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Skin problems related to personal protective equipment and personal hygiene measures during COVID-19 pandemic among healthcare workers in Aseer Region, Saudi Arabia

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ABSTRACT

Background: Reports revealed rising levels of skin diseases secondary to protective equipment use. Healthcare providers who are working day and night during the pandemic of COVID-19 are more susceptible to the damage of the skin. There is scarce published data about the incidence of skin disorders secondary to protective equipment use during the COVID-19 pandemic and what factors are associated in Saudi Arabia. *Aim:* Assessing the potential skin damage as a result of personal protection equipment (PPE) and intensive hygiene measures for healthcare providers during COVID-19 pandemic in Aseer region. *Methods:* This study a cross-sectional questionnaire-based study done in Aseer region from January to October 2021. Personal data and related to history of skin disease, practices toward personal protective equipment, and new skin damage was collected and analyzed. Independent t-test and chi-square test was used to determine factors associated with the incidence of new skin damage during the COVID-19 pandemic. *Results:* Total of 214 participants was included in the study. (47.7%) of the participants reported experiencing new skin damage during the COVID-19 pandemic, while 112 (52.3%) of the participants did not. Age, having a history of chronic skin disease, and number of worn gloves layers were all significantly associated with the incidence of skin damage during COVID-19 pandemic. *Conclusion:* The considerable rate of new skin damage during the COVID-19 pandemic makes it essential to take action and start rising awareness toward this topic among health-care workers as well as teaching them how to prevent the incidence of new skin damage.

Keywords: Skin damage, COVID-19, Pandemic, Hygiene, Personal protective equipment, Asser region.

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1. INTRODUCTION

In December 2019, idiopathic pneumonia was discovered in Wuhan, China. It was later revealed that the new type of corona virus causes the transmission of respiratory diseases from person to person. The outbreak was declared a Public Health Emergency of International Concern on January on January 30, 2020, and on February 11, 2020, the WHO identified the novel coronavirus disease COVID-19 (Coronavirus disease 2019 situation report 59, 2020). Except for Antarctica, the epidemic has spread to all continents. All over the world, the number of cases exceeded 200,000 by mid-March 2020. The first 100,000 cases were reported in 3 months. However, the next 100,000 cases took only 12 days (Coronavirus disease 2019 situation report 59, 2020). By March 21, 2020, reports from United States revealed > 10,000 diagnosed cases of COVID-19 infection of which 150 deaths were reported (Severe Outcomes among Patients with Coronavirus Disease 2019, 2020).

It was reported that mucosal membranes, including conjunctiva, constitute the most common portal for infection entry with the otic canal having the lowest risk of transmission (Yan et al., 2020); so, there are some dermal changes attributed to COVID-19 infection that had not been described, and iatrogenic secondary skin involvement can be expected (Darlenski & Tsankov, 2020). Regarding the transmission of the highly contagious COVID-19 virus, it was reported that it spreads mainly via the respiratory route through coughing, sneezing, where community transmission can occur through droplets from infected people as well as contact with contaminated surfaces. Limiting the infection spread therefore can be achieved via several protective measures including utilizing adequate personal protective equipment, practicing diligent hand hygiene and social distancing (Wang & Parish, 2019).

The new Coronavirus is creating a challenging climate for all doctors and healthcare staff, influencing various financial, personal, and social aspects in this population. The skin represents the largest organ as well as the first line of defense in the human body, and thus skin issues are associated with a large proportion of work place injuries as well as days away from work (Schallom et al., 2015; Warshaw et al., 2019). Several skin problems are attributed to using personal protective equipment for prolonged period and extensive personal hygiene protective measures. In healthcare professionals, these skin conditions are mainly because of friction of the skin, the effects of hyperhydration, and contact reactions (Kantor, 2020). Occasionally, these factors can aggravate a pre-existing skin disorder. The most frequently reported skin manifestations among healthcare professionals that are related to the use of personal protective equipment are redness, itching, scaling, irritation, and maceration of the skin. Applying facemask for prolonged period of time was reported to lead to pressure urticaria, contact dermatitis, pruritis, indentations, and acneiform skin eruption (Masood et al., 2020). Protective caps are associated with occlusion of the sculp with consequent folliculitis, itching, and exacerbation of seborrheic dermatitis. The skin of the nasal bridge is most affected site secondary to the prolonged protective goggles use. Additionally, using latex gloves is often associated with occlusion, formation of blisters, and occasionally contact dermatitis. Using disinfectants and detergents frequently and excessively for washing hands have negative impact on the hydro-lipid barrier leading to irritation and dryness (Masood et al., 2020).

