Vol. 34 / No. 2 / August 2022
Sinta 2 (Decree No: 200/M/KPT/2020)
Online ISSN : 2549-4082 ; Print ISSN : 1978-4279
Available online at https://e-journal.unair.ac.id/BIKK

Berkala Ilmu Kesehatan Kulit dan Kelamin
Periodical of Dermatology and Venereology

Original Article

Hand Eczema in Nurses in COVID-19 Treatment Room: Frequency of Handwashing, Hand Sanitizer, Moisturizer, and Duration of Latex Gloves Use

Ervina Rosmarwati[1], Suci Widhiati[2], Dita Eka Novriana[1], Alfina Rahma[1], Harijono Kariosentono[2], Muhammad Eko Irawanto[2], Arie Kusumawardani[2], Endra Yustin Ellistasari[2], Triasari Oktavriana[2]

[1]Recidency Program in Dermatovenereology Departement, Dr. Moewardi General Hospital/Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia
[2]Dermatovenereology Departement, Dr. Moewardi General Hospital/Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia

ABSTRACT

Background: The COVID-19 pandemic causes health workers to use level 2 and level 3 personal protective equipment. Hand washing and the use of latex gloves are important in limiting the spread of COVID-19, but they can potentially induce hand eczema and skin pH disturbance if used too frequently. **Purpose:** Determine the correlation between the frequency of handwashing and duration of using hand sanitizer and moisturizer as well as skin pH level on the incidence of hand eczema in nurses in the COVID-19 treatment room at RSUD Dr. Moewardi Surakarta. **Methods:** This cross-sectional study was conducted in the COVID-19 treatment room at RSUD Dr. Moewardi Surakarta with 90 nurses as subjects. A validated questionnaire carried out the frequency of handwashing, hand sanitizer, moisturizer, duration of using latex gloves, and hand eczema complaints. The subject's pH assessment was conducted after 4-5 hours in the COVID-19 treatment room. Data were analyzed bivariately with a Spearman rank correlation test. **Result:** There was a significant correlation with the incidence of hand eczema with the frequency of handwashing with soap (r=0.305 and p=0.003) and the duration of using latex gloves (r=0.328 and p=0.002) with a weak category correlation (r=0.200-0.399). The frequency of using hand sanitizer, moisturizer, and skin pH did not correlate with the incidence of hand eczema. **Conclusion:** Frequency of handwashing and the duration of using latex gloves correlated with the incidence of hand eczema, meanwhile frequency of using hand sanitizer, using moisturizer, and skin pH didn't correlate with the incidence of hand eczema.

Keywords: COVID-19, hand eczema, latex glove, nurse.

Correspondence: Suci Widhiati, Dermatovenereology Departement, Dr Moewardi General Hospital/Faculty of Medicine Sebelas Maret University, Surakarta; Address: Dr Moewardi General Hospital, Jl Kol Sutarto 132 Jebres Surakarta Central Java Indonesia, Email: suciwidhiati@staff.uns.ac.id, Phone: +62 271634634

| Article info |
Submited: 31-12-2022, Accepted: 09-02-2022, Published: 31-07-2022

BACKGROUND

Coronavirus disease 2019 (COVID-19) is a serious health problem worldwide caused by the severe acute respiratory syndrome coronavirus (SARS-CoV-2). SARS-CoV-2 is transmitted through direct or indirect contact or through exposure to COVID-19 contaminants. Thus, appropriate prevention needs to be made to break the chain of transmission.[1,2] Medical personnel are at a higher risk of being exposed to COVID-19. Therefore, one of the preventive measures recommended by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) is to wash hands frequently and use personal protective equipment (PPE).[2]

According to WHO, performing six steps of handwashing using soap and running water and occupying five moments to wash hands with soap could prevent the transmission of the virus.[2,3] Hand washing using soap can be replaced with hand sanitizer or hand rub, except when exposed to liquids from the

patient, which must be rinsed using running water. Hand sanitizer contain 70% or 75% alcohol, effectively killing viruses or bacteria. Research by Wicaksono et al. reported that the frequency of handwashing was increased by health workers during the COVID-19 pandemic (≥ 20 times a day) with 70% alcohol and hand soap, causing hand dermatitis in the form of irritant contact dermatitis (ICD) by 66% and allergic contact dermatitis (ACD) by 34%.[4,5]

