



Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Review Article

COVID-19 Risk Factors Among Health Workers: A Rapid Review

Malizgani Mhango¹, Mathias Dzobo², Itai Chitungo², Tafadzwa Dzinamarira^{3,*}

¹ School of Public Health, University of Western Cape, Cape Town, South Africa

² Department of Medical Laboratory Sciences, University of Zimbabwe, Harare, Zimbabwe

³ Department of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa



ARTICLE INFO

Article history:

Received 4 May 2020

Received in revised form

1 June 2020

Accepted 1 June 2020

Available online 6 June 2020

Keywords:

coronavirus

COVID-19

health worker

risk factor

ABSTRACT

Coronavirus disease 2019 (Covid-19) poses an important occupational health risk to health workers (HWs) that has attracted global scrutiny. To date, several thousand HWs globally have been reported as infected with the severe acute respiratory syndrome coronavirus 2 virus that causes the disease. It is therefore a public health priority for policymakers to understand risk factors for this vulnerable group to avert occupational transmission. A rapid review was carried out on 20 April 2020 on Covid-19 risk factors among HWs in PubMed, Google Scholar, and EBSCOHost Web (Academic Search Complete, CINAHL Complete, MEDLINE with Full Text, CINAHL with Full Text, APA PsycInfo, Health Source—Consumer Edition, Health Source: Nursing/Academic Edition) and WHO Global Database. We also searched for preprints on the medRxiv database. We searched for reports, reviews, and primary observational studies (case control, case cross-over, cross-sectional, and cohort). The review included studies conducted among HWs with Covid-19 that reported risk factors irrespective of their sample size. Eleven studies met the inclusion criteria. Lack of personal protective equipment, exposure to infected patients, work overload, poor infection control, and preexisting medical conditions were identified as risk factors for Covid-19 among HWs. In the context of Covid-19, HWs face an unprecedented occupational risk of morbidity and mortality. There is need for rapid development of sustainable measures that protect HWs from the pandemic.

© 2020 Occupational Safety and Health Research Institute, Published by Elsevier Korea LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The coronavirus disease (Covid-19) pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has challenged the health systems of countries it has affected. As of 30 April 2020, the pandemic has infected more than 3,2 million individuals with over 230,000 fatal cases in 187 countries [1]. The person-to-person transmission routes of Covid-19 include direct transmissions, such as cough, sneeze, droplet inhalation transmission, and contact transmission, such as the contact with oral, nasal, and eye mucous membranes [2]. Health workers (HWs) are at the forefront of the Covid-19 outbreak response and as such are exposed to hazards that put them at risk of infection [3]. As early as February 2020, scholars had established that transmission of the disease among HWs is associated with overcrowding, absence of isolation room facilities, and environmental contamination [4]. However, in the context of the rapidly evolving Covid-19 pandemic, occupational health and safety policymakers need timely access to

updated health information on the risk HWs face. This evidence is best obtained through a systematic review; however, this review method requires vast resources, including time, to complete that do not suit the needs [5–7]. In this study, we aimed to map available evidence on Covid-19 risk factors among HWs to guide future research and policy.

2. Methods

2.1. Information sources and literature search

We searched PubMed, Google Scholar, and EBSCOHost Web (Academic Search Complete, CINAHL Complete, MEDLINE with Full Text, CINAHL with Full Text, APA PsycInfo, Health Source—Consumer Edition, Health Source: Nursing/Academic Edition) and WHO Global Database for relevant studies. We also searched for preprints on the medRxiv database. The search terms included “Coronavirus,” “Covid-19,” “2019-nCoV,” “SARS-CoV-2,” “risk,” “risk

* Corresponding author. Department of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa.
E-mail address: anthonydzina@gmail.com (T. Dzinamarira).

factor”, “infection”, “illness”, “disease”, “health care worker”, “health care professional”, and “occupational health”. Boolean terms, AND and OR, were used to separate the keywords. The reference lists of all full-text articles screened were searched for relevant studies.

2.2. Inclusion criteria

We searched for reports, reviews, and primary observational studies (case-control, case-cross-over, cross-sectional, and cohort). The review included studies conducted among HWs that reported COVID-19 risk factors irrespective of their sample size.

2.3. Screening process

We developed a screening criterion *a priori* for each of the three stages, title and abstract and full text. Two researchers screened the articles independently. Differences in screen results at full-text stage were resolved by discussion.

