SYSTEMATIC REVIEW

Impacts of Covid-19 Pandemic on Frontline Health Care Workers in Africa and Asian Countries: A Systematic Review

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ABSTRACT

Introduction: The outbreak of COVID-19 is causing a serious global panic, with resultant impacts inflicting difficulties among human population. Frontline healthcare workers face increased impacts due to their roles during the pandemic. Impacts on healthcare workers may worsen the current global shortage of trained healthcare workforce and grossly affect public healthcare services if the pandemic persists. This review assessed the impact of COVID-19 on frontline healthcare workers in order to suggest measures that would reduce the impacts and optimize public healthcare and safety. **Methods:** We conducted literature search on PubMed, Medline, Google Scholar, Science Direct, CINAHL, and PsycINFO using key words and phrases in line with PRISMA protocol. **Results:** Out of 537 studies retrieved, 39 which met the inclusion criteria were included. The impacts of the COVID-19 pandemic on the frontline healthcare workers in Africa and Asia can be grouped into psychological, physical, and economic, with higher impacts seen among women and nurses. **Conclusion:** Strategies that address the impacts of COVID-19 among the healthcare workers would require multiple approaches from the perspective of individuals, institution and government levels.

Keywords: Coronavirus (COVID-19), Frontline Healthcare Workers, Psychological Impact, Physical Impact, Economic Impact

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INTRODUCTION

The COVID-19 pandemic which started as a cluster of pneumonia of unknown origin in Wuhan, Hubei Province of China in December 2019 has caused a serious global distress. The novel disease has continued to spread locally and internationally with more than 206 countries of the world currently battling with the pandemic (1). Various measures such as social distancing, movement restrictions, lockdown, borders closure, and the standard of operation protocol (SOP) among others have been employed at local and international levels to curtail the spread of the virus (2). Although these measures have shown high level of effectiveness, they are also not without economic and psychological consequences on humans (2). Experts had predicted that the effects of these preventive measures may be high in developing countries, particularly in low resource regions with weak healthcare infrastructures. However, it may be difficult to assess the overall possible impacts during intra-pandemic period.

Currently, more than 68.2 million cases of COVID-19 and 1.6 million deaths have been recorded globally (3). Asia has become the third-worst hit by the burden of COVID-19 pandemic after America and Europe; with over 11.2million cases and more than 169,070 deaths (3). Healthcare workers represent more than ten percent of total global infections; with the current global shortage of trained healthcare workforce likely to worsen if COVID-19 pandemic persists. Healthcare workers (HCWs) as frontline professionals in the management of COVID-19 infection are not immune to the impacts of COVID-19 outbreak responses. Studies have consistently demonstrated that HCWs who are directly in contact with COVID-19 patients are both at increased risks of getting infected as well as the psycho-social impacts of the pandemic (2,4). Their vulnerability to multi-dimensional COVID-19 impacts could be attributed to personal, institutional and societal factors. For instance, the global shortage of professional

healthcare workforce in the face of rapidly increasing infections and associated high demands for healthcare services, in part increase the workload and likelihood for healthcare providers to work for longer hours (5). Recent reports have also shown that healthcare workers face increased COVID-19 infections, workload, longer working hours, socio-economic and psychological challenges following the outbreak (5-6). Earlier evidence demonstrates that pressure on the healthcare system affects the ability of health professional to make the best healthcare decisions for the public and increase the chances for medical errors (7). Experts suggest that higher risks for COVID-19 impacts among healthcare workers (HCWs) in low resource countries may be due to the probable weaknesses in their healthcare system (2). Earlier reviews on the impacts of SARS outbreak on healthcare workers in developing countries suggested that HCWs were at higher risks for stress, anxiety, depression and fatigue during the outbreak (8-10). This review assesses the impacts of COVID-19 pandemic on the frontline HCWs in Asia and Africa. We also hope to recommend strategies that would reduce the impacts of the pandemic and further prepare frontline healthcare providers for the present and possible future outbreaks.

MATERIALS AND METHODS

Study Design

This study was underpinned in the checklist for preferred reporting items for systematic review and meta-analysis (PRISMA) framework. Five major steps guided this study; identifying a clear research question, a systematic search of electronic databases for relevant studies, defining criteria for inclusion and selection of articles, data extraction, and data analysis and reporting of findings. The primary research question that guided this review was "What are the impacts of COVID-19 outbreak on the frontline healthcare workers in Asia and Africa?"

Search Strategy

We systematically conducted a literature search on six databases; Pub Med, Medline, Google Scholar, Science Direct, CINAHL, and PsycINFO using the following keywords and phrases; "impacts of COVID-19 on frontline healthcare workers" or " impacts of coronavirus 2019 outbreak on frontline healthcare workers ". Database filters were used to limit literature hits to peer-reviewed articles published in English language (only), from 1st January to 31st October 2020. Besides, reference lists of the identified studies were also scrutinized for possible eligible studies.

Eligibility Criteria

We included in this review, only studies conducted in Africa and Asia that assessed the impact of COVID-19 outbreak on frontline healthcare workers. Africa was chosen for this study due to the presumed weaker healthcare system and consequent higher vulnerability of African population to adverse COVID-19 impacts (11). While Asia was added to the study as a region where COVID-19 was first discovered and a continent where five (HCoV-22E, SARS, HKU1, MERS and SARS-CoV-2) out of seven known human coronaviruses were historically discovered (12-13). Moreover, frontline healthcare workers in the context of this study included doctors, nurses and allied healthcare professionals who ever deals with Covid-19 cases. We excluded articles whose full text were not available, those without clear and appropriate methodology, commentaries, editorials and studies published in other languages other than English.

Screening and Selection of Studies

Two members of our research team (N.C and N.M.) independently screened the retrieved literature to compare and remove duplicated articles and to assess the methodological qualities of the articles. The study selection flow chart is presented as the PRISMA flow diagram (fig.1).

