



ORIGINAL ARTICLE

Adverse Skin Reactions Among Frontline Personnel Due To Personal Protective Equipment Against COVID-19

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Received date: March 20, 2021; Accepted date: June 3, 2021; Published date: June 30, 2021

Abstract

Background: Coronavirus disease 2019 (COVID-19) has attracted global attention as it has expeditiously spread. Therefore, adherence to Personal Protective Equipment (PPE) has become a daily necessity, particularly among front-line personnel. However, PPE is associated with some adverse skin reactions; hence, this study aimed to investigate the characteristics and prevalence of adverse skin reactions from PPE usage.

Methods: This cross-sectional study with a random sample was carried out at Bahrain Defense Force Hospital (BDF) from January to March 2021, targeting the front-line personnel. An online questionnaire was sent regarding adverse skin reactions from PPE. A total of 145 healthcare workers (HCWs) were approached, and 132 (91%) responded. The results were analyzed through SPSS 21.0 software, and the Chi-square test or Fisher's exact test was used to analyze discrete variables.

Results: A total of 100 (75.8%) respondents suffered from adverse skin reactions. The most common findings were skin dryness, 100 (75.8%); itchiness, 67 (50.8%); and acne, 48 (36.4%). The most affected distant site was hands, 92 (69.7%). Female gender was significantly associated with skin changes, and only 22 (22%) participants with adverse skin reactions took medical advice.

Conclusion: Adverse skin reactions from PPE were common. Therefore, improving awareness of practical methods is quintessential.

Keywords: COVID-19; Eczema; Hand Hygiene; Masks; Skin Care

Introduction

By the beginning of 2020, the novel Coronavirus 2019 (COVID-19) outbreak was considered a global pandemic by World Health Organization

(WHO). In May 2021, WHO reported 153,094,318 confirmed cases and 3,206,339 deaths globally.¹⁻³ COVID-19 has variable clinical presentations depending on patients' age and comorbidities.

Meanwhile, many studies concluded that human-to-human transmission through respiratory droplets or direct contact is the leading cause of this outbreak.^{1,4} The rapid rise in the number of cases has drawn the attention of policymakers worldwide to implement protective measures to limit the spread of the infection.⁵

Gulf countries, including the Kingdom of Bahrain, have been implementing protective measures such as temporarily suspending flights to affected areas, encouraging social distance, hand hygiene, and wearing protective masks. Also, it provided tremendous efforts in testing and supporting positive cases with medical care that is free of charge.^{5,6} Because healthcare workers (HCWs) and particularly those working in the front-line are at the most significant risk of exposure to the disease, adherence to the daily usage of Personal Protective Equipment (PPE) such as gloves, protective masks, face shields, and gowns are essential.⁵

A few international studies investigated the adverse effects of these measures on the skin, and more studies are needed to evaluate the prevalence of adverse skin reactions concerning PPE.⁷⁻⁹ Of these, some have stated that hand eczema in HCWs is quite common due to wearing gloves for an extended period of time and frequent hand hygiene.^{10,11} Others have concluded that protective masks are ubiquitous to cause cutaneous irritation and acne.^{12,13} One of the studies showed that adverse skin reactions were primarily due to N95 masks (95.1%) followed by latex gloves (88.5%).⁷

Due to the paucity of research delineating the adverse skin reactions resulted from PPE, the present study proposed to explore the prevalence and characteristics of adverse skin reactions due to PPE usage by front-line personnel in the Kingdom of Bahrain and to suggest possible solutions for them.

Methods

Study design and duration

This cross-sectional study was carried out at Bahrain Defense Force (BDF) Hospital, one of the leading hospitals that play a vital role in detecting and managing COVID-19 patients. The study was conducted from 10th January to 10th March 2021.

Study population

This study targeted front-line personnel, particularly doctors, nurses, and practical nurses working in COVID-19 tent, field Intensive Care Unit (ICU), Emergency Department, and general practitioner (GP) department. Out of 145 participants, who were available during the study, 132 (91%) responded.

Selection criteria

Participants from the above-mentioned departments aged >20 years were included. On the other hand, cleaners and military guards were excluded since it was difficult to approach them due to their limited English proficiency. Also, HCWs, who were working in other departments, were ruled out.

