

# PPE AND THE IMPACT ON THE PERFORMANCE DURING COVID 19 PANDEMIC- A QUESTIONNAIRE BASED SURVEY AMONG RADIOLOGY RELATED HEALTH CARE WORKERS

Nasreen Naz,<sup>1</sup> Shabnum Abbas,<sup>2</sup> Javerya Sattar,<sup>2</sup> Ummei Aymen,<sup>1</sup> Ghulam Abbas,<sup>3</sup> Areej Fatima<sup>4</sup>

<sup>1</sup> Dow Institute of Radiology, Dow University of Health Sciences (DUHS), Karachi, Pakistan.

<sup>2</sup> Department of Radiology, DMC / Dr. Ruth K.M. Pfau Civil Hospital, Karachi, Pakistan.

<sup>3</sup> Department of Cardiology, DMC / Dr. Ruth K.M. Pfau Civil Hospital, Karachi, Pakistan.

<sup>4</sup> Dow Medical College, Dow University of Health Sciences (DUHS), Karachi, Pakistan.

PJR July - September 2021; 31(3): 141-146

## ABSTRACT

**OBJECTIVE:** Personal protective equipment (PPE) is requisite for all health professionals including radiology related health care workers (R-HCW) to protect against severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2). Despite imparting protection, these PPEs may affect both technical and non technical performance on its wearer due to their prolonged use. The rationale of this study is to evaluate the impact of using PPE on the performance of R-HCW during the radiological/imaging procedures. **METHODS:** A pre designed online survey/questionnaire was forwarded to R-HCW via whatsapp/email. Through this survey, both demographic data and effect of PPE i.e (i)effect on technical skills/performance, (ii)impairment of vision during procedure and film reporting, (iii) effect on communication skills/decision making and (iv)increase in the level of fatigue/discomfort by using PPE was recorded. **RESULTS:** There were 288 participants in this survey comprising 57 % male and 43 % female. Around 57 % R-HCW experienced technical limitations in radiological performance, 62 % reported visual impairments during procedures and film reporting and 85 % experienced increase in discomfort and level of fatigue. However communication skills and decision making was hampered in less than half of respondents i.e 44%. **CONCLUSION:** R-HCW experienced impediment in the performance of both technical and non technical skills due to PPEs while performing emergency procedures as well as elective procedures. The impact on the level of fatigue, discomfort and visual impairment was significant. Special attention is needed in this regard to avoid suboptimal performance among R-HCW.

**Keywords:** COVID-19, PPEs, SARS-CoV-2.

## Introduction

The severe acute respiratory syndrome Coronavirus 2 (COVID-19) pandemic has created a havoc since its emergence worldwide, with 163 million reported cases and 3.37 million deaths worldwide.<sup>1</sup> In the early phase of outbreak in Wuhan, the city of China, in December 2019, the etiology was unknown but later this infection was diagnosed to be caused by an

enveloped viral species, the severe acute respiratory syndrome coronavirus (SARS-CoV-2).<sup>2</sup> After a short span of 5 weeks, this outbreak was declared as lethal pandemic by world health organization (WHO).<sup>3</sup> Current evidence suggested predominant route of transmission of COVID-19 is close unprotected contact via respiratory droplets.<sup>4</sup> Other possible routes are

**Correspondence :** Dr. Nasreen Naz  
Dow Institute of Radiology,  
Dow University of Health Sciences (DUHS),  
Karachi, Pakistan.  
Email: nasreen.naz@duhs.edu.pk

Submitted 29 July 2021, Accepted 3 September 2021

aerosols generating procedures (AGP), ocular surface and fomites.<sup>5</sup> With the rise in the number of COVID-19 patients, all health care workers (HCW), including radiology related health care workers (R-HCW), working as frontliners, were exposed to perilous working environment, and therefore protection to all HCW in all health care facilities remain paramount. During this pandemic it was experienced that adequate prevention of infection, control efforts and proper hygiene practices play a key role to protect both patients and HCW. Wong et al also suggested basic infection control measures i.e wearing surgical masks and maintaining hand and environmental hygienic conditions to control nosocomial spread.<sup>6</sup>

