

## Original Research Article

# Effect of using face shield and its relation to musculoskeletal disorder among health practitioners

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**Received:** 02 March 2026

**Accepted:** 23 May 2026

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## ABSTRACT

**Background:** Personal protective equipment (PPE) is considered a very essential element in controlling the spread of infection in health care facilities; however, prolonged use of various PPE, especially face shields cause discomfort, neck impingement and restricted movement leading to musculoskeletal disorders (MSDs).

**Methods:** A cross-sectional survey was conducted with 145 Health Practitioners (HPs) at a tertiary care hospital in Chennai, utilising a validated questionnaire from December 2022 to May 2023. Univariate analysis was using Social Sciences (SPSS) Statistics version 23.0.

**Results:** Approximately 52% indicated experiencing MSDs, while 44.7% reported MSDs associated with the prolonged use of face shields in the workplace. The risk of MSDs was 3.4 times higher among individuals who used Personal Protective Equipment (PPE) (95% CI: 1.0–11.2). PPE-related restrictions on movement resulted in MSD for 72% of healthcare professionals, presenting a 2.5-fold risk (95% CI: 1.2-5.0). A significant association was observed between the history of work-related MSDs and their prevalence among healthcare professionals utilising face shields (OR: 9.5; 95% CI: 2.7-33.5). Many HPs reported discomfort, diminished visual clarity and movement restrictions, all of which are associated with MSDs. Although not statistically significant, 9% of healthcare professionals who wore PPE for more than 6 hours/day reported experiencing MSDs.

**Conclusions:** PPEs can serve as a deterrent in certain aspects, yet they are essential for safeguarding HPs from various infections. Customising and utilising tailored PPEs can assist healthcare professionals in safeguarding themselves from both infections and MSDs.

**Keywords:** Face shield, Health practitioners, Infection control, Musculoskeletal disorders, Personal protective equipment

## INTRODUCTION

Healthcare practitioners (HPs) are the warriors who treat infectious disease cases and are at excessive risk of communicable infections.<sup>1</sup> The transmission of infections is usually enhanced through droplet spread and direct contact; HPs often come underexposure within clinical procedures, such as injection and invasive procedures, thus having many risks placed on them at high levels as a result of their direct contact with the patient's saliva,

blood, aerosols and other bodily fluids.<sup>2</sup> In this regard, policies related to infection prevention are also updated periodically to safeguard patients and HPs from transmission by droplet spread and aerosol-generating procedures with considerable potential for transmission.<sup>3</sup>

Use of PPE is an infection control practice that keeps health care settings free from potential transmission of disease. PPE is regarded as a protection barrier against the passing of microorganisms from patients to healthcare providers and this includes such things as gloves, masks

for your face, eye goggles, Face Shields (FS), gowns and shoe covers.<sup>4</sup> The use of PPE is crucial to ensure a safe working environment and generally, universal guidelines advocate its use in curtailing the spread of infectious diseases.<sup>5</sup>

The faces of the HPs have been observed as the areas most frequently impacted by splashes, sprays and scatters of body fluids. A face shield serves as a protective barrier, safeguarding the facial area and mucous membranes (eyes, nose and mouth) from potential sources of contamination. The frames utilized for face shields in healthcare environments come in various types and styles, encompassing both adjustable and nonadjustable options that either fully or partially encircle the skull's circumference, as well as those featuring eyeglass-type temple bars that are worn similarly to standard eyewear.<sup>6</sup>

An FS offers several advantages compared to full-face respirators: they are easy to use, provide full facial protection, reduce retention of dermal facial heat and have less claustrophobic sensation. Moreover, face shields do not elevate breathing resistance and do not necessitate fit testing. It can be readily disinfected and mitigate self-inoculation across a broader facial region. Disadvantages encompass glare, fogging and optical imperfections. Specific FS models, when employed alongside respirators to safeguard healthcare professionals from severe infections, may not provide adequate fit over some respirators, are more significant than goggles and safety glasses and offer reduced peripheral vision compared to protective facemasks about other types of face and eye protection used in healthcare.<sup>7</sup>

The centre for disease control and prevention defines MSDs as injuries or disorders affecting soft tissues, including muscles, tendons, joints, nerves and supporting structures of the upper and lower limbs, neck or lower back. These conditions may arise from sudden efforts or prolonged exposure to repetition, force, vibration or awkward posture. The most prevalent occupational disorders associated with HPs are MSDs, resulting from awkward postures and improper use of bodily mechanisms. These diseases can affect physical, social and psychological well-being, leading to risks of reduced work efficiency and frequent absenteeism.<sup>8</sup> Prior research indicated that using PPE during treatment may lead to discomfort in the nose and ear region.

