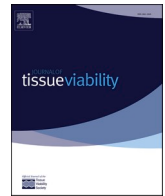




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Skin-related problems associated with the use of personal protective equipment among health care workers during the COVID-19 pandemic: A online survey study

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ABSTRACT

Aim: The aim of this study was to determine the skin-related problems caused by personal protective equipment (PPE) use in health care workers (HCWs) and to identify the factors contributing to their occurrence.

Materials and Methods: This descriptive and cross-sectional online survey study was carried out with 297 HCWs working in a university hospital in Turkey between March 20, 2021, and May 20, 2021. The study data was collected using an online questionnaire consisting of 3 parts. Descriptive statistics, Pearson's Chi-square, and Fisher's Exact Chi-square tests were used to analyze the data.

Results: Among the HCWs, 95.6% reported that skin-related problems associated with at least one PPE use. Skin-related problems that develop due to PPE use were mostly associated with the use of Surgical/N95 masks (97.1%) and gloves (96.8%). The most commonly reported problems were "dryness" (%74.0) and "itching" (% 72.1) when wearing gloves, "perspiration and moisture" (73.6%), "formation of equipment traces" (53.9%), and "skin lesions" (52.8%) when wearing a surgical/N95 mask, "perspiration and moisture" (89.7%) when wearing protective overalls/gowns. Wearing PPE for more than 4h ($p=0.001$), taking additional precautions to increase the sense of protection ($p=0.026$), and not applying preventive measures while using PPE ($p=0.003$) significantly increase the risk of skin-related problems.

Conclusion: The results suggest that skin-related problems due to the use of PPE are common among HCWs.

1. Introduction

From past to present, the world has fought various epidemics. Currently, the global fight against the COVID-19 pandemic is still ongoing. According to the World Health Organization (WHO) data, by the end of July 2021, 193,657,725 confirmed cases and more than 4 million deaths were reported due to COVID-19 which is highly contagious and pathogenic [1]. Healthcare workers (HCWs) are the primary point of care for the community, especially in the fight against communicable disease outbreaks. They are at risk of being affected by infectious diseases and occupational exposure while both controlling the spread of disease and providing infected patients with the medical care they need [2]. According to the International Council of Nurses, as of December 31, 2020, more than 1.6 million HCWs in 34 countries have been infected with COVID-19, with the total number of nurse deaths

from COVID-19 in 59 countries being 2710 [3]. Bandyopadhyay et al. [4] pointed out that infections and deaths from COVID-19 among the HCWs in different countries worldwide in the early stages of the pandemic were at a critical level. Similar to the other countries, HCWs in Turkey were exposed to risks occurring due to COVID-19 during the pandemic. More than 40,000 HCWs have been reported to be infected with COVID-19, according to unofficial statements of the Ministry of Health, and one in every 10 people infected with the disease is an HCW [5].

The use of personal protective equipment (PPE) is recommended for all HCWs working in hospital and community settings and at high risk of contact with COVID-19 patients. PPEs, such as gloves, surgical/N95/FFP3 masks, safety glasses, face shields, protective gowns/overalls, that create a physical barrier between the pathogens in the environment contacted and the user, are known to reduce the risk of transmission of

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infection [6,7]. Therefore, the use of PPE is the focus of employee safety for HCWs, which are at the frontline during the pandemic. However, another aspect brought out by the use of PPE during the COVID-19 pandemic is the skin-related injuries and dermatological problems caused by the use of one or more PPE during long and uninterrupted working hours [8–10]. The necessity of using PPE to ensure infection control in this process has shown that this non-medical equipment that comes into contact with skin and tissues can also cause skin injuries and should be considered within the scope of medical device-related pressure injuries [11–13].

Pressure, friction and shear forces that PPEs cause at the contact points on the skin are the main factors in the etiology of skin damage associated with the use of PPE [9]. It is also known that sweating and moisture, which happen due to stress and discomfort caused by long hours of work with PPE that is used to prevent transmission by contact, droplets, and respiration, leading to skin softening by reducing tissue tolerance and providing the ground for skin injury [8,9,14,15]. Moreover, the fact that HCWs with different face sizes and shapes have to use the equipment, especially masks and safety glasses, that are manufactured in standard sizes, for a long time also leads to these injuries [12, 16]. Many studies have shown that HCWs, having to work using PPE to protect themselves and other patients during the pandemic, suffer from dermatological problems and skin injuries [12,16–18].