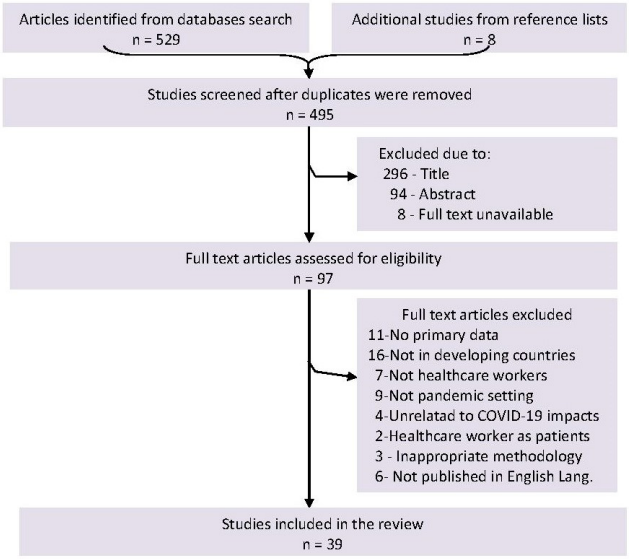

Figure 1: PRISMA flow chart showing studies screening and selection process

Appraisal for Quality and Risk of Bias

Two independent researchers (N.C and R. H.) also assessed the quality of all the included studies using the Newcastle-Ottawa scale (NOS) adapted for cross-sectional studies (14). The criteria for participant selection and outcome were the two major domains used to determine the risk of bias. In participant selection criteria, the adequacy of sample size, method of recruitment and use of validated data collection instrument were assessed. The risk of bias was attributed to the measurement of outcome through independent blind assessment. These outcomes were rated on a scale of zero to one each; with zero points suggestive of low while one point represented high risk, based on the quality of evidence and information available on each article (1). Articles scoring three (3) points and above

were considered to have a high risk of bias.

Data Extraction and Analysis

Two independent reviewers extracted data from the studies that met the inclusion criteria. Where conflicting opinions were observed, a simple consensus of the research team members was used. Domains of variables extracted from the included studies were: study authors and year of publication, research design, setting, sample size, subjects' characteristics, instrument used for data collection, and key reported findings (Table I). We descriptively analyzed the generated data and summarised the findings into domains using relevant themes such as physical impacts, psychological impacts and economic impacts.

RESULTS

Out of a total of 537 articles retrieved from a search of databases and reference lists, only 39 studies met the inclusion criteria (Fig.1). The included articles comprised of cross-sectional studies drawn across thirteen (15) Asian and African countries of Turkey, Saudi Arabia, Singapore, Oman, China, India, Bahrain, Pakistan, Israel, Egypt, Cameroon, Bangladesh, and Sierra-Leone. The qualities of the included studies were generally good, with a total sample size of 67,733. All studies assessed three (3) main domains which are psychological, physical and economic. Psychological domain comprised of the anxiety, depression, posttraumatic stress disorders, stress, burnout and sleep quality items. Physical domain

Table I: Characteristics of included studies

Study	Design	Setting/ Sample size	Subjects Character-istics	Measurement Instrument	Key finding	Impacts	Domains
Wang, et al., 2020a [2]	Cross-sectional online survey	China N=274	Physicians Nurses	GAD-7, PHQ-9, PSQI, PSS-14 CD-RISC-10	-38% had psychological disorders (anxiety, depression and insomnia) -Development of mental disorders was associated with increased exposure to COVID-19 patients (p=0.005)	Anxiety Depression Insomnia	Psychological
Teng, et al., 2020[4]	Cross -sectional online survey	China N=2614	Physicians Nurses	PHQ-9 SAS	-50%, 23.4% and 75.7% respectively had depression, anxiety and fatigue. -Gender (female) and age (18-24yrs) were associated with higher depression anxiety and fatigue -Family income less than USD14,200 was associated with higher depression (OR:1.2, 95%CI, p=0.05), anxiety (OR: 1.6, 95%CI, p=0.05) and fatigue (OR: 1.3, 95%CI, p=0.05) -HCWs working more than 6hrs per day, Poor family support and job dissatisfaction respectively were 1.6, 6.1 and 9.4 times at risks of developing more severe depression and anxiety -HCWs with physical or mental disease and feeling worried about being infected by COVID-19 were respectively 4.2 and 2.7 times at higher risks of developing more severe psychological disorders.	Depression Anxiety Increased Workload	Psychological Physical
Lai, et al., 2020b [5]	Cross sectional study	China N=9684	Doctors, Nurses and healthcare Assistants	RT-PCR screening	-110 HCWs tested positive for COVID-19 with infection rate of 1.1% and 0.9% death -Frontline HCWs (Females-71.8%) and nurses below 45yrs were infected more than others -Majority of infected HCWs showed symptoms with only 1.0% asymptomatic -10.9% of HCWs infected by COVID-19 had secondary co-morbidities -Contact with index patients (59.1%), colleagues with infection (10.9%) and community acquired infections (12.7%) were main sources of HCWs infections.	COVID-19 Infections	Physical
Yasmin et al., 2020[6]	Retrospective cross-sectional study	Bangladesh N=343	Physicians Nurses, Lab technicians, others	RT-PCR test	-More than 1 in 10 HCWs were infected by COVID-19 and only 56.76% showed symptoms -Majority 64.86% of infections were females, nurses; with only 29.7% of infected HCWs with co-morbidities -70.26% of infected HCWs used appropriate PPEs during their duties.	COVID-19 Infections	Physical
An, et al., 2020[7]	Cross-sectional online survey	China N=1103	Nurses	WHO-QOL-BRIEF	-43.61% prevalence of depression -Directly caring for COVID-19 patient and smoking were significantly (p=0.001) associated with depression at 95%CI (OR: 1.421 and 3.843 respectively) -Nurses with depression had lower quality of life ($F_{(1,1103)}$=423.83, *p=0.001*).	Depression Low Quality of Life	Psychological Economical
Chew, et al., 2020[13]	Cross sectional online survey	Singapore India N=906	Physicians Nurses, Allied HCWs, others	IES-R DASS-21	-Physical symptoms are associated with psychological disorders -Commonest reported symptom was headache (32.3%) -5.3% had very severe depression, anxiety (8.7%) and stress (2.2%) -Gender, age and pre-existing illness were significantly associated with depression (OR:2.79, *p=0.001*), anxiety (OR:2.18, p=0.001), stress (OR:3.06, p=0.13) and post-traumatic stress disorders (OR:2.20, p=0.023) at 95%CI.	Depression Anxiety Post Traumatic Stress Disorders Headache	Psychological