Reports reveals significantly high levels of prevalence of skin diseases related to protective equipment use. However, little published data regarding the effective measures that can be utilized to limit the incidence of such various skin disorders among healthcare professionals (Shenal et al., 2012; Elston, 2020). There is no doubt that healthcare professionals who are working the front line against COVID-19 are more susceptible the damage of the skin protective barrier. Therefore, they should be familiar with the consequences of using personal protective equipment and the methods used to protect themselves from such problems (Foo et al., 2020; Bhoyrul, 2019). This study aims to assess the potential skin damage as a result of personal protection equipment (PPE) and extensive and frequent personal hygiene measures for frontline healthcare professionals who provided care for patients with coronavirus disease 2019 (COVID-19) in Aseer region.

2. METHODS

Study design and settings

This study was an observational cross-sectional study undertaken in Aseer region, Saudi Arabia. The study targeted all health-care workers in Aseer region hospitals.

Study subjects, inclusion, and exclusion criteria

The study subjects are the health-care workers who consented to participate in the study and have filled the questionnaire between January and October 2021 while meeting the inclusion and exclusion criteria.

The inclusion criteria were being a health-care worker, working in Aseer region hospitals, being 18 years and older, consenting to participate in the study. The exclusion criteria were any non-health-care worker, any health care worker who is not working in

Aseer region, those who were younger than 18 years old, those with no consent to participate, and participants with incomplete data.

Sample size and Sampling

Convenient random sampling was utilized for data collection. An online questionnaire was disseminated on social media with an invitation for the health-care worker to fill it up. The minimally required sample size was calculated using the formula n = z2pq\d 2. With a confidence level of 95%, an estimated proportion of 50%, a 7% level of precision, and an estimated population of 13000 (based on the Saudi ministry of health regarding the number of health-care workers in Aseer region). The minimum sample size was calculated to be 194; however, higher number was included in the study.

Study tool and its validation

In order to validate the used study tool, a survey was established by the investigators and was presented to consultants in dermatology and medicine. They revised the survey, modified it, and then affirmed using it. The questionnaire was made in English was presented to a language expert which have approved it after minor grammatic and linguistic editing. After that, a pilot study was done on a small group of people (21 persons) to ensure a uniform understanding of the questionnaire content.

Data collection

An online questionnaire was constructed in Google forms for collecting data. The online questionnaire was spread to on social media platforms and invited the health-care workers in Aseer region for participation. Data were gathered through a self-administered manner where participants initially consent to participate in the study before starting to fill the survey. The questionnaire included four sections, the first section asked about personal information, the second section asked about history of skin disease, the third section asked about practices toward personal protective equipment, and the fourth and last section asked about the incidence of new skin damage during the COVID-19 pandemic and its related information.

Data management and statistical analysis

Data was collected initially in Google form, and then coded into Microsoft Excel sheet. After that, data was transferred for analysis in Statistical Package for the Social Sciences, SPSS 23rd version. Frequency and percentages were utilized to present categorical data. Mean and standard deviation were used to present continuous variables. Independent t-test and chi-square test were used to test for association. Significance level was set at 0.05.

Confidentiality and Ethical Consideration

Data was managed with top confidentiality; privacy was ensured throughout all study steps. Ethical approval was obtained from the ethical board in Armed Forces Hospital in Southern Region (IRB code: 2020-024).