2.4. Data abstraction and analysis process

A data abstraction form was developed, discussed, and revised *a priori*. The form extracted information on first author, title, sample size, reported risk factors, and other relevant findings. Only one reviewer (TD) abstracted data from the included studies. For collating, summarizing, and reporting of the findings, first, the reviewers familiarized themselves with the content of the articles. Second, findings reported in the articles were grouped into categories based on the reported factors, and a narrative was provided.

3. Results

Our initial keyword database search found 1,698 potentially eligible articles. Results from each database search are presented in Supplementary File 1. Following title screening, 82 articles were eligible for inclusion in abstract screening. These articles were imported into EndNote X9 and eight duplicates removed, leaving 74 articles included in abstract screening. Following abstract screening, 38 studies were excluded, leaving 36 articles for full-text screening. Twenty-five articles were excluded after full articles screening, leaving 11 articles for data extraction.

3.1. Characteristics of included studies

Table 1 shows characteristics of included articles. All included studies reported Covid-19 risk factors among HWs. Of these, one was a short communication [8], two were reports [9,10], four were reviews [11–14], one retrospective cohort [15], one retrospective data analysis [16], one prospective cohort [17], and one case–control [18]. All included studies were published in 2020. The total number of HWs reported in the studies was 1,619; however, five studies did not specify a sample size. One study was a preprint article pending peer review [16].

3.2. Study findings

Eleven articles were included for data extraction and narrative summary. The reported Covid-19 risk factors among HWs were grouped into five: lack of personal protective equipment (PPE), exposure to infected patients, work overload, poor infection control, and preexisting medical conditions. Insufficient PPE

[9,10,14,16] or lack thereof [8] was reported as an important risk factor for Covid-19. Exposure to infected patients mainly through work in high-risk departments and contaminated fluid/aerosols were reported as another important Covid-19 risk factor among HWs. Work overload resulted in lack of rest, long-time exposure to infected patients [8,9], and working under pressure [16]. Longer duty hours were reported as Covid-19 risk factor in a retrospective cohort conducted at a hospital in Wuhan, China [15]. A review conducted by Yu et al. revealed limited or absence of knowledge on infection control as a risk factor for Covid-19 among HWs in the radiology department [13]. Similarly, a retrospective analysis by Bai et al. [16] and a rapid review by Viswanath et al. [11] revealed lack of established practices of infection control poor infection control and direct contact with contaminated surfaces as important risk factors. Surprisingly, suboptimal hand hygiene was reported as a Covid-19 risk factor among HWs [15]. A review conducted by Ing et al. [14] on physician deaths from Covid-19 reported older age (physicians 57 years of age or older accounted for three-quarters of Covid-19-related deaths), male gender (90% of deaths were male physicians), and preexisting conditions (hypertension, diabetes mellitus, cardiovascular disease, chronic lung disease, and immunocompromised individuals) as risk factors.

4. Discussion

This review has revealed that research on Covid-19 risk factors for HWs is still in its infancy. While this is to be expected given the pandemic only broke out in December of 2019, the available evidence shows active research interest on the subject. The review revealed lack of PPE, exposure to infected patients, work overload, poor infection control, and preexisting medical conditions as Covid-19 risk factors among HWs. The WHO released interim guidance on HWs risk assessment and management in the context of Covid-19³. The guidance is offered for both the HWs and their facilities. While this blanket guidance is available, occupational health policymakers would need to contextualize the procedures based on available resources and information.

Our review revealed exposure to infected patients and work overload as two important Covid-19 risk factors among HWs. This corroborates a recent Centers for Disease Control and Prevention report that estimated that of the 9282 cases of Covid-19 cases among HWs in the United States of America, 55% had exposure in the healthcare setting [19]. Further, a mathematical modeling study by Temime et al. found that R0 for Covid-19 was higher for HWs as compared with that of the general public as they have prolonged contact with infected individuals [20]. HWs at greatest risk are those who are exposed to the airways and the oral cavity of patients for prolonged periods such as dentists. Our review found contact with contaminated fluid as a Covid-19 risk factor. Similarly, according to Meng et al., dentists accounted for 5% of the fatalities among physicians exposed to Covid-19 [21]. Concerns on contamination through suction have also been reported elsewhere [2]. Covid-19 has overwhelmed health systems globally resulting in longer working hours and increased workload for HWs. Italian physicians have suggested a community-centered or home care system for Covid-19 to not only lessen the workload on HWs but also decrease the transmission of disease and HWs exposure [22]. Further, there is a need for social support services to help HWs who are struggling emotionally and allow for periodic breaks from work.

