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## “Face mask dermatitis” due to compulsory facial masks during the SARS-CoV-2 pandemic: data from 550 health care and non-health care workers in Germany

**Background:** During the COVID-19 pandemic, wearing face masks is mandatory not only for health care workers (HCWs) but also for the general population in many countries around the globe. **Objectives:** The aim of the study was to investigate the onset of adverse facial skin reactions due to compulsory face masks during the COVID-19 pandemic in HCWs and non-HCWs, and draw awareness of this new dermatological condition and its preventive measures. **Materials & Methods:** A questionnaire was distributed to 550 patients and HCWs from the Department of Dermatology and Allergy of the University Hospital Munich (LMU), Germany. Participants were surveyed regarding mask type, duration of usage and adverse facial skin reactions. Information on symptoms and the use of skin care products and topical drugs were retrieved. **Results:** The duration of wearing masks showed a significant impact on the prevalence of symptoms ( $p < 0.001$ ). Type IV hypersensitivity was significantly more likely in participants with symptoms compared to those without symptoms ( $p = 0.001$ ), whereas no increase in symptoms was observed in participants with atopic diathesis. HCWs used facial skin care products significantly more often than non-HCWs ( $p = 0.001$ ). **Conclusion:** Preventive and therapeutic measures should be established in order to avoid “face mask dermatitis”, especially for people with underlying risk factors.

**Key words:** adverse skin reactions, COVID-19, face mask dermatitis, health care workers, SARS-CoV-2 pandemic

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The COVID-19 pandemic represents a significant challenge for the global population, and has strongly increased the need for protective measures and hand hygiene worldwide in order to slow down the spreading of SARS-CoV-2.

The World Health Organization presumes two main routes of SARS-CoV-2 transmission: respiratory droplets and direct or indirect contact [1]. Therefore, thorough and frequent hand washing as well as wearing face masks has become omnipresent advice to prevent new SARS-CoV-2 infections. Recent data suggests asymptomatic and pre-symptomatic patients can transmit COVID-19 [2]. The universal use of masks aims to reduce the distribution of contagious droplets from symptomatic patients, especially while coughing and sneezing, but also from non-symptomatic patients while speaking [3].

Although the effect of masks during the COVID-19 pandemic is not yet indisputably confirmed, a growing number of countries introduced the mandatory use of facial masks in public areas, including the United States and some parts of

the European Union [4-7]. In Bavaria (Germany), wearing masks is compulsory as of April 27<sup>th</sup> 2020 [8]. For HCWs in Germany during the COVID-19 pandemic, the use of masks is mandatory during the entire working period [9].

Due to these recommendations, the use of facial masks quickly became a daily routine and led to a “new normal” regarding public appearance in most countries.

The COVID-19 pandemic also has a strong impact in dermatology [10]. Besides dermatologic manifestations associated with COVID-19, including pernio-like lesions, dermatologic manifestations due to protective measures in the context of the pandemic are increasingly apparent [11]. As previously shown during respiratory epidemics, sensitive facial skin especially the cheeks, nasal bridge and auricular areas is prone to adverse skin reactions due to facial masks [12]. Also, during the COVID-19 pandemic, mask-related changes in facial skin conditions were observed and subsequently investigated [13, 14].

We hypothesized a positive correlation between the occurrence of symptoms and mask-wearing time. In this study, we surveyed dermatologic patients and HCWs, and evaluated the most common symptoms of “face mask dermatitis” and the associated type of mask worn. In addition, we

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investigated whether adverse skin reactions arose more often in patients with previously known contact allergies or atopic diathesis.

## Materials and methods

### Study design

A cross-sectional, fully anonymous questionnaire study that included patients and HCWs of the Department of Dermatology and Allergy of the University Hospital of Munich was conducted from May 6 to 22, 2020. Patients were all non-HCW persons entering the clinic, including visitors and patients requiring dermatological consultation for any reason.

### Ethics approval

This study was approved by the institutional ethics committee of the University Hospital (LMU Munich/Germany) on 5th May 2020 (20-414 KB).