(Continued)

Table I: Characteristics of included studies (continue)

Study	Design	Setting/ Sample size	Subjects Character-istics	Measurement Instrument	Key finding	Impacts	Domains
Song, et al., 2020[14]	Cross sectional online survey	China N=14,825	Physicians Nurses	PSSS, CES-D and DSM-5(P-CL-5)	-High prevalence of depression 25.2% and PTSD-9.1% -HCWs- meddle aged, work longer hours daily, males, lower level of social support, worked for fewer years were at higher risks for depression - working as a Nurses was associated with PTSD.	Depression Post Traumatic Stress Disorders	Psychological
Keubo, et al., 2020[15]	Cross sectional study	Cameroon N=292	Nurses and Doctors	HAD	-High prevalence of anxiety (42.2% and depression 43.5% among HCWs -Anxiety was associated with age (p=0.006), fear of getting infected (p=0.019); while both anxiety and depression were significantly associated with fear of death (p=0.000).	Depression Anxiety	Psychological
Cai, et al., 2020[16]	Cross-sectional observational study	China N=534	Doctors, Nurses, medical technicians & others	Modified DASS-21	-High prevalence of stress and anxiety among HCWs -Nurses felt more anxious working and more concerned about financial compensation during and after the outbreak (p=0.02) -Concern for safety(p=0.001), family infec-tion(p=0.001) and for patients' mortality (p=0.001) were associated with stress and anxiety -Age ≥50, longer working hour(p=0.03) and inadequate protective clothing(p=0.0195) were associated with increased anxiety and stress.	Stress Anxiety	Psychological
Lai, et al., 2020a[17]	Cross sectional Descriptive study	China N=1257	Physicians Nurses	PHQ-9 GADS-7 ISI-7 IES(R)-22	-High prevalence of depression (50.4%), anxiety (44.6%), Insomnia (34%) and distress (71.5%) -Being a Nurse, female and directly caring for COVID-19 patients was associated with more severe symptoms of depression, anxiety, insomnia and psychological distress (p≤0.01).	Depression Anxiety Insomnia Psychological distress	Psychological
Wang, et al., 2020b[18]	Cross sectional study	China N=123	Doctors, Nurses	PSQI, SAS, SDS	-High prevalence of anxiety-7%, depression- 25% and poor sleep quality-38% among pediatrics HCWs -Sleep disturbances were associated with exposure to COVID-19 patients (OR:2.97,95%-CI:1.08-8.18; p=0.05) and presence of depression (OR:2.83,95%CI:1.10-7.27; p=0.05).	Anxiety Depression Poor sleep quality	Psychological
Xiao, et al., 2020a[19]	Cross sectional online survey	China N=958	Doctors Nurses, Lab.Sc., others	PSS-14 HADS	-High prevalence of depression (58%), anxiety (54.2%) and stress (55.1%) -Increased anxiety and depression were associated with gender (male, *p=0.01*), inadequate protective equipment*(p=0.001)* and history of contact with suspected or confirmed COVID-19 patient*(p=0.01).*	Anxiety Depression stress	Psychological
Yin, et al., 2020[20]	Cross sectional online survey	China N=377	Doctors, Nurses, others	DSM-5(PCL-5), PSQI	-Post traumatic psychological symptoms was 3.8% after 1month of outbreak -Female HCWs were more vulnerable to PTSS (Hazard Ratio:2.136,95%CI) -Increased frequencies of contact or exposure to COVID-19 patient and presence of PTSS were in-directly associated with poor sleep quality(p≤0.01).	post traumatic stress disorders Poor sleep quality	Psychological
Xiaoming, et at., 2020[21]	Cross-sectional online survey	China N=8817	Physicians Nurses	SSI PHQ-9 GAD-7 PHQ-15	-high psychological impacts (depression-30.2%, anxiety-20.7%, somatic symptoms-42.6% and suicidal and self-harm ideation (SSI) - 6.5%) -High level of depression, somatic symptoms and suicidal and SSI were associated with gender(fe-males), young, pre-existing mental illness, and willingness to attend parties.	Depression Anxiety Suicidal and self-harm ideation Somatic symptoms	Psychological Physical
Kassen, et al., 2020[22]	Cross sectional study	Egypt N=138	Physicians, Nurses, cleaners	RT-PCR Screening	-13.5% prevalent of COVID-19 infections among frontline HCWs -16.1% of infected HCWs were asymptomatic.	COVID-19 infection	Physical
Badahdah, et al., 2020[23]	Cross sectional online survey	Oman N=509	Physicians Nurses	GAD-7 WHOQOL	-High prevalence (74.1%) of anxiety -Anxiety was higher among gender (female) and younger HCWs -HCWs who directly care for COVID-19 patients had lower level of general wellbeing using WHO-5 wellbeing index *(p=0.001)* - Lower level of general wellbeing was more prevalent among Female and younger HCWs than others.	Anxiety Lowered level of general wellbeing	Psychological Physical
Khattab &Abou-Mada-wi 2020[24]	Cross sectional online Survey	Egypt N=190	Doctors	Self-structured and validated Questionnaire	-Decrease in monthly income -lesser workload resulting from decrease in outpatient's attendance, elective and emergency surgeries -Increased psychological stress	Lowered income psychological stress	Economic Psychological