Informed consent and Institutional research committee approval

Participation in this study was voluntary, and electronic informed consent was obtained before enrollment. The protocol of this study was approved by the Research Ethics Committee at (BDF) hospital and National COVID-19 National Research Team.

Study procedure

An online questionnaire was constructed based on important questions highlighted in the literature which was reviewed by the research committee, and then it was uploaded onto Google® Forms in English format for the participants to fill voluntarily. The survey included HCWs' demographic data such as age, gender, occupation, department, and position. Questions regarding the usage of PPE (the type of different equipment that has been used, estimated time of wearing them, frequency of changing them) and questions about (different possible perceived skin reactions, their locations, hygiene, and skincare). A reminder for answering the survey was sent through the official WhatsApp groups after two weeks of survey administration.

Statistical Analysis

Data was exported from Google® Forms into Microsoft Excel 2010 to calculate the sum and percentage of each question with the aid of SPSS1 21.0 software for further data analysis. The significance level was set at $P < 0.05$, and the confidence interval (CI) was set at 95%, and Chi-square test or Fisher's exact test was used to analyze the association between discrete variables.

Results

General characteristics of HCW

A total of 145 HCW were approached. Of them, 132 (91%) responded. A majority of 93 (70.5%) females, in comparison to 39 (29.5%) males, was observed. Participants' age ranged between 21- 60 years, and most participants were between 31-40 years. The highest number of respondents were from the field ICU, 58 (43.9%), followed by Emergency Room (ER), 30 (22.7%); Primary care clinics, 27 (20.4%); and COVID-9 tent, 17 (12.9%). The number of Nurses was higher than Physicians (74 (56.1%), 58 (43.9%) respectively).

Prevalence and Characteristics of Skin Injuries in HCW

Out of 132 participants, 100 (75.8%) suffered from adverse skin reactions. Among these, a significantly higher proportion of females developed adverse skin reactions, 71 (79.7%) (Odd's ratio (OR) = 3.276; (CI) = 1.708- 8.301; P value= 0.005), in comparison to 18 (20.2%) males.

Most of the participants, 43 (32.5%) who reported new skin changes, were aged between 31 to 40 years, followed by 32 (24.2%) participants who were between 21 to 30 years. More than half of the Nurses and Doctors developed new skin changes, 56 out of 74 (75.6%) and 44 out of 58 (75.9%), respectively. HCWs at the field ICU were more potential for skin changes, 43 (32.5%). However, none of these findings were statistically significant.

Table 1 shows that the majority of participants, 89 (67.4%), did not have previous skin conditions, and the remaining 43 (32.5%) had variable chronic skin conditions, mostly acne 18 (13.6%) followed by urticaria and eczema (13 (9.8%) and 11(8.3%)) respectively. Also, it demonstrated that the majority, 113 (85.6%), practiced standard hand hygiene at least five times or more per day and that more than half of the participants, 79 (59.9%), applied hand moisturizer twice or three times per day.

Almost all participants used gowns and gloves (122 (92.4%), 121(91.7%) respectively). A high number of HCWs used two layers of gloves, 78 (59.1%) in comparison to a single layer, 54 (40.9%). Moreover, it was noticed that participants wearing two layers

of gloves reported adverse skin reactions more often than the usage of a single layer of gloves (51 (65.20%), 19 (34.80% respectively). Although OR was 1.5, it was statically insignificant (P=0.32). A higher number of participants used the N95 mask rather than the surgical mask alone (104 (78.8%), 80 (60.6%), respectively). In addition, a majority of the participants, 96 (72.7%), used PPE for more than 6 hours.

According to the findings, the most common adverse skin reaction was dry skin, 100 (75.8%) followed by itchiness, 67 (50.8%) and acne, 48 (36.4%), while the lowest reported problem was skin ulcer 4 (3%) as illustrated in Figure 1.

Figure 2 shows that hands were the most affected site of adverse skin reactions, 92 (69.7%) followed by the nasal bridge, 66 (50%) and cheeks, 47 (35.6%), and feet were the least affected site 8 (6.1%).