### Questionnaire design

As no validated survey tools exist for the objective of our study, a one-page questionnaire was developed based on a review of the literature and dermatological expert consulting. The questionnaire was pre-tested by independent researchers for clarity and comprehension and thereafter revised to the final form. It consisted of questions on the different types of masks (cloth, surgical or N95 [=FFP2/=KN95] mask), duration of usage and basic demographic information (age, gender, occupation [HCW or non-HCW]) (figure 1A-C). Using a multiple-choice question format, participants were asked about underlying dermatological conditions such as type IV hypersensitivity, atopic diathesis (atopic dermatitis, allergic rhinitis, asthma), rosacea, perioral dermatitis and seborrheic eczema. Additional questions addressed specific symptoms, such as itching, stinging, burning, pain, erythema, scaling, fissures, papules, pustules



**Figure 1.** A) An example of a sewed cloth mask prepared by an individual from the general population. B) An example of a surgical mask (ARMA Surgical, Ref: AFM2003). C) An example of a N95 mask (Neolution, Ref: 235 V).

and watery papules. Furthermore, the frequency of skin care, possible topical treatment or make-up application during the COVID-19 pandemic was investigated.

### Data analysis

Statistical analyses were performed by a professional statistician using SPSS (Statistics® Version IBM 2019 Inc, Armonk, NY/USA). A  $p$  value  $<0.05$  was considered statistically significant and  $p < 0.01$  was considered highly significant. Demographic data was analysed using descriptive statistics. Further tests such as the Chi-square test, Mann-Whitney test, McNemar's test and Wilcoxon test were performed as applicable. In order to avoid a bias, only rated questions were evaluated. Since not all items in the questionnaire were completed by every participant, the percentages refer to the proportion who answered each respective question.

## Results

### Demographic data

A total of 2,393 participants were invited to fill in the questionnaire, of whom 550 did so and thus were included in the analysis; 56.4% ( $n = 299$ ) were female and 43.6% ( $n = 231$ ) male. The median age was 47 years (mean:  $46 \pm 19$  years). Of the participants, 17.9% ( $n = 80$ ) were HCWs, 26 of whom were dermatologists, rendering the majority of participants non-HCWs. Detailed demographic data is shown in table 1.

Participants between 20 and 59 years were most affected by symptoms. Most of the elderly participants did not report symptoms ( $p = 0.047$ ). Men showed a highly significant reduced risk of developing symptoms ( $p < 0.001$ ). There was no significant difference in mask usage time between sexes ( $p = 0.066$ ) (table 2).

The median duration of wearing a mask in all participants was two hours per day (mean:  $2.2 \pm 1.4$  hours) (table 3). In HCWs, the period of usage was five hours per day (mean:  $4.3 \pm 1.2$  hours) and thus significantly longer ( $p < 0.001$ ) compared to non-HCWs, with a mean wearing period of one hour per day (mean:  $1.8 \pm 1.2$  hours). The duration of wearing a mask highly significantly correlated with the incidence of symptoms ( $p < 0.001$ ). In HCWs, 48.8% stated having mask-related symptoms compared to 7.3% of non-HCWs, therefore HCWs were more likely to develop symptoms

**Table 1.** Demographic data of the study population.

	Number	Percentage [%]
Female	299	56.4
Male	231	43.6
HCWs	80	17.9
Non-HCWs	366	82.1
Type IV hypersensitivity	70	14.1
Atopic dermatitis	17	3.1
Allergic rhinitis	16	2.9
Asthma	15	2.7

**Table 2.** Gender-related differences.

	Female	Male	Total	<i>p</i> value
Mask-wearing time ( <i>n</i> ± <i>SD</i> ) [hours]	2.3 ± 1.5	1.9 ± 1.2	2.2 ± 1.4	0.066
Symptomatic participants ( <i>n</i> )	54 (18.7%)	13 (5.8%)	67 (13.1%)	<0.001

*n*: number; *SD*: standard deviation

**Table 3.** Differences between HCWs and non-HCWs regarding duration of mask-wearing, symptoms and use of skin care, make-up and treatment based on symptomatic HCWs and non-HCWs.

	HCWs	non-HCWs	Total	<i>p</i> value
Mask-wearing time ( <i>n</i> ± <i>SD</i> ) [hours]	4.3 ± 1.2	1.8 ± 1.2	2.2 ± 1.4	<0.001
Symptomatic participants ( <i>n</i> )	39 (48.8%)	26 (7.3%)	65 (14.9%)	<0.001
Number of symptoms per participant ( <i>n</i> ± <i>SD</i> )	1.1 ± 1.4	.2 ± .8	.3 ± 1.0	<0.001
No. times of skin care application per day	1.5 ± .8	1.1 ± 1.0	1.2 ± 1.0	<0.001
No. times of make-up application per day	0.5 ± .8	0.1 ± 0.5	0.2 ± 0.6	<0.001
Participants with treatment ( <i>n</i> )	10 (15.6%)	23 (9.5%)	33 (10.7%)	0.157

*n*: number; *D*: standard deviation

**Table 4.** Correlation between reported mask-related symptoms and treatment (based on whether certain symptoms are more likely to be associated with treatment).