The importance of PPE use in the prevention of hospital-acquired infection cannot be denied. However, it should be taken into consideration that the skin-related injuries and dermatological problems that this equipment may cause, which is supported by the literature findings, also pose a risk in terms of employee safety. Because it has been reported that problems that may arise due to the ergonomics, comfort and physical properties of PPE provided by institutions can increase the risk of infection transmission to HCWs by damaging the skin integrity [19,20]. Furthermore, it is known that the problems caused due to the use of PPE negatively affect the attitudes and behaviors of HCWs to use this equipment effectively [21,22]. Therefore, given these risks, it is important to address and be aware of the problems associated with PPE use in terms of both employee and patient safety in the delivery of healthcare services, demonstrating the need for more ergonomic and skin-friendly PPEs with a higher protective effect. In this study, we aimed to evaluate the skin-related problems caused by the PPE use in HCWs during the Covid-19 pandemic and to identify the factors contributing to their occurrence.

2. Materials and methods

2.1. Study design

It is a descriptive and cross-sectional online survey study conducted between March 20, 2021 and May 20, 2021 to investigate skin-related problems, caused by the use of PPE, of HCWs working in a 600-bed university hospital, in the Aegean Region of Turkey, where treatment and care services are also provided for COVID-19 patients.

2.2. Participants

A total of 1250 HCWs work in the hospital where the study was carried out. Among these HCWs, 850 HCWs, meeting the inclusion criteria of taking part in bedside patient care and treatment services, using PPE, and not having any chronic diseases that prevent interaction with COVID-19 patients, formed the population of the study. Determination of the total number of HCWs that were known to meet the inclusion criteria for the study was done through the interviews with the occupation-related management departments of the HCWs. The online survey link was not shared with 400 HCWs that were found not to meet the inclusion criteria and were excluded from the study. The minimum sample number to be included in the study was calculated as 260 among 850 HCWs with a 0.05 margin of error, according to the $n = Nt^2 pq/d^2$

$(N-1) + t^2pq$ formula [23], which is used when the number of individuals in the population is known. The HCWs to be sampled were invited to study by using a simple random sampling method. Considering the very busy working conditions of HCWs and the volunteering principle of the study, a total of 297 people reported volunteering to participate in the study and answered the questions in the online survey link fully.

2.3. Data collection and data tool

As a data collection tool in the study, a questionnaire, developed based on literature review [8,9,15,19,21,24], consisting of a total of 25 questions was used. For the content validity of the questionnaire used in this study, three nurse academicians experts in pressure injuries, one doctor specialized in dermatology, and four HCWs who use PPEs in the clinic were asked to evaluate the suitability, reliability and understandability of the items. As per the Davis technique [25] for content validity, the experts assessed and graded each question in the questionnaire as "Relevant (4)", "Need minor revision (3)", "Need major revision (2)", "Not relevant (1)". As per the experts' suggestions, no item was removed from the questionnaire while items that were graded as 2–3 have been revised with the most appropriate statements. The Content Validity Index, based on the experts' opinions, of the questionnaire used as a data collection tool in this study, was found to be 0.93. Furthermore, Kendall's W value related to the scores obtained from eight experts was determined as $W = 0.940$, $p = 0.020$. The final questionnaire consists of 3 parts. The first part includes questions aimed at obtaining data on the demographic characteristics of HCWs (9 questions), while the second part on PPE usage characteristics and exposure to skin-related problems due to PPE use (10 questions). In the last part, (6 questions) HCWs were asked to state skin-related problems they were exposed to, according to the type of equipment they used. In this part, they were also requested to mention the anatomical parts where stated skin-related problems develop according to the type of equipment. The data were obtained by sharing the online link of the questionnaire, created using the Google forms, in the WhatsApp groups of HCWs.