(Continued)

Table I: Characteristics of included studies (continue)

Study	Design	Setting/ Sample size	Subjects Character-istics	Measurement Instrument	Key finding	Impacts	Domains
Jahrami, et al., 2020[25]	Cross sectional study	Bahrain N=280	Doctors, Nurses	PSQI, & PSS	-Poor sleep quality and stress are common among frontline HCWs during covid-19 -75% frontline HCWs had poor sleep quality, 85% had moderate to severe stress while 60% had both poor sleep quality and stress -Female (OR:2.0, 95%CI:1.1-3.5; p=0.01) and being a frontline healthcare worker OR:0.7, 95%CI:0.5-1.1; p=0.05) were the most impacting for sleep quality and mental health	Poor sleep quality Stress	Psychological
Hasan, et al.,2020[26]	Cross sectional online Survey	Pakistan N=151	Doctors	GAD-7	-High prevalence of anxiety (63.6% mild to severe) and depression (42.1%) -Females had more cases of anxiety than males -Working directly with COVID-19 patients was associated with higher anxiety(p=0.008)	Anxiety Depression	Psychological
Buonsenso, et al., 2020[27]	Cross sectional Descriptive study	Sierra-Leone N=560	healthcare and non-HCWs	Self-structured and validated Questionnaire	- 60% had anxiety - All, except one, declared a range of 19.2% to 79.4% reduction in income -82% declared having difficulties in meeting the family needs	Anxiety Reduced Income Difficulty meeting family need	Psychological Economic
Zhuo, et al., 2020[28]	Cross sectional online survey	China N=1734	Doctors Nurses	PROQOL (Chi-nese version)	-Prevalence of burnout is lower , but with higher compassion satisfaction among HCWs -Nurses, younger age and males experienced lower burnout compared to others -Lower burnout was associated with self-reported higher hand hygiene behaviour -Burnout was negatively associated with overall hand hygiene (β=-0.088, *p=0.001*).	Burnout	Psychological
Ramaci, et al., 2020[29]	Cross sectional study	Singapore N=273	Doctors, Nurses	JCQ, PROQOL, SSQ), MCQ	-High prevalence of psychological distress, fatigue and burnout among HCWs -Gender (women) reported higher incidences of burnout (p=0.001) -Fatigue and burnout increased with increase in working hours and stigmatization -stigma and longer working hours were associated with job dissatisfaction	Psychological distress, Fatigue Burnout Stigma Longer working hours	Psychological Physical
Elbay, et al., 2020[30]	Cross sectional online survey	Turkey N=442	Frontline medical staff	DASS-21	- 64.7% had depression, 51.6% anxiety and 41.2% had stress -Psychological disorders were associated with gen-der (female), younger age, less working experience, directly caring for COVID-19 patients, increased working hours, increased number of COVID-19 patients cared for, lower level of supports (from family, peers and supervisors), and feeling of hav-ing lower competence in COVID-19 related tasks	Depression Anxiety	Psychological
Ong, et al., 2020[31]	Cross sectional study	Singapore N=158	Doctors, Nurses & paramedical staff	Self-structured and validated Questionnaire	-High prevalence (81.0%) of de-novo PPE-associat-ed headache among HCWs -De-novo PPE-associated headache was inde-pendently associated with pre-existing headaches (OR:4.20, 95%CI, *p=0.030*) and combined PPE use for >4hours per day (OR:3.91, 95%CI, *p=0.012)* -Majority (88.1%) had headache in less than 60minutes of wearing eye Goggle and face mask, while 87.5% reported PPE-associated sensational pressure or heaviness.	De-novo PPE associ-ated headache PPE-associated sensa-tional pressure Longer hours of wearing PPE	Physical
Zhu, et al., 2020[32]	Cross sectional online survey	China N=5062	Healthcare workers	PHQ-9 GAD-7 IES-R	-Psychological disorders: depression 13.5%, anxi-ety 24.1% and stress 29.8% -Psychological disorders were associated with gen-der-female (OR:1.31, *p=0.032*), years of working experience <10years (OR:2.02, *p=0.001*), pre-exist-ing disease (OR:1.51, p=0.001), history of mental illness (OR:3.27, *p=0.001*) and current incidence of suspected or confirmed COVID-19 case being family member (OR:1.23, *p=0.030*).	Depression Anxiety Stress	Psychological
Wilson, et al., 2020[33]	Cross sectional online survey	India N=350	Doctors Nurses	GAD-7 PHQ-9 PSS-10	-Psychological disorders-depression (11.4%), Anxiety (17.7%) and stress (3.7%) -Gender (females) and staying away from family members (hostel) had two times increased odds of developing psychological disorders requiring treatment	Depression Anxiety Stress	Psychological
Wang, et al., 2020c[34]	Cross sectional descriptive Study	China N=1208	Doctors Nurses others	SSCIP-32	-Low levels of stress among COVID-19 frontline HCWs -higher stress was associated with being a nurse, being married, caring directly for COVID-19 patients, fear of self or family members getting in-fected, discomfort caused by protective equipment, and having worked more than 20days in caring for COVID-19 patients.	Anxiety Stress PPE associated discomfort	Psychological Physical

(Continued)

Table I: Characteristics of included studies (continue)

