

Hand dermatitis, Prevalence and Risk Factors among Healthcare Workers during the COVID-19

Omolbanin Motamedrezaei^{1,2}, Hamed Lotfi³, Farnaz Jahani³, GholamReza Sharifzadeh⁴,
Hadis Rajabipour⁵, Fereydoon Laal^{6*}

¹ Social Determinant of Health Research Center, Department of Occupational Health, Birjand University of Medical Sciences, Birjand, Iran • ² Instructor of toxicology, Social Determinants of Health Research Center, Faculty of Health, Birjand University of Medical Sciences, Birjand, Iran • ³ Department of Medical Sciences, Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran • ⁴ Social Determinants of Health Research Center, Birjand University of Medical Sciences, Birjand, Iran • ⁵ Student Research Committee, Birjand University of Medical Sciences, Birjand, Iran • ⁶ Social Determinants of Health Research Center, Department of Occupational Health Engineering, Birjand University of Medical Sciences, Birjand, Iran • *Corresponding author: Fereydoon Laal, Email: fereydoonlaal@gmail.com

ABSTRACT

Background: Healthcare workers (HCWs) need to perform new preventive measures to protect themselves and patients against ongoing COVID-19 transmission, which can increase hand dermatitis (HD) among them. This study aims to investigate the prevalence of HD among HCWs and its possible risk factors in IRAN. **Methods:** A survey of 159 HCWS working in university hospitals was performed from August to September 2020 in a cross-sectional study. Research data were collected via standardized self-administered questionnaire. The history of HD was determined via standardized Nordic Occupational Skin Questionnaire (NOSQ-2002). **Results:** The prevalence of HD in the study population was 51.6%. A significant association was found between the prevalence of HD among HCWs and sex, age, working hours per week, and wearing gloves ($P < 0.05$). Females had a 3.84 fold higher risk of HD than males (confidence interval (CI): 1.85-8). HCWs older than 40 and those who aged 30-39 had a 9.6 and 1.72 fold higher risk of HD than those aged 20-29 (CI: 2.6-35.7; CI: 0.87-3.4, respectively). **Conclusion:** Possible risk factors for developing HD among HCWs are female gender, age, wearing gloves, and fewer working hours per week. Preventive measures for HD are needed for HCWs, especially during the COVID-19 pandemic.

Keywords: COVID-19; SARS-CoV-2; Dermatitis; Eczema; Hand; Health Care

Introduction

The Coronavirus disease of 2019 (COVID-19) first appeared in December 2019 in Wuhan, China. Later, the World Health Organization (WHO) declared it a pandemic on March 11, 2020.¹ The Centers for Diseases Control (CDC) and WHO recommended preventive measures to hinder the spread of this novel virus

(SARS-CoV-2). The measures emphasize the importance of social distancing, wearing a facemask and gloves, frequent hand washing with water and soap, or using alcohol-based hand sanitizers.²⁻³ These preventive measures are critical to protect healthcare workers (HCWs), and prevent cross-transmission and spread of pathogens have already been

Citation: Motamedrezaei O, Lotfi H, Jahani F, Sharifzadeh GhR, Rajabipour H, Laal F. **Hand dermatitis, Prevalence and Risk Factors among Healthcare Workers during the COVID-19.** Archives of Occupational Health. 2023; 7(1): 1385-91.

Article History: Received: 10 July 2023; Revised: 28 October 2023; Accepted: 05 November 2023

Copyright: ©2023 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

emphasized.⁴⁻⁵ Although these recommendations may be effective against infectious diseases, they may alter the integrity of the skin, resulting in skin barrier dysfunction and increased risk of hand dermatitis (HD).⁶⁻⁷

Contact dermatitis is a skin disorder which occurs when the skin encounters irritants or allergens. Contact dermatitis is the most common occupational disease, which includes irritant contact dermatitis (80%) and allergic contact dermatitis (20%).⁸⁻⁹ prolonged glove-wearing and frequent hand hygiene using detergents, soaps, water, alcohol-based sanitizers, and other disinfectants are known risk factors for developing contact dermatitis. Therefore, HCWs are at higher risk of developing contact dermatitis.⁹ Studies before COVID-19 pandemic indicated that the prevalence of contact dermatitis affecting HCWs' hands ranged from 12% to 50%.¹⁰⁻¹² This was while the prevalence of contact dermatitis was increased based on studies from different countries during the COVID-19 outbreak.¹³⁻¹⁶

Currently, there is limited data on the prevalence of HD among HCWs in Iran during the COVID-19 outbreak. The authors aim to determine the prevalence of HD among HCWs in three university hospitals in Birjand, Iran, during the COVID-19 pandemic. Furthermore, the association between HD and other related factors was investigated.