In treatment rooms for COVID-19, health workers, especially nurses, must use Level 3 PPE with a layered latex glove for a longer time than other health workers. Nurses also wash their hands more often than other health workers, making them more susceptible to hand eczema. The average duration of using latex gloves generally reaches 3-10 hours, which is prone to developing eczema initially. Research conducted by Huang et al. reported that health workers who used latex gloves more than 10 hours per day mostly experienced hand eczema symptoms due to latex.[5,6]

Hand eczema is a recurrent inflammatory skin disease characterized by red skin lesions, papules, vesicles, scales, itching, and pain. Recurrent hand eczema can interfere with daily activities and cause psychological disorders, which commonly occur in health workers.[4,6] Based on this description, the purpose of this study was to determine the correlation between the frequency of handwashing and the duration of using latex gloves on the incidence of hand eczema. In addition, this study hopefully would provide beneficial information to prevent hand eczema, especially for health workers during the COVID-19 pandemic.

METHODS

This is a hospital-based cross-sectional study conducted in the COVID-19 treatment rooms at Dr Moewardi Surakarta. The time of the study was carried out from May to July 2021. The study population was all nurses who served in the COVID-19 treatment rooms at RSUD Dr Moewardi Surakarta. The inclusion criteria for this study were nurses diagnosed with hand eczema based on anamnesis, physical examination, and the 2015 European Society of Contact Dermatitis (ESCD) diagnostic criteria, in good general condition, over 18 years of age, and willing to sign a consent form. Subjects with a history of tinea manus, psoriasis, cutaneous candidiasis, and pompholyx were excluded from this study.

Assessment of hand eczema using an occupational hand eczema questionnaire by Guertler et al. in 2020, validated by the Department of Dermatology and Allergy University Hospital of Munich, Germany. The questionnaire was classified into questionnaire sections 1,2, and 3. Questionnaire 1 discussed the history of atopy and smoking, including the number of cigarettes consumed in a day and the type of atopy the subject had (Asthma, Allergic Rhinitis, Atopic Dermatitis, Others, specify like drug or food allergies). Part 2 of the Handwashing Questionnaire asks about handwashing frequency (times), hand sanitizer (times), and use of latex gloves (hours per day). The last part, which is part 3 of the questionnaire, asks about self-reported diagnosis filled out by each subject regarding the symptoms of hand eczema, including dry, scaly, itchy, cracked skin, red patches, heat, and pain. The hand eczema category is met if at least one complaint is found in the subject. The questionnaire also evaluates the frequency of washing hands with soap per day, using hand sanitizers per day, the duration of using latex gloves, and using moisturizer per day. The evaluation results were then associated with complaints of hand eczema in the subject.

The skin's acidity level (pH) was measured in a closed room with a temperature of 20-22°C, measured using PH100: ExStik® pH Meter (Extech, United States). Research subjects rested for 10-15 minutes before taking measurements to get the same conditions in all subjects. The area to be measured is cleaned with 0.9% NaCl and dried using a tissue, then the end of the pH meter tube is affixed vertically until the value appears on the monitor screen. Measurements were made on both palms three times in a row for 30 seconds with the same emphasis, and then the average value was calculated.

The Spearman test was conducted to find a correlation between the incidence of hand eczema and the frequency of handwashing with soap, the frequency of using hand sanitizer, the duration of using a latex glove, the frequency of use of hand cream, manifestations of hand eczema, and the pH value of the skin. All data were analyzed with SPSS version 21 software (IBM, Chicago, IL, USA) at a significance level of $p<0.05$. This research has received ethical approval from the Health Research Ethics Committee of RSUD Dr Moewardi/Faculty of Medicine, Sebelas Maret University, Surakarta, with the number: 379/III/HREC/2021. All data obtained will be kept confidential and only used for research and scientific purposes.

