

Report

Cutaneous adverse effects due to personal protective measures during COVID-19 pandemic: a study of 101 patients

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Introduction

The use of personal protective equipment (PPE) and practice of personal hygiene measures such as hand washing have become a common practice, now more than ever among health-care workers (HCWs) as well as the general population amidst the COVID-19 pandemic. The different types of protective measures (PMs) being employed for protection against acquiring and transmission of the novel coronavirus (SARS-CoV-2) can directly affect the skin physiology and its barrier function. This can lead to adverse effects and allergic reactions in susceptible individuals.^{1,2} During the SARS outbreak in 2003, PPE-related adverse skin effects among HCWs were up to 35.5%, and during the COVID-19 pandemic, it is reported to be as high as 97%.^{3,4} However, review of literature suggests that cutaneous adverse effects due to the necessitated use of PMs during viral

Abstract

Background Coronavirus Disease 2019 (COVID-19) is a viral illness caused by the novel coronavirus SARS-CoV-2 which spreads via droplets from an infected person. There has been an unprecedented rise in the use of personal protective equipment and practice of personal hygiene measures against COVID-19. The extended use of protective measures (PM) can lead to ill effects on the skin. Our aim was to investigate PM-induced dermatoses amongst healthcare workers and the general population during the COVID-19 pandemic.

Methods A cross-sectional study was conducted over a period of 2 months. The study subjects were patients who presented to dermatology outpatient clinics or sought teleconsultation for skin problems related to the use of PMs against COVID-19. A detailed history was obtained and cutaneous examination was documented for all the patients in a pre-set proforma. Diagnoses of the adverse skin effects were formulated based upon history and clinical examination.

Results A total of 101 cases with cutaneous adverse effects due to the use of PMs against COVID-19 were included in the study. The general population and healthcare workers were affected similarly, comprising of 54.5% and 45.5%, respectively. The mean age of the study participants was 36.71 ± 15.72 years. The most common culprit material was soap and water (56.4%). Contact dermatitis was found to be the most common adverse effect in the majority of our patients (72.3%). The most common symptom reported was pruritus (45.5%). The wearing of personal protective equipment for a longer duration was significantly associated with multiple symptoms ($P = 0.026$).

Conclusion The enhanced use of different PMs against COVID-19 can result in a variety of adverse skin effects. In our study, the use of soap and water was the most common culprit PM, and contact dermatitis was the most common adverse effect noted.

pandemics is scarce. Whereas previous studies have focused on the cutaneous adverse effects due to PMs in frontline HCWs, this study has included both HCWs and the general population.

Patients and Methods

This was a cross-sectional study conducted over a period of 2 months (March 2020 to May 2020). The target population was patients presenting to the dermatology outpatient clinics or seeking teleconsultation for skin problems related to the use of protective measures against COVID-19. After obtaining written informed consent, a detailed history regarding the onset and duration of the problem, the specifics of the culprit PMs, duration and frequency of the use of PMs, presenting symptoms, and any pre-existing skin conditions were obtained

from the patients and recorded in a pre-set proforma. Cutaneous examination was performed to document the affected sites, primary lesions and any secondary features, and morphology of the lesions. The diagnosis was rendered based on history and clinical examination by the dermatologist.

Data management and statistical analysis

The data were entered and managed in MS Excel 2010 and later exported to SPSS version 20 (IBM SPSS Inc., Armonk, NY, USA) for further statistical analysis. The qualitative variables were expressed in percentages and the quantitative variables in mean \pm standard deviations. Chi square test was applied for comparison and significance threshold was set at $P < 0.05$.

