Original Article

The risk of occupational contact dermatitis in COVID-19 isolation ward setting

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Abstract

Background The preventive measures of coronavirus disease-19 (COVID-19) transmissions require the healthcare workers (HCWs) to be more cautious. Irritants or allergens exposure from these measures might induce adverse skin reactions and lead to the development of occupational contact dermatitis (OCD).

Methods Questionnaires were distributed to HCWs in COVID-19 isolation ward of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. The questionnaire consisted of personal and work characteristics, clinical history, skin complaints, and occupational exposures.

Results Fifty-three completed questionnaires were gathered from eligible subjects. History of atopic dermatitis (AD) was found on 8 subject (15.09%). Many of the subjects had complained of dry skin (28.30%), itchy skin (26.41%), and redness of skin (20.75%) on the hands in the last 12 months. As many as 50.94% of the subjects washed their hands with water and soap at least 6-10 times a day and 49.06% used hand sanitizers 6-10 times a day. The use of PPE were mostly 4 hours a day or less. There were associations between history of AD with complaints related to hand dermatitis (p=0.004) and history of AD with incidence of OCD assessed with Mathias criteria (p=0.016). It was also found that the use of gloves for 2 or more hours a day was associated with skin complaints after gloves use (p=0.021) and the use of hand sanitizer for more than 10 times a day was associated with complaints related to hand dermatitis (p=0.041).

Conclusion The repeated and prolonged exposure to irritative or allergenic substances contained in PPE and hand hygiene products is related to OCD, particularly hand dermatitis, among HCWs in COVID-19 isolation ward.

Key words
Occupational dermatitis, Health personnel, Personal protective equipment, Hand hygiene, Human and Disease.

Introduction

The preventive measures of COVID-19 transmissions require the healthcare workers to be more cautious and perform hand hygiene frequently as well as wear personal protective equipment (PPE) when working. The use of specific PPE for HCWs to prevent the transmission of COVID-19 is recommended by WHO. For HCWs who provide direct care to COVID-19 patients, the use of PPE such as gown, gloves, face shield or goggles, and surgical mask is mandatory. The use of N95 mask or equivalent is needed in places with aerosol-inducing procedures.[1] Frequent hand

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washing with soap and water or hand sanitizer with at least 60% alcohol is also recommended as one of the preventive measures.[2]

The effects of prolonged wear of PPE and frequent hand hygiene to the skin had been studied in many countries. A study in Ireland found that 82.6% (223 of 270) HCWs of an Irish hospital reported symptoms of dermatitis with hands as the most prevalent site (76.47%) and dry skin as the most complained symptom (75.37%).[3] Meanwhile, a study reported that 74.5% (280 of 376) of the HCWs from several hospitals in Wuhan, China, had complained of skin reactions due to the infection prevention procedures. The most prevalent site were hands (84.6%), cheeks (75.4%), and nasal bridge (71.8%). This number was much higher than the number of OCD during the SARS outbreak which was 21.4-35.5%.[4] From these studies, it was shown that hand dermatitis and facial dermatoses were the most common occupational skin diseases among the HCWs since the COVID-19 pandemic. These skin diseases can have a negative impact on HCWs' motivation, productivity, and quality of life. Inadvertent violations of the preventive measures may occur as a result of seeking alleviation from such symptoms, increasing the chance of COVID-19 transmission.[5]

Significant decrease in natural moisturizing factor and increased transepidermal water loss (TEWL) after repeated exposure of detergent (sodium lauryl sulphate) and alcohol on hand sanitizer was reported on researches.[6] Frequent hand hygiene might exacerbate symptoms in people who already have skin barrier impairment, such as atopic dermatitis (AD).[7] The ability of the skin barrier to offer physical, chemical, and biological protection against the external environment is very important. When the barrier is disrupted, it is not only a risk factor for OCD, but it is also linked to a poor clinical outcome. People with previous or present AD, is linked to the increase risk of developing hand dermatitis, particularly irritant contact dermatitis (ICD) by 3-fold.[8] Various irritant or allergen exposures in healthcare setting might induce adverse skin reactions, especially during COVID-19 pandemic and the mandatory infection prevention measures for HCWs. This research aimed to study the risk of occupational contact dermatitis among healthcare workers in COVID-19 isolation ward.

Methods

This descriptive study was held by distributing questionnaires to the healthcare workers in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. The inclusion criteria for this study were healthcare workers who actively working in the COVID-19 isolation ward and had agreed to participate on the study. The questionnaire consisted of personal and work characteristics, clinical history, skin complaints, and occupational exposures. The data were extracted in Excel spreadsheets (ver.2016, Microsoft) and statistical analysis was done using SPSS software (ver.26, IBM). This study had received ethical clearance from Ethical Committee of Dr. Soetomo Academic General Hospital Surabaya, Indonesia (No. 0160/KEPK/III/2021).