Study	Design	Setting/ Sample size	Subjects Character-istics	Measurement Instrument	Key finding	Impacts	Domains
Wang, et al., 2020d[35]	Cross sectional Online survey	China N=1045	Doctors, Nurses and others	HADS, PSS-14 1SI	-High prevalence of Anxiety 55.4%(p<0.001), depression 43.6%(p=0.028) -Anxiety and depression were higher among high-risk frontline HCWs -Frontline HCWs had higher clinical Insomnia 13.5%(p=0.011) and stress 24.7%(p<0.037) -Work experience negatively correlated with insomnia	Depression Anxiety Insomnia Stress	Psychological
Dai, et al., 2020[36]	Cross sectional online survey	China N=4357	Doctors, Nurses, others	GHQ-12	-39.1% had psychological stress -Stress was associated with directly caring for COVID-19 patient, infection of family members or colleagues, medical violence and protective equipment	Psychological distress work associated stress	Psychological
Bazilay, et al., 2020[37]	Cross sectional online survey	Israel, Others N=3042	Doctors, Nurses, others	GAD-7 PHQ-2	-Higher prevalence of anxiety, depression and stress -Common causes of psychological distress were fear of family members getting infected (48.5%) and unknowingly infecting other (36%), than getting infected themselves (19.9%) p<0.0005. -Gender (female) was associated with higher score of anxiety and depression (β=0.143, p=0.001), and higher COVID-19 worries, except for financial burden they were comparable to males (p=0.0001)	Depression Anxiety Stress	Psychological
Saurabh & Ranjan, 2020[38]	Cross sectional study	India N=120	Doctors, Nurses	Self-structured and validated Questionnaire	-High prevalence of anxiety -Anxiety was higher among nurses than doctors -Higher uptake of prophylactic hydroxychloro-quine by doctors than nurses	Anxiety. Increased uptake of prophylactic hydroxychloroquine by doctors	Psychological
Temsah, et al., 2020[39]	Cross sectional online survey	Saudi Arabia N=582	Physicians Nurses, Midwives, Auxiliary workers	GAD-7	-COVID-19 related anxiety level higher (59.4%) than experienced during MERS-CoV -Major cause of anxiety was transmitting infection to their family and friends (57.1%) than to themselves	Anxiety.	Psychological
Tan, et al., 2020[40]	Cross sectional study	Singapore N=470	Physicians Nurses, others	DASS-21 IES-R	-Anxiety -14.5%, Depression-8.9%, Stress-6.6% and PTSD-7.7% - prevalence of anxiety was higher among Non-medical healthcare workers than the medical professionals 20.7% versus 10.8% (RR:1.85, 95%CI:1.15-2.99; p=0.011)	Depression Anxiety Stress PTSD	Psychological
Kang, et al., 2020[41]	Cross sectional online survey	China N=994	Doctors, Nurses	PHQ-9 GAD-7 ISI, IES-R	-63% had mild to severe mental health disorders -Disorder was higher among women and increased with increase in number and frequency of contacts with confirmed COVID-19 patients	mild to severe mental health disorders	Psychological
[59]Si, , et al., 2020[42]	Cross sectional Online survey	China N=1136	Doctors, Nurses and others	IES-6 DASS SCSQ	- post traumatic stress was prevalent 40.2% among HCWs -Depression-13.6%, Anxiety-13.9% and stress-8.6% -Anxiety and general impacts were higher in Nurses than other HCWs -Perceived threat of COVID-19 and social supports were associated with negative psychological outcome	Depression. Anxiety. Post traumatic stress disorder	Psychological
[60]Liu, et al., 2020[43]	Cross sectional study	China N=512	Healthcare Workers	SAS	-Anxiety was 12.5% among HCWs -HCWs who had direct contact with COVID-19 infected patient had higher anxiety scores (β=2.33, CI:0.65-4.00; P=0.006) -Highest level of anxiety was associated with HCWs who were suspected to have been infected by COVID-19 (β=4.44, CI:1.55-7.33; P=0.0028)	Anxiety	Psychological
Elkholy, et al., 2020[44]	Cross sectional hospital-based survey	Egypt N=502	Physicians, Nurses, others	PHQ-9 GAD-7 ISI-7 PSS	-High prevalence of anxiety, depression, insomnia and stress among HCWs -Females are higher risks of experiencing severe anxiety (OR:1.85, 95%CI:1.12-3.05; P=0.016), depression (OR:2.013, 95%CI:1.17-3.4; P=0.011), and severe stress (OR:2.68, 95%CI:1.5-4.6; P=0.001), compared to others -Working in fever unit was associated with higher risk for severe depression (OR:1.52, 95%CI:1.11-2.09; P=0.01)	Depression Anxiety Stress Insomnia	Psychological
Hendy, et al., 2020[45]	Cross sectional study	Egypt N=374	Nurses	NSS	-91.7% of nurses had mild to severe stress associated with treatment of COVID-19 patients -Stress was significantly associated with fewer nurses to COVID-19 patients' ratio, availability of personal protective equipment (PPE), fear of infection and stigma, and fear of infecting family members (≤0.01).	Stress. Anxiety Stigma.	Psychological

(Continued)

Table I: Characteristics of included studies (continue)

Study	Design	Setting/ Sample size	Subjects Character-istics	Measurement Instrument	Key finding	Impacts	Domains
Jiang, et al., 2020[46]	Cross sectional online Survey	China N=1648	Nurses	SAS, SDS, COVID-19-related questionnaire	-72.1% of Nurses had sleep disorder and irritability (86.5%) -36.8% of nurses had depression -Interpersonal isolation from family and friends (73.7%) -Directly caring for COVID-19 patients, restriction from social activities, knowledge of COVID-19, fear of infecting self and family members, year of working experience and age were associated with anxiety and depression(p≤0.03)	Anxiety. Sleep disorder. Irritability Depression. Interpersonal isolation	Psychological

