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## Evaluation of hand hygiene and onset of hand eczema after the outbreak of SARS-CoV-2 in Munich

**Background:** Since the outbreak of SARS-CoV-2, authorities have preached the importance of personal hygiene, including hand washing and disinfection. **Objective:** To evaluate changes in the frequency of hand washing and hand care, the onset of hand eczema (HE) and risk factors associated with HE since the outbreak of SARS-CoV-2 in Munich in January 2020. **Materials & Methods:** All dermatologic outpatients at the university hospital between April 6 and April 19 were asked to complete a structured questionnaire. **Results:** Data of 512 patients with a median age of 49 years (243 females, 267 males) were analysed. The frequency of hand washing and hand disinfection increased after the outbreak of SARS-CoV-2 ( $p < 0.001$ , respectively). While symptoms associated with HE were reported by 29.9% (149/499) of patients, the actual diagnosis of HE was reported less frequently by 11.2% (53/473) with a median duration of 120 days. Frequent hand disinfection ( $p = 0.039$ ), atopic dermatitis ( $p = 0.006$ ) and young age ( $p = 0.0499$ ) were identified as risk factors for symptoms of HE. Hand care was performed more frequently during the pandemic than before ( $p < 0.001$ ). A high frequency of hand care during the pandemic was not significantly associated with symptoms of HE ( $p = 0.172$ ), but was associated with self-recognition of HE symptoms ( $p = 0.002$ ). **Conclusion:** After the outbreak of SARS-CoV-2, the frequency of hand hygiene measures increased. A considerably high prevalence of HE symptoms was associated with frequent hand disinfection, atopic dermatitis and young age. Awareness of HE should be raised in order for preventive measures to be taken earlier.

**Key words:** COVID-19, hand hygiene, hand eczema, irritant contact dermatitis, preventive measures, SARS-CoV-2

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Since the outbreak of SARS-CoV-2 with the first reported case in Munich on January 27, 2020 [1, 2], German authorities have preached the importance of personal hygiene to minimize the number of infections. Hand washing with soap and hand disinfection with alcohol-based sanitizer play an important role in the prevention, as the SARS-CoV-2 virus is transmitted by respiratory droplets [3, 4]. Increased hand hygiene measures are thus inevitable, however, there are also associated negative implications. Excessive washing and sanitizing of hands affect the natural flora and protective barrier of the skin [5]. These exogenous factors can lead to an onset of hand eczema (HE) through direct irritation (toxic-irritative contact dermatitis) and/or through the development of a type IV immune reaction (allergic contact dermatitis). Hand eczema and associated symptoms are frequently seen in the general population with a recently reported point prevalence of 6.7% in German dermatological prac-

tice before the COVID-19 pandemic [6]. Investigations on the importance of genetic and environmental factors have shaped our understanding of the disease. The aetiological background comprises endogenous variables, such as impaired skin barrier function in patients suffering from an atopic dermatitis [7]. However, the majority of triggering factors for the development of HE seem to be related to occupational and/or domestic exogenous exposure, such as working in wet conditions, occlusive gloves and mechanical skin damage [8]. Hand washing and disinfection therefore contribute to an onset of the disease with the first reports outlining an increased prevalence amongst health care workers during the COVID-19 pandemic [9]. However, since the implemented hygiene regulations apply to all, we hypothesize that the incidence and prevalence of HE will increase, not only in the medical field, but also in the general population.

This study was thus conducted in dermatological outpatients to evaluate changes in the frequency of hand washing and hand care, onset of hand eczema (HE) and risk factors associated with HE after the outbreak of SARS-CoV-2 in Munich.

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## Materials and methods

### Study design and population

All patients, aged 18 years or older, consulting the outpatient clinic of the Department of Dermatology and Allergy, Hospital of the Ludwig-Maximilian-University, Munich (Germany), between April 6 and April 19, 2020, were eligible and were asked for participation in this cross-sectional hospital-based study. The study was approved by the ethics committee of the medical faculty (Ref.-No. 20-294 KB), and all procedures were in accordance with the Helsinki Declaration of 1975.

