# **Original Research Article**

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# Adverse effects of prolonged use of personal protective equipment among health care workers during COVID-19 pandemic

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# **ABSTRACT**

**Background:** To know adverse effects of prolonged use of (PPE) personal protective equipment among various categories of health care providers while taking care of COVID-19 patients.

**Methods:** This study include health care workers involved in care of covid-19 positive patients admitted in COVID dedicated hospital. A preformed questionnaire based performa was distributed among health care providers. Questions were framed about various possible adverse effects of use of PPE. Duration of study was six month from first July 2020 to 31 December 2020. The data was obtained from questionnaire and thereafter analysed to determine the adverse effects of different parts of PPE among various categories of HCPs depending on their age, sex and duration of exposure.

**Results:** A total of 150 health care workers of various categories were surveyed. Maximum numbers of health care workers were in the age group of 31-40 years. Most common side effects were itching, rash, suffocation and impaired cognition. N-95 masks, gloves and face shield when used caused maximum discomfort.

**Conclusions:** COVID-19 is ongoing pandemic with uncertainty about its end. Health care workers are continuously exposed to COVID-19 positive patients and almost all the healthcare providers experienced discomfort while using PPE causing reduced work efficiency.

Keywords: Personal protective equipment, health care workers, N- 95 masks, Gloves, Face shield

# **INTRODUCTION**

The COVID-19 pandemic is an ongoing pandemic caused by severe acute respiratory distress syndrome corona virus-2 (SARS-CoV-2). Virus was first identified in December 2019 in the Wuhan city of China. Soon it involved whole of the world and it was declared a public health emergency of International concern in January 2020 and a pandemic in March 2020. Till date 181,550,029 coronavirus cases have been confirmed with 3,932,768 deaths worldwide. In India upto the end of June 2021 total numbers of diagnosed cases are 30,232,320. In India till date 3,95,720 deaths have been occurred which also involved health care workers.

Virus spreads mainly by droplets and aerosols which are produced by infected persons while coughing and sneezing. The virus may also spread by direct contact with infected person and contaminated surfaces. People get infected when they remain in close contact with an infected person. Virus even can spread by presymptomatic and mildly symptomatic individuals. Patient can remain infectious upto ten days in moderate cases and upto two weeks in severe cases.

As virus mainly spreads by respiratory droplets, while taking care of these infectious patients health care workers have to protect themselves. To protect themselves health care workers and all those involved in

the management of these patients have to wear some protective covering which is called as personal protective equipment (PPE), as virus can spread by droplets, contaminated surfaces, fomites health care workers have to cover them all with personal protective equipment. PPE consist of mask, gloves, goggles, protective clothing, face shield and cap.

Health care workers are not used to this kind of protective covering. If we review literature the last incidence of prolonged use of PPE was during the (SARS) severe acute respiratory outbreak in 2003-2004 which originated in Guangdong China. Personal protective equipment has to be used for prolonged periods of time upto hours, which can cause stress and adverse reactions on health. Studies focussing on the effects of prolonged use of PPE during the SARS outbreak were published in the subsequent years. A study by Lim et al focused on the headaches related to mask use and another study by Foo et al discussed adverse skin reactions such as rash, acne, itching from prolonged use of mask.<sup>2,3</sup>

As COVID-19 is an ongoing pandemic and there is no treatment or vaccine available which can cause full protection till date as the virus is continuously mutating. Time span of pandemic is also not known, so health care workers and all others involved in management of COVID-19 are expected to work for long shifts in physically demanding environment. Not much studies has been done to see the various adverse effects of this type of working with PPE. Unfortunately, wearing PPE has negative effects on the physical as well as mental health of the workers. Time frame that an activity can be sustained is decreased when wearing PPE.4 This study was done at Dr. Radha Krishnan Government medical college and hospital Hamirpur Himachal Pradesh to findout the various adverse effects of prolonged use of PPE among health workers including doctors who are fighting continuously in this pandemic as "corona worriers".

# **Objectives**

Objectives of current study were to access adverse effects of prolonged PPE use by health care workers in Himachal Pradesh and to compare the magnitude of adverse effects in different categories of health workers.