2.4. Ethical considerations

In order to carry out the study, permission (2021-01-17T12_37_04) was obtained from the Ministry of Health Scientific Research Platform on January 18, 2021. Written approval of the ethical committee was obtained from the Clinical Research Ethics Committee of the university (2021/95). Also, on the first page of the online survey link shared with the HCWs invited to the study, the purpose of the study was explained and it was stated that the participation was voluntary.

2.5. Statistical analysis

All statistical analyses were performed with the SPSS version 22.0 (Armonk, NY: IBM Corp) package program. Categorical data were shown as numbers and percentages, while continuous variables data as mean and standard deviation. Pearson's Chi-square and Fisher's Exact Chi-square tests were used to analyze inferential statistics, which include the correlation between some characteristics of HCWs and the presence of skin-related problems associated with PPE use, depending on the size of the cells examined. $P < 0.05$ was considered for the level of statistical significance in all analyses.

3. Results

3.1. Characteristics of healthcare workers

While 82.2% of the HCWs participating in the study were women, 81.8% were nurses, and 11.8% were doctors. Of the participants, 19.5% were working in COVID-19 clinics and the COVID-19 intensive care unit,

31.3% were in internal clinics, while the majority of them had previously worked in pandemic clinics, and 51.6% of them had a working time of >8 h in a shift. (Table 1).

3.2. Characteristics of the use of PPE

The findings related to the PPE usage characteristics of HCWs are shown in Table 2. According to findings; the percentage of participants with working time >4 h with PPE in a shift was 67.0%. The most frequently used PPEs were found to be gloves (95.6%), surgical masks (96.0%), and N95 masks (69.7%). The vast majority of the participants (83.8%) reported using methods in order to increase the sense of protection of the PPE.

Almost all the HCWs (95.6%) participating reported experiencing skin-related problems associated with at least one PPE use. Skin-related problems that develop due to PPE use were mostly associated with the use of Surgical/N95 masks (97.1%) and gloves (96.8%) (Table 2).

3.3. Characteristics of types and anatomical regions of skin-related problems

The characteristics of developed skin-related problems according to the type of PPE used are presented in Table 3. According to the findings, dryness (74.0%) and itching (72.1%) were the most common problems related to the use of gloves. The reported skin-related problems due to the use of surgical/N95 masks (73.6%) and protective gowns/overalls (%89.7) were mostly perspiration and moisture. Participants reported nasal bridge (69.4%), behind the ear and around (69.8%) and chin (38.4%) as the anatomical regions where skin-related problems occur due to the use of Surgical/N95 mask (Table 3).

3.4. Comparison of the presence of skin-related problems due to the use of PPE

When the presence of skin-related problems developing due to the use of PPE was compared with some of the characteristics of the HCWs,

Table 1
Characteristics of healthcare workers (N = 297).

Characteristics	Categories	n	%
Gender	Male	53	17.8
	Female	244	82.2
Marriage status	Single	150	50.5
	Married	147	49.5
Level of education	Health vocational high school	15	5.1
	Associate degree	14	4.7
	Undergraduate degree	225	75.8
	Postgraduate degree	43	14.3
Occupation	Nurse	243	81.8
	Physician	35	11.8
	Emergency medical technician	7	2.4
	Support personnel	12	4.0
Department	COVID-19 clinic	24	8.1
	COVID-19 Intensive care unit	34	11.4
	Intensive care unit	46	15.5
	Internal medicine clinic	93	31.3
	Surgery clinic	66	22.2
	Emergency service	20	6.7
	Operating room	14	4.7
Working time per shift (hours)	≤8	144	48.4
	>8	153	51.6
Previously work in pandemic clinic	Yes	233	78.5
	No	64	21.5
Infected with COVID-19 during the pandemic	Yes	74	24.9
	No	223	75.1
Years employed in the profession	Mean ± SD		
	10.74 ± 9.19		

Table 2
Characteristics the use of PPE (N = 297).

