

Short Communication

Skin Reactions to Personal Protective Equipment among First-Line COVID-19 Healthcare Workers: A Survey in Northern Morocco

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Abstract

Objectives: Health care workers (HCWs) adopted several protective measures, including hand hygiene and wearing personal protective equipment (PPE) during the COVID-19 outbreak. However, the frequent use of these preventive measures can lead to skin reactions. Our study aimed to determine the frequency of these reactions in Northern Morocco. In addition, we also looked at the risk factors and the consequences of these injuries on work efficiency and performance.

Materials and Methods: An anonymous online survey was used to collect data, which was sent to 500 health workers in the study region. Descriptive and inferential statistics were used to analyze the data on IBM SPSS software.

Results: In total, 273/500 responded to the questionnaire (55%). For the participants' profession, 41% were doctors, 32% were nursing staff, and 26% held other jobs. The general prevalence rate of adverse reactions for all health workers was (80%), including skin problems: after wearing goggles (58%), after wearing surgical masks and respirators (57%), after handwashing and wearing gloves (45%), after wearing a face shield (23%), and after wearing protective clothing (11%). Bleach immersion was highly significantly associated with hand reaction (OR: 2.9, 95% CI: 1.77–4.90; $P < 0.001$). Moreover, we found a statistically significant association between hand cream use more than twice daily and fewer reactions (OR: 1.9, 95% CI: 0.98–3.77; $P = 0.038$). The skin reactions related to goggles use were also significantly associated with use duration (OR: 1.7, 95% CI: 0.988–3.12; $P = 0.05$). Similarly, wearing masks and N95 respirators and their related adverse reactions were significantly associated with use duration (OR: 0.5, 95% CI: 0.20–0.7; $P = 0.02$). In addition, adverse reactions of regular use of protective clothing were related to the frequency of its use per shift (OR: 3.5, 95% CI: 1.47–8.54; $P = 0.05$).

What's important about this paper

The COVID-19 pandemic has heightened the use of personal protective equipment and hygiene activities among healthcare workers. We surveyed healthcare workers in Morocco, and found that 80% of respondents reported adverse skin reactions associated with work. Bleach immersion for cleaning and was associated with increased prevalence of skin reactions on the hand, and skin reactions were generally associated with personal protective equipment (other than gloves) when used over longer durations or more days of work per week. Intensive use of personal protective equipment and hygiene may adversely affect skin health.

Conclusions: Our survey-based study showed that the prevalence of these skin reactions in our context should not be neglected. The length of daily wearing time and the frequency of PPE uses were the most implicated factors. More attention must be paid to these reactions for better care of HCWs during these critical times.

Keywords: adverse skin reactions; COVID-19; eye protection; hand hygiene; healthcare workers; medical mask; personal protective equipment; respiratory protection; SARS-CoV-2

Introduction

Since the World Health Organization (WHO) declared the COVID-19 pandemic on 11 March 2020, the number of cases has continued to increase, reaching >100 million cases (as of 31 January 2021). In response, health care workers (HCWs) worldwide have been mobilized to treat patients with COVID-19. These front-line health professionals are vulnerable to infection and represent a significant number of all COVID-19 cases reported globally so far. In Africa, the WHO has declared that SARS-CoV-2 has infected over 10 000 health (Erdem *et al.* 2021). Therefore, to prevent infection, healthcare workers require personal protection to avoid contact and inhalation transmission (Demirtaş *et al.* 2020).

The Centers for Disease Control and Protection (CDC) and the WHO recommend standard precautions, including gloves, gowns, and eye protection. Besides, the CDC recommends N95 filtering facepiece respirators for the care of all COVID-19 patients (suspected and confirmed), while the WHO recommends surgical masks for COVID-19 patient care and respirators only for aerosol-generating procedures. (Cheng *et al.* 2020). The frequent application of these measures and their prolonged use can cause various adverse skin reactions, which may decrease performance. The prevalence of skin injuries varies across recent reports, ranging from 43% (Jiang *et al.* 2020) to 97% (Lan *et al.* 2020). Our study aimed to measure the prevalence of skin and other adverse reactions to prolonged use of personal protective

equipment by healthcare workers during the COVID-19 pandemic.

