

Dermatologic problems associated with personal protective equipment in health-care workers managing COVID-19 patients

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Background: The safety of health-care workers (HCWs) during the COVID-19 pandemic is a major concern worldwide. Dermatological problems due to personal protective equipment are annoying issues. We aimed to evaluate dermatological adverse events following the use of these protections in HCWs managing COVID-19 patients. **Materials and Methods:** One hundred and fifty-six workers managing COVID-19 patients were enrolled in this cross-sectional study. We conducted face-to-face interviews to collect the data and focused mainly on protection type and mucocutaneous symptoms with new onset or exaggeration after this equipment. **Results:** Dermatological problems following protective equipment usage occurred mainly during the 1st week (65.4%). The most common site of skin involvement was the nose (82.7%) and the most frequent visible complaints were the pressure effect and erythema on the nose in 80.8% and 57.7% of cases, respectively. There was a significant association between mask type and facial skin problems ($P < 0.001$). The main symptoms were itching (21.8% scalp, 39.1% face and body) and burning sensation (14.1% scalp, 23.7% face and body). Skin desquamation (37.2%) and dorsal hand dermatitis (41.66%) were significantly more frequent in atopic participants ($P = 0.02$ and $P = 0.01$, respectively). Hand involvement was significantly associated with frequency of hand washing (odds ratio = 1.97, 95% confidence interval = 1.04–3.74, $P = 0.03$). **Conclusion:** We found that skin problems related to protective equipment were common and frequently located on the face mainly due to facial masks. These complications should be prevented by proper use of this equipment.

Key words: COVID pandemic, personal protective equipment, skin

How to cite this article: Alizadeh N, Darjani A, Rafiei R, Gharaeinejad K, Eftekhari H, Bahrami E, *et al.* Dermatologic problems associated with personal protective equipment in health-care workers managing COVID-19 patients. *J Res Med Sci* 2022;27:80.

INTRODUCTION

Personal protective equipment (PPE) has an important role in the prevention of infectious diseases such as Ebola and COVID-19 in health-care workers (HCWs) and is mandatory during patient care.^[1-3] This equipment is made of waterproof materials with a compressive effect which has occlusive and pressure effects that may result in hyperthermia, sweating, and erythema. Also irritant and allergic contact dermatitis may occur due to some agents such as latex or dyes in PPE.^[2-4] There are few researches about dermatologic adverse effects of PPE usage in certain industrial

occupations and HCWs, but the association with previous skin diseases was not evaluated in prior reports.^[1-3,5-8] Furthermore, we did not find sufficient data about these problems in Iranian HCWs during the recent pandemic, while they had to use this equipment in those difficult and stressful conditions. Hence, we evaluated dermatologic complications of PPE in HCWs and relation with some previous dermatosis in this cross-sectional study during the first peak of the pandemic in Iran. Because these problems may reduce HCWs' cooperation in terms of proper use of PPE and improvement of their quality should be considered in future.

Access this article online

Quick Response Code:



Website:

www.jmsjournal.net

DOI:

10.4103/jrms.jrms_921_21

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Submitted: 16-Oct-2021; **Revised:** 23-Apr-2022; **Accepted:** 11-Jul-2022; **Published:** 31-Oct-2022

STUDY DESIGN

This study was designed as a descriptive cross-sectional study at our research center during the first peak of COVID-19 infection in Guilan province in March and April 2020. Several COVID-19 cases were detected in our province soon after the pandemic initiation in China.

Our participants were HCWs including physicians, nurses, and paramedical staff at Razi hospital which was the main center for COVID patients. Exclusion criteria were as follows; participants working <1 week in infected wards, less than 2 h of PPE usage, less than two types of PPE during work hours, active dermatosis before PPE usage, or participants on immunosuppressive therapy which could have modified their dermatosis. Our data were collected with face-to-face interviews and mainly focused on skin and mucosal symptoms which occurred recently or exaggerated after using PPE. Physical examination was done if necessary. Written consent form was obtained from all participants. This research project was approved by the Ethics Committee of Guilan University of Medical Sciences (Code: IR.GUMS.REC.1399.123).

Our data were age, sex, job, work time duration, frequency of hand washing and using moisturizing cream per day and frequency of bathing per day, different types of PPE that were used, time onset, type, location of dermatologic symptoms, and history of previous dermatologic diseases that were recorded in data gathering form.

Statistical analysis

Quantitative variables were described using mean and standard deviation and qualitative data were reported by number and percentage. For the comparison of frequencies, the Chi-square test or Fisher's exact test was used. The association between the location of skin problems with the type of protective method based on the duration of exposure or times was assessed with binary logistic regression analysis.

All statistical tests were performed in SPSS software version 18.0 (SPSS Inc., Chicago, Illinois, USA). All *P* values were two-sided; the significance level was set at *P* < 0.05.