### Study assessments and measures

Study data was collected using a structured questionnaire. Information on: a) demographics (gender and age); b) hand hygiene (frequency of hand washing and hand disinfection before and during the COVID-19 pandemic); c) presence of HE and/or associated symptoms; d) atopic diathesis (asthma, allergic rhinitis, atopic dermatitis); e) type IV hypersensitivity; f) occupation; g) frequency of hand care (skin cream use before and during the COVID-19 pandemic) and h) topical anti-inflammatory treatment were obtained. Depending on the stated occupation, we classified participants as either working in wet conditions, or not. Working in wet conditions was defined as working in a humid milieu, with frequent use of occlusive gloves or ensuring intensive hand hygiene at work [10, 11].

### Statistical analysis

Medians with interquartile range were calculated for descriptive statistics of numerical data, and proportions were calculated for describing categorical variables. The Wilcoxon's signed rank test with continuity correction, Pearson's Chi-squared test with Yates' continuity correction and logit regression models were used, as appropriate, for inferential statistics. *P* values equal to or below 0.05 were considered statistically significant. All analyses were conducted in R (version 3.6.0, 2010, R Foundation for Statistical Computing, Vienna, Austria) using the R packages: MASS [12], aod [13] and ggplot2 [14].

## Results

### Study population

The study population consisted of 512 patients (47.6% [243/510] female, 52.4% [267/510] male), with a median age of 49 years. The prevalence of atopic dermatitis was 8.0% (40/500), 15.0% (75/499) of patients had allergic rhinitis and 8.5% (43/500) of patients suffered from bronchial asthma. A pre-existing type IV hypersensitivity/contact allergy was self-reported by 6.8% of patients. We classified 15.0% of patients as working in wet conditions (table 1).

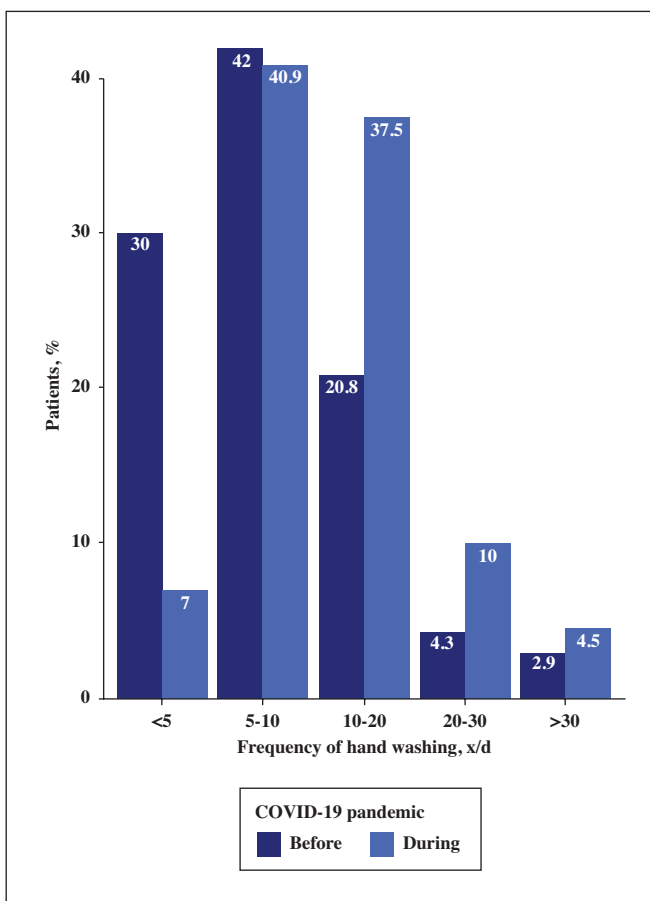
### Frequency of hand washing

The frequency of hand washing during the SARS-CoV-2 pandemic showed a significant increase compared to