According to NHS guidance, updated on 27<sup>th</sup> April 2020, the type of PPE depends upon individual and organizational risk assessment and appropriate use of PPE should be imposed depending on risk stratification.<sup>7</sup> PPEs are recommended in imaging departments where there is general contact with COVID-19 positive or suspected patients, high risk areas like intensive care units and during AGPs. The Royal college of Radiologists recommended fluid resistant surgical mask, disposable apron and gloves for general contact while eye protection shield/ goggles/ visor, filtering face piece respirator, long sleeve fluid repellent gown and gloves for high risk areas and during AGP.<sup>8</sup> The appropriate use of PPE work as physical barrier between HCW and infectious agent and is necessary to minimize exposure as well as to control infection transmission.<sup>9</sup> Liu Min et al reported that use of PPE has protected against COVID-19 and also helped in establishing protective immunity against SARS-CoV-2.<sup>10</sup>

Despite imparting protection against virus, these PPEs may affect both technical and non-technical performance i.e compromising skills during procedures, impairment of vision during procedure or film reporting, may have effect on communication skills and decision making and can increase the level of fatigue and discomfort due to prolong use. The impact of these protective measures on performance and execution of both technical and non technical skills during the pandemic should be considered, which are all important for the compliance of using PPE. According to the systematic review and meta analysis, the prevalence of side effects among health care workers was 78%, which is quite significant.<sup>11</sup> This

review comprises the previously conducted studies from different countries worldwide. These studies included general health care workers, dentists, surgeons and nursing staff but didn't include radiology related health care workers.

The purpose of this study was to evaluate the impact of using PPE on the performance of R-HCW during the radiological/imaging procedures during COVID-19 pandemic.

## Material and Methods

Approval from IRB was taken and a questionnaire survey was designed based on 12 questions by the radiology faculty at DMC/CHK, based on personal experience and the current literature, to assess the impact of using PPE among the RHCW. The survey sheet was created by using Google platform and circulated among RHCW using WhatsApp and email from August till December 2020. Survey was conducted as a descriptive cross sectional study using simple random sampling method. Participants giving consent were proceeded further for the online questionnaire. Through this online survey, both demographic data (i.e age, gender, working institute and working position) and effect of PPE was recorded from both private and non private sectors, among whom there were faculty of radiology, radiologists, sonologists, residents and radiographers. Impact of PPE was evaluated under four categories i.e (i) effect on technical skills/performance, (ii) impairment of vision during procedure and film reporting, (iii) effect on communication skills/decision making and (iv) increase in the level of fatigue/discomfort by using PPE. The online questionnaire was formulated in such a way that participants had to chose their response in either "yes" (agree) or "no" (disagree) and don't know for each category .

Outcome measures from the survey were recorded automatically upon submission to Google Drive and downloaded in the form of Microsoft Excel spreadsheet tabulation. Data categorization coding was done and file was converted into SPSS Statistics software version 20.0 for preliminary analysis, determination of the frequencies , result interpretation and graphical representation.

## Results

Response was recorded from 288 RHCW out of 290 RHCW where 2 of RHCW were above 60 years of age and were excluded. Demographic data analysis showed that out of 288 respondents 56% were females (164 out of 288 ) and 43% males (124 out of 288) (as depicted in Tab.1). Of whom 61% were from public sector (176 out of 288) while 36% were from private sector (104 out of 288) and only 3% (8 out of 288) belonged to non-governmental organisation (NGO). Majority (47.6% i.e 137 /288)) were between 30 and 40 years of age, 22% (64/288) were between 40 and 50 yrs, 10% (31/288) were between 50 and 60 years while 18% (54/288) were less than 30 years.