Overall, only 22 (22%) reported adverse skin reactions (P <0.05) and sought medical attention, where the remaining 78 (78%) did not seek medical attention.

Table 1: Assessment of potential factors associated with adverse skin reactions

| Previous skin conditions | Number | Percentage |
|---|--------|------------|
| Eczema | 11 | 8.3 |
| Psoriasis | 4 | 3 |
| Acne | 18 | 13.6 |
| Rosacea | 0 | 0 |
| Latex Allergy | 3 | 2.3 |
| Urticaria | 13 | 9.8 |
| Others | 2 | 1.5 |
| None | 89 | 67.4 |
| Frequency of performing standard hand hygiene | | |
| < 5 times/day | 19 | 14.4 |
| 5- 10 times/day | 49 | 37.1 |
| > 5 times/day | 64 | 48.5 |
| Frequency of applying hand moisturizer | | |
| I do not apply | 29 | 22 |
| Once/day | 24 | 18.2 |
| Twice/day | 31 | 23.5 |
| Three/day | 48 | 36.4 |
| Type of PPE used | | |
| Hair cups | 90 | 68.2 |
| Goggles | 18 | 13.6 |

| | | |
|------------------------------|-----|------|
| Face shields | 89 | 67.4 |
| Surgical masks | 80 | 60.6 |
| N95 masks | 104 | 78.8 |
| Gowns | 122 | 92.4 |
| Gloves | 121 | 91.7 |
| Shoe covers | 78 | 59.1 |
| Plastic boots | 36 | 27.3 |
| Time of using PPE | | |
| < 4 hours/ day | 10 | 7.6 |
| 4-6 hours/day | 26 | 19.7 |
| > 6 hours/ day | 96 | 72.7 |
| Number of gloves worn | | |
| One-layer | 54 | 40.9 |
| Two-layer | 78 | 59.1 |

PPE, personal protective equipment

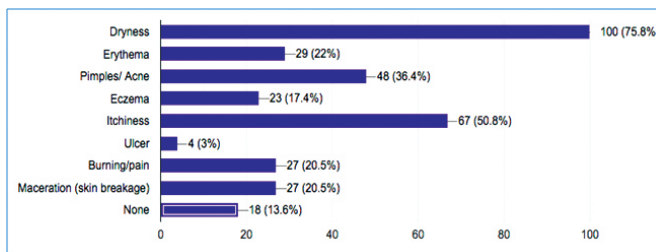


Figure 1: Adverse skin reactions on using Personal Protective Equipment

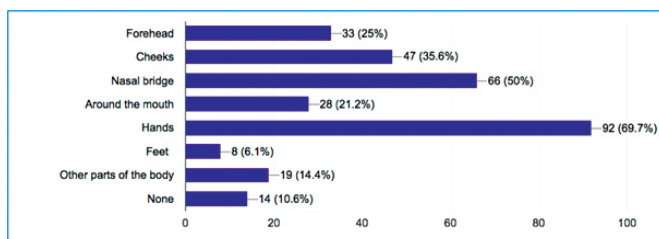


Figure 2: Sites of skin irritation following Personal Protective Equipment usage

Discussion

HCWs, especially the front-line personnel, are exposed to COVID-19 patients, and this perhaps increases their risk for encountering COVID-19 infection, as it is highly contagious besides the ease of transmission through respiratory droplets or indirect contact when touching contaminated surfaces with the viral infectious material.⁹ This demonstrates the importance of implementing WHO strict preventative measures, including their recommendations regarding the utmost importance of PPE usage to limit cross-infection in this pandemic.¹⁴ However, adherence to PPE has increased the incidence of adverse skin reactions.^{8,9} As 75.8% (100) HCWs reported adverse skin

reactions related to PPE utilization, and the most prevalent complaint was skin dryness followed by itchiness and acne, which was similar to previous studies.^{13,15} One possible explanation for hand dermatitis is excessive hand washing, rubbing without using proper hand moisturizers.¹⁶ Another explanation reported by the literature is prolonged usage of PPE, and as suggested by other studies wearing double gloves is a potential risk factor.¹⁶⁻¹⁹