Results

Fifty-three completed questionnaires were gathered from eligible subjects. The subjects were consisted of 69.81% female and 30.19% male, with mean age of 33.53±4.37 years old. Nurses (69.81%) and midwives (26.42%) dominated the population of the study. Most of the subjects had worked as healthcare worker for less than 1 year (32.08%) and worked 40-49 hours per week (71.70%). Characteristic of the subjects can be observed in **Table 1**. The subject's history of allergic disease was assessed

Table 1 Subject characteristics.

Characteristics	*Total (%)*
Gender	
Female	37 (69.81)
Male	16 (30.19)
Age Group (years old)	
25-29	9 (16.98)
30-34	19 (35.85)
35-39	21 (39.62)
40-44	3 (5.66)
≥45	1 (1.89)
Profession	
Resident doctor	2 (3.77)
Nurse	37 (69.81)
Midwife	14 (26.42)
Working history	
Less than 1 year	17 (32.08)
1-5 years	6 (11.32)
6-10 years	13 (24.53)
11-15 years	15 (28.30)
More than 15 years	2 (3.77)
Working hours per week	
Less than 30 hours	2 (3.77)
30-39 hours	7 (13.21)
40-49 hours	38 (71.70)
50 hours or more	6 (11.32)

Table 2 History of allergic disease.

	Total (%)
History of atopic disease*	
Allergic eye reaction to pollen, animal fur, etc.	10 (18.87)
Atopic dermatitis	8 (15.09)
Hay fever	8 (15.09)
Asthma	2 (3.77)
History of hand dermatitis	
Positive history of hand dermatitis	31 (58.49)
Location*	
Hands (palm/back of the hand)	28 (52.83)
Wrists or lower arms	12 (22.64)
Improvement of symptoms when not working	19 (35.85)

*One subject might have more than 1 answer.

in the questionnaire (**Table 2**). History of other allergic eye reactions from pollen, animal fur, or other substance was found on 10 subjects (18.87%). Furthermore, it was found that 8 subjects (15.09%) had history of atopic dermatitis and 8 subjects (15.09%) had history of hay fever. Approximately 3 subjects had both history of atopic dermatitis and hay fever. There are 31 subjects (58.49%) with history of hand dermatitis. There were 19 subjects (35.85%) who confessed of improving symptoms when they were away from work.

Table 3 Hand dermatitis symptoms

Type of symptoms*	Total (%)
Dry skin, chipped/scaly skin	15 (55.56)
Itchy skin	14 (51.85)
Redness of skin	11 (40.74)
Wheal	8 (29.63)
Teared/cracked skin	6 (22.22)
Papules	5 (18.51)
Pain	5 (18.51)
Small blisters filled with fluid (vesicles)	2 (7.41)
Burning/stabbing/stinging sensation	1 (3.70)
Discharge/crusty skin	1 (3.70)

*One subject might have more than 1 answer.

Table 3 shows the symptoms of hand dermatitis that the subjects experienced in the last 12 months. The symptoms could appear in the hands, wrists, and lower arms. From 27 subjects who complained of hand dermatitis, the most prevalent complaint was dry skin (55.56%), followed by itchy skin (51.85%), redness of skin (40.74%), and wheal or urticaria (29.63%). The least complained symptoms are burning/stabbing/stinging sensation and presence of discharge/crusty skin. Furthermore, sixteen subjects (30.19%) confessed of experiencing dry or itchy skin after wearing gloves at work. After further investigation, as many as 13 subjects (24.53%) had met the Mathias criteria for OCD.

Infection prevention measures including hand hygiene and the use of PPE might be related to the risk of dermatitis in occupational setting among the healthcare workers. As shown in **Table 4**, 50.94% of the subjects washed their hands with water and soap at least 6-10 times a day, 22.64% washed hands 11-20 times a day, while 16.98% washed hands more than 20 times a day. Most of the subjects use hand sanitizers 6-10 times a day (49.06%). The use of PPE were mostly 4 hours or less, this was caused by the hospital's isolation ward policy to serve the

Table 4 Risk of contact dermatitis among healthcare workers.

	Times per day, n (%)			
Hand hygiene frequency	≤5	6-10	11-20	≥20
Hand washing	5 (9.43)	27 (50.94)	12 (22.64)	9 (16.98)
Hand sanitizer use	15 (28.30)	26 (49.06)	6 (11.32)	6 (11.32)
	Hours per day, n (%)			
Duration of PPE use	1-2	2-4	4-6	>6
N95 mask	5 (9.43)	34 (64.15)	8 (15.09)	2 (3.77)
Surgical mask	0 (0)	18 (33.96)	10 (18.87)	20 (37.74)
Gloves	5 (9.43)	38 (71.70)	4 (7.55)	1 (1.89)

COVID-19 patients for 3-4 hours per shift. However, the use of surgical mask was mostly more than 6 hours per day (37.74%) as the use of mask especially in public spaces was mandatory.

Statistical analyses of the study had found significant associations between history of AD with complaints related to hand dermatitis (p=0.004) and history of AD with incidence of OCD assessed with Mathias criteria (p=0.016). It was also found that the use of gloves for 2 or more hours a day was associated with skin complaints after gloves use (p=0.021) and the use of hand sanitizer for more than 10 times a day was associated with complaints related to hand dermatitis (p=0.041).