| Demographic data    |                 |
|---------------------|-----------------|
| <b>Gender:</b>      | 43% (124/288)   |
| Male                | 56% (164/288)   |
| Female              |                 |
| <b>Age:</b>         |                 |
| Less than 30 years  | 18% (54/288)    |
| 30-40 years         | 47% (137 /288)) |
| 40-50 years         | 22% (64/288)    |
| 50 -60 years        | 10 % (31/288)   |
| Above 60 years      | 0.7% (2/288)    |
| <b>Institution:</b> |                 |
| Public sector       | 61 % (176/288)  |
| Private sector      | 36% (104/288)   |
| NGO                 | 2% (8/288)      |

**Table 1:** Demographic data of R-HCW

Majority of the R-HCW that is 73% (209/288) were using PPE for less than 8 hours , while 21% (62/288) were using for 8 to 12 hours and very few i.e 5 % (15/288) used them for more than 12 hours. Duration of contact with patients was less than 15 minutes in 46 % (132/288) and between 15 and 30 minutes in 45 % (130/288) with very few R-HCW i.e 8% (24/288) were using for more than 30 minutes. The impact of usage of PPE among R-HCW as recorded showed that level of fatigue and discomfort was significantly effected which experienced by most of R-HCW i.e 85% (247/288). Around 62% (180/288) reported visual impairments during procedures and film reporting.

57% (165/288) R-HCW experienced technical limitations in radiological performance. However communication skills and decision making was hampered in less than half of respondents i.e 44% (128/288).

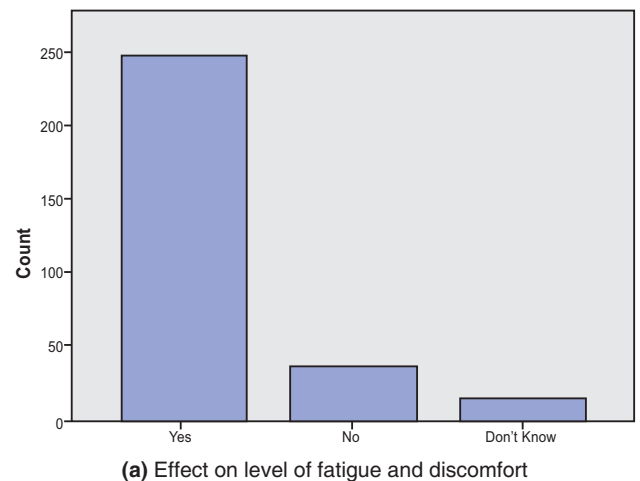
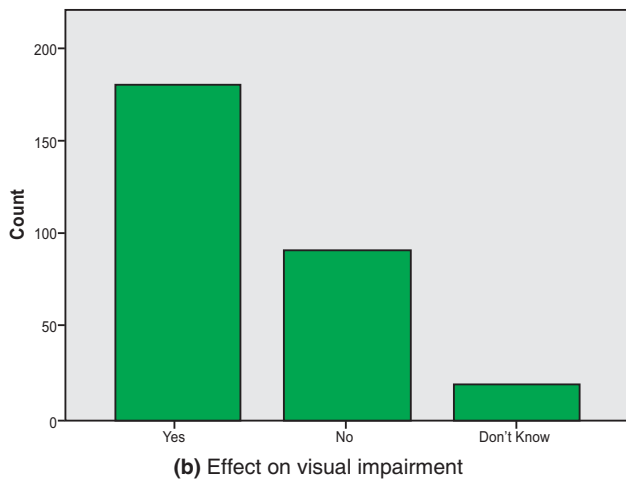
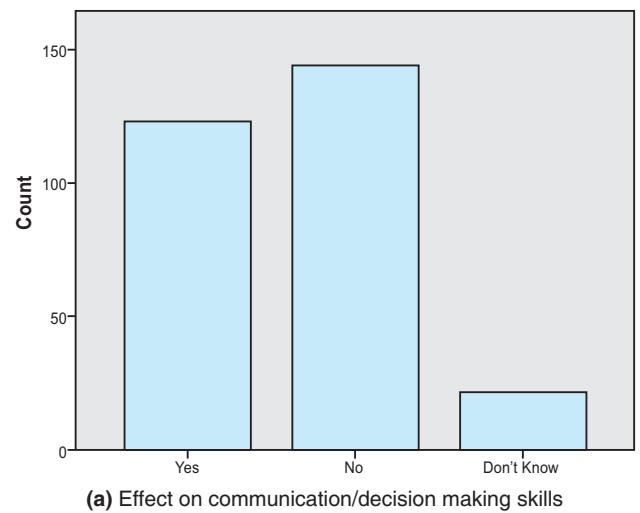
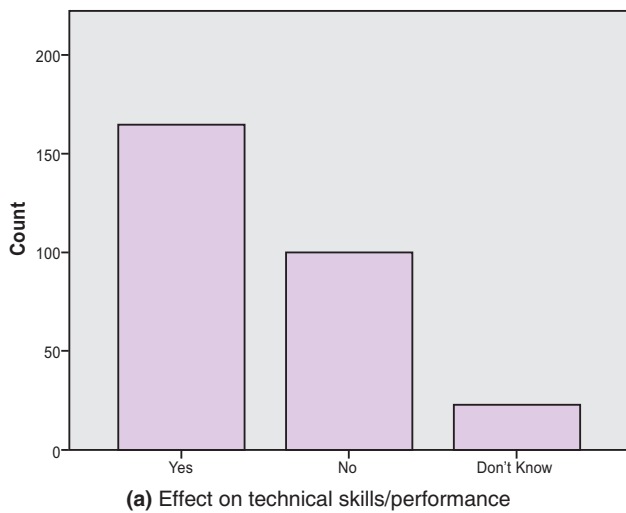
## Discussion