The use of FS has been associated with overall discomfort and work-related difficulties, including MSDs, across various work environments.<sup>9-12</sup> PPE plays a significant role in protecting healthcare professionals; however, it is associated with various issues, including supply shortages and challenges related to heat and dehydration during use. Consequently, there are a limited number of studies examining susceptibility to PPE-related musculoskeletal disorders and other discomforts, highlighting the

necessity to evaluate the challenges encountered by healthcare professionals.

## METHODS

A cross-sectional survey with 145 HPs was conducted from December 2022 to May 2023. After fully explaining the study protocol and enumerating the benefits of participation, we got permission from the higher authority of the Faculty of Dental Sciences, the Faculty of Physiotherapy and the Faculty of Speech and Language Pathology. Authors obtained ethical clearance from the Institutional Ethics Committee (XXX). Participants must be HPs with at least six months of practice experience. The margin of error (d) was established at 5%, with a 95% confidence interval and a population size (n) of 95 HPs, accompanied by a response distribution (p) of 6.6%.  $Z=1.96$ . We excluded the participants who had a chronic neck pain condition resulting in 145 health professionals. Before administering the questionnaires, we provided each participant with a description of the potential risks and benefits of the study and secured their informed consent for participation.

We developed a structured questionnaire with internal and external peers and experts. The questionnaire consisted of four main sections participant demographics and information, occupational history, medical history and details and perceptions related to the use of PPE. The questionnaire also included a section for qualitative comments at the end. The HPs self-administered this English survey, returning their responses to the researcher within 15 minutes. The researcher answered any doubts or provided clarifications.

We used Microsoft Excel to enter and consolidate the data. The demographic factors were grouped and categorised based on age, marital status and work experience. The dependent variables were categorised according to the presence or absence of MSDs and related consequences as rated on the following criteria: such as continuous face shield usage, discomfort, lack of visual clarity, temperature at the workplace, stress and difficulty concentrating, other face-related PPE, duration of face shield use, past history of MSDs and movement restrictions. The outcome variables were categorized into two groups: the presence or absence of MSDs. All the outcomes are reported with an odd ratio >1, which is interpreted as a risk. The significance of each exposure or outcome is established with univariate analysis and crude odds ratios are calculated and presented as a measure of association. All p values have been interpreted with a cut-off of 0.05. Statistical analyses have been done using the IBM SPSS Statistics version 23.0.

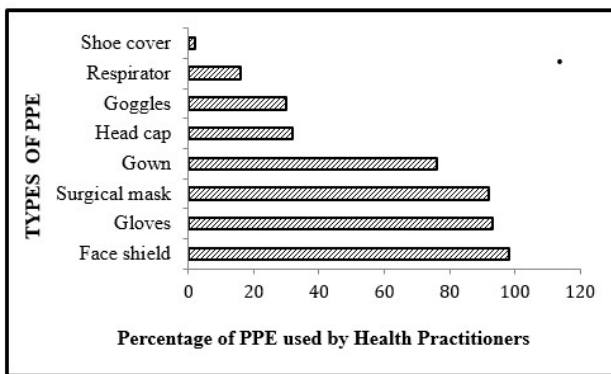
## RESULTS

The study population was divided into two age groups: those under 30 (90.3%) and those over 30 (9.6%). Females comprised the majority of the population (n=100

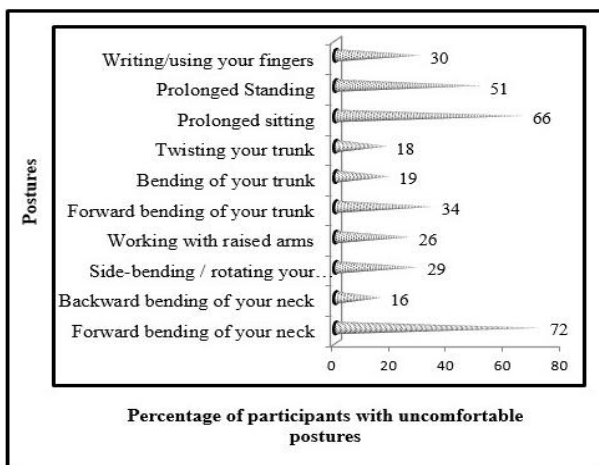
or 75.1%), while males comprised roughly 24.8%. 54% of the HPs had less than 5 years of professional experience and the rest had more than 5 years of work experience (Table 1).