Methods

1.1. Study design

This was a cross-sectional study conducted from August to September 2020 in Birjand, the capital of South Khorasan province, Iran. Cluster sampling was carried out in three hospitals affiliated with Birjand University of Medical Sciences, including Razi, Valiasr, and Imam Reza. **Sample size calculation**

A sample size of 159 HCWs, defined as first-line workers performing patient-related duties, was calculated through convenience sampling method. HCWs working at the hospitals for at least one year

were included in the study. Those who did not complete the questionnaire were completely excluded.

1.2. Data collection

Data were collected using a validated self-administered questionnaire. The history of occupational HD was determined using standardized Nordic Occupational Skin Questionnaire version 2002 (NOSQ-2002)¹⁷, which included two forms; the first form included questions about demographic information :of age, gender, level of education, occupation, marital status, work experience, workplace ward, working hours per week, etc.; the second form consisted of questions about the most important occupational and environmental risk factors for formation of HD (i.e. history of allergy, history of HD, wearing gloves, frequency of hand washing, etc), and symptoms associated with HD (i.e. itching, burning, redness, dry skin with scaling, irritation, pain, and tiny water blister on the hand, wrist, or forearm) to determine prevalence of HD and the associated factors among HCWs.¹⁸ In this questionnaire, having any of dermatitis-associated symptoms over the last six month (the length of time HCWs were involved in caring for COVID-19) was considered dermatitis.

1.3. Data quality control

The use of this standardized questionnaire makes it possible to compare the results with other studies. The English version of NOSQ was translated to Persian by a professional translator familiar with medical terminology; thereafter, a panel of experts of academics (two dermatologists and eight faculty members of nursing and midwifery) familiar with terminologies reviewed and confirmed the validity of the questionnaire. The reliability of the questionnaire was also confirmed by calculation of Cronbach's α coefficient of 82%.¹⁹

1.4. Data analysis

Chi-square and logistic regression tests were used

for data comparisons, regarding the α level of 0.05. Data analysis was done using SPSS version 18. P-value < 0.05 was considered significant. Data were shown as mean \pm SD and number (percent).

Results

The mean age of 159 HCWs was 31.7 ± 10 . The majority of the subjects participating in the study, (66.9%) were females (111 people), and most of HCWs (81.1%) were nurses (129 people). Demographic data of the HCWs participating in this study are shown in Table 1.

Table 2 shows the prevalence of HD based on different variables of HCWs participating in this study. 82 (51.6%) participants had HD; and the prevalence of HD had an almost equal distribution among HCWs. The frequency was significantly higher ($P < 0.05$) in females (61.3%) than in males (29.2%). There was an almost equal distribution among HCWs with a high school diploma (45.5%) and a bachelor's degree (49.6%). However, most of the HCWs with an MSc degree (65.2%) reported to

have HD. The prevalence of HD was highest (86.4%) in the group above 40 and lowest (39.7%) in 20-29 group. Among 133 HCWs using gloves, 66 (58.4%) had HD, and the prevalence of HD was reported equal among those who did not wear gloves. The highest prevalence of HD (62.4%) was found in HCWs working fewer than 50 hours per week, and decreased with increasing working hours.

Table 1. Demographic data of healthcare workers.

Variable	Frequency	Percentage
Gender		
Male	48	30.20
Female	111	69.80
Education level		
High school diploma	11	6.90
Bachelor's degree	125	78.60
MSc degree	23	14.50
Position		
Nurse	129	81.10
Auxiliary nurse	10	6.30
Supervisor	11	6.90
Midwife	9	5.70
Marital status		
Single	36	22.60
Married	123	77.40

Table 2. Logistic regression analysis to investigate the prevalence of hand dermatitis based on different variables