Literature review showed that continued and prolonged use of PPEs have negative impact not only on physical performance but also affected cognitive abilities of HCWs. Davey SL et al reported consequences of heat stress due to PPE which resulted in both cognitive impairment and performance of HCWs.<sup>12</sup>

In this study we analysed the impact of PPE on both technical and non technical performance of R-HCWs while performing radiological procedures in imaging departments. Although the duration of use of PPE was less than 8 hours in majority (72% i.e 209/288) but the overall negative impact was quite significant. In our survey, 57% respondents (165 out of 288) experienced technical resilience and faced compromised performance of skills as represented in (Fig.1a). Benítez CY13 also reported nearly same results in their survey, i.e more than half of the respondents (54%) perceived compromised surgical performance. This percentage was even more in the survey conducted by Davey SL et al where they found 91 % of the respondents facing job difficulties with PPEs.<sup>12</sup> However 34 % R-HCW (100 out of 288 ) in our survey didn't face technical limitations while 8% R-HCW (23/288) didn't know about the change of effect on their technical performance.

Visual impairment during the procedure and film reporting is another considerable impact of PPE. 62% of our respondents (180 out of 288) reported visual disturbances, as depicted in (Fig.1b). Negative visual impact has also been assessed among HCW by Swaminathan R et al, which reported high VAS (Visual analogue scale) score of more than 8 in those who used goggles or plastic visor.<sup>14</sup> In our survey , 31 % R-HCW (90/288) didn't experienced effect on their visual impairment; however 6% (18 /288) didn't know about the change or effect if any .

In our study as shown in (Fig.2a), effect on communication and decision making skills was reported by 44 % of respondents (i.e 128 out of 288) but majority



**Figure 1:** Graphical (bar graph) representation depicting (a) effect on technical skills or performance and (b) effect on visual impairment.

**Figure 2:** Graphical (bar graph) representation depicting (a) effect on communication skills and decision making and (b) increase in level of fatigue and discomfort with usage of PPE.