**Table 1.** Characteristics of the study population.

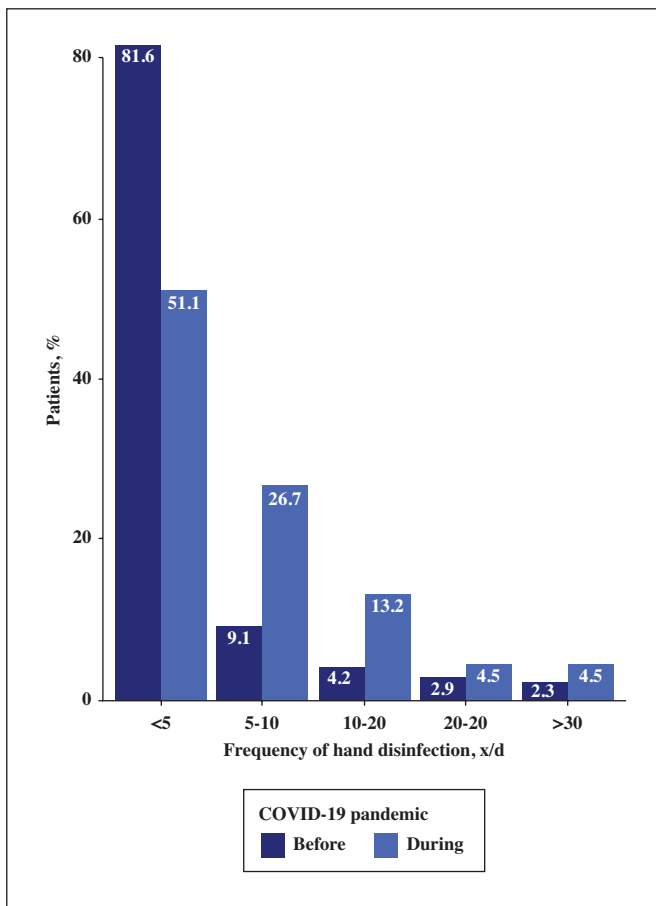
	% of patients or median (IQR)	<i>n</i> <sup>1</sup>
Female	47.6	243/510
Male	52.4	267/510
Age, years	49 (33-63)	506
Atopic dermatitis	8.0	40/500
Allergic rhinitis	15.0	75/499
Asthma	8.5	43/500
Pre-existing and self-reported type IV hypersensitivity	6.8	33/486
Working in wet conditions <sup>2</sup>	15.0	63/419

*IQR: interquartile range, n: number of patients.* <sup>1</sup>Incomplete questionnaires were not omitted, therefore, the number of responses differs among questions. <sup>2</sup>Participants were classified as being exposed to wet working conditions based on the stated occupation. During the pandemic, participants may not have worked in their usual working environment. The stated exposure to working in wet conditions should thus be interpreted with caution.



**Figure 1.** Frequency of hand washing before and during the SARS-CoV-2 pandemic showing a highly significant increase in the frequency of hand washing ( $V=1840.5$ ,  $p < 0.001$  [Wilcoxon's signed rank test]).

the time before the pandemic (Wilcoxon's signed rank test,  $p < 0.001$ ) (figure 1). While merely 28% (137/490) of patients reported hand washing 10 times or more per day prior to the pandemic, more than half of the patients (52.0%;



**Figure 2.** Frequency of hand disinfection before and during the SARS-CoV-2 pandemic showing a highly significant increase in the frequency of hand disinfection ( $V=1196.0$ ,  $p < 0.001$  [Wilcoxon's signed rank test]).

254/488) currently performed hand washing 10 times or more per day during the pandemic.

### Frequency of hand disinfection

With regards to hand disinfection, there was a significant increase in frequency (Wilcoxon's signed rank test,  $p < 0.001$ ) (figure 2). While only 18.4% (88/477) of patients disinfected their hands five times or more per day before the pandemic, nearly half of the patients (48.9%; 229/469) disinfected their hands at this frequency during the pandemic. Therefore, 81.6% (389/477) of participants disinfected their hands less than five times a day before the pandemic and 51.1% (240/469) during the pandemic.