Characteristics	Categories	n	%
In-service training related to PPE	Yes	228	76.8
	No	69	23.3
Experiencing difficulty in accessing PPE.	Yes	21	7.1
	Partially	128	43.1
	No	148	49.8
The use of PPE ^a	Gloves	290	97.0
	Surgical mask	288	96.0
	N95 mask	207	69.7
	Protective gowns/overalls	191	64.3
	Face shield	178	59.9
	Safety glasses	126	42.4
Total PPE use time in a work shift (hours)	≤4	98	33.0
	>4	199	67.0
Taking any additional precautions to increase the sense of protection when using PPE	Yes	249	83.8
	No	48	16.2
Precautions taken to increase the sense of protection when using PPE ^a	Wearing more than one surgical mask on top of each other	167	56.2
	Using a surgical mask and N95 mask together	163	54.9
	Wearing on more than one glove on top of each other	133	44.8
	Covering the wrist joint between the glove and the apron/gown with an adhesive material	64	21.5
	Using two protective gowns/overalls	13	4.4
	Using two protective glasses/face shields	13	4.4
Skin problems related to the use of at least one of the PPE	Yes	284	95.6
	No	13	4.4
Skin problems reported types of PPE ^a	Surgical/N95 mask	276	97.1
	Gloves	275	96.8
	Protective glasses/Face shield	155	54.5
	Protective gowns/overalls	139	48.9
The use of protection methods	Yes	153	51.5
	No	144	48.5
Types of protection methods ^a	Applying moisturizing cream/pomade	82	56.2
	Removing PPE periodically	77	52.7
	Using an ear saver strap	71	48.6
	Using barrier cream	40	27.4
	Applying prophylactic dressing before putting on PPE	24	16.4
	Using nasal strips	8	5.5
	Using face shield	8	5.5

^a More than one option has been selected. PPE: Personal protective equipment.

those who used PPE >4 h per a shift, those taking additional precautions to increase the sense of protection, and those not applying preventive measures while using PPE were found to have more problems, which was statistically significant (p = 0.001; p = 0.026; p = 0.003 respectively) (Table 4).

4. Discussion

The fight against COVID-19, transmitted from an infected person by direct contact with respiratory droplets and aerosols and indirect contact with contaminated surfaces or materials, put the HCWs at high risk during the pandemic, resulting in the importance and necessity of PPE use coming to the fore. However, this has also created global awareness on the skin-related injury and dermatological problems that the HCWs may be subject to due to the long term use of PPE.

In this study, the majority of HCWs reported having skin-related problems associated with at least one of the PPEs they used. Montero-Vilchez et al. [8] reported the prevalence of cutaneous adverse events related to PPE as 75.1% [8]. The overall prevalence of skin-related adverse reactions among HCWs was found to be 80% in another study conducted in Morocco [26]. In a multicenter study with 4306 HCWs in 161 hospitals in China, the prevalence of skin injury was found to be

Table 3
Distribution of types and anatomical regions of skin-related problems.

Characteristics	Categories	n	%
Skin problems related to use of gloves ^a	Dryness	199	74.0
	Itching	194	72.1
	Perspiration and moisture	117	43.5
	Rash, allergies	83	30.9
	Maceration	59	21.9
	Dermatitis	76	28.3
Skin problems related to use of surgical/N95 mask ^a	Perspiration and moisture	209	73.6
	Formation of equipment traces	150	53.9
	Skin lesions (papule, pustule etc.)	153	52.8
	Pain in contact areas	148	52.1
	Itching	108	38.0
	Erythema of intact skin	99	34.8
Anatomical parts of skin problems related to use of surgical/N95 mask ^a	Deterioration of skin integrity	32	11.3
	Nasal bridge	179	69.4
	Behind the ear and around	180	69.8
	Chin	99	38.4
	Cheek	93	36.8
	Around the eyes	71	27.5
Skin problems related to use of protective glasses/face shield ^a	Back of head	24	9.3
	Perspiration and moisture	107	48.2
	Pain in contact areas	87	39.2
	Formation of equipment traces	85	38.3
	Itching	40	18.0
	Erythema of intact skin	35	7.7
Anatomical parts of skin problems related to use of protective glasses/face shield ^a	Deterioration of skin integrity	9	4.1
	Forehead	120	67.8
	Nasal bridge	101	63.5
	Around the eyes	86	54.1
	Behind the ear and around	55	31.5
	Cheek	22	12.4
Skin problems related to use of protective gowns/overall ^a	Perspiration and moisture	124	89.7
	Itching	77	39.5
	Allergies	22	11.3

^a More than one option has been selected.