49%(141/288) respondents didn't experience limitations over communication and decision making skills. Again 6% (19/288) respondents didn't know if there is any effect of PPE on their communication and decision skills. Benítez CY found that PPE had considerable effect on communication skills and decision making during surgical performance<sup>13</sup> which was seen in less than half of R-HCW in our study. Though Morris NB et al negates the impact of PPE on cognitive function and thermal discomfort and emphasizes only on aggravation of dyspnea,<sup>15</sup> which is contrary to our survey results, as nearly half of the respondents experienced cognitive limitations. Increase in the level of fatigue and discomfort is found to be the most predominant effect of PPE among R-HCW, as illustrated in (Fig.2b), which was noted

among 85% of respondents (247 out of 288). Only 10% (29/288) didn't find increase in the level of their fatigue and discomfort and only 4% (12/288) didn't know if there is any effect. Literature review showed increased level of fatigue, exhaustion and discomfort among surgeons<sup>13</sup> and general HCWs<sup>14</sup> which was nearly same as in our study. Agarwal A also reported fatigue, excessive sweating and headache as the most common problems in their survey.<sup>16</sup> The main cause of significant discomfort is prolong use of masks especially N95 FFR, which leads to hypoventilation resulting in hypercapnia and causing many physiological effects such as headache,<sup>17</sup> increased pressure inside the skull, increased work of breathing, increased breathing frequency, cardiovascular and

nervous system effects and decreased tolerance to lighter work loads.<sup>18</sup>

Although healthy individuals may not experience symptomatic changes or changes in Plasma Oxygen and Carbondioxide levels but masks wearing for an extended time produce resistance in breathing due to filtering particles in masks, or aerosols and particles entrapped in masks.<sup>19</sup> As PPEs are mandatory to control virus transmission and virus reduction, this benefit outweigh all the discomfort faced by HCW.<sup>20</sup>

The present study highlights the importance of negative impact being faced by R-HCW while using PPE and therefore there is need for some modifications in using them. Literature review showed that keeping good hydration, taking short interval breaks, 12 hour breaks after 6 hour duty may help in reducing heat stress and discomfort.<sup>14</sup> Unfortunately, these strategies are hard to follow due to hectic schedule and working conditions during pandemic.

There are some limitations to our study. First the type of PPE was not categorized for each respondent rather general use of PPE was considered only. Second there was no option to categorize those R-HCW who were using lead apron along with PPE together for fluoroscopic procedures, which would have resulted in significant negative impact.

## Conclusion

The use of PPE is mandatory for all R-HCW but the compromised technical performance, increase in the level of fatigue, discomfort and visual impairment may suggest its negative impact among R-HCW. Necessary recommendations and working strategies are needed to be encouraged to minimize the effects as much as possible. Future research is required in making PPEs more user friendly to ensure more ease, comfort and minimize long term hazards especially to HCWs.

**Conflict of Interest:** None

**Acknowledgement:** We thank all radiology related health care workers for contributing their experiences for this study.