3. RESULTS

The number of participants included in this study was 214. Table 1 present the socio-demographic information of the participants. 98 (45.8%) of the participants were males, and 116 (54.2%) of the participants were females/ as for the age, the mean age of participants was 29.31 $\pm$ 8.36. As for the designated department of the participants, 55 (25.7%) of the participants were working in the medical wards, 24 (11.2%) of the participants were working in the surgery wards, 20 (9.3%) of the participants were working in the emergency department, 16 (7.5%) of the participants were working in the primary health clinics, 16 (7.5%) of the participants were working in the department of outpatients clinic, 8 (3.7%) of the participants were working in the ICU, 7 (3.3%) of the participants were working in the fever clinics, 5 (2.3%) of the participants were working in the isolation wards, 1 (0.5%) of the participants were working in the critical care clinics, and 62 (29%) were working in other places (such as operation rooms, laboratory, endoscopy unit, preventive medicine department, and infection control department, and other hospital departments).

Table 1 Socio-Demographic Profile of the Participants (n = 214)

Demographical Characteristics	n	%
Gender		
Male	98	45.80
Female	116	54.20

Age		
Mean	29.31	
Standard deviation	8.36	
Designated department		
Medical wards	55	25.70
Surgery wards	24	11.20
Emergency department	20	9.30
Primary health clinics	16	7.50
Department of outpatient clinics	16	7.50
Intensive care unit (ICU)	8	3.70
Fever clinics	7	3.30
Isolation wards	5	2.30
Critical care unit (CCU)	1	0.50
Others	62	29.00

Table 2 displays the history of skin disease among participants. 39 (18.2%) of the participants reported having a history of skin disease. 27 (12.6%) reported a history of eczema, 5 (2.3%) of the participants reported a history of acne vulgaris, 3 (1.4%) of the participants reported a history of urticaria, 1 (0.5%) of the participants reported a history of lichen planus, 1 (0.5%) reported a history of photosensitivity, 1 (0.5%) of the participants reported a history of psoriasis, and 1 (0.5%) of the participants reported a history of vitiligo.

Table 2 History of Skin Diseases among Participants (n = 214)

Question	n	%
Q1/ Do you have a history of any chronic skin disease, such as hand eczema, atopic dermatitis, allergic dermatitis etc.?		
Yes	39	18.2
No	175	81.8
Q2/ If your answer in the above question is "Yes", please mention the type of the chronic skin disease you have. (n = 39)		
Eczema	27	12.6
Acne vulgaris	5	2.3
Urticaria	3	1.4
Lichen planus	1	0.5
Photosensitivity	1	0.5
Psoriasis	1	0.5
Vitiligo	1	0.5

Table 3 present the participants practices toward personal protective equipment. When asked how often the participants were performing hand hygiene procedures, 112 (52.3%) of the participants reported performing hand hygiene procedures for 10 times or less every day, while 102 (47.7%) reported they practiced it for more than 10 times every day. As for when the participants were asked what equipment they used for to protect their eyes from droplets, 60 (28%) reported using face shields, 18 (8.4%) reported using goggles, 25 (11.7%) reported using both, while 111 (51.9%) reported not using any. When asked for how long the participants were wearing tertiary protective devices, 153 (71.5%) reported they were wearing the equipment for 6 hours and less, while 61 (28.5%) of the participants reported wearing the equipment for more than 6 hours. As for the layers of worn gloves, 168 (78.5%) of the participants reported wearing 1 layer of gloves, 33 (15.4%) of the participants were wearing 2 layers of gloves, while 13 (6.1%) of the participants were wearing 3 layers or more of gloves.

Figure 1 demonstrates the incidence of obvious skin damage during COVID-19 pandemic. 102 (47.7%) of the participants reported experiencing new skin damage during the COVID-19 pandemic, while 112 (52.3%) of the participants did not.