RESULT

The results showed that the demographic data of 90 research subjects were female, as many as 55 subjects (61.1%), with an average age was 33±0.7 years old. Most of the subjects (40.0%) wash their hands with soap 5-10 times a day. However, only

28.9% used hand sanitizers 5-10 times. Using latex gloves mainly for 3-5 hours in 50 subjects (55.6%). Using a moisturizer was mostly 1-2 times in 47 subjects (52.2%). Based on the questionnaire, there were 20 people who experienced hand dermatitis. The most common manifestation of hand eczema was as dry skin in 61 subjects (67.8%). Complaints of hand eczema, mostly 1-2 complaints, were found in 42 issues (46.7%), with the average skin pH value of all subjects being 7.14 ±0.4 (Table 1).

Table 1. Characteristics of research subjects with hand eczema

Variable	n (%) Mean± SD
Gender	
Woman	55 (61.1%)
Man	35 (38.9%)
Age	33±0.7
Frequency of hand washing	
<5 times	9 (10.0%)
5-10 times	36 (40.0%)
11-20 times	19 (21.1%)
21-30 times	15 (16.7%)
>30 times	11 (12.2%)
Frequency of using hand sanitizer	
5-10 times	26 (28.9%)
11-20 times	26 (28.9%)
21-30 times	22 (24.4%)
>30 times	16 (17.8%)
Duration of using latex glove	
<3 hours	14 (15.6%)
3-5 hours	50 (55.6%)
5-8 hours	12 (13.3%)
8-10 hours	9 (10.0%)
>10 hours	5 (5.6%)
Frequency of using moisturizer	
Never	31 (34.4%)
1-2 times	47 (52.2%)
3-5 times	9 (10.0%)
6-10 times	3 (3.3%)
Manifestations of hand eczema	
Dry skin	61 (67.8%)
Scaly	27 (30.0%)
Itch	26 (28.9%)
Cracked	21 (23.3%)
Red stain/purpura	13 (14.4%)
Feels Hot	12 (13.3%)
Pain	6 (6.7%)
Skin pH	7.14±0.4
Fulfill the criteria for hand eczema	20(22.2%)
Does not fulfill the criteria for hand eczema	70(77.8%)

Notes: pH=acidity level

Table 2. Correlation between handwashing and duration of using latex gloves on hand eczema

Variable	Frequency of hand washing	Frequency of hand sanitizer	Duration to use latex glove	Frequency of moisturizer	Skin pH
Hand eczema	r = 0.305 p = 0.003	r = 0.091 p = 0.394	r = 0.328 p = 0.002*	r = 0.095 p = 0.371	r =0.042 p =0.696

*Significantly correlated if p<0.05

Figure 1. An example of hand eczema case discovered in this study.

The Spearman rank correlation test was used to analyze the correlation findings for numerical and ordinal data. The results showed a significant relationship between the incidence of hand eczema with the frequency of handwashing with soap (r=0.305, p=0.003) and the duration of using latex gloves (r=0.328, p=0.002). However, the correlations were weak. The more frequently the subjects wash their hands and the longer they use latex gloves, the more frequent hand eczema complaints appear. Variables that did not correlate with the incidence of hand eczema were the frequency of using hand sanitizer (r=0.091, p=0.394), the frequency of using moisturizer (r=0.095, p=0.371), and skin pH (r=0.042, p=0.696) (Table 2).

DISCUSSION

One of the most critical efforts to prevent and reduce the transmission of COVID-19 infection is washing hands with soap which contains antimicrobial components that can destroy the integrity of the viral membrane. Research by Chandler et al. reported that health workers in China wash their hands with

antiseptic soap more than ten times a day, but only 22.1% use moisturizer after washing their hands, so the incidence of hand eczema has increased significantly.[7,8]