Results

A total of 101 cases were included in the study, with reported skin-related adverse effects due to the use of PMs against COVID-19. These comprised 54.5% (55/101) patients from the general population, 19.8% (20/101) ancillary health staff, 13.9% (14/101) nurses, and 11.9% (12/101) doctors. Males and females comprised 43.6% (44/101) and 56.4% (57/101) of the study participants, respectively. The mean age of the study subjects was 36.71 ± 15.72 years. The mean duration of use of the culprit protective measure was 41.46 ± 14.71 days, and the mean duration of the onset of skin complaints was 11.05 ± 7.40 days. In our study, the most common culprit protective measure encountered was soap and water in 56.4% (57/101) cases followed by gloves 47.5% (48/101), sanitizer 38.61% (39/101), mask 20.8% (21/101), and full body suit in 6.9% (7/101) of cases (Table 1). The type of masks used were N95 in 61.9% (13/21), surgical masks and cloth masks in 14.3% (3/21) each, and FFP2 in 9.5% (2/21). The material of the gloves used by most of the cases was latex (95.8%, 46/48). Hand washing with soap and water was observed in 56.4% (57/101) with mean frequency of washing 7.5 times per day. Composition of the soaps and their pH could not be ascertained. The sanitizers used were mainly alcohol based with mean frequency of use 6.8 times per day. Cutaneous adverse effects in nearly half of the cases (50.5%) were due to the use of multiple protective measures.

The majority of the patients (96%) were symptomatic except for 4.9% who did not report any symptoms. The most common symptom was pruritus 45.5% (46/101) followed by burning 3.9% (4/101) and stinging 2.9% (3/101). There were 42.6% (43/101) patients who reported a multitude of symptoms with itching and burning (38.6%) being the most common. Hands were the most common site affected (72.3%). The common lesion morphologies encountered were erythema 79.2% (80/101), papules 60.4% (61/101), vesicles 17.8% (18/101), xerosis 15.9% (16/101), and pustules 9.9% (10/101) (Table 2). Contact dermatitis (CD) was the most common adverse effect observed in 72.3%

Table 1 Background characteristics of the study subjects ($n = 101$)

Variable	<i>n</i>	Mean \pm SD/ Percentage	95% CI
Age	101	36.71 ± 15.72	33.61–39.82
Gender			
Female	57	56.44	46.70–65.70
Male	44	43.56	34.30–53.30
Group			
Patient	55	54.46	44.76–63.83
AHS	20	19.80	13.12–28.69
Nurse	14	13.86	8.32–22.06
Doctor	12	11.88	6.78–19.77
Number of culprits			
Single	50	49.50	39.95–59.09
Multiple	51	50.50	40.91–60.05
Culprit PM			
Soap	57	56.44	46.70–65.70
Gloves	48	47.52	38.06–57.18
Sanitizer	39	38.61	29.69–48.37
Mask	21	20.79	13.95–29.77
Full Body Suit	7	6.93	3.17–13.85
Duration of use of PM (days)	101	41.46 ± 14.71	38.55–44.36
Duration of current problem (days)	101	11.05 ± 7.40	9.59–12.51

AHS, ancillary health staff; CI, confidence interval; SD, standard deviation; PM, protective measure.

(73/101) of cases (Fig. 1). Acne and related disorders like rosacea and perioral dermatitis comprised 9.9% (10/101) of the total cases, followed by eczema 6.9% (7/101), urticaria 4.9% (5/101), and others 5.9% (6/101) (Table 3, Figs. 1–3). In our study, the use of PMs resulted in aggravation of pre-existing skin conditions in 18.8% (19/101) of patients. These included atopic dermatitis in 57.8% (11/19), rosacea in 10.5% (2/19) of cases, and acne and seborrheic dermatitis in 5.3% (1/19) each. Patients who wore PPE for >4 hours per day reported multiple symptoms as compared to those who used PPE for <4 hours per day ($P = 0.026$). Patients were managed on a case-by-case basis depending on the diagnosis. Those with pruritus were prescribed antihistamines wherever required. Treatment of eczemas included emollients and topical corticosteroids. Patients who developed acne and related disorders were prescribed topical and/or oral antibiotics. All patients were counseled on good skin care regimen to allow healing and prevent recurrence. Patients were also advised to switch to gentler formulations of sanitizers whenever possible.