Table 3 Participants Practices toward Personal Protective Equipment (n = 214)

Question	n	%
Q1/ During your worktime in designated department, how often do you perform standard hand hygiene procedures every day approximately?		
10 times or less / day	112	52.3
More than 10 times / day	102	47.7
Q2 /During your worktime in designated department, what kind of device do you wear to protect droplets from getting into your eyes?		
Face shield	60	28
Goggles	18	8.4
Both of the above	25	11.7
None of the above	111	51.9
Q3/ During your worktime in designated department, how long do you wear tertiary protective devices (gloves, goggles, or face shield, N95 masks and overall gowns) every day approximately?		
6 hours and less / day	153	71.5
More than 6 hours / day	61	28.5
Q4/ During your worktime in designated department, how many layers of gloves do you wear?		
1 layer	168	78.5
2 layers	33	15.4
3 layers and more	13	6.1

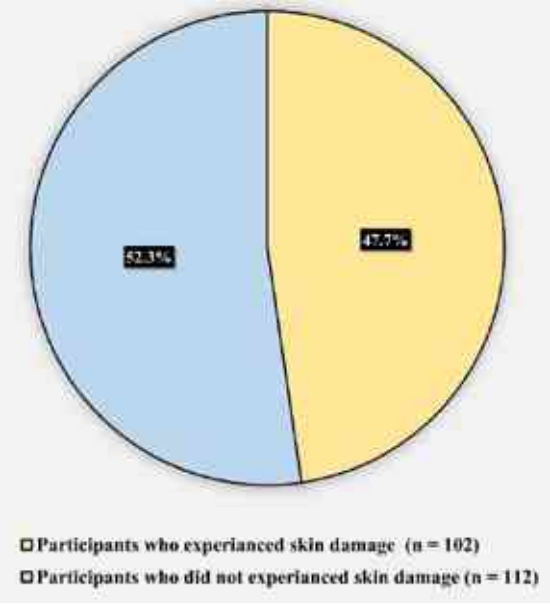


Figure 1 Incidence of Obvious Skin Damage during COVID-19 Pandemic

Figure 2 illustrates the sites of skin damage in participants with affected skin during the COVID-19 pandemic. 45 (21%) reported their hands were affected, 33 (15.4%) of the participants their nasal bridge was affected, 23 (10.7%) of the participants reported the area around the ears were affected, 23 (10.7%) of the participants reported their cheeks were affected, 16 (7.5%) reported their forehead was affected, and 3 (1.4%) of the participants reported their neck was affected.