RESULTS

Participants' characteristics and different types of PPE which were used by HCWs were shown in Table 1 and Figure 1, respectively.

Different dermatologic complaints and distribution of skin problems after using PPE have been summarized in Table 2 and Figure 2. Dermatologic side effects related to facial,

Table 1: Characteristics of health-care workers participated in the study

Variable	n (%) / Mean ± SD
Gender (156 cases)	
Men	46 (29.49)
Women	110 (70.51)
Age (years), mean±SD (minium-maximum)	37.98±9.92 (23-59)
Occupations, n (%)	
Physician	61 (39.1)
Nurse	55 (35.3)
Paramedical staff	40 (25.6)
Duration of each work shift (h), mean±SD	9.12±4.38*
History of previous dermatologic problems, n (%)	
Atopic dermatitis	50 (32.1)
Seborrheic dermatitis	14 (9)
Acne	12 (7.7)
Allergic contact dermatitis	17 (10.9)

*There was no significant difference in work hours between different health-care workers. SD=Standard deviation

Table 2: Different dermatologic complaints after using personal protective equipment

Location	Complaints	n (%)
Scalp	Burning	22 (14.1)
	Itching	34 (21.8)
	Folliculitis	3 (1.9)
	Dandruff	15 (9.6)
	Hair loss	18 (11.5)
Face or body	Damaged hair	4 (2.6)
	Burning	37 (23.7)
	Itching	61 (39.1)
	Erythema	90 (57.7)
	Scaling	58 (37.2)
	Fissuring	12 (7.7)
	Furunculosis	1 (0.6)
	Petechia	0
	Acne	22 (14.1)
	Milia	0
	Urticarial	2 (1.3)
	Pigmentation	5 (3.2)
	Sweating	22 (14.1)
	Maceration	5 (3.2)
	Pressure effect	126 (80.8)
Nail	Fragility	33 (21.2)
	Hangnail	28 (17.9)
	Periungual erythema	4 (2.6)
Mucosa	Ocular erythema	1 (0.6)
	Ocular burning	2 (1.3)
	Ocular itching	8 (5.1)
	Lip dryness	30 (19.2)
	Mouth dryness	82 (52.6)
	Runny nose	37 (23.7)

scalp, body, and hand regions were mentioned below, respectively. Furthermore, the association of some skin problems with history of atopic dermatitis (AD), seborrheic dermatitis (SD), and acne was assessed.

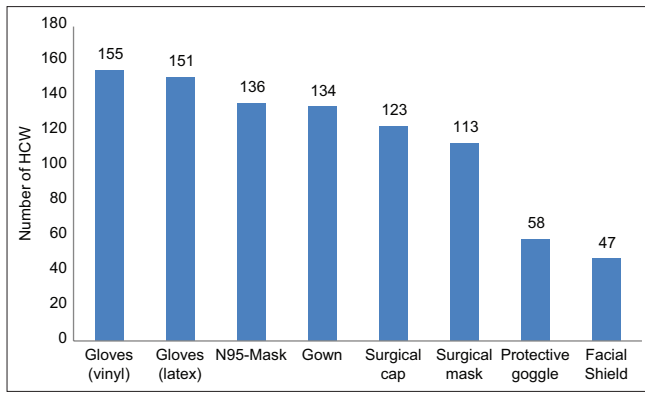


Figure 1: Different types of PPE used by HCWs. Some workers used more than one type of gloves or mask. PPE = Personnel protection equipment; HCWs = Health-care workers

All participants had at least one dermatologic problem on the face during PPE usage that occurred mainly during the 1st week of PPE usage; 102 participants (65.4% of cases) developed skin symptoms during the 1st week.

All HCWs used facial masks (surgical or N95 masks or both of them) and 132 cases (84.6%) had skin involvement on the lower two-thirds of their faces. Twenty participants (12.8%) used only surgical masks. In this group, six cases had complaints of facial skin involvement. Forty-three participants (27.6%) used only N95 masks of whom 41 cases had facial skin problems. Ninety-three workers had both types of masks of whom 85 cases had facial problems. Hence, there was a significant association between mask types with facial problems ($P < 0.001$).

The most common site of skin involvement was the nose (82.7%) [Figure 2] and the most frequent visible complaints were the pressure effect and erythema which were induced by N95 mask on the nose in 80.8% and 57.7% of cases, respectively [Table 2]. The main symptoms were itching and burning [Table 2].

Scalp burning and itching were reported in 22 and 34 cases, respectively, that were significantly more frequent in SD cases ($P = 0.03$ and $P = 0.003$, respectively), but scalp folliculitis and hair loss were not associated with SD ($P = 0.24$ and $P > 0.99$, respectively). Four participants complained of damaged scalp hair that they had daily hair washing.