The frequency of handwashing often causes repeated exposure to water and the content of hand soap, which is often allergenic and irritating. The ingredients of hand soap that most often cause ICD and ACD are sodium lauryl sulfate (SLS) and surfactants. The use of hand soap more than ten times a day without using a moisturizer afterward can cause damage to the skin barrier through the mechanism of keratinocyte damage, increased transepidermal water loss (TEWL), the release of proinflammatory cytokines, activation of the innate and adaptive immune systems, and delayed-type hypersensitivity reactions. Damage to the skin barrier accompanied by the entry of irritants and allergens into the epidermis will cause hand eczema with manifestations in the form of dry skin, ACD, and ICD.[7,9]

This study showed that the frequency of washing hands with soap was 5-10 times in 36 subjects (40.0%). This result is different from the research by Hu et al., who reported that 66.1% of health workers washed their hands more than ten times per/day. Guertler et al. stated that the majority of health workers (38.9%) washed their hands 10-20 times a day during the COVID-19 pandemic,[9,10] The difference between these two results could be due to differences in the number of samples and policies in each hospital. The frequency of handwashing with the incidence of hand eczema has a positive correlation with a weak category (r=0.305, p=0.003). This correlation is in accordance with research by Longuenesse et al. who reported that a high frequency of handwashing correlated with hand eczema with the main complaints of dry skin, redness, and itching with a value of $p < 0.05$, namely $p = 0.001$. Techasatian et al. showed that health workers had a 1.85 times greater risk of experiencing hand eczema than controls. The high frequency of handwashing correlates with the incidence of hand eczema due to damage to the skin barrier, making it easier for irritants and allergens to enter the skin. [11]

The frequency of using hand sanitizer too often will disrupt the skin barrier. Hand sanitizers generally contain 70-75% alcohol, which is irritating, causing dry skin. Using hand sanitizer more than 10 times per day is at risk of causing hand eczema. Stratum corneum disorders occur due to repeated exposure to alcohol, causing damage to filaggrin, lipid bilayer membranes, and natural moisturizing factor (NMF). Increased TEWL also plays a role in the occurrence of hand eczema.[12]

In this study, the frequency of using hand sanitizers was 5-10 times and 10-20 times, respectively, in 26 subjects (28.9%). Research by Erdem et al. reported that the frequency of using hand sanitizers for health workers was more than 20 times/shift (42.1%).[13] The high frequency of hand sanitizers by health workers prevents infection before and after contact with patients. In this study, the use of hand sanitizer or hand rub did not correlate with the incidence of hand eczema (r=0.091, p=0.394). The insignificant correlation in this study could be caused by the insufficient number of samples, the different alcohol concentrations in each hand sanitizer, and the moisturizing content of the hand sanitizer. The gender factor affects the incidence of hand eczema due to hand sanitizers. The incidence of hand eczema is more common in women due to having a thinner skin layer (epidermis and dermis), so allergens and irritants are more easily absorbed.[13,14]

Latex gloves made of latex or rubber are allergenic and irritating to the skin. Diphenyluanidine (DPG) content in latex gloves can cause ICD and ACD.[15,16] Health workers are at a higher risk of developing hand eczema due to latex gloves due to the increased duration of exposure to latex allergens. Research by Kampf and Lemmen also states that using latex gloves, especially rubber-based ones, by health workers will increase the risk of developing hand eczema. The damaged skin barrier causes allergens such as latex to quickly enter and trigger type I and type IV hypersensitivity responses.[16,17] The process of ACD due to latex begins when latex penetrates to the stratum corneum and is considered a hapten by the immune system and then goes through a process of sensitization and elicitation. Keratinocytes, upon sensitization, will release inflammatory mediators such as interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF-α) to activate T cells upon first exposure. Subsequent exposure will trigger the elicitation process, characterized by the formation of memory T cells that have been sensitized by hapten, which will then release inflammatory mediators such as IL-1, IL-6, TNF-α, and histamine due to mast cell degranulation. The process of the occurrence of ICD does not involve the immune system. Irritants penetrate cell membranes, activate phospholipases, and secrete arachidonic acid, which releases prostaglandins and leukotrienes, triggering inflammation.[17]