Variable	Hand dermatitis "Yes" Frequency (Percentage)	Hand dermatitis "No" Frequency (Percentage)	Odds ratio (OR)	Confidence interval (CI)	P-value
Total	82 (51.60)		77 (48.40)		
Gender					
Male	14 (29.20)	34 (70.80)	1	1.85 – 8.00	P < 0.001
Female	68 (61.30)	43 (38.70)	3.84		
Education level					
High school diploma	5 (45.50)	6 (54.50)	1		P = 0.35
Bachelor's degree	62 (49.60)	63 (50.40)	1.18	0.34 – 4.10	
MSc degree	15 (65.20)	8 (34.80)	3.25	0.52 – 9.70	
Age					
20-29	29 (39.70)	44 (60.30)	1		P = 0.001
30-39	34 (53.10)	30 (46.90)	1.72	0.87 – 3.40	
>40	19 (86.40)	3 (13.60)	9.60	2.60 – 35.7	
Working hours					
<50 hours / week	53 (62.40)	38 (37.60)	1		P < 0.001
\geq 50 hours / week	19 (32.80)	39 (67.20)	0.29	0.15 – 0.58	
Wearing gloves					
Yes	66 (58.4)	47 (41.6)	1		P = 0.021
Yes, but not now	14 (33.3)	28 (66.7)	0.36	0.17 – 0.75	
Not using gloves	2 (50)	2 (50)	0.71	0.96 – 5.20	

Based on the results obtained from logistic regression test, female HCWs had a 3.84 fold increased risk of HD compared with males (CI: 1.85-8; $P < 0.001$). HCWs over 40 and those between 30 to 39 had a 9.6 and 1.72 fold increased risk of HD compared with HCWs aged 20 to 29 (CI: 2.6-35.7; CI: 0.87-3.4; $P=0.001$; $P=0.001$, respectively). Moreover, the prevalence of HD in HCWs who worked less than 50 hours per week was significantly higher than those who worked 50 hours or more (OR: 0.29; CI: 0.15-0.58; $P < 0.001$). Furthermore, Chi-square test revealed that the prevalence of HD among HCWs wearing gloves was significantly higher than those who never used gloves (OR: 0.71; CI: 0.96-5.2; $P < 0.05$). Although most of the HCWs with a MSc degree suffered from HD, there was no significant association between the prevalence of HD in HCWs and educational level ($P > 0.05$).

Discussion

HD is a common occupational disease with a prevalence of 12-50% among HCWs prior to COVID-19 pandemic.¹⁰⁻¹² In the current study, the frequency of HD was 51.6% among HCWs at university hospitals of Birjand, Iran during the pandemic. A significant correlation was also found between the prevalence of HD and female gender, age, working hours per week, and wearing gloves. The results of this study was consistent with other studies conducted on skin damages among HCWs during COVID-19 pandemic, showing an increase in the prevalence of HD. Lan et al.²⁰ reported the first evidence of increasing prevalence of skin damage among HCWs in China. It was reported that the prevalence of hand skin damage was 74.5%, which was probably related to frequent hand hygiene and wearing gloves for a longer time. A study conducted by Aydin et al.¹³, (2020) in Turkey suggested that the rate of HD among nurses was 70.9%. Another study by Erdem et al.¹⁶, (2020) showed that the frequency of HD included 50.5% of the HCWs

working in COVID-19 wards. Similarly, Imani Khanegah et al.'s study¹⁸, (2020) reported that 65.7% of nurses working in COVID-19 ward in Ardabil Province suffered from HD. Other studies from different countries reported the prevalence of symptoms associated with a contact dermatitis of 46.4% in Saudi Arabia¹⁵, 90.4% in Germany²¹, 82.6% in Ireland²², 80% in Italy²³, and 73.1% in China.²⁴ Disparity in the rate was probably due to different study designs, population sizes, and genetic differences. Moreover, some studies assessed all types of skin damage, which reported the overall skin damage of HCWs during the COVID-19 pandemic. This was while in the current study, the only the prevalence of HD was assessed. Similarly, Tousi et al.²⁵, (2006) reported that the prevalence of HD was 43.9% among HCWs in a university hospital in Tehran. Thus, the prevalence of HD clearly increased among HCWs during COVID-19 pandemic.