**GAD-7-general anxiety and depression scale.DASS-depression, anxiety and stress scale.ISI- insomnia severity index.PHQ-9-patients health questionnaire; IES-R-impact of event scale (reversed); WHOQOL-world health organization quality of life score; SSI-self-rated stress index; SAS -Zung's Self-rating anxiety scale, SDS- self-rating depression scale; PSQI- Pittsburg sleep quality index ; PSS- perceived stress scale; GHQ-general health questionnaire; PSSS -perceived social support scale; CES-D-centre for epidemiological studies depression scale; DSM-5(PCL-5)-Diagnostic & statistical manual checklist for Mental disorders. NSS- nursing stress scale; JCQ- job content questionnaire; PROQOL-professional quality of life questionnaire; SSQ- Rosenberg self-esteem scale; MCQ- Self-administered multiple choice questionnaire by See, et al.; CD-RISC-10-Connor-Davidson Resilience Scale; SSCIP- stress scale of caring for highly infectious patient developed for SARS HCWs(byBaoyu Zhuang 2005). RT-PCR-real time polymerase chain reaction; PSS-perceived sleep quality index; SDS- self-rating depression scale; SCSQ -Simplified coping style questionnaire; JCQ- job content questionnaire; SSI- suicidal and self-harm ideation scale. HCWs-healthcare workers*

consists of workload, duration of working hour, infection rate items. Meanwhile, economic domain consisted of the income and quality of life items. Table I summarizes the characteristics of the included studies and their key findings.

In the studies reviewed, the mean age range of healthcare workers (HCWs) was between 18-44years. Females formed the predominant participants (61.5% - 98.8%) across 22 of 39 studies included. Eleven studies consistently reported that being a woman was associated with the development of severe psychological impacts such as anxiety, depression and stress among HCWs (4-6,19,31,32,35,39,42,46-47). The prevalence of psychological disorders among frontline HCWs ranged from depression (5.3% - 72.4%), anxiety (8.7% - 74.1%), stress (2.2% -91.2%) and up to 40.1% with post-traumatic stress disorders. Besides, younger HCWs (<30years) had higher scores for depression than their older counterparts (4,15-17). Nevertheless, Cai, et al. (18) shows that age has the likelihood to influence individuals' levels of worry. In the study, the commonest sources of worries were fears of getting infected and risks infecting loved ones with COVID-19. Similarly, self-safety and patient's death were found to cause more stress in HCWs aged 41-50years and >50years, respectively (19).

The review shows that nurses had higher cases and are at higher risks for depression, anxiety, stress, infection and poor sleep quality compared to other frontline healthcare workers (HCWs). However, finding from one of the included studies (20) contrarily shows no significant difference in anxiety and depression scores among COVID-19 female HCWs from various specialties in China. Regionally, studies included from China consistently showed that female FHCWs who worked in Wuhan had more severe symptoms of anxiety, depression, poor sleep quality and higher scores on the impact of event scale (IES) compared to others (5,15,19,21-22). Factors associated with the development of these impacts ranged from individual, institutional and social factors. For instance, 29 out of 39 studies analyzed in this review consistently demonstrated that gender (female), working as a nurse, having a pre-existing illness, increase workload, job satisfaction and level of tolerance to pressure were associated with the development of higher scores for stress, anxiety and depression.

Among healthcare providers, frontline healthcare workers (FHCWs) had a higher prevalence of Covid-19 infections, particularly those in direct contact with COVID-19 patients. Included studies that assessed the prevalence of COVID-19 infection showed a prevalence range of 10.9% to 13.5% among frontline healthcare providers (6, 23-24). This may imply that COVID-19 infects more than one in every ten FHCWs. Majority of the infection cases were also among women and nurses.

Risks associated with jobs could influence the perception and satisfaction of workers. Job satisfaction is essential in reducing emotional instability associated with low quality of life among frontline healthcare workers (FHCWs). In this review, studies that assessed the quality of life of care providers during COVID-19 pandemic consistently demonstrated reductions in income and quality of life among FHCWs (4,25-26). Lowered quality of life was associated with the loss of secondary sources of income, increased expenditure and presence of depression. Other identified impacts of COVID-19 pandemic on the frontline healthcare workers (FHCWs) in this review include; insomnia, isolation and loneliness, fatigue, burnout and social stigma. Sleep disturbances were correlated with the workload, direct exposure to COVID-19 patients, and number of working hours per day and level of social supports. In addition, social factors such as the societal perception of frontline healthcare workers, supports from peer and family members, and media news were also found to have strong links with the impacts experienced by healthcare providers during COVID-19 pandemic.

DISCUSSION

The findings of this review demonstrate that frontline healthcare providers face various impacts due to COVID-19 pandemic. These impacts are grouped and

discussed under three domains; psychological, physical and economic.

Psychological Impacts of COVID-19

Generally, healthcare workers (HCWs) are at increased risks for work-related stress (27). The outbreak of COVID-19 was initially greeted with fears emanating from the uncertainties about the novel viral disease. This fear was further heightened by the observed high infectivity and fatalities associated with COVID19; and it is expected that these factors could raise much psychological concerns, resulting to depression, anxiety and sleep disturbances especially among healthcare workers who provide direct care for COVID-19 patients. Also, the number of HCWs who were victims of COVID-19 infection, and the inadequacy of specific COVID-19-related trainings and personal protective equipment were reported as factors associated with increased fear, stress and anxiety among frontline HCWs (21). In part, a recent systematic review that assessed the impact of COVID-19 on frontline healthcare workers in the United States supports this finding. However, the infection rate of COVID-19 and the prevalence of psychological impacts among frontline HCWs were significantly lower compared to finding of this study (49). This suggests that there may be variation in the severity of COVID-19-related impacts among frontline HCWs in the developed and developing countries. The United States of America is known to have a more robust healthcare infrastructure compared to developing countries-Asia and Africa. For instance, an earlier report from world health organization (50) estimated the ratio of available HCWs per 1000 population as 0.2 in Africa, 0.6 in Asia and 1.5 in America. This global shortage of healthcare professionals is reported to promote increased workload, longer working hours, workers' exhaustion and associated poor mental health outcomes (51). Therefore, psychological impacts such as anxiety and depression are expected during the pandemic due to increased pressures faced by HCWs from rapid cases of COVID-19 infections in regions with weak healthcare infrastructure.