This study showed that the majority of subjects' use of latex gloves was 3-5 hours in 50 subjects (55.6%). The time of use of latex gloves in this study was positively correlated with the incidence of hand eczema (r=0.328, p=0.002). This result is different from the research by Hu et al. who reported that health

workers who experienced symptoms of hand eczema used latex gloves for an average duration of 10 hours per day for 3.5 months.[9] Hamnerius et al. found an association between latex glove use and hand eczema, with a result of 6% in the health worker group and 1% in the control group, with p=0,02. The difference between the results of this study and the research of Hu et al. is related to the duration of using latex gloves. It can be caused by differences in working time between nurses in Indonesia and nurses in other countries, so the different periods of using latex gloves.[8,13] The results of the correlation between the duration of using latex gloves and the incidence of hand eczema in this study follow research by Hamnerius et al. because the use of latex gloves is the leading cause of ACD in health workers, especially nurses. Allergic contact dermatitis is a skin disorder that most often causes occupational hand eczema after going through the elicitation process of type IV hypersensitivity due to repeated exposure.[15,17]

Clinical symptoms of hand eczema vary, such as dry, scaly, itchy skin, fissures, red patches, burning sensation, and pain. The research subjects who met the criteria for the diagnosis of hand eczema in this study were 22%. In this study, the most common manifestation of hand eczema was dry skin in 61 subjects (67.8%) and scaly skin in 27 subjects (30.0%). This is in accordance with the literature that states that hand eczema manifestations that are often found in health workers are ICD, ACD, and dry skin (xerosis cutis).[18] Guertler et al. reported that dry skin (83.2%) was the most common symptom of hand eczema among health workers, followed by scaly skin (18.4%). Irritants that enter during the occurrence of ICD will damage the stratum corneum and cause denaturation of keratin. The layer of fat that functions as the main component of the epidermis is also eroded, so that the skin is easily dry, peeling, and scaly. Allergic contact dermatitis begins when allergens or haptens penetrate the epidermis, then are processed by antigen-presenting cells (APCs), presented to T lymphocytes, and trigger inflammation. Repeated exposure to allergens in ACD will cause the loss of NMF so that the skin becomes dry and scaly. The increase in TEWL due to damage to the skin barrier in ACD also causes the skin to become dry, even peeling in cases of chronic ACD.[19]

The average skin pH value is between 4.2-5.6, which is needed in skin barrier homeostasis such as lipid metabolism, bilayer and ceramide structures, and desquamation, thus protecting the skin surface from bacterial colonization. Exposure to soap/cleaning agents, alcohol, and other irritants affects the structure and function of the skin, including disruption of the composition and structure of the lipid bilayer of the skin's surface, which causes an increase in pH and triggers epidermal inflammation, increased permeability, and microbiome development. This process causes susceptibility to infection and triggers hand eczema.[20]

The average pH value of the skin of the palms of the subjects of this study was 7.14±0.4, higher than the moderate findings. This is possibly due to an increase in the skin pH of health workers' hands due to the long-term use of latex-based latex gloves.[21] However, Wang et al. stated that an increase in pH was more common in occupational hand eczema ($p < 0.01$) [21,22], though our results showed that the pH value was not correlated with the incidence of hand eczema ($r=0.042$, $p=0.696$). The correlation between skin pH values and the incidence of hand eczema, which was not significant, could be caused by the frequent use of hand sanitizer or hand rub on health workers who contain alcohol. The weak acid in alcohol can cause an insignificant decrease in the pH value.[22,23]

Moisturizer is an emollient, humectant, or occlusive type of substance. Emollients work by forming an additional lipid layer on the epidermis. In contrast, humectants work by increasing the water storage capacity of the stratum corneum and attracting water from the outer environment of the epidermis. Occlusive moisturizers create a protective layer over the epidermis, thereby preventing water evaporation. The use of moisturizer is needed to avoid hand eczema in health workers due to exposure to soap, alcohol, or other irritants that make the skin dry. Moisturizer should be applied immediately after washing hands with soap or using hand sanitizer as often as possible to prevent hand eczema.[24]