The protection of HWs is essential despite the increased demand and global shortage of PPE. To ensure the availability of adequate

Table 1
Characteristics of included studies

Number	First author	Country	Title	Study design/article type	Sample size	Reported risk factors
1	Liu M	China	Clinical characteristics of 30 medical workers infected with new coronavirus pneumonia	Case control	30	Exposure to infected patients
2	Wang J	China	Reasons for healthcare workers becoming infected with novel coronavirus disease 2019 (COVID-19) in China	Short communication	Not specified	Lack of PPE, exposure to infected patients, work overload, and poor infection control
3	Ran Li	China	Risk Factors of Healthcare Workers with Corona Virus Disease 2019: A Retrospective Cohort Study in a Designated Hospital of Wuhan in China	Retrospective cohort	72	Exposure to infected patients, work overload, and poor infection control
4	Viswanath A	Singapore	Working through the COVID-19 outbreak: Rapid review and recommendations for MSK and allied health personnel	Rapid review	Not specified	Exposure to infected patients and poor infection control
5	Bai Y	China	SARS-CoV-2 infection in health care workers: a retrospective analysis and a model study	Retrospective analysis	171	Lack of PPE, exposure to infected patients, work overload, and poor infection control
6	Romano MR	Italy	Facing COVID-19 in Ophthalmology Department	Review	Not specified	Exposure to infected patients and work overload
7	Grimm CA	USA	Hospital Experiences Responding to the COVID-19 Pandemic: Results of a National Pulse Survey March 23–27, 2020	Report	323	Lack of PPE
8	Yu J	China	Infection Control against COVID-19 in Departments of Radiology	Review	Not specified	Exposure to infected patients, work overload, and poor infection control
9	Schwartz L	Taiwan	Protecting Healthcare Workers During the Coronavirus Disease 2019 (COVID-19) Outbreak: Lessons From Taiwan's Severe Acute Respiratory Syndrome Response	Brief report	Not specified	Lack of PPE, exposure to infected patients, work overload, and poor infection control
10	Barrett E	United States of America	Prevalence of SARS-CoV-2 infection in previously undiagnosed health care workers at the onset of the U.S. COVID-19 epidemic	Prospective cohort	829	Exposure to infected patients
11	Ing EB	(This study was a review of studies in various countries)	Physician Deaths from Corona Virus Disease (COVID-19)	Review	194	Lack of PPE, exposure to infected patients, and preexisting conditions

PPE, personal protective equipment.

PPE for all HWs, governments need to expedite the procurement and devise strategic use of the available PPE. For example, in developing countries, the strategic use of PPE may include extended wear and reuse of certain PPE like gowns, especially in low-risk hospital departments. With the Covid-19 pandemic, there is also the potential for panic among HWs that may result in the irrational use of PPE. A balance will need to be struck between HWs safety and strategic use of available resources. Finally, HWs should be trained on proper ways of wearing and taking off PPE to prevent contamination.

The Covid-19 pandemic has put a strain on the health system workforce because of the overwhelming infection rates in some countries. This has meant that older HWs, mostly doctors and nurses, have had to join as frontline workers and some to come out of retirement to offer experience, expertise, leadership, and boost the morale of younger professionals. Old age alongside preexisting health conditions such as hypertension, diabetes mellitus, cardiovascular disease, chronic lung disease, and immunosuppression were important Covid-19 risk factors identified in this review. These have been touted as major risk factors for severe Covid-19 disease elsewhere [23,24]. Health facilities ought to assign duties for high Covid-19 risk departments based on age and underlying conditions.

This article has a number of strengths and weaknesses. While there are many existing papers dealing with occupational health issues related with the Covid-19, identifying the risk factors for infection is an important first step to guide appropriate measures to reduce these risks. This article provided a concise review of available evidence on the subject as at 20 April 2020, a period when there was an upward trajectory in the number of cases among HWs globally. Rapid reviews by nature have multiple limitations [25]. In this study, important omissions were made on steps for a full systematic review. These include publication language restriction and risk of bias/quality appraisal. However, this review will serve as a precursor to a larger, thorough, and systematic review and meta-analysis the authors of this article are working on. Secondly, the evidence on risk factors are likely to be underreported given the rapid evolution of the pandemic and lack of readily available data from other parts of the world like Africa at the time of the review. Third, owing to the heterogeneity among included articles, our review findings cannot be generalized or clinically implicated. However, we believe the review yielded important findings to inform occupational health policymakers on Covid-19 risk factors among HWs and researchers on gaps in scientific evidence.

5. Conclusion

In the context of Covid-19, HWs face an unprecedented occupational risk of morbidity and mortality. Lack of and/or inadequate PPE, exposure to infected patients, work overload, poor infection control, and preexisting medical conditions put HWs at risk for nosocomial Covid-19 infection. Further studies are needed to inform the development of efficacious infection control measures. There is a need for rapid development of sustainable measures that protect HWs from the pandemic.