42.8% [16]. A study conducted in Brazil indicated the prevalence of PPE-related skin injury to be 69.4% and the number of skin injuries per HCW to be 2.4 [27]. The results of a limited number of studies conducted in Turkey, similar to the international literature, also confirmed that the use of PPE can cause skin-related injuries or dermatological problems in HCWs. Yıldız et al. [12] reported the overall rate of skin injury due to PPE use in HCWs in Turkey as 47.9% [12]. Etgu and Onder [19] found that 88.1% of HCWs experienced adverse skin reactions due to PPE use and personal hygiene measures [19]. These findings emphasize that the prevalence of skin-related problems due to PPE use should not be neglected.

Our findings indicated that the skin-related problems reported by HCWs were mostly associated with PPE such as gloves, surgical/N95 masks. Montero-Vilchez et al. [8] reported that frequent handwashing, glove, and mask use are the most important factors associated with adverse skin reactions [8]. The results of different studies have also proven the presence of skin-related problems occurring due to the use of gloves, surgical/N95masks, which are reported to be used more frequently [15,17,19,21,24,26–29]. Although they differ by the type of equipment used, the most common adverse effects of PPE on the skin have been reported to be contact dermatitis, dryness, acne and eczema, pressure-related symptoms and itching [8]. Dryness, itching,

Table 4
Comparison of the presence of skin-related problems due to the use of PPE.

Characteristics	Categories	Skin problems related to use of PPE n (%)		p-value*
		Yes (n = 284)	No (n = 13)	
Gender	Male	50 (17.6)	3 (23.1)	0.709
	Female	234 (82.3)	10 (76.9)	
In-service training related to PPE	Yes	220 (77.4)	8 (61.5)	0.189
	No	64 (22.6)	5 (38.5)	
Previously work in pandemic clinic	Yes	225 (79.2)	8 (61.5)	0.163
	No	59 (20.8)	5 (38.5)	
Working time per shift (hours)	≤8	136 (47.8)	8 (61.5)	0.402
	>8	148 (52.2)	5 (38.5)	
Total PPE use time in a work shift (hours)	≤4	88 (30.9)	10 (76.9)	0.001
	>4	196 (69.1)	3 (23.1)	
Taking any additional precautions to increase the sense of protection when using PPE	Yes	241 (84.8)	8 (61.5)	0.026
	No	43 (15.2)	5 (38.5)	
The use of protection methods	Yes	141 (49.6)	12 (92.3)	0.003
	No	143 (50.4)	1 (7.7)	

p < 0.05 *Pearson's or Fisher's Exact Chi-square test PPE: Personal protective equipment.

perspiration and moisture were the most common problems among the glove-related skin problems reported by the participants in this study. Kiely et al. [30] emphasized the prevalence of skin symptoms associated with dryness on hands due to glove use [30]. Long-term use of gloves made of waterproof materials with poor air permeability, such as rubber and plastic, prevents the evaporation of sweat on the skin of the hands, leading up to the development of skin-related problems [9]. Darlenski et al. [31] reported that moisture-related skin injuries in the hands are associated with glove use, which causes hyperhydration of the stratum corneum layer of the skin [31]. Furthermore, hand washing, the use of disinfectants and the irritating features of gloves, whose importance and necessity become more prominent during the pandemic, are known to contribute to the development of skin problems such as dryness of the hands, itching, dermatitis and eczema [9,30]. Various studies have also supported the presence of problems such as dryness, itching, dermatitis, skin soaked with sweat associated with the use of gloves and hand hygiene [15,24,26,28,32]. The use of masks has been a basic protective barrier during the pandemic for the HCWs, at high risk of contact with COVID-19 patients. However, the pressure and shear force occurred in the contact areas due to the use of the masks for long hours and the tight fit on the face, and decreased tissue tolerance due to increased moisture in the areas under the mask is responsible for the development of adverse skin injuries and problems associated with the use of masks [11, 12,17]. Besides, it is known that preservatives and allergens in the materials from which surgical masks and especially N95 masks are produced increase the risk of contact dermatitis, the barrier dysfunction of the skin and damage to the skin microbiota, which facilitates the formation of skin lesions [33]. The majority of studies in the literature have confirmed that respirators such as N95 are the most harmful type of mask to the skin, with prolonged use time [8,9,17,34]. Peko et al. [35] showed that the surgical mask is potentially less irritating to the facial skin than the KN95 mask, as it applies less pressure and facilitates the

