staffing.<sup>1</sup> Cao et al reported nursing staff caring for up to 200 SARS-CoV-2 patients a day due to understaffing.<sup>19</sup>

## 5.5 | Social support

A lack of social support (including from peers, supervisors, family, spouse, and/or children) was shown to have a negative impact on HCWs’ mental health. Social support can provide HCWs with an outlet for managing work-related stress and improving self-confidence in their abilities. Wang et al demonstrated that support from peers and supervisors was associated with reduced job strain.<sup>94</sup> Conversely, living with family was identified as a risk factor in this review.<sup>26</sup> This is likely due to fear of transmitting the virus to loved ones, which brings a significant psychosocial burden.

## 5.6 | Working experience

HCWs with more clinical experience are more likely to have developed individual coping mechanisms for increased workload. This is in-line with the study by Chong et al during the SARS-CoV pandemic, in which IES scores were significantly higher in HCWs with less than 2 years of experience.<sup>7</sup> In addition, according to Xiao X et al, junior doctors and nurses had more contact with SARS-CoV-2 patients (both with confirmed and suspected diagnoses) compared to their seniors.<sup>70</sup>

## 5.7 | Limitations of studies

Within the challenging environment of the SARS-CoV-2 pandemic, this review has highlighted varying methods used to measure the prevalence of mental health outcomes in HCWs. These methods largely utilized self-reported data and were mostly cross-sectional. Due to this study design, no definitive causal relationships can be made. Although psychiatric assessment tools such as PHQ-9 and GAD-7 have shown efficacy for screening and monitoring purposes, their use in quantifying prevalence is inherently subjective.<sup>95</sup> In addition, crucial

‘effect modifiers’ such as pre-existing psychiatric disease and low socioeconomic status were not considered in the majority of studies. Following the onset of SARS-CoV-2, HCWs in these subgroups may have displayed exacerbated symptoms which may have confounded the study findings. Some studies used social media platforms such as WeChat to maximize questionnaire distribution through convenience sampling. As it cannot be ascertained how many HCWs received them, it is impossible to quantify response rates. There is also high selection bias as HCWs not using these platforms were unable to participate. ‘Wenjuanxing’, a Chinese survey website used by two studies, financially rewards participants on survey completion. This raises the possibility of data falsification, rushed answers, and multiple entries using different accounts. Due to the novelty of SARS-CoV-2 and the rapid publication of relevant work, preprint studies were included in this review. Preprint studies have not undergone rigorous academic peer review and the conclusions drawn from their datasets may not be as robust. Medrxiv was the sole search platform for preprint studies.<sup>96</sup> The long-term mental health consequences cannot be concluded from currently available literature and there is a need for future follow-up studies to quantify the long-term implications.

## 5.8 | Recommendations

- HCWs should follow working patterns which balance service provision and staff safety, with designated rest periods to prevent burnout and insomnia.
- All HCWs should have access to Psychiatric Rapid Response teams.
- Healthcare employers should systematically screen HCWs for mental health illness using risk factors identified and use this to implement mental health programs locally.
- Social support is crucial and can be provided through hospital support groups. Staff should be actively encouraged to remain in contact with their friends and family.
- There is a need for a validated, standardized HCW mental health scoring tool for specific use during a contagion outbreak. One such scale for work-related stress and anxiety during SARS-CoV-2 (‘SAVE-9’) has been recently devised.<sup>97</sup>
- Future research should assess the international incidence of long-term psychiatric disorders in HCWs as a result of the SARS-CoV-2 pandemic to inform mitigation and future prevention strategies.

## 6 | CONCLUSION

This systematic review aimed to investigate the prevalence of mental health issues in hospital-based HCWs during

the SARS-CoV-2 pandemic, and identify associated risk factors for psychological interventions. Disturbances in mental health such as insomnia were commonplace and may be predicted by risk factors such as direct exposure to SARS-CoV-2 patients and pre-existing medical comorbidity. Hospitals should screen their staff and provide early supportive psychological intervention. Future global research should be focused on the long-term psychological impact of SARS-CoV-2 and formulating a standardized questionnaire for use in future pandemics. The repercussions of SARS-CoV-2 have far surpassed its predecessors such as SARS-CoV. It has brought new challenges to mental health, and the impact on HCWs is likely to be present far after the conclusion of the pandemic.

## 7 | TRANSPARENCY DECLARATION

NP, JS, and JB confirm that the manuscript is honest, accurate, and that a transparent review of studies included is reported and that no important aspects of the study have been omitted.

## ACKNOWLEDGMENTS

All authors receive no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years. JB holds a Royal College of Surgeons of England clinical research fellowship supported by Bowel Research UK. The views expressed in this publication are those of the authors and not necessarily those of the NHS, RCS England, Bowel Research UK, Health Education England, or the Department of Health.








## DISCLOSURE STATEMENT

*Ethical Approval of Research Protocol:* N/A; *Informed Consent:* N/A; *Registration No. (PROSPERO):* CRD42020181204; *Animal Studies:* N/A; *Conflict of Interest:* N/A.

## AUTHOR CONTRIBUTIONS

JS and NP share joint first authorship and contributed to this study equally. JB conceived the research question and is the study guarantor. JS and YH drafted the protocol. JS, NP, and YH carried out the literature search and screening of studies. YH drafted the methodology, JS and NP extracted and analyzed the data, and then drafted the manuscript. JB, KV, MC, AB, and YH critically revised the draft manuscript providing text and intellectual corrections. All authors reviewed the final manuscript and approved it for submission. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

**How to cite this article:** Sanghera J, Pattani N, Hashmi Y, et al. The impact of SARS-CoV-2 on the mental health of healthcare workers in a hospital setting—A Systematic Review. *J Occup Health.* 2020;62:e12175. <https://doi.org/10.1002/1348-9585.12175>