Discussion

Personal protective equipment (PPE) use during the COVID-19 pandemic has been linked to an increase in report of occupational skin problems.[9] History of atopy, wet work, glove use, hand washing, and work duration are some of the risks for hand dermatitis among HCWs.[10] Skin problems and a higher risk of contact sensitization can result from frequent and prolonged use of sterilizing products, such as hand soaps, disinfectants, detergents, as well as frequent exposure to water.[9,11] Furthermore, the most often reported contact allergens causing occupational contact dermatitis (OCD) among HCWs are rubber gloves, preservatives, and fragrances. A study in Sweden found that the incidence of OCD among HCWs was 62% and 11% of the OCD cases were diagnosed as occupational contact allergy after patch testing.[12]

The subjects in this study were dominated with females and nurses, which is similar with the population of several studies about skin problems among HCWs during COVID-19 pandemic.[3,4] A study on contact dermatitis (CD) in non-HCWs discovered that women made up the majority of CD patients with 79.5% (291 out of 367). Female skin generates slightly less sebum than males. Moreover, the older the age, skin becomes thinner due to the breakdown of collagen. This demonstrates that women are at higher risk in CD than males.[13] The increase in reported skin problems in HCWs were associated with female sex, inpatient wards HCWs, and HCWs in hospitals with severe epidemic according to a study in Wuhan, China.[4] The working hours per week, however, was not correlated with the incidence of OCD, therefore more focus was put on the analysis of the duration and frequency of PPE use and hand hygiene. Skin problems related to the use of full-body PPE for more than 6 hours a day was found to be significant with odds ratio of 2.44.[4]

Hand dermatitis had prevalence of 14% among the HCWs[14] while, on other study the number of prevalence can be as high as 80.21%.[15] Approximately 50.94% of the subjects in this study reported symptoms of hand dermatitis with dry or chipped skin as the most complained symptom. Other prevalent hand skin related

symptoms found in other studies including redness, itch, and fissures.[15] Clinically, ICD and allergic contact dermatitis (ACD) may look identical. During the acute phase, both might exhibit erythema, papules, and vesicles. During the chronic phase, scaling, lichenification, and fissures are frequent. Pruritus, discomfort, or burning sensations may be present in ICD and ACD during both acute and chronic forms, however pruritus appears more often in ACD.[16] The use of hand sanitizer for >10 times a day was found to be associated with reported hand dermatitis symptoms. Meanwhile, no significant association was found between hand washing and hand dermatitis symptoms in this study. The duration of gloves use for ≥2 hours a day was associated with skin complaints after gloves use. A study found that hand washing with soap and water >20 times a day and duration of gloves use for >3 hours a day were associated with hand dermatitis.[14] Another study in Hubei, China found that frequent hand hygiene for more than 10 times a day could increase the risk of hand dermatitis with odds ratio of 2.17.[17]

Irritant contact dermatitis (ICD) has been found to be related to frequent use of hand hygiene products, such as soaps and detergents. Hand hygiene products can harm the skin by inducing alterations in intercellular lipids (either reduction or restructuring of lipid moieties), lowered corneocyte cohesiveness, and impaired stratum corneum water-binding capacity. Frequent hand washing causes a gradual loss of surface lipids, which allows detergents to penetrate deeper into the top layers of skin. Furthermore, alcohols in hand sanitizers can cause dryness and skin irritation even though they are safer than detergents. Ethanol is found to be less irritating than n-propanol or isopropanol.[1] On the other hand, thiurams, a commonly found substance in surgical gloves, is one of the most prevalent rubber contact allergens reported in HCWs. Additionally, increase in the number contact allergy to other substances of surgical gloves, such as diphenylguanidine and carba-mix have been more common over the past few years.[12] Gloves also have occlusive effects and the combination between occlusion and exposure to soaps/detergents may cause skin barrier impairment caused by soaps/ detergents in a dose-response relationship.[18]

Atopic dermatitis is one of the internal factors of OCD.[8] Atopic predisposition has been identified as a well-known risk factor for higher vulnerability to ICD or hand dermatitis.[19] Frequent hand hygiene may exacerbate symptoms in people who already have skin barrier impairment, such as AD. Hapten penetration through the epidermis is more likely in AD patients with skin barrier impairment. AD may relapse after being exposed to chemicals repeatedly, particularly those that irritate the skin.[8] Research on people with AD have shown that exposure to alcohol in hand sanitizers and detergents in soaps decreased the natural moisturizing factor and increased TEWL compared to healthy controls.[7] In this study, history of AD was significantly associated with hand dermatitis symptoms as well as OCD. However, history of previous hand dermatitis, other atopic disease such as hay fever, asthma, and other history of allergy were not associated with hand dermatitis and OCD. Other study had also found association between history of AD with hand dermatitis and facial dermatoses.[14]

Conclusion

The repeated and prolonged exposure to irritative or allergenic substances contained in PPE and hand hygiene products is related to OCD, particularly hand dermatitis, among HCWs in COVID-19 isolation ward especially to those with AD predisposition.

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