Figure 1 illustrates that most of the sample used PPE, including face shields, gloves, surgical masks and gowns, while a minority employed shoe covers, head caps, respirators and goggles. FS exhibited the highest proportion among the evaluated PPE at 98%, followed by gloves at 93% and surgical masks and gowns at 92%. Only 2% of the surveyed HPs reported wearing shoe covers. In the study population of 145 HPs, during the 8-hour work shift, 65.2% (n=25) wore face shields for less than one hour, 32% (n=46) for one to three hours, 30% (n=44) for three to six hours, 9% (n=13) for more than six hours and 12% (n=17) wore them exclusively while attending to patients during their shifts.

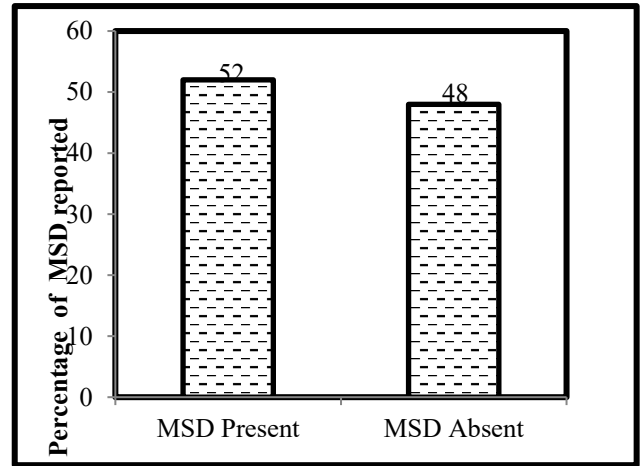
A lot of the people who participated, 72 % (n=105), bend their necks at work. This could make them more likely to get MSDs, like neck pain, lower back pain and other problems linked to holding the same awkward position over and over again, as shown in Figure 2.



**Figure 1: Protective gears used by health practitioners.**



**Figure 2: Uncomfortable postures for long periods during the working hours.**



**Figure 3: Prevalence of MSDs reported by participant.**

In the study population, 62% (n=90) of HPs reported experiencing movement restriction while wearing an FS. Participants 44.7 % (n=34) reported that prolonged use of the face shield restricts movements such as neck bending and turning, potentially leading to discomfort or challenging inpatient treatment. MSDs refer to various conditions affecting the muscles, bones and joints, often resulting in pain and functional impairment. Intrinsic factors contributing to musculoskeletal pain encompass age, genetics, obesity and psychological stress. Additional extrinsic factors contributing to MSD include repetitive movements, prolonged static postures, unfamiliarity with the face shield and improper alignment of the face shield (Figure 3).

Approximately 52% of health professionals have MSD, while 48% do not. These factors may significantly impact physical, social and psychological well-being, leading to decreased work efficiency, increased absenteeism and various physiological effects.

Most participants, 90% (n=130), reported experiencing discomfort and a lack of visual clarity while using the face shield. The study found a significant association between MSDs and the prolonged use of face shields during work hours. Additionally, the continuous use of face shields, which necessitates increased neck and head bending, significantly increases discomfort and reduces visual clarity, leading to a 3.4 times higher risk of developing MSDs (95% CI: 1.0–11.2).

Authors observed a significant association between prior work-related musculoskeletal disorders (MSDs) and current MSDs, indicating a 9.5-fold increase in risk (95% CI: 2.7-33.5). We identified movement constraints in most HPs as 2.5 times more likely to be associated with MSDs (95% CI: 1.2-5.0). We observed no significant correlations despite the increased likelihood of other illnesses, stress, focus, duration of PPE usage and MSDs (Table 2).