#### **METHODS**

# Study design, location, duration and participants

Current study was a cross sectional study conducted at dedicated COVID-19 hospital under Dr. R.K.G.M.C., Hamirpur for period of six months. Health care workers working in COVID-19 wards under the institution were selected as study participants.

# Inclusion and exclusion criteria

Inclusion criterion for current study was HCWs consenting to participate in the study. HCWs who were isolated after tested positive for COVID-19 were excluded from the study.

#### Data collection

150 participants were randomly selected by convenience sampling from different categories. A pretested structured interview schedules was used to collect information on adverse effects of prolonged PPE use.

# Statistical analysis

Data was entered in MS office excel spreadsheet. Data was analyzed by using IBM SPSS software version 20.0 (New York, USA). Results were described in frequencies, means and relative frequencies. Chi square test was used to compare categorical variables and unpaired t test for continuous variables, p<0.05 were considered to be statistically significant.

#### **RESULTS**

A total of 150 health care workers which included doctors, nurses and supporting staff were surveyed by a preformed questionnaire, among them were 41 males and 109 were females. Females were more in the study because maximum numbers of nursing staff were females. Maximum numbers of health care workers were in the age group of 31-40 years (Table 1). There were 19 doctors and 86 staff nurses and others were sanitation workers (19), security staff (5), lab technician (11), ECG technician (1) (Table 2). All these workers wear PPE for variable durations depending upon their nature of work. Mean time of wearing was 2.79 hours and maximum time for tolerating PPE was 2.31 hours. Gloves: latex gloves were most commonly used followed by plastic gloves used by sanitation workers. Among 150 workers who regularly used latex gloves 84% reported adverse effects. Most common adverse effect was sweating followed by itching, rash and chapped skin. Plastic gloves were used by sanitation workers but none of them reported any side effect (Table 3). All these adverse effects were mild as none of them reported doctor for treatment. Masks: N-95 masks were used by all while going to patients area and triple layer surgical masks and cloth masks were used by all when not in patient treatment area. As N-95 masks fit tightly around the mouth and nose so suffocation was the most common problem faced by 99 workers, others were abrasion nose bridge, facial itching, wheel on nose, jaw and cheek, breathlessness, dry skin, impaired cognition (Table 4). One more problem excessive fogging was faced by workers who use spectales. Workers who used surgical masks or cloth masks did not show any problem. Sweating was the most common (83%) adverse effects occurred after wearing full PPE including protective clothing, as when workers get ready after wearing full PPE suffocation occurred in 74% of workers followed by fogging due to face shield (73%) (Table 5). Among

different components of PPE face shield caused maximum discomfort to the workers. among different type of categories of workers doctors showed maximum discomfort by masks (58%) nurses experienced maximum discomfort by protective clothing (32.6%) and face shield (66%) (Table 6). Reduced work efficiency was reported by nurses (16%) but no other category reported decrease in work efficiency even after experiencing adverse effects caused by PPE, it may be because of their nature of work.

Table 1: Age and sex distribution of health care workers.

Age groups (years)	Female N (%)	Male N (%)	Total
21-30	39 (86.7)	6 (13.3)	45 (30)
31-40	55 (72.4)	21 (27.6)	76 (50.7)
41-50	15 (60)	10 (40)	25 (16.7)
51-60	0	4 (100)	4 (2.6)
Total	109 (72.7)	41 (27.3)	150

Chi square 17.0, p value=0.001.

Table 2: Category of HCWs.

Category	Female N (%)	Male N (%)	Total
Doctors	2 (10.5)	17 (89.5)	19 (12.7)
Staff nurses	86 (100)	0	86 (57.3)
Lab technician	3 (27.3)	8 (72.7)	11 (7.3)
ECG technician	1 (100)	0	1 (0.7)
Doctors	2 (10.5)	17 (89.5)	19 (12.7)
Sanitation worker	8 (42.1)	11 (57.9)	19 (12.7)
Security staff	1 (20)	4 (80)	5 (3.3)
Other support staff	8 (89)	1 (11)	9 (6.0)