Discussion

COVID-19 was recognized as a public health emergency of international concern in January 2020, and in less than 2 months, the World Health Organization (WHO) declared it a

Table 2 Clinical characteristics of adverse skin reactions among the study subjects ($n = 101$)

S. No.	Clinical feature	<i>n</i>	%
Morphology of skin lesion			
1	Erythema	80	79.20
2	Papules	61	60.40
3	Vesicles	18	17.82
4	Xerosis	16	15.84
5	Pustules	10	9.90
6	Plaque	5	4.95
7	Urticarial plaques	5	4.95
8	Fissuring	5	4.95
9	Scaling	3	2.97
10	Desquamation	3	2.97
11	Excoriation	3	2.97
12	Ulceration	1	0.99
Symptoms			
1	Pruritus	89	88.11
2	Burning	47	46.53
3	Stinging	7	6.93
4	Asymptomatic	5	4.95
Site			
1	Hands	73	72.27
2	Face	23	22.77
3	Trunk	7	6.93

pandemic in March 2020.⁵ The number of COVID-19 cases worldwide stood at a staggering 12,685,374 as of July 13, 2020, with 565,000 deaths worldwide.⁶ In the absence of an effective treatment or a vaccine, countries across the globe have employed various preventive measures to reduce transmission of the novel coronavirus. These measures form the cornerstone of WHO's preventive strategy to curtail the spread

Table 3 Diagnosis of dermatological adverse effects due to protective measures ($n = 101$)

Diagnosis	<i>n</i>	%
Contact dermatitis	73	72.28
Acne and related disorders	10	9.90
Acne	5	4.95
Rosacea	4	3.96
Perioral dermatitis	1	0.99
Eczema	7	6.93
Seborrheic dermatitis	1	0.99
Atopic dermatitis	2	1.98
Pompholyx	1	0.99
Xerotic eczema	3	2.97
Urticaria	5	4.95
Others	6	5.94
Total	101	100

of SARS-CoV-2 and to contain the surge in COVID-19 cases. Some of the transmission reduction measures include the use of personal protective measures like adhering to physical distancing, hand hygiene, respiratory etiquette (covering the nose and mouth while coughing and sneezing), environmental disinfection, covering the face with a mask or cloth when leaving the home, etc.⁷ Many of the personal protective measures like the use of PPE and hand hygiene practices carry risk of skin barrier dysfunction and sometimes aggravation of pre-existing skin conditions due to prolonged contact time or increased frequency of use.^{1,2} This can lead to absence from work, non-compliance in using the protective measures effectively, and hence increased risk of transmission and infection with coronavirus. The HCWs may be at a greater risk due to prolonged working hours in a

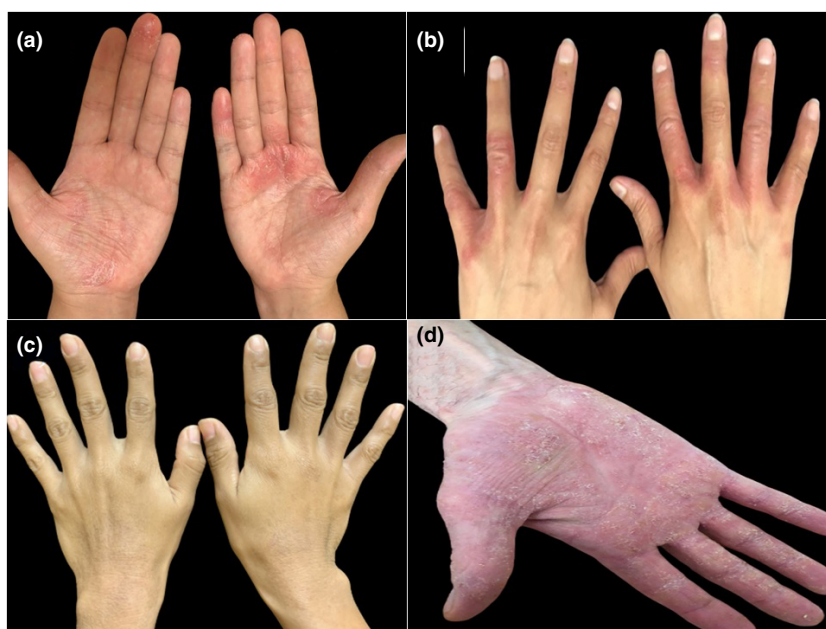
**Figure 1** Adverse effects involving the hands due to gloves/soap/sanitizer use: (a-c) Contact dermatitis; (d) Pompholyx