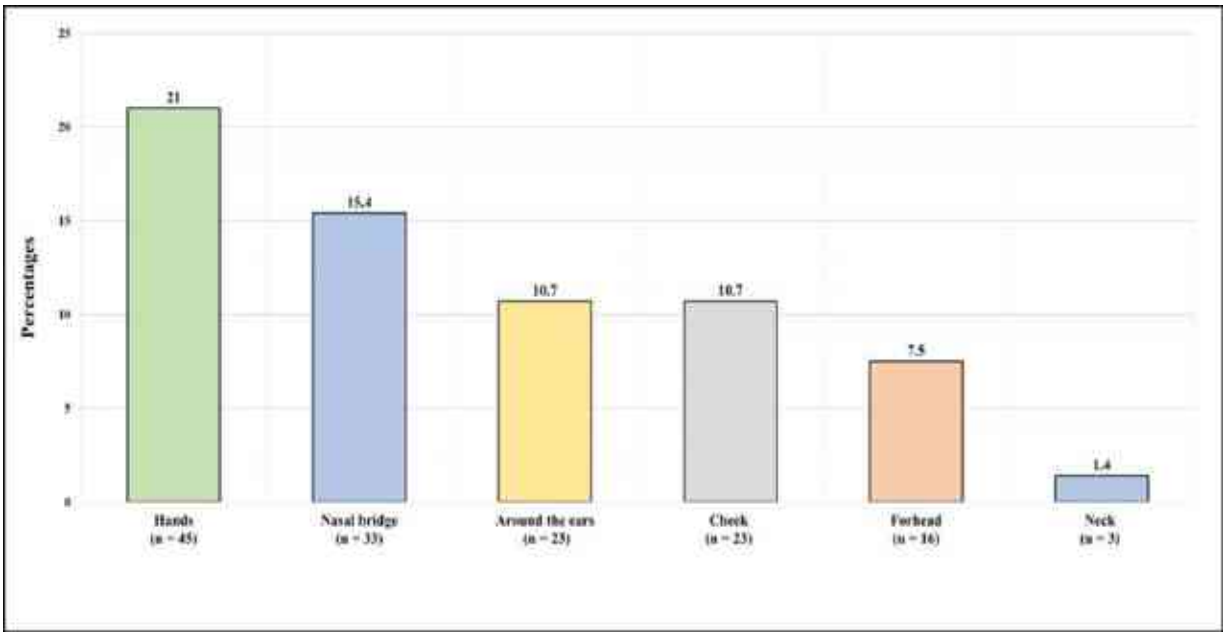


Figure 2 Sites of Skin Damage in Participants with Affected Skin during the COVID-19 Pandemic

Figure 3 displays the symptoms of participants with skin damage during the COVID-19 pandemic. 68 (31.8%) of the participants reported experiencing itching, 55 (25.7%) of the participants reported experiencing dryness / tightness, 16 (7.5%) of the participants reported experiencing burning sensation / pain, and 30 (14%) of the participants reported experiencing tenderness.

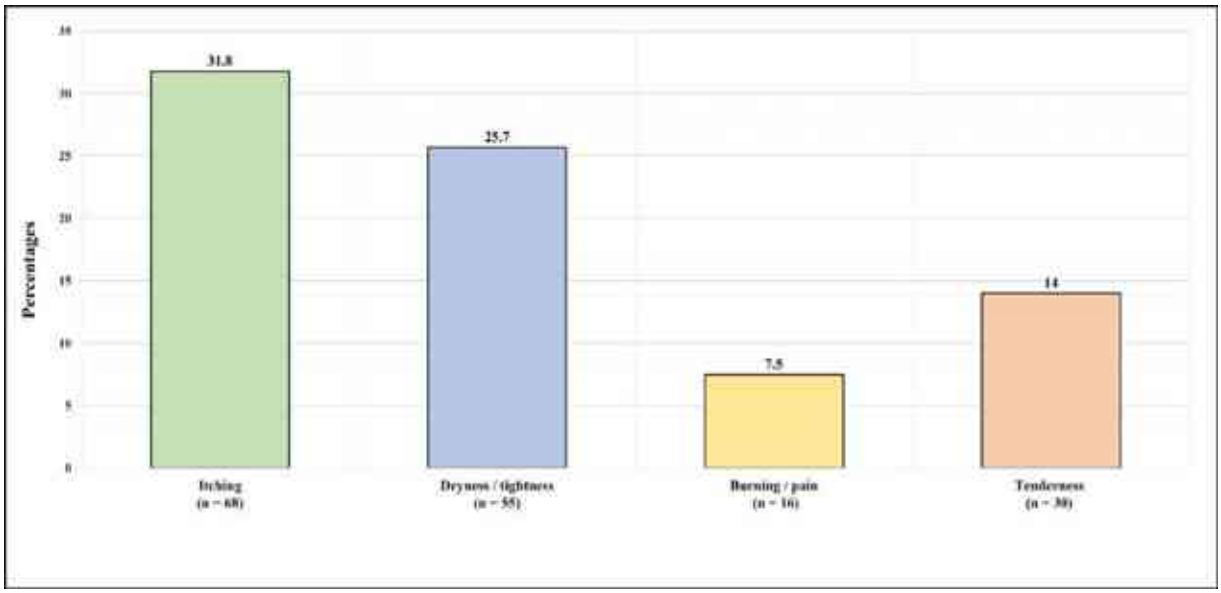


Figure 3 Symptoms of Participants with Skin Damage during the COVID-19 Pandemic

Figure 4 present the description of skin lesion in participants with skin damage during the COVID-19 pandemic. 72 (33.6%) described their lesion as erythema, 34 (15.9%) described their lesion as papules, 24 (11.2%) of the participants described their lesion as desquamation, 21 (9.8%) of the participants described their lesion as erosion and/or ulcers, 12 (5.6%) of the participants described their lesion as fissures, and 9 (4.2%) of the participants described their lesion as maceration.