Funding

No funding was received for this study.

Conflicts of interest

None declared.

Acknowledgments

The authors acknowledge librarians Dzingayi Shangwa and Nontobeko Sikhosana for assistance with search criteria for multiple databases.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2020.06.001>.

References

- [1] WHO. Coronavirus disease 2019 (COVID-19) situation report – 101; 30 April 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200430-sitrep-101-covid-19.pdf?sfvrsn=2ba4e093_2. [Accessed 1 May 2020].
- [2] Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci* 2020;12(1): 9-9.
- [3] WHO. Health Workers exposure risk assessment and management in the context of COVID-19 virus (Interim guidance); 2020. <https://apps.who.int/iris/handle/10665/331340>. [Accessed 23 April 2020].
- [4] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *Jama* 2020.
- [5] Tricco AC, Antony J, Zarin W, et al. A scoping review of rapid review methods. *BMC Med* 2015;13:224.
- [6] Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D. Evidence summaries: the evolution of a rapid review approach. *Syst Rev* 2012;1: 10-10.
- [7] Petticrew M, Roberts H. Systematic reviews in the social sciences: a practical guide. John Wiley & Sons; 2008.
- [8] Wang J, Zhou M, Liu F. Reasons for healthcare workers becoming infected with novel coronavirus disease 2019 (COVID-19) in China. *J Hosp Infect* 2020.
- [9] Schwartz J, King C-C, Yen M-Y. Protecting healthcare workers during the coronavirus disease 2019 (COVID-19) outbreak: lessons from Taiwan's severe acute respiratory syndrome response. *Clin Infect Dis* 2020.
- [10] Grimm CA. Hospital experiences responding to the COVID-19 pandemic: results of a national pulse survey March 23–27, 2020; 2020. <https://justthenews.com/sites/default/files/2020-04/HHS2020ReportPandemicHospitals.pdf>. [Accessed 20 April 2020].
- [11] Viswanath A, Monga P. Working through the COVID-19 outbreak: rapid review and recommendations for MSK and allied health personnel. *J Clin Orthop Trauma* 2020. <https://doi.org/10.1016/j.jcot.2020.1003.1014>.
- [12] Romano MR, Montericchio A, Montalbano C, et al. Facing COVID-19 in ophthalmology department. *Curr Eye Res* 2020;1–6.
- [13] Yu J, Ding N, Chen H, et al. Infection control against COVID-19 in departments of radiology. *Academic Radiology*; 2020.
- [14] Ing EB, Xu AQ, Salimi A, Torun N. Physician deaths from corona virus disease (COVID-19). *medRxiv*; 2020. 2020.2004.2005.20054494.
- [15] Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with corona virus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. *Clin Infect Dis* 2020.
- [16] Bai Y, Wang X, Huang Q, et al. SARS-CoV-2 infection in health care workers: a retrospective analysis and a model study. *medRxiv*; 2020.
- [17] Barrett ES, Horton DB, Roy J, et al. Prevalence of SARS-CoV-2 infection in previously undiagnosed health care workers at the onset of the U.S. COVID-19 epidemic. *medRxiv*; 2020. 2020.2004.2020.20072470.
- [18] Liu M, He P, Liu HG, et al. [Clinical characteristics of 30 medical workers infected with new coronavirus pneumonia]. *Zhonghua Jie He He Hu Xi Za Zhi* 2020;43:E016.
- [19] COVID C. Characteristics of health care personnel with COVID-19—United States, February 12–April 9, 2020; 2020.
- [20] TEMIME L, Gustin M-P, Duval A, et al. Estimating R0 OF SARS-COV-2 IN healthcare settings. *medRxiv*; 2020. 2020.2004.2020.20072462.
- [21] Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dental Res* 2020;99(5): 481–7.
- [22] Nacoti M, Ciocca A, Giupponi A, et al. At the epicenter of the Covid-19 pandemic and humanitarian crises in Italy: changing perspectives on preparation and mitigation. *NEJM Catalyst Innovations Care Deliv* 2020;1(2).
- [23] Jordan RE, Adab P, Cheng KK. Covid-19: risk factors for severe disease and death. *BMJ* 2020;368:m1198.
- [24] CDC COVID-19 Response Team. Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, february 12-March 16, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69(12):343–6.
- [25] Ganann R, Ciliska D, Thomas H. Expediting systematic reviews: methods and implications of rapid reviews. *Implement Sci* 2010;5: 56-56.