faster return of increased temperature in the facial area to its basal levels [35]. However, in a different study, it was emphasized that deformations in the structure of surgical masks, examined with an electron microscope after short but continuous use, may damage the moisture and temperature balance of the skin, increasing the susceptibility to the development of inflammatory skin diseases [36]. Chaiyabutr et al. [37] reported that when compared to cloth masks, the surgical mask is more associated with the development of skin lesions such as acne and itching, especially in individuals with oily skin [37]. Our study findings, similar to the literature, showed that skin-related problems reported due to the use of surgical/N95 mask may be mostly related to these etiological factors, although there was no investigation performed on the type of mask used. The findings of a similar study in Turkey indicated sweating, redness of the cheeks, redness of nasal bridge, and redness of the ear as the most frequently reported problems related to the use of both surgical masks and N95 masks [24].

It is important to investigate areas where the negative effects of PPE use on the skin develop, to identify areas where protection and precautions need to be taken for safer use of this equipment. In this study, the negative effects of the use of surgical/N95 mask were found to be mostly on areas such as the nasal bridge and behind the ear and around, while the negative effects of the use of safety glasses/face shields were mainly on the forehead, nasal bridge and around the eyes. In similar studies, the nasal bridge, forehead, cheeks and hands have been reported to be the anatomical areas most affected by the long-term use of PPEs [8, 9, 11, 12, 24, 26]. Meanwhile, these areas may vary depending on the type of equipment used. Kiely et al. [30] reported the hands as the most frequently affected area in PPE use, associated with the use of gloves [30]. The skin behind the ears is known to be susceptible to pressure injuries due to repetitive friction caused by the ear loops of face masks [9]. Long-term use of the N95 mask is a predisposing factor for the development of pressure injury on the nasal bridge and the dorsum of the nose [17, 26]. Furthermore, it is a known fact that the hard texture of the materials used in the production of protective gowns/overalls type equipment worn as a part of isolation measures are likely to cause friction and irritation on the skin, and also excessive sweating and moisture they cause can lead to damage to the barrier function of the skin [24]. This has been supported by the fact that perspiration and moisture were the most reported problems by the HCWs in this study related to the use of protective gowns/overalls.

Several studies have focused on risk factors that are effective in the occurrence of skin-related problems associated with PPE use. In these studies, different from our findings, variables such as gender, working time, previous history of dermatitis or allergic diseases and status of working in pandemic clinics were also found to be risk factors for adverse skin problems [15, 19, 37]. In this study, working time with PPE over >4 h is determined to be a significant variable affecting the presence of skin-related problems. Xia et al. [38] showed that the use of >8 h PPE was associated with skin damage due to the use of gloves, and the risk of pressure injury may increase with the use of >4 h PPE [38]. Lam et al. [17] reported that the use of N95 respirators ranging from 3 to 7 h is a risk factor for adverse skin outcomes [17]. Marraha et al. [26] found that wearing protective gowns more than 3 times in a shift, wearing safety glasses >2 h, and working with masks/N95 respirators for 4–7 days significantly increased the presence of skin injuries [26]. Lin et al. [15] and Etgu and Ozdemir [19] found that working with PPE >6 h per day was associated with adverse skin reactions. Although there are different findings in the literature, studies emphasize that increased working time with PPEs is a major risk factor for the presence of skin-related injury and problems [8, 27, 38]. Therefore, the continuous working durations of HCWs with PPEs is a problem that needs to be addressed and managed in terms of employee safety.