### Hand eczema and associated symptoms

One or more symptoms of HE were reported by 29.9% of participants (table 2). Erythema (19%; 95/499) and itching (19%; 95/499) were reported most frequently, followed by scaling (8.2%; 44/499), pain (6.6%; 33/499), burning sensation (8.4%; 42/499) and fissures (4.2%; 21/499). The presence of HE was stated by 11.2% (53/473) of participants with a median duration of 120 days. All symptoms were

**Table 2.** Reporting of hand eczema and associated symptoms.

	% of patients or median (IQR)	n <sup>1</sup>
Self-reporting of redness	19.0	95/499
Self-reporting of itching	19.0	95/499
Self-reporting of scaling	8.2	44/499
Self-reporting of pain	6.6	33/499
Self-reporting of burning	8.4	42/499
Self-reporting of fissures	4.2	21/499
Self-reporting of one or more symptoms of HE	29.9	149/499
Self-reporting of HE <sup>2</sup>	11.2	53/473
Reporting of HE duration, days	120.0 (20.8-565.0)	44

HE: hand eczema; IQR: interquartile range, n: number of patients. <sup>1</sup>Incomplete questionnaires were not omitted, therefore, the number of responses differs among studies. <sup>2</sup>Pearson's Chi-squared tests showed highly significant associations between the reporting of HE and redness ( $\chi^2[df=1, n=473]=94.6, p < 0.001$ ), itching ( $\chi^2[df=1, n=473]=74.6, p < 0.001$ ), scales ( $\chi^2[df=1, n=473]=59.7, p < 0.001$ ), pain ( $\chi^2[df=1, n=473]=32.1, p < 0.001$ ), burning ( $\chi^2[df=1, n=473]=26.8, p < 0.001$ ) and rhagades ( $\chi^2[df=1, n=473]=61.3, p < 0.001$ ).

**Table 3.** Logit regression model for estimating the probability of having one or more symptoms of hand eczema.

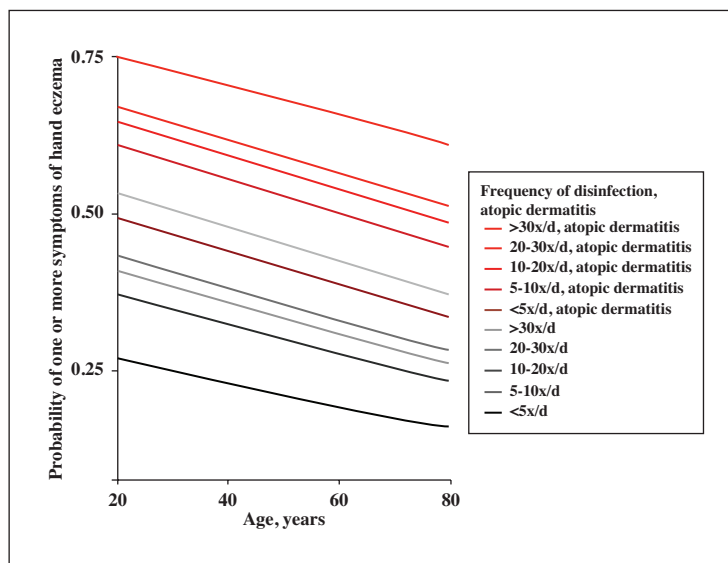
Coefficients <sup>1</sup>	Estimate	SE	z-score	p value
(Intercept)	-0.78	0.30	-2.54	0.011
Age	-0.01	0.01	-1.96	0.0499
Atopic dermatitis	0.98	0.35	2.76	0.006
Frequency of hand disinfection	–	–	–	0.039 <sup>2</sup>
<5x/day	0.48	0.25	1.89	0.058
5-10x/day	0.63	0.31	2.01	0.043
10-20x/day	0.73	0.52	1.43	0.154
20-30x/day	1.13	0.47	2.42	0.157
>30x/day	–	–	–	–

SE: standard error. <sup>1</sup>Allergic rhinitis ( $p=0.918$ ), gender ( $p=0.783$ ), asthma ( $p=0.674$ ), high frequency of hand washing ( $p=0.640$ ), working in wet conditions ( $p=0.254$ ), and pre-existing type IV hypersensitivity ( $p=0.098$ ) were excluded by backward elimination. <sup>2</sup>Calculated by applying Wald's test.

associated with self-diagnosed HE (Pearson's Chi-squared test,  $p < 0.001$ ).

### Risk factors

Atopic dermatitis ( $p=0.006$ ), younger age ( $p=0.0499$ ) and a high frequency of hand disinfection ( $p=0.039$ ) were identified as risk factors for one or more symptoms of HE (Logit regression model) (table 3, figure 3). With regards to allergic rhinitis ( $p=0.918$ ), asthma ( $p=0.674$ ), gender ( $p=0.783$ ), frequency of hand washing ( $p=0.640$ ), working in wet conditions ( $p=0.254$ ) and pre-existing type IV hypersensitivity ( $p=0.098$ ), no significant correlation with the presence of one or more symptoms of HE was identified.