In the present study, a higher rate of HD was observed in females compared with males. In line with this study, Celik et al.²⁶, (2020) conducted a study on HCWs and showed that the rate of HD was significantly higher in women. Hamnerius et al.'s research²⁷, (2017) reported similar results. Additionally, a large population-based Norwegian survey demonstrated that the overall rate of HD was higher in women than men in their lifetime.²⁸ The higher prevalence of dermatitis in women than men could be attributed to the role of women in housekeeping and more exposure to water, detergents, and irritants.^{26,29-30} However, some studies reported that HD was not associated with gender.³¹⁻³²

According to this study, there was a positive correlation between age of HCWs and HD, and the highest prevalence of HD was found in HCWs above 40. 2 studies conducted on Danish children reported that older children were at a higher risk of developing HD. They attributed their observations

to a higher frequency of hand washing in older children.^{29,33-34} On the other hand, the prevalence of HD was varied at different ages in other studies^{30,34-35}; therefore, age could not be considered a direct risk factor for developing HD. This finding is probably due to the higher prevalence of HD among HCWs with more years of working experience.³⁶

In the current study, a negative correlation was found between the risk of developing HD and the working hours per week among HCWs. Lampel et al.¹¹ found no significant association between the rate of HD in inpatient nurses working at an academic hospital and their working hours per week. In contrast, Özyazicioğlu et al.³² reported that the incidence of HD among SENIOR nursing students was significantly higher than junior ones. They attributed this finding to higher working hours of the senior students compared with junior students; this was inconsistent with findings of this research. A possible speculative explanation for this could be increased time of HCWs' exposure to other irritants at home while housekeeping, or the fact that HCWs with HD may work fewer hours per week.

There were some known risk factors for developing contact dermatitis including frequent hand washing, long term wearing gloves, and using disinfectants.⁹ It has been reported that COVID-19 transmits through contact, thus proper hand hygiene is one of the main ways to prevent the spread of infection.³⁷ Previous studies showed a significant increase in the frequency of hand washing and use of disinfectants among HCWs during the COVID-19 pandemic.^{21,38} Repeated exposure to soap and water and disinfectants could alter the integrity of the skin and damage its protective effect by changing the pH of epidermis, depleting lipid barrier, and increasing trans-epidermal water loss, which finally leads to contact dermatitis. Paradoxically, prolonged wearing of gloves may cause maceration and irritant contact dermatitis of the hand skin by over-hydrating stratum corneum layer.⁹ Additionally, wearing latex gloves could develop skin

reactions through immunoglobulin E-mediated hypersensitivity to latex, latex allergy, and irritant contact dermatitis.³⁹⁻⁴⁰ In the present study, 58.4% of HCWs using gloves had HD. Similarly, Kaihui et al. (2020)⁴¹ reported that 88.5% of HCWs using latex gloves for a long time during the pandemic complained about adverse skin reactions.

HD is one of the main factors which can reduce the quality of life and productivity of HCWs, and may cause physical discomfort and increase their absence as well.⁴²⁻⁴³ Therefore, the results of this study may help prevent HD among HCWs, especially those who at higher risk.

Conclusion

Although hand hygiene is an effective method to prevent transmission of infectious diseases such as COVID-19, it may increase the risk of hand dermatitis formation. The prevalence of HD was 51.6% among HCWs during COVID-19 pandemic. Additionally, it was revealed that female gender and older age might be possible risk factors for the occurrence of HD among HCWs. It is suggested that hospitals provide education on HD to HCWs, and take proper measures for prevention.

Conflict of Interest

All authors have no conflicts of interest to declare.

Acknowledgement

We sincerely thank the help of the Vice-Chancellor for Research of Birjand University of Medical Sciences for the general support.

The protocol of study was approved by the Committee on Research Ethics at Birjand University of Medical Sciences with the approved No. 3789. (Ethic code IR.BUMS.REC.1398.008). Additionally, before entering the study, health care workers completed an informed consent form.

Authors Contributions

Omolbanin Motamedrezaei designed the study,

supervised the project. GholamReza Sharifzadeh analyzed the data and also performed statistical analysis. Hadis Rajabipour collected the research data. Farnaz Jahani collaborated on manuscript preparation and also contributed to interpretation of data. Hamed Lotfi and Fereydoon Laal prepared the manuscript and critically revised the manuscript; besides, all authors read and approved the final version of the manuscript.