Materials and methods**Survey**

An online survey was used to collect data about demographics, using the “Google Forms” interface. The questionnaire was sent to 500 health workers: It consisted of demographic data, including age, sex, worksite, work city, environment, and medical history; it also contained information about PPE use and skin problems. The time to complete this questionnaire was approximately 10 min. It was in the form of a short or multiple-choice response with several photos and illustrations to facilitate the choice of answers. The questionnaire was anonymous; the first item informed the participants about the study's objectives to give their consent to use their data for research purposes. The second one was about demographic information. Then, each part dealt with one type of protective activity or equipment (hand hygiene, goggles, mask, face shield, and protective clothing), its use (frequency, length of wear, precaution before use), and consequences (symptoms, lesions sites, and type) before concluding with a question about the impact of these injuries on quality of life.

Statistical analysis

The data entry and analysis were carried out by the epidemiology team of Tangier University hospital center. IBM

SPSS statistics (Version 21) was used for data analyses. Chi-squared or Fisher's exact tests were used to compare categorical variables. Odds ratios (OR) were calculated with their corresponding confidence intervals at 95%. P -value <0.05 was considered statistically significant.

Results

General characteristics of the study population

This study's target population was the first-line COVID-19 HCWs from Morocco's Northern region (Tangier, Tetouan, and Al Hoceima). The study population covered several health specialists, including doctors, nurses, nursing assistants, laboratory technicians, administrative staff, cleaning agents, etc. In total, 273/500 (55%) responded to the survey. Our study population's median age was 34 years (range: 20–61), and 51% were women. Sixty-one percent of participants were HCWs in regional hospitals, 14% in the university hospital. Moreover, 60% of participants worked in inpatient wards, 20% in the standard care ward, and 11% in the intensive care ward. Details on participants' characteristics are listed in [Table 1](#).

Characteristics of skin injuries in HCWs

The general prevalence rate of adverse reactions for all HCWs was (80%), with 45% reporting hand injuries, 57% had skin reactions after wearing masks and respirators, 58% after wearing goggles, 23% after wearing a face shield, and 11% after wearing protective clothing ([Table 2](#)).

Hand hygiene

The most frequently reported symptoms were dryness (68%), followed by itching (26%), and burning and pain in 19%. The most common signs were erythema (31%), desquamation (12%), maceration (10%), fissures (11%), erosion (4%), vesicles (4%), and papules (3%). The use of liquid handwashing soap was reported in 90% of cases, bar soap in 73%, and hydro-alcoholic gel in 99%. Bleach immersion to clean surfaces and some materials was reported by 39% of respondents and was significantly associated with hand skin reactions (OR: 2.9, 95% CI: 1.77–4.90; $P < 0.001$). We found a statistically significant association between hand cream use more than twice daily and fewer lesions (OR: 1.9, 95% CI: 0.98–3.77; $P = 0.038$).

Masks/N95 respirators

Among the 273 participants, 57% reported adverse reaction after wearing a surgical mask and N95 respirator,

Table 1. Characteristics of study population.

Characteristics	Study population
Number of participants	273
Age (years)	
Median	34
Range	20–61
Standard deviation	10
Gender (%)	
Female	51
Male	49
Professional group (%)	
Doctors	41
Nursing staff	32
Others (e.g. cleaning agents, administrative staff, laboratory staff, pharmacy)	27
Worksite (%)	
University hospital	14
Regional hospital	61
Private clinic	5
Rehabilitation center	10
Emergency medical services	3
Others (e.g. ambulatory nursing service, healthcare administration)	7
Work environment (%)	
Standard care ward	20
Inpatient wards	60
Intensive care unit	11
Outpatient unit	2
Diagnostics and sampling unit	4
Others (e.g. administration, cleaning services, pharmacy)	3

including pressure lesions in the nasal bridge (erythema, erosion or ulceration) (41%), erythema (19%), difficulty in breathing (8%), urticaria (3%), and aggravation of pre-existing skin problems (4%) such as acne and seborrheic dermatosis. Most of these reactions were localized in the nasal bridge (46%), the cheek (30%), ears (10%), and the chin (5%). There was a significant association between these injuries and working more than three days per week (OR: 0.5, 95% CI: 0.20–0.7; $P = 0.02$).