**Figure 3.** Estimation of the probability of having one or more symptoms of hand eczema according to the prevalence of atopic dermatitis, age and frequency of disinfection based on a visualized logit regression model.

### Preventive and therapeutic measures

Hand care was performed more frequently during the pandemic than before (Wilcoxon's signed rank test,  $p < 0.001$ ) (figure 4). The relative number of patients applying hand cream more than two times a day increased from 28.5% (140/491) before to 43.5% (214/491) during the pandemic. There was no significant correlation between the frequency of emollient use during the pandemic and the presence of one or more symptoms of HE (Logit regression model,  $p = 0.172$ ). However, patients who recognized their symptoms as HE applied hand cream more frequently (Logit regression model,  $p = 0.002$ ). Out of 53 patients who reported HE, 21 patients (39.6%) used topical anti-inflammatory products.

### Discussion

This hospital-based cross-sectional study shows an increase in hand washing and hand disinfection since the outbreak of SARS-CoV-2 in Munich. Around one third of participants suffered from symptoms of HE. The actual diagnosis of HE was reported by a minority of these patients. Symptoms of HE were more prevalent when hand disinfection was performed frequently, in patients with atopic dermatitis and in young patients. Hand care was performed more often than before the pandemic. While a high frequency of hand care during the pandemic was not significantly associated with the presence of HE symptoms, there was an association with self-recognition of HE symptoms.

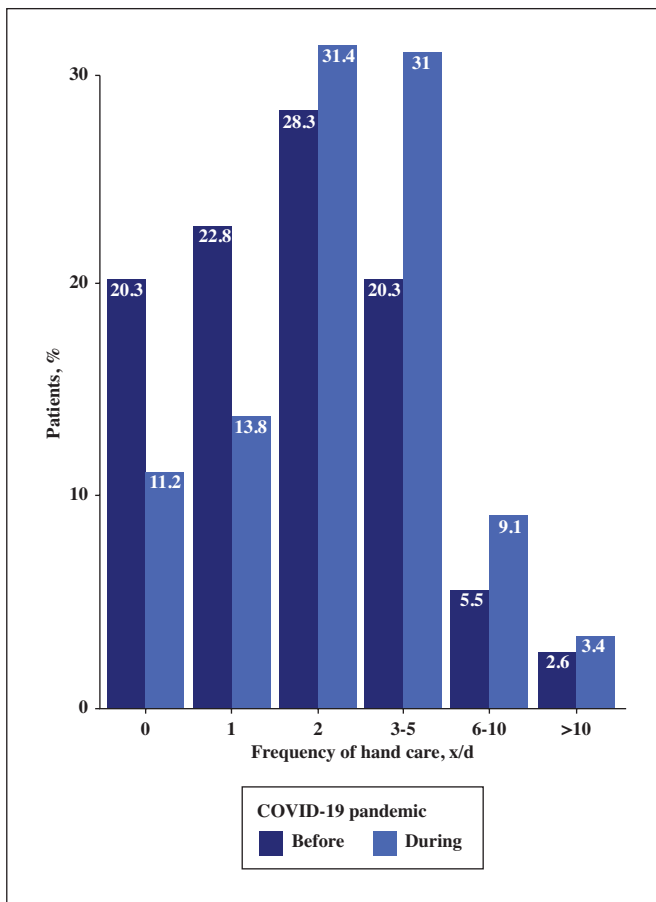
In the past, increased hand hygiene has demonstrated efficacy in reducing infections with SARS-CoV-2-related viruses, such as MERS-CoV and influenza viruses [15, 16]. We therefore agree with Yang *et al.* that hand washing and disinfection are important during the current SARS-CoV-2 pandemic [3]. The reported increase in the frequency of hand washing and disinfection in Munich's population suggests that the hygiene recommen-

dations of health authorities have been conscientiously implemented.