Furthermore, both stress, anxiety, depression and sleep quality may be influenced by the level of social supports. This review found that inadequate supports from families, peers, institutions and government were essential factors associated with the development of negative psychological outcomes (16, 28). Previous studies on the impacts of social supports on psychological outcomes supports this finding. A study (36) demonstrated that adequate social supports during COVID-19 outbreak could improve Healthcare workers' emotional stability, self-efficacy and self-control during intense physical or mental threats. Also, adequate social supports had also been documented to indirectly promote sleep quality and reduce stress, anxiety and depression (37). Various interventions to support the psychological needs of frontline healthcare workers (HCWs) have been developed. However, understanding the healthcare providers' individualized psychological needs are essential for effective outcomes. Individualized psychological support interventions require a multi-sectorial collaboration to meet the specific training needs that would promote HCWs self-confidence and competency during crises; and guarantee the provision of daily supplies such as personal protective equipment, accommodations, meals, safety and accurate and timely communication (53). To improve sleep quality of frontline HCWs, consideration could be given to both individual and environmental factors. Factors such as the nature of working environment, physical strain, long nights and number of hours per shift, perceived inter-personal isolation from families and friends, and the adverse effects of prolonged use of personal protective equipment (PPE) during working hours could significantly promote negative experiences of HCWs during the pandemic (37). Others include; concerns and fears of infecting loved ones, the trauma of watching colleagues, family and friends suffer or die from COVID-19 infection, and above all, the all-time need for extreme vigilance regarding infection control procedures are important factors that may promote severe impacts among HCWs treating COVID-19 patients (37). More recent review supports this, and shows that poor sleep quality and severity of stress are influenced by age, gender, specialty of practice, prolonged night shifts, and direct contacts to COVID-19 patients (54). Therefore, efforts should focus on addressing these factors; with additional focus on providing adequate diets that are rich in vitamins, minerals, proteins and healthy fats to HCWs (55-56).

Physical Impacts of COVID-19

The key adverse physical impacts suffered by frontline healthcare workers (FHCWs) during COVID-19 included high prevalence of Covid-19 infections, increased workloads, and longer working hours (5-6, 23-24). Impacts were more in women and nurses than other groups; with more than one in every ten FHCWs infected by COVID-19. Although this finding is consistent with earlier systematic review (54), both reviews used studies whose sample sizes were dominated by women. For instance, 22 out of 39 studies included in this review used females-dominated participants ranging from 61.5% to 98.8% of the sample sizes. Moreover, earlier studies had demonstrated that women generally have higher likelihood to complain of stress and sleep disturbances (55-56); and psychosomatic symptoms such as depression, anxiety and headaches (52). Beside this, women are known to be more sensitive and attentive to their bodies and physical symptoms than men; and the society is also considered to be more receptive to women to express their bio-psychosocial distresses (52, 57). These may explain the higher prevalence of poor sleep quality, anxiety, depression and stress found among women in this study.

Secondly, Nurses as a group of healthcare workers

(HCWs) generally face multiple occupational stressors due to the peculiarity of their roles in the healthcare settings (47). In general practice, risks for occupational hazards have been documented to greatly depends on the workers' exposure to the source of hazard (47). Frontline HCWs provide care for COVID-19 infected patients, and therefore may be at greater risks for exposure to COVID-19 infection. In addition, the responsibilities of nurses in patients care, unlike some other healthcare specialists, require more frequent and closer contacts with patients during treatment for early identification of danger signs and for best treatment outcomes. Earlier studies have also demonstrated that risk for infection among healthcare workers was associated with the duration and frequency of contacts with COVID-19 patient (5, 20,22). Among frontline HCWs reportedly infected by COVID-19 in this study, majority had contact with either the index case (59.1%), infected colleagues (10.9%) or got the virus through community transmission (12.7%). Other factors that were correlated with infection were long working hours (>4hour per day), lower self-confidence about roles, co-morbidity, inadequate supply of PPE and poor institutional supports.

Historically, healthcare workers (HCWs) in developing countries, particularly the Nurses have been reported to ridiculously work longer hours compared to their counterparts in developed world. In Africa, reports suggest that some HCWs work between 24:00hours to 36:00hours non-stop, with little work flexibility and options to determine their schedules, unlike other parts of the world (4). This, in part, may be to compensate for the shortage of professional HCWs. During COVID-19 pandemic, this long working hours among HCWs may further increase in line with the rapidly increasing number of COVID-19 infections and other patients requiring admission and care. Consequently, these likely results to increased rate of cross-infections, stress, fatigue, emotional distress, poor sleep quality, psychological disorders such as depression, anxiety and posttraumatic stress disorders. The results of previous studies that assessed the impacts of long working hours among health professionals supports this. A study that attempted to model the impact of the components of long hours on injury and accidents among medical professionals found that work scheduling pattern and longer working hours were significantly associated with higher risks for errors and accidents (58). In the finding, when 8-hour shifts were compared to 10-hour shifts and 12-hour shifts, the risk of medical professionals making errors in clinic judgment increased by 13% and 28% respectively (58). A similar retrospective study that analyzed 110,236 job records between 1987 and 2000 found that the risks for errors among HCWs working for 24 and 36hours per shift were 23% and 37% respectively (59). These suggest that HCWs would be more efficient in making sound clinical decisions for the public health when pressures around them are reduced. Therefore, the wellbeing of HCWs, especially those at the frontline of epidemics, should be made a fundamental goal and critical aspect of public health and safety.