This study reported that the highest frequency of using moisturizer was 1-2 times per day in 47 subjects (52.2%). Research by Dowdle et al. stated that during the COVID-19 outbreak in China, as many as 66.1% of health workers washed their hands >10 time per day, but only 22.1% of subjects used moisturizers. Another study by Erdem et al. reported that as many as 22 subjects (41.5%) never used moisturizer after washing their hands and only used moisturizer after hand eczema appeared. In this study, the use of moisturizer was not statistically correlated ($r=0.095$, $p=0.371$).[16] The results are different from the study by Kampf and Ennen, who reported that moisturizer was correlated with a decrease in the incidence of hand eczema. The difference between these two results may be due to the lack of sample size and some confounding factors that were not evaluated, such as the type of moisturizer or moisturizer used.[24]

The damaged skin barrier also increases TEWL, thereby triggering the inflammatory process in hand eczema. Research by Bauer et al. in 2018 in Germany stated that moisturizer has a protective effect in primary prevention of hand eczema and dry skin due to hand hygiene. Humectants and emollients in moisturizers can improve the skin barrier function, fill small gaps in the epidermis, act as a protective layer for the epidermis, and increase the fluid level in the epidermis. Humectants such as glycerin and urea have the property of attracting water into the stratum corneum and retaining moisture in the stratum corneum. Emollient-type moisturizers such as ceramides work by filling the spaces in the intercellular gaps between keratinocyte cells and forming a barrier in the stratum corneum.[25]

The advantages of this study are assessing the correlation between the frequency of handwashing and the use of special latex gloves in COVID-19 treatment room nurses that have not been studied before and evaluating the pH of the palms of the skin on each subject. However, the limitation of data that hand eczema complaints were only assessed subjectively by the subject; there was no classification of hand eczema into ACD or ICD and the study did not evaluate the type of moisturizer used, which was a confounding factor in this study.

The frequency of handwashing and the duration of using latex gloves correlate with the incidence of hand eczema. Meanwhile, the frequency of using hand sanitizer, the frequency of using moisturizer, and skin pH didn't correlate with the incidence of hand eczema. Hand eczema due to hand washing and the use of PPE for health workers during the COVID-19 pandemic is increasing, especially for nurses in the COVID-19 treatment room. The high frequency of handwashing and the use of latex gloves for a long time are the main causes of hand eczema. The use of moisturizer after washing hands is necessary to prevent the occurrence of hand eczema and maintain the normal function of the skin barrier.