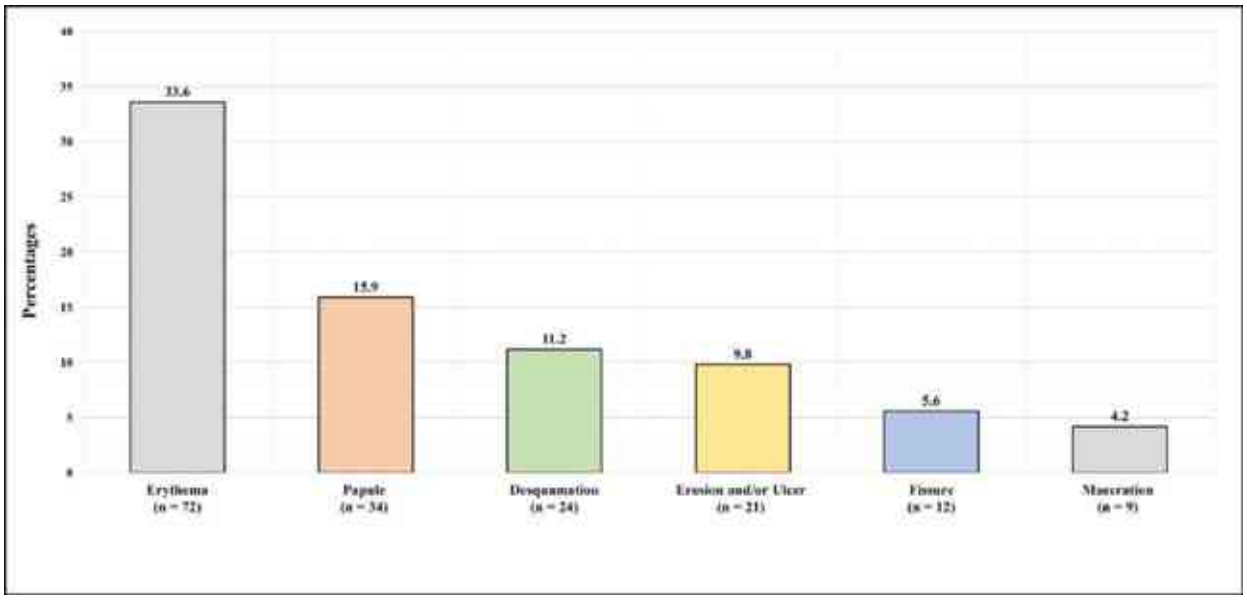


Figure 4 Description of Skin Lesion in Participants with Skin Damage during the COVID-19 Pandemic

Table 4 shows the factors associated with the factors associated with the incidence of skin damage during COVID-19 pandemic. Having a history of chronic skin disease was significantly associated with the incidence of skin damage during COVID-19 pandemic ($p = 0.023$), whereas participants with history of chronic skin disease had a notably higher incidence rate of new skin damage during COVID-19 pandemic compared to those with no history of chronic disease (64.1% vs 44%). Number of gloves layers was also significantly associated with the incidence of skin damage during COVID-19 pandemic ($p = 0.009$), where it was observed that those who used a single layer of gloves had a lower incidence rate of new skin damage compared to those with two and three layers of gloves respectively (42.3% compared to 69.7% and 61.5% respectively). Moreover, age was significantly associated with the incidence of skin damage during COVID-19 pandemic ($p = 0.007$). Where; it was observed that participants with new skin damage had a significantly lower mean age compared to those with no new skin damage (27.71 ± 5.34 vs 30.77 ± 10.19). Gender, number of times performing hand hygiene every day, and number of hours using tertiary protective devices were all not significantly associated with the incidence of skin damage during COVID-19 pandemic.