**Table 1: Demographic details of the study participants (n=145).**

Gender	Age group		Marital status		Work experience	
	<30 years (N%)	>30 years (N%)	Single (N%)	Married (N%)	<5 Years (N%)	>5 Years (N%)
Male	31 (92.9)	5 (7.1)	30 (89.3)	6 (10.7)	20 (35.7)	16 (64.3)
Female	100 (93.9)	9 (6.1)	93 (85.4)	16 (14.6)	59 (35.4)	50 (64.6)
Total	131 (90.3)	14 (9.6)	123 (84.8)	22 (15.1)	79 (54.4)	66 (45.5)

**Table 2: Association between MSDs, continuous wearing of face shield and other variables for the HPs.**

Study variables	MSD Present (N %)	MSD Absent (N %)	Crude odds ratio <sup>‡</sup>	95% CI	P value	
M U S C U L O S K E L E T A L D I S O R D E R (M S D)	Continuous wearing of face shield					
	Yes	34 (44.7)	42 (55.3)	0.5	0.26-1.00	0.052*
	No <sup>#</sup>	42 (55.3)	27 (39.1)			
	Discomfort and lack of visual clarity	72 (94.7)	58 (84.1)	3.4	1.03-11.28	0.035*
	Yes	4 (5.4)	11 (15.9)			
	No <sup>#</sup>					
	Any other illness	7 (9.2)	1 (1.4)	6.8	0.82-57.58	0.041*
	Yes	69 (90.8)	68 (98.6)			
	No <sup>#</sup>					
	Temperature at work environment	48 (63.2)	49 (71.0)	0.7	0.34-1.40	0.315
	Yes	28 (36.8)	20 (29.0)			
	No <sup>#</sup>					
	Stress and difficulty in concentrating	72 (94.7)	60 (87.0)	2.7	0.79-9.20	0.101
	Yes	4 (5.3)	9 (13.0)			
	No <sup>#</sup>					
Other face related PPE	76 (100)	69(100)	NA	NA	NA	
Yes	0	0				
No <sup>#</sup>						
Duration of wearing a face shield						
<1 hr	15 (65.2)	10 (52.6)	1.6	0.48- 5.85	0.408	
Only while seeing the patient <sup>#</sup>	8 (34.8)	9 (47.4)				
1-3 hrs	27 (77.1)	19 (67.9)	1.5	0.52-4.89	0.409	
Only while seeing the patient <sup>#</sup>	8 (22.9)	9 (32.1)				
3 – 6 hrs	21 (72.4)	23 (71.9)	1.0	0.33-3.15	0.963	
Only while seeing the patient <sup>#</sup>	8 (27.6)	9 (28.1)				
>6 hrs	5 (38.5)	8 (47.1)	0.7	0.16-3.05	0.638	
Only while seeing the patient <sup>#</sup>	8 (61.5)	9 (52.9)				
Past MSD history			9.5	2.71-33.53	0.000*	
Yes	23 (30.3)	3 (4.3)				
No <sup>#</sup>	53 (69.7)	66 (95.7)				
Movement Restrictions			2.5	1.27-5.07	0.007*	
Yes	55 (72.4)	35 (50.7)				
No <sup>#</sup>	21 (27.6)	34 (49.3)				

\*p value<0.05 shows it is significant; <sup>‡</sup>COR-More than 1 denotes the presence of risk; <sup>#</sup> Denotes the reference group.

## DISCUSSION

The current investigation examined the relationship between the face shield and MSDs in HPs. The disclosure of the three-minute average response time, the assurance of data privacy and the option to provide the subject name made the survey questionnaire more acceptable to HPs interested in this subject.

HPs are widely recognised as having a high risk of infectious disease transmission as a result of their direct contact with patients, as blood and sputum can be dispersed. PPE is frequently worn in healthcare settings as a transmission-based precaution to protect healthcare professionals from diseases and to prevent the dissemination of these diseases to patients in their vicinity, thereby reducing the high risk of cross-infection.<sup>1,2</sup>

Consequently, choosing appropriate PPE by a risk assessment is crucial. This equipment should serve as an effective barrier between the human body and contaminated materials such as blood, body fluids, respiratory secretions and aerosols, as well as protect the skin, eyes, face, nose, mouth, hands, feet and head.<sup>2</sup> Researchers have demonstrated the ease of use and effectiveness of face shields, leading to their widespread use.<sup>12</sup> However, the limitations of face shields in patient care and their effects on HPs have not received the necessary attention. This research holds significance as it is the first to investigate the interaction between face shields and MSDs.