Goggles/face shield

Among 202 who regularly used goggles, 118 (58%) reported skin reactions, including pressure lesions (50%) and erythema (19%). The most affected sites were the nasal bridge (44%) and forehead (40%). These adverse skin reactions were significantly associated with wearing goggles for more than two hours (OR: 1.7, 95% CI: 0.988–3.12; $P = 0.05$).

Table 2. The association between skin damages and influencing factors.

Variables	Skin reactions		OR (95%CI)	P value
Hand hygiene				
	Yes (n = 123)	No (n = 150)		
Working days			0.7 (0.465–1.216)	0.149
1–3 days	71	76		
4–7 days	52	74		
Working hours			0.6 (0.40–1.07)	0.06
<12 h	78	80		
12–24 h	45	70		
Frequency of hand washing			1.2 (0.71–2.10)	0.497
<10 times per day	31	44		
>10 times per day	92	106		
Wearing time of gloves (h)			1.5 (0.86–2.58)	0.094
1–5 h	86	115		
>5 h	37	33		
Use of bleach immersion (n = 104/273)	64	40	2.9 (1.77–4.90)	<0.001
Use of warm water (n = 97/273)	40	57	0.8 (0.47–1.29)	0.208
Use of hand cream/emollients (n = 113/273)	67	46	2.7(1.64–4.44)	<0.001
Frequency of use of moisturizers			1.9 (0.98–3.77)	0.038
<2 times	91	115		
>2 times	26	17		
Masks/ N95 respirators				
	Yes (n = 156)	No (n = 117)		
Working days			0.5 (0.29–0.78)	0.02
1–3 days	60	66		
4–7 days	96	51		
Goggles				
	Yes (n = 118)	No (n = 84)		
Length of time			1.7 (0.98–3.12)	0.05
<1 h	39	39		
>2 h	79	45		
Protective clothing				
	Yes (n = 23)	No (n = 250)		
Frequency of use/shift			3.5 (1.47–8.54)	0.05
<3 times	11	156		
>3 times	12	48		
Length of use of face shield/shift			1.3 (0.51–3.31)	0.37
<1 h	7	73		
>1 h	16	128		

Protective clothing

Of the 175 HCWs who regularly wore protective clothing, 45 (11%) reported adverse reactions, and they are mainly associated with using these gowns more than three times per day (OR: 3.5 95% CI: 1.47–8.54; $P = 0.05$). The most described lesions and symptoms were itching (8.2%) and erythema (1.9%), and only one person reported a rash.

Discussion

During the COVID-19 pandemic, occupational skin disease in healthcare workers was expected. The adverse events of PPE were initially neglected, given the increased risk of contamination and health crisis. Nevertheless, these measures can trigger adverse skin reactions that affect staff performance and work quality. To our knowledge, few reports have been conducted to address this issue (Foo *et al.* 2006; Hu *et al.* 2020; Jiang *et al.* 2020; Lan *et al.* 2020; Lin *et al.* 2020). Hence, further studies are needed to explore these effects and the causal links that propose solutions. Previously, Foo *et al.* have reported an earlier experience with SARS-CoV-1 infection and observed adverse skin events associated with PPE (Foo *et al.* 2006). They noticed that 35% of the participant who used N95 respirator had acne, facial dermatitis, and pigmentation of the nasal bridge, and 21% who used gloves regularly reported dry skin, itch, and rash (Foo *et al.* 2006).

Lan *et al.* found that most (97%) surveyed HCWs reported adverse events related to wearing PPE during the COVID-19 pandemic. The most affected site was the nasal bridge (83%), and the most reported symptoms were dryness and desquamation (70%) (Lan *et al.* 2020). Others have also reported a high prevalence of skin injuries in doctors and nurses. (Hu *et al.* 2020; Jiang *et al.* 2020; Lin *et al.* 2020). Since the emergence of COVID-19 and as direct contact contamination has been reported (Rudnicka *et al.* 2020), disinfecting and handwashing with soap or alcohol-based hand rubs (ABHRs) have been recommended as essential measures to prevent the virus spread, especially for HCWs (Kratzel *et al.* 2020; Siddharta *et al.* 2017). The WHO and CDC recommend hand washing with soap and water when hands are visibly soiled rather than ABHRs because it reduces a vast spectrum of pathogenic germs and eliminates dirt on the hands (Foddai *et al.* 2016; Golin *et al.* 2020). However, several papers showed that alcohol use, especially for health workers, is less irritating than soap (Große-Schütte *et al.* 2011; Manche *et al.* 2017). Notably, it was also shown that washing hands 10 times a day is significantly associated