The median onset of HE was reported to be within the last four months of completing the questionnaire with a high prevalence of acute symptoms of HE such as erythema and itching, compared to chronic symptoms such as scaling and fissures. Lan *et al.* recently reported a high prevalence of damaged skin of the hands among health care workers (74.5%) treating patients with COVID-19 in Hubei, China, based on an evaluation of 542 online questionnaires [9]. Compared to this prevalence data in Chinese health care workers, our results show a much lower prevalence of HE associated symptoms among outpatients in dermatological practice (29.9%), however, a comparison of the data with the results of Ofenloch *et al.* [6] mentioned in the introduction suggests a considerable increase in the prevalence of HE in dermatological practice (6.7% vs. 11.2%). In accordance, Singh *et al.* recently reported an increasing number of patients with HE diagnosed by telemedicine in India during the current pandemic [17].

A high frequency of hand disinfection was associated with an increased risk of HE symptoms in our study population. Interestingly, we did not find a correlation between the presence of HE symptoms and frequency of hand washing or working in wet conditions. Due to supply shortages in pharmacies, hand sanitizers were intermittently unavailable and therefore harmful products and disinfections may have been used instead for hand hygiene. However, we do not generally recommend frequent hand washing with products other than those specifically manufactured as hand disinfectants. The lack of an association between exposure to wet conditions during work and symptoms of HE may partly be attributed to a broad implementation of home office working during the current pandemic situation and/or better education about preventive measures.

Furthermore, atopic dermatitis and younger age increased the likelihood of having HE symptoms. While the association with atopic dermatitis can be explained by an endogenous defect in skin barrier function [18, 19], the association with younger age, which was described



**Figure 4.** Frequency of hand care before and during the SARS-CoV-2 pandemic. A highly significant increase in frequency of hand care was observed using the Wilcoxon's signed rank test ( $V = 1419.0$ ,  $p < 0.001$ ). Based on logistic regression, no significant correlation between the frequency of hand care during the pandemic and presence of one or more symptoms of HE ( $z = 1.4$ ,  $p = 0.172$ ) was identified, but a significant correlation was observed between the frequency of hand care during the pandemic and self-reported prevalence of HE ( $z = 3.1$ ,  $p = 0.002$ ). HE: hand eczema.

previously [20], has not yet been resolved and could hypothetically be due to increased exposure to irritative substances at younger age, greater susceptibility of younger skin, and/or under-reporting of HE symptoms at older age. Additionally, we found a borderline association between type IV hypersensitivity and symptoms of HE. Bearing in mind that the entry of allergens is facilitated by a damaged skin barrier in toxic irritative HEs, the initial toxic reaction may facilitate additional contact sensitization [21]. In terms of preventive measures, the frequency of hand cream application increased in the study population, although the rates were considerably small. The largest group of participants applied moisturizing hand cream twice a day before and during the current pandemic, and patients with HE symptoms showed no augmented use of hand creams, emphasizing the significant potential for preventive measures. The current guidelines of the European Society of Contact Dermatitis (ESCD) recommend application of a thin moisturizing lotion during the working day and after work, as well as a fragrance-free, lipid-rich moistur-

izer at night for the prevention of HE [5]. Other preventive measures include the use of intact, clean and dry protective gloves when performing work in wet conditions and hand washing in lukewarm instead of hot water.

This study is based on an anonymous questionnaire-based survey, with no confirmation of HE or HE symptoms by a physician; the prevalence of HE and HE symptoms might therefore have been different if the disease was diagnosed by a physician. Although this study was conducted in dermatological practice and the demographic profile of participants comprised more males and older people compared to the average German population [22], the knowledge gained from the study may partly be adapted to the general population. As mentioned above, we hypothesize that irritant harmful external products may have been used for hand disinfection and that broad implementation of working from home may explain the lack of association between working in wet conditions and HE. Based on the present data, these aspects remain speculation, but may be of interest in subsequent research. Furthermore, based on a multicentre approach, regional differences in hygiene regulations may be investigated to further elucidate the onset of HE following the outbreak of SARS-CoV-2.

In conclusion, the frequency of hand washing and hand disinfection increased after the outbreak of SARS-CoV-2 in Munich. A considerably high prevalence of HE symptoms in dermatological practice appears to be related to frequent hand disinfection, atopic dermatitis and young age. Awareness of HE should be raised in order for preventive measures to be taken earlier. ■

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