References

1. Coronavirus disease 2019 (COVID-19) Situation Report-101 2020 Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200430-sitrep-101-COVID-19pdf?sfvrsn=2ba4e093_2. Accessed July 10,2020.
2. Centers for Disease Control & Prevention. Coronavirus Disease 2019 (COVID-19). June 2021. www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/hand-sanitizer.html. Last accessed June 25, 2021.
3. WHO. Coronavirus Disease (COVID-19) advice for the public. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>. 2020.
4. Pires D, Pittet D. Hand hygiene mantra: teach, monitor, improve, and celebrate. *J Hosp Infect.* 2017;95(4):335-337. Doi: 10.1016/j.jhin.2017.03.009.
5. Verbeek JH, Rajamaki B, Ijaz S, Tikka C, Ruotsalainen JH, Edmond MB, Sauni R, Kilinc Balci FS. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. *Cochrane Database Syst Rev.* 2019;7(7):Cd011621. Doi: 10.1002/14651858.Cd011621.Pub3. Update in: *Cochrane Database Syst Rev.* 2020 Apr 15;4:Cd011621.
6. Dejonckheere G, Herman A, Baeck M. Allergic contact dermatitis caused by synthetic rubber gloves in healthcare workers: Sensitization to 1,3-diphenylguanidine is common. *Contact Dermatitis.* 2019;81(3):167-173. Doi: 10.1111/cod.13269.
7. Afshar M, Lotfi H, Hassanzadeh Taheri MM, Zardast M. The Effect of Aqueous-Alcoholic Extract of Toothbrush Tree (*Salvadora Persica*) on the healing of Second-degree Skin Burns in BALB/c Mice. *Pharm Sci.* 2022. Doi:10.34172/ps.2022.1.
8. Dhingra N, Shemer A, Correa da Rosa J, Rozenblit M, Fuentes-Duculan J, Gittler JK, Finney R, Czarnowicki T, Zheng X, Xu H, Estrada YD, Cardinale I, Suárez-Fariñas M, Krueger JG, Guttman-Aspky e. Molecular profiling of contact dermatitis skin identifies allergen-dependent differences in immune response. *J Allergy Clin Immunol.* 2014;134(2):362-72. Doi: 10.1016/j.jaci.2014.03.009.
9. Abdali S, Yu J. Occupational Dermatoses Related to Personal Protective Equipment Used During the COVID-19 Pandemic. *Dermatol Clin.* 2021;39(4):555-568. Doi: 10.1016/j.det.2021.05.009.
10. Ibler KS, Jemec GB, Flyvholm MA, Diepgen TL, Jensen A, Agner T. Hand eczema: Prevalence and risk factors of hand eczema in a population of 2274 healthcare workers. *Contact Dermatitis.* 2012;67(4):200-7. Doi: 10.1111/j.1600-0536.2012.02105.x.
11. Lampel HP, Patel N, Boyse K, O'Brien SH, Zirwas MJ. Prevalence of hand dermatitis in inpatient nurses at a united states hospital. *Dermatitis.* 2007;18(3):140-2. Doi: 10.2310/6620.2007.06024.
12. Van der Meer EW, Boot CR, van der Gulden JW, Jungbauer FH, Coenraads PJ, Anema JR. Hand eczema among healthcare professionals in the Netherlands: Prevalence, absenteeism, and presenteeism. *Contact Dermatitis.* 2013;69(3):164-71. Doi: 10.1111/cod.12099.
13. Aydın Aİ, Atak M, Özyazicioğlu N, Dalkızan V. Hand Dermatitis among Nurses during the COVID-19 Pandemic: Frequency and Factors. *Adv skin wound care.* 2021;34(12):651-655. Doi: 10.1097/01.Asw.0000765916.20726.41.
14. Lin P, Zhu S, Huang Y, Li L, Tao J, Lei T, Song J, Liu D, Chen L, Shi Y, Jiang S, Liu Q, Xie J, Chen H, Duan Y, Xia Y, Zhou Y, Mei Y, Zhou X, Wu J, Fang M, Meng Z, Li H. Adverse skin reactions among healthcare workers during the coronavirus disease 2019 outbreak: A survey in Wuhan and its surrounding regions. *Br J Dermatol.* 2020;183(1):190-192. Doi: 10.1111/bjd.19089.