Furthermore, recent evidence (7) has shown that using complete personal protective equipment (PPE) during duties put frontline healthcare providers at more than three-times risks of discomfort, stress, fatigue, burnout and headache (OR:3.91, 95%CI, p=0.012). The report demonstrated that over 88.1% of frontline healthcare workers in a Chinese hospital developed severe headaches within 60minutes of wearing eyes goggle and facemask, while 87.5% reported PPE-associated sensational pressure or heaviness. Overall, these could compromise the cognitive abilities and clinical judgments thus, increasing the likelihood of medical errors among the HCWs and the associated risks for patients (60).

Economic Impacts of COVID-19

Generally, the adverse impacts of COVID-19 pandemic on the economy have been widely reported. In countries such as America, UK, South Africa, China, millions of jobs have been reportedly lost following COVID-19 pandemic (27). This change in economy transcends beyond governments to affect citizens resulting to closure of small and medium scale businesses with consequent loss of jobs (24). Although the services of healthcare providers are at all times classified as "essential" especially during outbreak crises, a good number of secondary jobs and private clinics were closed during the pandemic, resulting to income losses (28). Earlier study that assessed the adverse impacts of SARS outbreak responses on healthcare workers found that reduction in income was associated with lowered public patronage of frontline healthcare workers in their areas of secondary services due to their perceived risks of infection and transmission to others (61). In extreme cases, healthcare workers have been stigmatized and banned from use of public facilities by communities due to misconception that they could be potential sources of infection during outbreaks (29). Such actions may have multiple negative impacts on frontline healthcare workers. Nevertheless, change in income remains an important factor that could influence the standard of living and quality of life. Findings from recent study (24) supports the low quality of life of COVID-19 frontline healthcare found in this study. Various factors such as nature of job, environment, income, relationships, inter-personal communication, health and psychological status often work together to shape individuals' quality of life (23,29). Low quality of life may lead to psychological disorders among health workers, with the likelihood to affect their clinical judgments leading to possible medical errors.

Limitation

A number of limitations need to be considered while interpreting the result of this systematic review study.

First, the difficulty in locating all relevant studies using conventional search strategies is a well-established challenge. Although we employed a broad and purposeful search protocol, including full text review of 97 journal articles and screening of reference lists, however, the possibility of omitting relevant studies may not be completely overruled. Secondly, the cross-sectional studies included were carried out within the ranges of days to months and may not have reflected the entire impacts frontline healthcare workers (HCWs) may develop as the pandemic continues. Therefore, future review will be required at the end of the crisis to assess the post-pandemic impacts of COVID-19 on HCWs that will be more comprehensive to capture the impacts that were yet to develop at the time of this study. Although this review focused on Asia and Africa, many countries in these regions were not represented due to limited literature. Higher proportion of the studies (48.7%) were from China while 51.3% were retrieved from the rest parts of Asia and Africa according to their available publications. Although this may suggest higher COVID-19-related research activities in China compared to other countries in Asia and Africa, on the other hand, it is a limitation to the generalizability of this result. The sample sizes of the studies ranged from 123 to 14,825, with 14 studies having sample sizes <500. Larger sample size would better identify the extent of the impacts.

Recommendations

Interventions with strong focus on the welfare, safety and the mental health of the frontline (HCWs) could be essential in addressing this challenge. Beside this, healthcare providers should recognize that fears and anxiety are naturally justifiable defense mechanism, particularly when faced with threats. Fears and anxiety help individuals to identify risks and stay safe. Although many countries have developed rapid interventions to tackle the impact of COVID-19 on their HCWs, however, most of these interventions were centered on mental health (47, 60,62). In this review, we suggest a more comprehensive providers-centered interventions that would reduce the impacts of COVID-19 on HCWs with clear and specific roles for HCWs as individuals, institutions or employers and the governments.

As a frontline healthcare provider, practices such as building resilience, choosing credible sources of information, adopting healthy lifestyles, staying connected with family and friends and cutting down expenses to reflect incomes may reduce the level of impacts during crises situation. It is also important to rest adequately, observe COVID-19 prevention rules, use PPE strictly, be open and communicate your employers of any difficulty and seek guidance where you have less idea. To institutions, authors recommend that visible and quality leadership that would serve as role model of how staff should behave and allow staff autonomy and input in decision-making and remove bureaucratic hindrances to work flexibility is required for impact reduction in COVID-19 crisis period. Also, employers should provide effective, timely and accurate risk communication to the HCWs and engage psychological first aiders for staff support. In addition, employers should provide continuous and specific in-serving training on infection control, patients care and appropriate use of PPE, engagement of staff in peer support practices and partnering of experienced staff with those with less experience, positive monitoring, adequate motivation and adoption of creative interventions to reduce risks of infection, such as 'Eagle-Eye Observers' who are dedicated full-time staff charged with observing and correcting infection control errors based on checklists (62). Nevertheless, government efforts are also needed to provide adequate insurance packages for frontline HCWs and immediate family, training and recruitment of more healthcare workers to cushion shortage, and to make available test kits and PPE for frontliners. Government should also Prioritize SARS-CoV-2 testing, treatment and vaccines for frontline HCWs, free medical treatments and finances to cover the costs of funerals for diseased and Special risk allowance for frontline HCWs. Politicians and other public figures should routinely visit FHCWs to acknowledge their commitment and sacrifices. This would serve as motivation and may boost workers morale.

CONCLUSION

Frontline healthcare workers in developing countries face various adverse psychological, physical and economic impacts due to COVID-19 pandemic. These impacts are particularly higher among women and nurses. Inadequacy of trained healthcare workforce, social supports and weak healthcare systems may be responsible for higher impacts in some countries. Multi-dimensional approach is required to keep the healthcare workers fit for optimum healthcare delivery during COVID-19 and thereafter.

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