REFERENCES

1. Shi Y, Wang G, Cai X, Deng J, Zheng L, Zhu H, et al. An overview of COVID-19. J Zhejiang Univ Sci B 2020; 21(5): 1–18.
2. CDC. Centres for Disease Control and Prevention. COVID-19 Using Personal Protective Equipment (PPE). CDC 2021; 2(1): 1-10.
3. Christopher PM, Roren RS, Tania C, Jayadi NN, Cucunawangsih C. Adverse skin reactions to personal protective equipment among health-care workers during COVID-19 pandemic : a multicenter cross-sectional study in Indonesia. Int J Dermatol Venereol 2020; 3(4): 211-8.
4. Wicaksono AJ, Zuhri UM. Hand cleaning activities during COVID-19 pandemic and the manifestation on human skin : a retrospective study. Indones J Pharm 2020; 1(1): 38–46.10
5. Kersh AE, Helms S, Feld S De. Glove-related allergic contact dermatitis. Dermatitis 2018; 29(1): 13–21.
6. Huang D, Tang Z, Qiu X, Liu X, Guo Z, Yang B, dkk. Hand eczema among healthcare workers in Guangzhou city : a cross-sectional study. J Eur Acad Dermatol Venereol 2020; 8(9): 1-7.
7. Rundle CW, Presley CL, Militello M, Barber C, Powell DL, Jacob SE, et al. Hand hygiene during COVID-19: recommendations from the American Contact Dermatitis Society. J Am Acad Dermatol 2020; 83(6): 1730–7.
8. World Health Organization. Rational use of personal protective equipment for coronavirus disease (COVID-19) and considerations during severe shortages. World Health Organization 2020; 1(1): 1-6.
9. Hu K, Fan J, Li X, Gou X, Li X, Zhou X. The adverse skin reactions of health care workers using personal protective equipment for COVID-19. Medicine 2020; 99(24): 206-13.
10. Guertler A, Moellhoff N, Schenck TL, Hagen CS, Kendziora B, Giunta RE, et al. The onset of occupational hand eczema among healthcare workers during the SARS-CoV-2 pandemic: comparing a single surgical site with a COVID-19 intensive care unit. Contact Dermatitis 2020; 83(2): 108–14.
11. Techasatian L, Thaowandee W, Chaiyarit J, Uppala R, Sitthikarnkha P, Paibool W, et al. Hand hygiene habits and prevalence of hand eczema during the COVID-19 pandemic. J Prim Care Community Health 2021; 12(1): 1-7.
12. Hui-Beckman J, Leung DYM, Goleva E. Hand hygiene impacts the skin barrier in health care workers and individuals with atopic dermatitis. Ann Allergy Asthma Immunol 2021; 1(2): 1-6.
13. Alsaidan MS, Abuyassin AH, Alsaeed ZH, Alshmmari SH, Bindaaj TF, Alhababi AA. The prevalence and determinants of hand and face dermatitis during COVID-19 pandemic: a population-based survey. Dermatol Res Pract 2020; 2(1): 1–8.
14. Erdem Y, Altunay IK, Aksu Çerman A, Inal S, Ugurer E, Sivaz O, et al. The risk of hand eczema in healthcare workers during the COVID-19 pandemic: do we need specific attention or prevention strategies?. Contact Dermatitis 2020; 83(5): 422–3.

15. Hamnerius N, Svedman C, Bergendorff O, Björk J, Bruze M, Engfeldt M, et al. Hand eczema and occupational contact allergies in healthcare workers with a focus on rubber additives. Contact Dermatitis 2018; 79(3): 149–56.
16. Kampf G, Lemmen S. Disinfection of gloved hands for multiple activities with indicated glove use on the same patient. J Hosp Infect 2017; 97(1): 3–10.
17. Alluhayyan OB, Alshahri BK, Farhat A, Alsugair S, Siddiqui JJ, Alghabawy K, et al. Occupational-related contact dermatitis: prevalence and risk factors among healthcare workers in the Al'Qassim Region, Saudi Arabia during the COVID-19 pandemic. Cureus 2020; 12(10): 1-7.
18. Elston DM, Ahmed DD, Watsky KL, Schwarzenberger K. Hand dermatitis. J Am Acad Dermatol 2002; 47: 291–9.
19. Agarwal US, Besarwal RK, Gupta R, Agarwal P, Napalia S. Hand eczema. Indian J Dermatol 2014; 59(3): 213-24.
20. Proksch E. pH in nature, humans and skin. J Dermatol 2018; 45(9):1–9.
21. Tiedemann D, Clausen ML, John SM, Angelova fischer I, Kezic S, Agner T. Effect of glove occlusion on the skin barrier. Contact Dermatitis 2016; 74(1): 2–10.
22. Wang X, Ye L, Lai Q, Wen S, Long Z, Qiu X, dkk. Altered epidermal permeability barrier function in the uninvolved skin supports a role of epidermal dysfunction in the pathogenesis of occupational hand eczema. Skin Pharmacol Physiol 2020; 33(2) 94-101.
23. Ahmed-lecheheb D, Cunat L, Hartemann P. American Journal of Infection Control Prospective observational study to assess hand skin condition after application of alcohol-based hand rub solutions. Am J Infect Control 2012; 40(2): 160–4.
24. Kampf G, Ennen J. Regular use of a hand cream can attenuate skin dryness and roughness caused by frequent hand washing. BMC Dermatol 2006; 13(1); 1-6.
25. Bauer A, Schmitt J, Bennett C, Coenraads PJ, Elsner P, English J, et al. Interventions for preventing occupational irritant hand dermatitis. Cochrane Database Syst Rev 2018; 1(4):1-10.