15. Alluhayyan OB, Alshahri BK, Farhat AM, Alsugair S, Siddiqui JJ, Alghabawy K, AlQefari GB, Alolayan WO, Abu Hashem IA. 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):E10975. Doi: 10.7759/cureus.10975.
16. Erdem Y, Altunay IK, Aksu Çerman A, Inal S, Ugurer E, Sivaz O, Kaya HE, Gulsunay IE, Sekerlisoy G, Vural O, Özkaya E. 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):422-423. Doi: 10.1111/cod.13632.
17. Susitaival P, Flyvholm MA, Meding B, Kanerva L, Lindberg M, Svensson A, Olafsson JH. Nordic Occupational Skin Questionnaire (NOSQ-2002): a new tool for surveying occupational skin diseases and exposure. *Contact Dermatitis.* 2003;49(2):70-6. Doi: 10.1111/j.0105-1873.2003.00159.x.
18. Imani Khanegah N, Ayadi N, Heidarzadeh M, Ajri-Khameslou M, Davari M. Investigating hand dermatitis among nurses in Iran during the outbreak of COVID-19: Comparison of COVID and non-COVID wards. *Npt.* 2021;8(4):257-264.
19. Tamene A. Occupational Contact Dermatitis in Employees of Large-Scale Narcotic Crop Farms of Ethiopia: Prevalence and Risk Factors. A Self-Reported Study Using the Nordic Occupational Skin Questionnaire. *Environ Health Insights.* 2021;15:11786302211048378. Doi: 10.1177/11786302211048378.
20. Lan J, Song Z, Miao X, Li H, Li Y, Dong L, Yang J, An X, Zhang Y, Yang L, Zhou N, Yang L, Li J, Cao J, Wang J, Tao J. Skin damage among health care workers managing coronavirus disease-2019. *J Am Acad Dermatol.* 2020;82(5):1215-1216. Doi: 10.1016/j.jaad.2020.03.014.
21. Guertler A, Moellhoff N, Schenck TL, Hagen CS, Kendziora B, Giunta RE, French LE, Reinholz M. 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):108-114. Doi: 10.1111/cod.13618.
22. Kiely LF, Moloney E, O'sullivan G, Eustace JA, Gallagher J, Bourke JF. Irritant contact dermatitis in healthcare workers as a result of the COVID-19 pandemic: a cross-sectional study. *Clin Exp Dermatol*. 2021;46(1):142-144. Doi: 10.1111/ced.14397.
 23. Rizzi A, Inchingolo R, Viola M, Boldrini L, Lenkowicz J, Lohmeyer FM, De Simone FM, Staiti D, Sarnari C, Gasbarrini A, Nucera E. Occupational hand dermatitis web survey in a university hospital during COVID-19 pandemic: The SHIELD study. *Med Lav*. 2021;112(4):320-326. Doi: 10.23749/mdl.V112i4.11670.
 24. Pei S, Xue Y, Zhao S, Alexander N, Mohamad G, Chen X, Yin M. Occupational skin conditions on the front line: A survey among 484 Chinese healthcare professionals caring for Covid-19 patients. *J Eur Acad Dermatol Venereol*. 2020;34(8):E354-e357. Doi: 10.1111/jdv.16570.
 25. Tousi P, Rahmati M, Taheri A. Hand Dermatitis Among Staff in Loghman Hospital in Tehran. *PajooHande*. 2008; 12 (6) :521-526 [persian].
 26. Celik V, Ozkars MY. An overlooked risk for healthcare workers amid COVID-19: Occupational hand eczema. *North Clin Istanbul*. 2020;7(6):527-533. Doi: 10.14744/nci.2020.45722.
 27. Hamnerius N, Svedman C, Bergendorff O, Björk J, Bruze M, Pontén A. Wet work exposure and hand eczema among healthcare workers: a cross-sectional study. *Br J Dermatol*. 2018;178(2):452-461. Doi: 10.1111/bjd.15813.
 28. Vindenes HK, Svanes C, Lygre SHL, Hollund BE, Langhammer A, Bertelsen RJ. Prevalence of, and work-related risk factors for, hand eczema in a Norwegian general population (The Hunt Study). *Contact Dermatitis*. 2017;77(4):214-223. Doi: 10.1111/cod.12800.