Ocular burning, erythema, and pruritus were not associated with facial shields and goggles ($P > 0.99$). Lip dryness was significantly more frequent in participants with runny nose ($P = 0.02$), but there was no association between mouth dryness and runny nose ($P = 0.18$). Lip dryness, runny nose, and ocular complaints were not significantly different in atopic and nonatopic participants ($P > 0.05$).

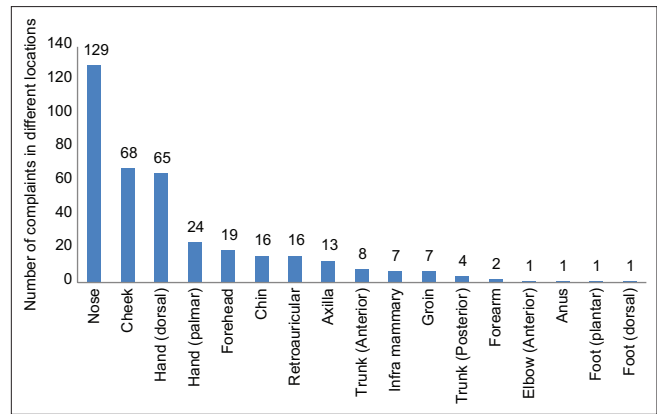


Figure 2: Distribution of skin problems in our participants

Complaint of acne lesions on the face and the body after PPE was significantly associated with previous history of acne ($P = 0.002$).

Complaints of skin lesions on the facial, retroauricular, truncal, and flexural areas were not significantly associated with previous history of SD (P values were more than 0.2 for all variables).

About 70.5% of cases had more than four times bathing per week, but scaling on body surface was not associated with bathing frequency ($P = 0.68$). Skin desquamation on the body area was significantly more frequent in atopic participants ($P = 0.02$).

One hundred and fifty-one participants (96.8% of cases) used both vinyl and latex gloves simultaneously during patient care so discrimination of specific problems related to the type of gloves was not impossible.

About 45.5% of all participants had more than 10 times hand washing per day. In these participants, hand dermatitis on palmar surfaces was significantly more frequent ($P = 0.02$) compared to cases with <10 times hand washing per day; but on dorsal surfaces of the hands, this difference was not significant ($P = 0.07$). Nail fragility was significantly more frequent in cases who washed their hands more than 10 times per day ($P = 0.006$). All hand and nail problems were significantly associated with frequency of hand washing [Table 3].

Fifty-seven percent of cases used moisturizing cream more than one time per day. The frequency of palmar dermatitis was not associated with frequency of moisturizing cream use in our study ($P = 0.13$), but the frequency of dorsal hand dermatitis was significantly more frequent in participants who applied moisturizing cream more than two times per day compared to participants who used moisturizing cream one time or less per day ($P = 0.003$). Dorsal hand

Table 3: The association of skin problems with the type of protective methods based on the duration of exposure or times

Protection type	Number of cases	Duration of exposure or times	Number of cases (%)	Number of cases with skin problems in related Locations (%)	OR	95% CI	P
Facial masks (N95 or surgical)	156	≤8 h/day	114 (73.1)	Lower two-thirds of the face*	1	0.41-3.06	0.81
		>8 h/day	42 (26.9)	Lower two-thirds of the face	1.12		
Shield	47	≤8 h/day	30 (63.8)	Forehead	1	0.02-1.83	0.15
		>8 h/day	17 (36.2)	Forehead	0.20		
Surgical cap	123	≤8 h/day	88 (71.5)	Scalp	1	0.65-3.23	0.36
		>8 h/day	35 (28.5)	Scalp	1.45		
Goggle	58	≤8 h/day	43 (74.1)	Eye and eyelid	1	0.12-17.41	0.76
		>8 h/day	15 (25.9)	Eye and eyelid	1.46		
Gown	134	≤8 h/day	98 (73.1)	Trunk and flexural regions	1	0.24-2.10	0.54
		>8 h/day	36 (26.9)	Trunk and flexural regions	0.72		
Glove (latex or vinyl)	156	≤8 h/day	114 (73.1)	Hands	1	0.47-1.96	0.91
		>8 h/day	42 (26.9)	Hands	0.96		
Hand washing	156	≤10 times/day	85 (54.5)	Hands and nails	1	1.04-3.74	0.03
		>10 times/day	71 (45.5)	Hands and nails	1.97		

*Lower two-thirds of faces include the nose, cheek, and chin. OR=Odds ratio; CI=Confidence interval

dermatitis was significantly more frequent in atopic participants ($P = 0.01$).