Figure 2 Adverse effects due to face masks: (a) Erythema and scaling over face in seborrheic dermatitis; (b) Erythema and papules over the face in rosacea; (c) Comedones over the chin and cheek in acne; (d) Erythematous papules over face in acne



Figure 3 Adverse effects: (a) Erythematous edematous plaques over the trunk in urticaria; (b) Pressure erythema over the ear due to strap of face mask

potentially infective environment that demands a strict adherence to the PMs.

The harmful effect on skin caused by various protective materials and measures has been evaluated in some previous studies (Table S1).^{3,4,8-10} In an online survey by Pei *et al.*⁸, studying adverse effects in 484 frontline HCWs using PMs against COVID-19, it was found that the most common culprit material was level 2 protection which included overalls, disposable hats, face masks such as N95, goggles, and as outer cover a protective suit with disposable gloves. Pruritus and

erythema were the most common complaints in their study. A similar observation was made in our study. The most common affected group among the HCWs in their study was ICU staff (44.8%). Singh *et al.*⁹ in their survey found that goggles and N95 masks were the most common culprits. They found irritant CD to be the most common cutaneous adverse effect. In another online survey during the COVID-19 pandemic, 542 HCWs responded to an online questionnaire, and it was found that staff in the isolation wards were most commonly affected with complaints of dryness/tightness and desquamation seen in

a majority of the cases.⁴ Lin *et al.*¹⁰ also conducted a survey on doctors and nurses caring for COVID-19 patients and observed that hands were the most commonly affected site, which was also the finding in the present study. The frequency of hand washing was, however, higher in their study with most of the study participants washing hands with soap and water more than 10 times per day. Similar studies have been conducted during the viral pandemics in the past. Foo *et al.*³ conducted a survey in 2006 following the SARS pandemic which included 340 HCWs and found that mask and gloves were the most common culprit materials causing skin adverse effects. All these studies focused on HCWs only whereas our study also included the general population. In our study, soap and water was the most common culprit leading to harmful effect on the skin. Hands were the most commonly affected site with the majority of cases developing pruritus and showing erythema and papules. We found a significant association between PPE worn for >4 hours per day and multiple symptoms.

The results of our study also show that not only HCWs but the general population as well is at risk of developing adverse effects related to skin due to the unprecedented use of PMs against the COVID-19 pandemic. This could result in non-compliance to wearing the PPE leading to an increased risk of infection and absenteeism from work leading to a decrease in manpower in the health sector. Creating awareness on the judicious and proper use of the various PMs and emphasizing the importance of general skin care in daily routine would go a long way in reducing the morbidity and disease burden due to use of PMs. Situation-suited, comfortable, and innovative PPE should be developed for better adherence and lesser adverse effects.¹¹

The limitation of the present study was the sample size and absence of confirmation of allergens via patch testing. In addition, recall bias in patient history cannot be ruled out.

Conclusion

The use of different PMs by the general population and health-care workers against COVID-19 can induce a variety of skin changes and reactions. In our study, the use of soap and water was the most common PM implicated. A majority of the cases developed contact dermatitis due to use of PMs. The present study highlights the burden of cutaneous adverse effects caused by PM use and the need for implementation of gentle skin care regimen during the pandemic. This is particularly important to minimize adverse effects from increased use of PMs and, more importantly, to maintain compliance with PMs

from HCWs and the general public alike to help with global efforts against COVID-19.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Review of literature of studies published on adverse skin effects due to use of protective measures during viral pandemics.