Table 4 Factors Associated with the Incidence of Skin Damage during COVID-19 Pandemic

Factor	Incidence of Skin Damage During COVID-19 Pandemic		P-Value
	Yes	No	
Gender			0.457
Male	44 (44.9%)	54 (55.1%)	
Female	58 (50%)	58 (50%)	
Do you have a history of any chronic skin disease?			0.023*
Yes	25 (64.1%)	14 (35.9%)	
No	77 (44%)	98 (56%)	
How often do you perform standard hand hygiene procedures every day approximately?			0.514
10 times or less / day	51 (45.5%)	61 (54.5%)	
More than 10 times / day	51 (50%)	51 (50%)	
How long do you wear tertiary protective devices every day approximately?			0.779
6 hours and less / day	72 (47.1%)	81 (52.9%)	
More than 6 hours / day	30 (49.2%)	31 (50.8%)	
During your worktime in designated department,			0.009*

how many layers of gloves do you wear?			
1 layer	71 (42.3%)	97 (57.7%)	
2 layers	23 (69.7%)	10 (30.3%)	
3 layers and more	8 (61.5%)	5 (38.5%)	
Age (mean ± standard deviation)	27.71 ± 5.34	30.77 ± 10.19	0.007*
*Significant at level 0.05			

4. DISCUSSION

With the outbreak of COVID-19 pandemic in December 2019, a new concerning issue has surfaced, which is the skin damage among the health-care workers related to the use of personal protective equipment (PPE). Which; may eventually lead to the impairment of the workers health and increase the chances of infection (Jiang et al., 2020). This study has investigated the skin problems related to personal protective equipment and personal hygiene measures during COVID-19 pandemic among healthcare workers in Aseer Region, Saudi Arabia. Which; up to our knowledge, is the first study to shed the light on this topic in Saudi Arabia. In this study the incidence of new skin damage among health workers was (47.7%), which is a considerable rate. This rate is similar to the incidence rate reported by Jiang et al., (2020) in their work where they reported a device-related pressure injury in (30.03%) among medical staff, and in (42.8%) of medical staff in the other study. However, other studies have reported a notably higher incidence rate of skin damage. Yuan et al., (2021) in their work reported a (77.09%) incidence rate of skin damage among medical staff in their work, Coelho et al., (2020) in their work reported a (69.4%) incidence rate of skin damage among medical staff in their work, while Wang & Parish (2019) in their work reported a 97% incidence rate of skin alteration in medical staff secondary to the use of personal protective equipment. This variation in the rate of skin damage in different studies can be attributed to multiple factors. First it can be due to the quality and type of medical equipment used, where it could be that some equipment leads to higher damage compared to the other based on the quality. Another possibility is the commitment of the medical staff toward the use of this equipment and that those with higher rate of commitment displays higher rate of damage. Another explanation could be that the racial variation and skin type, where some skin types and races are more sensitive thus more susceptible to skin damage compared to others.

In this study the most commonly observed site of skin damage were hands, nasal bridge, and around the ear. Similarly, Jiang et al., (2020) in their work reported that the susceptible sites for skin damage were nose bridges, checks, ears, and forehead. Moreover, Yuan et al., (2021) in their work reported hand skin reaction composing of mostly dryness, dermatitis, and itching, and was similar to the work of Foo et al., (2020). These hands symptoms were attributed to latex sensitivity and frequent hand washing by Jian et al., (2020). As for what mechanisms are behind the skin damage in sites other than the hand, it was previously suggested that the mechanism behind skin damage occurring in medical staff secondary to personal protective equipment (such as surgical face masks, the N95 masks, and goggles) is similar to the mechanism of pressure ulcers occurring in patients, and that there are three main components that lead to the development of these injuries. These components are pressure intensity, pressure duration, and tissue tolerance (while putting in consideration friction and moistures effects on tissue tolerance) (Haesler, 2019). Considering these three components while; putting in consideration the long working hours of the medical staff while wearing the PPE and the high likelihood of friction and moisture secondary to sweating and moving would explain the incidence of skin damage secondary to PPE during the COVID-19 pandemic.