DISCUSSION

Long-term use of PPE could induce different features of dermatologic problems that may involve any site of the body.^[2-4] In our study, burning and pruritus were the most common symptoms. The face, hands, and scalp were more frequently involved compared to other sites and nasal bridge was the main site of involvement on the face similar to prior reports.^[5-7]

We found that dorsal hand dermatitis was more frequent than palmar dermatitis, especially in atopic participants, and in our cases, only palmar hand dermatitis was associated with frequent hand washing.

In general, hand eczema is associated with atopy and frequent hand washing. The dorsal surface of the hands has a thinner skin compared to the palmar surface, so it is more sensitive to irritant or allergic agents.^[6-8] Hand dermatitis could develop due to different etiologies such as using gloves, especially latex type, frequent hand washing with soap, or using other detergents. Furthermore, wearing gloves for a long time hyperhydrates the horny layer and disturbs cutaneous barrier of the skin which by itself could potentially increase the risk of contact dermatitis.^[6,8,9]

We found that dorsal hand dermatitis was more frequent in participants who applied emollients more than two times a day. This finding could be justified in two ways; (1) Dryness and chapping on dorsal hand areas may result in more use of emollients, and (2) Moisturizer by itself may result in contact dermatitis on dorsal hand areas in sensitive cases, but we had no patch test for detecting allergic contact dermatitis due to moisturizing cream in this research.

Itching, burning sensation, furunculosis, and folliculitis in our cases could be related to occlusive effects of PPE which result in friction, hydration, and change in microbial colonization.^[8,10,11] Flexural involvement could be exacerbated in cases with previous history of SD or AD due to hyperhidrosis after using PPE.^[10-12] Some materials in PPE such as dyes and fixative also have a role in contact dermatitis.^[8] Sweating after using PPE could induce contact dermatitis or exacerbate previous dermatoses such as SD or AD. Excess sweating could alter the pH of the skin surface and may be contaminated by dust or some antigens of skin flora which could exacerbate AD. The colonization rate of *Malassezia* yeast could be increased by sweating, so SD could be aggravated. On the other hand, emotional stress has a negative effect on AD and SD and we know that this pandemic is a stressful event for humanity.^[5,10-12]

Retroauricular involvement was found in 10.3% of our cases which presented as itching, erythema, scaling, or fissuring. It may be due to exacerbation of SD, frictional effect of straps in earloop face masks, pressure urticaria, and allergic or irritant contact dermatitis.^[5,13-15]

History of acne was mentioned in 7.7% of cases but 14% of participants had complaints of acne lesions after PPE use. Occlusive effects and hyperhydration effects of these coverings are incriminated in developing acne lesions. Furthermore, anxiety caused by this pandemic may aggravate acne.^[16-19]

About 3.2% of cases developed a transient postinflammatory hyperpigmentation over the nasal bridge due to erythema and frictional effect of the masks on the nasal bridge. About 52.6% of cases developed mouth dryness which may be due to mouth breathing and dehydration. Lip dryness occurred in 19.2% of cases. Dehydration and hyperthermia induced

by PPE may result in lip lick dermatitis and cheilitis. Furthermore, mouth breathing may result in lip dryness. Nasal mucosa in normal participants has a moisturizing effect on the inspired air but with mouth breathing, this mechanism is removed. Rhinorrhea or runny nose was reported in 23.7% of patients. Runny nose could be explained by increasing the humidity behind the mask, especially in cases with mouth breathing.^[3,6,7,19]

Only about one-third of HCWs in our hospital used face shields or goggles, so periocular symptoms were lower than in previous reports. In prior reports, the goggles were the main cause of facial dermatitis but in our study, N95 mask was the main cause of facial skin problems as most of our cases did not use goggles.^[6,7,19]

CONCLUSION

We found that skin problems related to PPE were common and frequently located on the face mainly due to facial masks. We tried to describe the main skin problems associated with PPF but we had some limitations in this research as follows; small sample size and short duration of the study, impossibility to perform patch test due to pandemic situation, use of a mixture of different types and materials of PPE in an individual person and failure to remember some transient side effects. Furthermore, our study was done March and April during which the weather in our province is cool so sweat-related dermatoses may have a lower rate compared to a warm climate.

We had no a comprehensive understanding of common dermatologic problems in the first peak of the pandemic in our province. This study was conducted to learn more about these complications and help reduce them in future.

There are some recommendations in the literature to decrease these problems such as keeping the lower ambient temperature and humidity by appropriate ventilation, drinking more fluid for prevention of dehydration, wearing vinyl or nitrile gloves instead of latex type, using a headband face mask instead of earloop face masks, wearing cotton underwear beneath PPE, fit but no tight covering, applying frequent hypoallergenic moisturizer, using mild soap for hand washing, and finally reduction of work hours in a shift for HCWs.^[5,8,9,13-15,20]

Acknowledgments

The authors would like to appreciate the cooperation of Vice Chancellor of Research and Technology at Guilan University of Medical Sciences and all Health Care Workers at Razi hospital.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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