PPE, including face shields, has increased after the advent of COVID-19 and has been a norm in clinical practice.<sup>13</sup> Approximately 98% of respondents in our study reported using face shields during work hours. The questionnaire results revealed that 54% of respondents were using reusable face shields, while 46% were using disposable ones, a practice that most HPs worldwide adhere to.<sup>6</sup> In addition to facial shields, most participants are known to use other PPEs regularly. In our study, about 1/3 of the HPs used face shields for an average of 1–3 hours, 32%, 30% for a duration between 3–6 hours and only a small percentage of the HPs, 9%, used it for a duration exceeding 6 hours. 11% of HPs used it only when interacting with patients to avoid cross-infections, like in other healthcare settings.<sup>14</sup>

Our results show that approximately 51% of HPs had access to properly fitting face shields, while 36% reported having access to them only occasionally. Additionally, they reported that the absence of a properly fitting face shield results in discomfort and hinders working efficiency.<sup>6</sup> In this study, a more significant percentage of HPs reported that uncomfortable postures include forward bending of the neck (72%), prolonged sitting (66%) and prolonged standing (51%). Additionally, approximately 62% of the participants reported experiencing movement restrictions while wearing a face shield at work, which

were significantly associated with 2.5-fold MSDs ( $p$ -value=0.007), such as neck pain, nose pain and pinna pain, as previously reported.<sup>2</sup> 57% of the participants found the temperature comfortable, while 43% did not. Therefore, it is equally critical to regulate the climate of the work environment.<sup>10</sup>

Like other studies, study also showed that fatigue and headaches are strongly linked to the fact that about 89% of HPs have trouble seeing because they have to wear a face shield, which requires them to bend their neck and head more, which is uncomfortable ( $p$ =0.03) (Table 2).<sup>15</sup> Moreover, approximately 55% of the study population experienced difficulty concentrating while wearing a face shield and approximately 91% were anxious about donning one.

Authors have previously reported these kinds of responses.<sup>9</sup> Approximately 52% of the respondents reported experiencing current work-related MSDs that had a significant correlation with past work-related MSDs ( $p$ =0.0001). Therefore, healthcare professionals with FS must maintain optimal posture while administering patient care.<sup>7</sup>

The study also demonstrated that approximately 44% of the participants had fair work efficiency, 9% had poor work efficiency, 38% had good work efficiency and 9% had very good work efficiency while donning PPE. This could potentially impact the work practices of HPs.<sup>10</sup> Similarly to the previous study, participants reported additional discomforts while donning PPE, such as breathlessness (approximately 67%), sweating (80%), headache (55%), dizziness, skin irritation (30.6%) and face shield fogging (22%).<sup>2,16</sup>

The face shield's design should enhance tolerability and comfort, as well as restrict the duration of exposure. We should grant regular breaks or micro-breaks to HPs who are required to perform repetitive tasks and maintain unnatural postures.<sup>7,16</sup> Additionally, job rotation should be implemented.<sup>17</sup> Further research on MSD and the duration of PPE use among HPs could enhance occupational and health safety. Consequently, the health profession significantly influences the quality of life and considering the global epidemics, this may only be the beginning.<sup>18</sup>

Therefore, all healthcare professionals must wear properly fitted personal protective equipment (PPE) and face shields to prevent and control the spread of infection during any procedure, especially those that involve direct patient contact. Various ergonomic factors, including work posture, must also be considered to ensure occupational health and safety.

### Limitations

Even though we found a strong relationship between PPE and MSDs, our study has certain limitations. Our sample size was minimal ( $n$ =145) and was collected from a

particular region. So, our results might not reflect the participant's perceptions across the different regions or other areas of HPs throughout south India. The sample was not adequately randomized, although efforts were made to reduce bias appropriately.

However, data collection is subject to recall bias. Some questions were administered to participants during their valuable time at work and some were answered during their time in the room. There would have been altered responses as some were busy with their patients and we don't know whether the participants were giving a frank answer. Participants may also be susceptible to misunderstandings.

## CONCLUSION

The current study focuses on HPs' perceptions of face shield use and the MSDs that emerge from it. The majority of the participants reported discomfort, a loss of visual clarity and mobility restrictions, all of which were found to be strongly linked to MSDs, particularly neck pain produced by the use of a face shield. Most of the participants lacked adequately fitted face shields, which led to awkward positions and further increased their risk of MSDs.

Wearing an improperly fitting face shield causes various issues such as dyspnoea, perspiration and migraines and impairs HPs' concentration and productivity, which is counterproductive in healthcare settings. So, we must address and solve the problems using face shields. Since protection seems to be the norm in healthcare, this PPE research is imperative for improving efficiency and protecting healthcare professionals from any adverse impacts of using PPEs.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Damavarapu N, Shanmugam R, Venugopal V. Effect of using face shield and its relation to musculoskeletal disorder among health practitioners. *Int J Community Med Public Health* 2026;13:2951-7.