The finding of this study revealed a significant association between age and the incidence of skin damage secondary to PPE. Where; lower mean of age was seen in participants who reported an incidence of new skin damage. This finding comes in contrast to the finding of multiple studies, where they found that age of over 35 years is associated with higher incidence rate of skin damage (Jiang et al., 2020; Coelho et al., 2020). Moreover, previous studies reported a significant association between the daily duration of wearing PPE and the incidence rate of new skin damage (Jiang et al., 2020; Coelho et al., 2020), which is inconsistent with the finding of this study where no significant association was observed. The inconsistency between the finding of this study and the other studies suggests the presence of other factors playing a role in the development of skin damage, and thus prompt the need of further investigation regarding the topic. This study has also found a significant association between both having a previous history of skin disease and the number worn layers of gloves with the incidence of new skin damage. Previous studies have not explored these relationships.

Although no evidence supports these claims, multiple world organizations recommended strategies to help prevent medical devices related pressure injuries. These recommendations include using skin hygiene products like acid soaps, using barrier cream, not using oily products, using prophylactic dressing when needed, and removal of the face mask every two hours for 5 - 15 minutes

(Coelho et al., 2020; Ramalho et al., 2020). A previous study reported that only 17% of the medical staff practiced precautions to prevent skin damage and have attributed this low rate for multiple factors. It was suggested that this low rate is secondary to the medical staff not knowing enough about what measures to be taken to prevent skin damage. Additionally, they proposed that it might be due to being concerned that if they applied skin protective measures it would decrease the efficacy of PPE (Jiang et al., 2020; Clark et al., 2014). The moderate to high rate of skin damage secondary to PPE and the observed barriers toward practicing skin protective behaviors affirm the increased need for rising awareness toward skin damage secondary to PPE and affirm the increased need for promoting skin protective behaviors among health care workers.

Strength and Limitations

This study had some limitation such as the fact the data were collected in a self-administrated manner, which subject the results to bias and lower accuracy. Moreover, this research included only the participants that were living in Aseer which makes the results ungeneralizable on the country. A larger sample size that includes participants from all over the country's regions would generate a better view on the topic. The strength of this study resides in spotting the light on a newly emerging issue that needs to be addressed and managed as soon as possible.

Recommendations

Initially we recommend making a study to precisely determine the incidence of new skin damage during the COVID-19 pandemic in Saudi Arabia to scale the size of the problem in the country. Furthermore, we recommend starting initiative that aim to educate health workers about skin damage secondary to personal protective equipment and the measures to prevent.

5. CONCLUSION

The current study reported a 47.7% incidence rate of new skin damage among health care workers during the COVID-19 pandemic. This considerable rate warns an essential need for promptly taking action by rising awareness toward this topic among health-care workers as well as educating them how to prevent the incidence of new skin damage secondary to personal protective equipment.

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Author Contributions

Dr. Abdullah Jubran Alqhtani was in charge of formulation the research idea and has monitored the study process throughout all the steps. Dr. Abrar Ahmed Bin Abbas and Ghada Ahmed Bin Abbas were the ones who took care of writing the introduction and methods. Saleh Mohammed Saleh Alqahtani and Mousa Amer Alshehri were responsible for extracting the ethical approval, and then collect the data. Moayad Abdullah Jaber Zarbh was the one responsible for data analysis and writing the results. Rawan Abdullah Ahmed Alqahtani and Ebtehaj Sultan Muhammad Alshareif wrote the discussion and conclusion and then took care of publication process.

Ethical approval

The study was approved by the ethical board in Armed Forces Hospital in Southern Region (IRB code: 2020-024).

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Conflict of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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