# **DISCUSSION**

Covid-19 disease caused by SARS-Co-2V is highly contagious. As it mainly spreads by droplets, because of strong transmission of COVID-19 and uncertainty of the infectious status of the patient, health providers are at high risk to get infected while taking care of COVID patients. To prevent spread of infection as well as to protect health care workers personal protective equipment has been provided.<sup>5</sup> Personal protective equipment (PPE) consists of gloves, face mask, gown, face shield, goggles, head cover. As bearing PPE while treating patients is new for health care workers, use of PPE cause adverse skin reactions, cognitive impairment as well as decrease in work efficiency. There are limited studies of the adverse reactions caused by PPE on the health care workers. Adverse reaction caused by use of PPE can be studied

with probable solutions, which may be helpful to health care workers.

Table 3: Reported effects of use of gloves.

Reported effects	N (%)
Itching	48 (32)
Sweating	84 (56)
Rash	11 (7.3)
Chapped skin	12 (8)

Table 4: Effects of wearing N-95 mask.

Reported effects	N (%)
Abrasion nose bridge	66 (44)
Facial itching	70 (46.7)
Wheel on nose/jaw/cheek	31 (20.7)
Suffocation	99 (66)
Breathlessness	53 (35.5)
Dry skin	41 (27.3)
Impaired cognition	17 (11.3)

Table 5: Effects of full PPE on healthcare workers.

Reported effects	N (%)
Sweating	125 (83.3)
Itching	35 (23.3)
Wheel on nose/jaw/cheek	31 (20.7)
Suffocation	112 (74.7)
Rash	07 (4.7)
Fogging	110 (73.3)
Impaired cognition	15 (10)

Table 6: PPE components with maximum discomfort.

Reported effects	N (%)
Mask	64 (42.7)
Gown	36 (24)
Face shield	92 (61.3)
Foot cover	4 (2.7)
Double gloves	90 (60)

Masks are used to prevent spread of infection by droplets from mouth and nose. Masks are used to cover mouth and nose. If worn properly they can effectively prevent spread of infection. Various types of masks available are N-95 masks, triple layer surgical masks, simple cloth masks. N-95 masks have 95% filtration efficiency for particles of size more than 300nm. Diseases that can be prevented by the use of N-95 masks include tuberculosis, chicken pox, measles and SARS-CoV-2.6 Generally employees and visitors bear surgical masks and when providing direct care of COVID-19 patients health care workers donned N-95 masks. Prolonged use of masks causes headache, difficulty breathing, acne, skin breakdown, rashes, and impaired cognition. It also interferes with vision, communication and thermal equilibrium. Various studies have been done to study adverse skin reactions due to N-

95 masks. Foo et al reported acne, facial itching and rash as most common adverse skin reactions where as headache was the most common adverse effect in Lim research.<sup>2,7</sup>

Hand protection is one of the most important ways of preventing COVID-19 infection. The most common adverse reactions to wearing gloves are itching, dry skin and rash. Most common gloves used are latex gloves. Causes of adverse reactions are immunoglobulin Emediated hypersensitivity to latex, latex allergy and irritant contact dermatitis.8-10 Health care workers also wear protective clothing for longer durations. Skin reactions due to protective clothing are less, being most common are dry skin and itching, but wearing protective clothing during hot and humid atmosphere is troublesome because it result in excessive sweating. Goggles and face shield are used to protect face and eyes. Adverse reactions caused by these are fogging, itching. Fogging occurs due to variation in temperature outside and inside goggles which interferes with working.

#### Limitations

A limitation of current study was convenience sampling technique was used.

#### CONCLUSION

Almost all the healthcare professionals experienced discomfort while wearing PPE to take care of patients with COVID-19. Sweating, suffocation, breathlessness, abrasion and impaired cognition were some common adverse effects. All reported reduced efficiency after wearing PPE. It is important for healthcare personnel to be well prepared mentally as well as physically while treating patients with COVID-19. More attention should be offered to healthcare personnel because they are susceptible for adverse reactions as well as acquiring disease. Frequent breaks, improved hydration and rest, skin care, and potentially newly designed comfortable masks are recommended.

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involving prolonged use of masks and PPE among healthcare professionals.

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Institutional Ethics Committee

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