with skin problems (Lan *et al.* 2020). ABHRs contain emollients, which hydrate the skin; therefore, their use is recommended between handwashing with soaps to promote the regeneration mechanisms (Marraha *et al.* 2020).

According to a Spanish review, sodium hypochlorite (0.1%) is the principal-agent in surface disinfection (León Molina and Abad-Corpa, 2020). These data suggest that a concentration of 0.1% applied 1 min is sufficient to eliminate coronaviruses. WHO also recommends ensuring consistently and correctly cleaning and environmental disinfection procedures. Furthermore, sodium hypochlorite is a commonly used hospital-level disinfectant (Kampf *et al.*, 2020). However, in our study, this solution's use was associated with increased hand reactions in HCWs (bleach immersion; $P < 0.001$). In our context, in addition to cleaning surfaces, it can be used to wash several materials. Therefore, direct contact of sodium hypochlorite with the skin may be frequent. Thus, these reactions are related to inappropriate manipulation.

Reactions to wearing latex gloves for a long time have been reported in several studies (Foo *et al.* 2006; Jiang *et al.* 2020; Lan *et al.* 2020), but this was not significantly associated with the risk of hand lesions in our survey. This can be explained by the fact that most HCWs use a combination of irritants and allergens products (handwashing with soap, bleach immersion, gloves). In addition, we could not perform the patch test to define the causal agent given the circumstances.

The use of moisturizers can reduce skin dryness and avoid irritation, mainly if skin care measures are applied every time after hand hygiene (Yan *et al.* 2020). In our study, HCWs who used emollient creams more than twice a day had fewer skin reactions. For the management of contact dermatitis, it is recommended to avoid first the suspected agent. Wearing face masks for a long duration can cause pressure lesions or even bridge scarring lesions (Yin, 2020). In our study, the most common skin reaction was pressure injuries, including erythema and erosion, which was consistent with other studies (Hu *et al.* 2020; Lan *et al.* 2020). (Lan *et al.* 2020) reported that these reactions were associated with wearing time (more than 6 hours). However, in our case, these reactions were mainly associated with the worked days (>3 days a week). Moreover, forehead skin damages are less frequently met when wearing a face shield than goggles (Lan *et al.* 2020). Our results also confirmed this effect.

Adverse skin reactions related to protective clothing are reported less frequently in the literature, with itching and burning being the most often observed (Foo *et al.*

2006; Lin *et al.* 2020). We also found a low level of skin injuries among respondents (11%), with only one report of cutaneous rash. These reactions can be avoided by using natural material or untreated synthetic fabric, avoiding over tight clothing, and ingesting sufficient liquid for adequate hydration (Gheisari *et al.* 2020). Finally, the prevalence of many adverse skin reactions related to PPE can be avoided by reducing working hours and including frequent HCWs rotations.

Our study has some limitations that are related to the overlap of risk factors causing adverse skin reactions at the same site. For example, hand skin injuries could be caused by frequent washing, the products used during wearing, gloves, activities outside of work or a combination of any of these. Being cross-sectional, we cannot make any conclusions about causality linking PPE to health outcomes.

Our research demonstrates the prevalence of these lesions in our context and described some risk factors. Among the different symptoms and signs located in hand, dryness was the most common symptom, and it was significantly associated with the use of bleach immersion. Besides, the use of hand cream seemed to prevent hand injuries. The nasal bridge was the most affected site after wearing an N95 respirator; pressure injuries, including erythema and erosion, were the most reported signs. In our survey, these lesions were mainly associated with the worked days (>3 days a week). Fewer lesions were noticed when wearing a face shield than goggles, which were significantly associated with length of time.

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