As in many countries in the world, access to PPEs in the desired quality and quantity during the pandemic proved to be a problem for HCWs in Turkey for a while. In this study, about half of the participants reported experiencing complete or partial difficulty in accessing PPE.

However, this situation may have caused confidence issues regarding the protection capability and effectiveness of institution-supplied PPE, or HCWs to use different methods to feel safer when using them. In the literature, concerns about the quality, protection ability and comfort of PPE have been pointed out to be the effective factors in their use [39]. Our study findings showed that applying methods such as using multiple PPE on top of each other to increase the sense of protection is a factor that can be effective in the presence of PPE-related skin problems. These methods applied by HCWs are important since they increase the exposure to etiological factors in the development of skin problems associated with the use of PPE. For example, although it is recommended to use double gloves to reduce the risk of viral contamination during the removal stage of PPE [40], in some studies, an increase in the frequency of handwashing and disinfectant use, along with the use of gloves worn in more than one, have been shown possibly to contribute to the development of skin problems [19]. These findings, in addition to supplying PPEs for HCWs in the right quantity, timely and of sufficient quality, also highlight the need for training that focuses on the risks and benefits of PPE use and correct recommendations for PPE use.

Preventing skin-related problems that may develop due to the use of PPE is important for maintaining skin integrity as well as making the working conditions of HCWs safer and more comfortable during the use of this equipment [9, 12]. In the recommendations made by National Pressure Injury Advisory Panel (NPIAP), it has been reported that HCWs should relieve the areas at least 5 min every 2 h to protect the skin from the pressure caused by the N95 respirator in the contact areas, and thin prophylactic dressings in the form of strips can be used for the nasal bridge, cheekbones and behind the ears that are in contact with masks or loops. Furthermore, cleaning and drying the face with pH-balanced cleansers before putting on the face masks, protecting the skin moisture, and applying liquid protectors to the areas that the mask comes into direct contact with are recommended in order to prevent PPE-related skin injury [41]. It has also been reported that the use of moisturizing hand cream may prevent the development of side effects on the skin related to hand washing and the use of gloves [8, 15, 26]. Our study findings indicated that half of the HCWs applied similar preventive measures as recommended in the literature. Moreover, in this sample, among participants who used preventive measures, the number of participants who reported not being exposed to a skin-related problem was significantly higher. Benefits of the use of prophylactic dressings and methods that redistribute or reduce pressure in areas where pressure is intensified and repetitive friction are present due to long-term use of PPEs and moistening the hands in the right way and appropriate amount have been also supported by various studies [12, 42, 43].

4.1. Limitations

The fact that the skin problems associated with the use of PPE, reported of developing by healthcare professionals, are based on self-reports of the participants and not diagnosed by researchers was the main limitation of this study. Another limitation is that the findings of this study were limited to 297 participant HCWs, who could be reached online for a given period of time, working in a hospital in the Aegean region of Turkey. These limitations may restrict that the results obtained may not be generalized to the whole population of HCWs.

5. Conclusion

In this study, we used an online questionnaire to identify the prevalence and contributing factors of skin-related problems due to PPE use in a population of HCWs in Turkey. Our results revealed the presence of skin problems in the vast majority of participating HCWs associated with the use of at least one PPE. Furthermore, the presence of skin-related problems developing due to the use of PPE was mostly associated with the use of surgical/N95 mask respirators and gloves. Moreover, skin-

related problems were more likely to occur in HCWs who used PPE in a shift >4 h, those taking additional measures to increase the sense of protection, and those not applying preventive measures while using PPE. Given the results of this and similar studies in the literature, it seems that more efforts are needed to reduce the prevalence of skin-related problems that can happen due to PPE use. Therefore, we recommend, in health institutions, the plans to be made focusing on employee health, ergonomics and comfort, plans to be made for shorter shifts with PPEs since it is a major risk factor, to organise training emphasizing the correct use of PPEs and skin-related preventive measures, and to provide PPEs that are user and skin-friendly, with high quality to users.

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Conflicts of interest

The authors declare no conflict of interest.

Declaration of competing interest

The authors declare no conflict of interest.

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