As predicted, most participants in this study who used double gloves experienced adverse skin reactions, 58 out of 78 (74.4%). The hot climate and excessive humidity may also influence this in the Kingdom of Bahrain.²⁰ Also, rubber additives as the natural rubber latex protein found in medical gloves were reported to be the most common cause of occupational allergic dermatitis in medical staff.¹⁰ The second most affected site was the nasal bridge, as it a vulnerable area for pressure injuries and lacerations, especially when using N95 masks too tightly or wearing the goggles for a long duration.^{16,21} Acne and pimples were the third most familiar complaint, and cheeks were the third commonest affected site. This can be expected since the most prevalent chronic skin condition in the study participants is acne. Acne can be extrapolated to the prolonged usage of masks, which create a humid internal environment that eventually leads to pilosebaceous follicle obstruction and microbial colonization.¹⁸ Likewise, this study confirmed previous studies findings, as the female gender showed a significant correlation with adverse skin reactions in comparison to males, owing to the nature of females who pay more attention to their skin health.^{7,18}

The results showed that the younger population of HCWs, nurses, and those working in the field ICU reported more adverse skin reactions than others, although this was not statistically significant, but still can be explained by work-related stress, the degree of exposure to direct contact to COVID-19 patients and to apply strict precautions measures such as full PPE.¹⁸

The majority of respondents (n= 78) who had skin changes did not seek medical advice in comparison to (n=22) who did. This might be because the skin injuries were mild in nature or the HCWs

self-medicated. Another possible explanation is that their skin health was undermined due to the larger stresses from COVID-19. So, implementing strategic preventative measures can minimize these skin reactions. First, having a regular check on skin health is essential to limit any sustained skin injury. Second, to reduce hand dryness and itchiness, simple measures can be used such as avoiding washing hands with hot water, using powder-free, reduced protein, hypoallergenic gloves, and applying skin moisturizers, especially those containing ceramide.^{16,19}

Also, using alcohol gel formulation when the hand is not visibly contaminated can cause minor skin damage in comparison to soap and water.²² Moreover, facial cleansers containing salicylic acid (SA) and benzoyl peroxide can be used to reduce acne.¹⁶ Also, topical antibiotics may be warranted for papules and a low concentration of topical retinoid for comedones.¹⁶

Nevertheless, pressure injuries from N95 masks are a common problem. Thus, silicone gels can be applied as a protector at the vulnerable sites when the face is dried following the usage of a pH-balanced facial cleanser.¹⁶ Lastly, HCWs should be encouraged to get frequent short breaks from the PPE if possible and seek dermatologist advice when necessary.

This study has some limitations to be recognized. First, this study targeted one hospital only and did not cover all front-line personnel at other centers. Second, as this survey was online, the adverse skin reactions were self-reported and could not be assessed by dermatologists and recall bias might affect the results. Third, external risk factors that can impact the skin, such as stress, diet, sleep disturbance, and skincare outside the working hours, were not assessed, but PPE-related factors were evaluated and discussed in detail. However, the authors recommend that external factors may be evaluated in future research. Finally, as this was a cross-sectional study, it was unable to establish a proper cause-and-effect relationship.

Conclusion

In summary, this study presented the prevalence and characteristics of adverse skin reactions from PPE

usage. Adherence to PPE and protective measures are essential during the COVID-19 pandemic. However, adverse skin reactions are common findings in HCWs. The most adverse skin reactions were dryness, itchiness, and acne. Females were more affected than males. Increasing the awareness of simple, practical measures that can be applied to minimize skin damage is necessary, such as frequent PPE changing when used in long shifts or when excessively wet. Also, encouraging HCWs to seek dermatologist advice as required is an important step to reduce complicated skin injuries. For future studies, an exciting area to explore are the different brands of PPE that HCWs use in order to guide the hospitals' quality managers for minimizing skin reactions through PPE.

Conflict of Interest

No conflict of interest.

Financial Support

No financial support.

Acknowledgment

The authors wish to thank all participants from the front-line personnel for their time dedicated to responding to our questionnaire. We also extend our sincere gratitude to Ms. Aaruni Suresh and Ms. Asma Alkhan for their statistical input.

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