**Disclaimer:** None

**Funding disclosure:** None

## References

1. <https://www.worldometers.info/coronavirus>. Accessed May,16 2020.
2. Lu H, Stratton CW, Tang Y. Outbreak of pneumonia of unknown etiology in Wuhan China: the mystery and the miracle. *J Med Virol* 2020; **92(4)**: 401-2.
3. World Health Organization. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). 30 January 2020. [https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-internationalhealth-regulations-\(2005\)-emergency-committee-regarding-theoutbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-internationalhealth-regulations-(2005)-emergency-committee-regarding-theoutbreak-of-novel-coronavirus-(2019-ncov))
4. Ong JJY, Bharatendu C, GohY, Tang JZY, Sooi KWX, Tan YL, et al. Headaches associated with personal protective equipment- A cross-sectional study among frontline healthcare workers during COVID-19. *Headache* 2020; **60(5)**: 864-77.
5. Ontario Agency for Health Protection and Promotion (Public Health Ontario). COVID-19 – What We Know So Far About Routes of Transmission. Toronto, ON: Queen's Printer for Ontario; 2020. <https://www.publichealthontario.ca/-/media/documents/ncov/wwksf-routes-transmission-mar-06-2020.pdf?la=en>
6. Wong S, Kwong R, Wu TC. Risk of nosocomial transmission of coronavirus disease 2019:an experience in a general ward setting in Hong Kong. *J Hosp Infect* 2020; **105(2)**: 119-27
7. COVID-19: Guidance for maintaining services within health and care settings Infection prevention and control recommendations. Version 1.0 published 20 August 2020; Revised Version 1.1 published 21 January 2021. NHS.
8. The RCR (Royal College of Radiologists) statement on personal protective equipment (PPE) ([https://www.rcr.ac.uk/sites/default/files/radiology\\_ppe\\_poster\\_a3.pdf](https://www.rcr.ac.uk/sites/default/files/radiology_ppe_poster_a3.pdf))

9. IPAC Recommendations for Use of Personal Protective Equipment for Care of Individuals with Suspect or Confirmed COVID 19. Toronto, ON: Queen's Printer for Ontario; 2020. ©Queen's Printer for Ontario, 2020.
10. Liu M, Cheng SZ, Xu KW, Yang Y, Zhu QT, Zhang H, et al. Use of personal protective equipment against coronavirus disease 2019 by healthcare professionals in Wuhan, China: cross sectional study. *BMJ* 2020; **369**: m2195
11. Galanis P, Vraka I, Fragkou D, Bilali A, Kaitelidou D. Impact of personal protective equipment use on health care workers' physical health during the COVID-19 pandemic: a systematic review and meta-analysis. *American Journal of Infection Control*. May 2021;
12. Davey S L , Lee BJ , Robbins T. Heat Stress and PPE during COVID-19: Impact on health care workers' performance, safety and well-being in NHS settings. *J Hosp Infect*. 2021; **108**: 185-8.
13. Benítez CY, Güemes A, Aranda J, Ribeiro M, Ottolino P, Saverio SD, et al. Impact of Personal Protective Equipment on Surgical Performance During the COVID-19 Pandemic. *World J Surg*. 2020; **44(9)**: 2842-47.
14. Swaminathan R, Mukundadura BP, Prasad S. Impact of enhanced personal protective equipment on the physical and mental well-being of healthcare workers during COVID-19. *Postgrad Med J*. Published 2020
15. Morris NB, Piil JF, Christiansen L, Flouris AD, Nybo L. Prolonged facemask use in the heat worsens dyspnea without compromising motor-cognitive performance. *Temperature*. 2020; 1-6.
16. Agarwal A, Agarwal S, Motiani P .Difficulties encountered while using PPE kits and how to overcome them: an Indian perspective. *Cureus* Nov 2020; **12(11)**: e11652.
17. Lim ECH, Seet RCS, Lee KH, Wilder-Smith EPV, Chuah BYS, Ong BKC. Headaches and the N95 face-mask amongst healthcare providers. *Acta Neurologica Scandinavica*. 2006; **113(3)**: 199-202.
18. Psycho-physiological effects. Technical Specification Part 6: Respiratory Protective Devices - Human Factors (1<sup>st</sup> Edition 2014). Reference number: ISO/TS 1697; **6(6)**: 2014.
19. Lockhart SL, Duggan LV, Wax RS, Saad S, Grocott HP. Personal protective equipment (PPE) for both anesthesiologists and other airway managers: principles and practice during the COVID-19 pandemic. *Can J Anesth*. Aug 2020; **67(8)**: 1005-15.
20. Scheid JL, Lupien SP, Ford GS, West SL. Commentary: physiological and psychological impact of face mask usage during the COVID-19 pandemic. *Int J Environ Res Public Health*. 2020 Sep 12; **17(18)**: 6655.