 29. Simonsen AB, Ruge IF, Quaade AS, Johansen JD, Thyssen JP, Zachariae C. Increased occurrence of hand eczema in young children following the Danish hand hygiene recommendations during the COVID-19 pandemic. *Contact Dermatitis*. 2021;84(3):144-152. Doi: 10.1111/cod.13727.
 30. Simonsen AB, Ruge If, Quaade AS, Johansen JD, Thyssen JP, Zachariae C. High incidence of hand eczema in Danish schoolchildren following intensive hand hygiene during the COVID-19 pandemic: a nationwide questionnaire study. *Br J Dermatol*. 2020;183(5):975-976. Doi: 10.1111/bjd.19413.
 31. Zhang D, Zhang J, Sun S, Gao M, Tong A. Prevalence and risk factors of hand eczema in hospital-based nurses in northern China. *Australas J Dermatol*. 2018;5(3):E194-e197. Doi: 10.1111/ajd.12672.
 32. Özyazicioğlu N, Sürenler S, Aydin Aİ, Atak M. Hand Dermatitis in Nursing Students. *Adv Skin Wound Care*. 2020;33(4):213-216. Doi: 10.1097/01.Asw.0000655472.02780.E0.
 33. Borch L, Thorsteinsson K, Warner TC, Mikkelsen CS, Bjerring P, Lundbye-Christensen S, Arvesen K, Hagstroem S. COVID-19 reopening causes high risk of irritant contact dermatitis in children. *Dan Med J*. 2020;67(9):A05200357.
 34. DREWITZ KP, STARK KJ, ZIMMERMANN ME, HEID IM, APFELBACHER CJ. Frequency of hand eczema in the elderly: Cross-sectional findings from the German AugUr study. *Contact Dermatitis*. 2021;85(5):489-493. Doi: 10.1111/cod.13920.
 35. Voorberg AN, Loman L, Schuttelaar MLA. Prevalence and Severity of Hand Eczema in the Dutch General Population: A Cross-sectional, Questionnaire Study within the Lifelines Cohort Study. *Acta Derm Venereol*. 2022;102:Adv00626. Doi: 10.2340/actadv.V101.432.
 36. Lan CC, Feng WW, Lu YW, Wu CS, Hung ST, Hsu HY, Yu HS, Ko YC, Lee CH, Yang YH, Chen GS. Hand eczema among university hospital nursing staff: Identification of high-risk sector and impact on quality of life. *Contact Dermatitis*. 2008;59(5):301-6. Doi: 10.1111/j.1600-0536.2008.01439.x.
 37. Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: An overview. *J Chin Med Assoc*. 2020;83(3):217-220. Doi: 10.1097/jcma.0000000000000270.
 38. Erdem Y, Inal S, Sivaz O, Copur S, Boluk KN, Ugurer E, Kaya HE, Gulsunay IE, Sekerlisoy G, Vural O, Altunay IK, Aksu Çerman A, Özkaya E. How does working in pandemic units affect the risk of occupational hand eczema in healthcare workers during the coronavirus disease-2019 (COVID-19) pandemic: A comparative analysis with nonpandemic units. *Contact Dermatitis*. 2021;85(2):215-24.
 39. Douglas R, Morton J, Czarny D, O'hehir RE. Prevalence of IgE-mediated allergy to latex in hospital nursing staff. *Aust N Z J Med*. 1997;27(2):165-9. Doi: 10.1111/j.1445-5994.1997.tb00933.x.
 40. Weido AJ, Sim TC. The burgeoning problem of latex sensitivity. Surgical gloves are only the beginning. *Postgrad Med*. 1995;98(3):173-4, 179-82, 184.
 41. 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 (Baltimore)*. 2020;99(24):e20603. Doi: 10.1097/md.00000000000020603.
 42. Mekonnen TH, Yenealem DG, Tolosa BM. Self-report occupational-related contact dermatitis: Prevalence and risk factors among healthcare workers in Gondar town, Northwest Ethiopia, 2018-a cross-sectional study. *Environ Health Prev Med*. 2019;24(1):11. Doi: 10.1186/s12199-019-0765-0.
 43. Yüksel YT, Nørreslet LB, Flachs EM, Ebbenhøj NE, Agner T. Hand eczema, wet work exposure, and quality of life in health care workers in Denmark during the COVID-19 pandemic. *JAAD Int*. 2022;7:86-94. Doi: 10.1016/j.Jdin.2022.02.009.