Symptoms	Absolute and relative		<i>p</i> value (correlation of symptoms)
	%	<i>n</i>	
Itching	34	6.6	0.002
Erythema	32	6.2	0.002
Pustules	17	3.3	0.001
Burning	15	2.9	0.160
Papules	12	2.3	0.025
Pain	7	1.4	0.025
Scaling	7	1.4	1.0
Stinging	4	0.8	0.275
Watery papule	4	0.8	0.004
Fissures	4	0.8	0.004

(*p* < 0.001). Also, HCWs presented with significantly more symptoms compared to non-HCWs (*p* < 0.001) (table 3). One or more symptoms were reported by 13.1% of all participants. The most common symptoms were itching (6.6%) and erythema (6.2%). In 7.9% of participants, more than one symptom was reported (table 4, figure 2A-C).

The majority of participants used a surgical (47.2%) or a cloth mask (35.6%), and only few wore N95 masks (10.0%). Concerning the effect of mask type, irrespective of being a HCW or not, surgical masks correlated with a significantly higher number of symptoms compared to cloth masks (*p* = 0.009). In the present study, no correlation between any symptoms in particular and the different mask types could be demonstrated.

Previously diagnosed type IV hypersensitivity was reported in 14.1% (*n* = 70) of all participants. Of the participants suffering from type IV hypersensitivity, 25.7% reported symptoms in contrast to 11.0% in the group without type IV

hypersensitivity, thus revealing a highly significant correlation between type IV hypersensitivity and the occurrence of symptoms (*p* = 0.001). The most frequent type IV hypersensitivities reported were for nickel in 25.7% (*n* = 18) and adhesive plaster in 8.6% (*n* = 6) (table 5).

The overall prevalence of atopic dermatitis, allergic rhinitis and asthma was 3.1% (*n* = 17), 2.9% (*n* = 16), and 2.7% (*n* = 15) in participants, respectively. Overall, participants (HCW and non-HCW) with atopic diathesis reported symptoms in 16.0% (*n* = 27) of cases in comparison to 11.6% (*n* = 40) of participants without atopic diathesis. This difference was not significant (*p* = 0.170) (table 5).

Rosacea, seborrheic dermatitis and perioral dermatitis were reported in 4.7%, 2.4%, and 1.4%, respectively, of the entire collective. Participants with rosacea reported significantly more symptoms in comparison to those without rosacea (*p* = 0.038). Likewise, participants with perioral dermatitis showed significantly more symptoms than those without this pre-existing facial dermatosis (*p* < 0.001). Participants without seborrheic dermatitis also had significantly less symptoms than participants with seborrheic dermatitis (*p* = 0.014) (table 5).

Of all participants, 19.9% classified their symptoms as severely to very severely irritating. HCWs used make-up significantly more often than non-HCWs (*p* < 0.001).

Participants reporting any kind of symptoms were significantly more likely to use a topical treatment (*p* < 0.001). Itching (*p* = 0.002), pain (*p* = .025), erythema (*p* = 0.002), fissures (*p* = 0.004), papules (*p* = 0.025) and pustules (*p* = 0.001) were subject to treatment significantly more often than other symptoms such as stinging, burning and scaling. Approximately one third (32.9%; *n* = 160) of participants used skin care products for the facial area once or twice daily. HCWs applied skin care products significantly more often than non-HCWs (*p* = 0.001). HCWs used facial care on average twice daily (mean: 1.5 ± .8) compared to non-HCWs with one application per day (mean: 1.1 ± 1.0) (table 4).

**Table 5.** Symptomatic participants with and without pre-existing medical conditions.

Pre-existing medical condition	Participants <u>with</u> pre-existing medical condition (n)	Participants <u>without</u> pre-existing medical condition (n)	p value
Type IV hypersensitivity	18 (25.7%)	47 (11.0%)	0.001
Atopic diathesis	27 (16.0%)	40 (11.6%)	0.170
Rosacea	7 (30.4%)	55 (11.9%)	0.009
Perioral dermatitis	6 (85.7%)	56 (11.7%)	0.001
Seborrheic eczema	4 (30.8%)	57 (11.7%)	0.119

n: number

## Discussion

In summary, our study reveals a highly significant correlation between the duration of wearing face masks and the appearance of skin symptoms. Participants with type IV hypersensitivity reported significantly more adverse skin reactions compared to participants without this medical condition. Surprisingly, however, reports of adverse skin reactions were not increased in patients with atopic diathesis. However, participants with pre-existing facial dermatoses, such as rosacea, seborrheic eczema and perioral dermatitis, were more likely to show skin symptoms.

The group of non-HCWs consists of patients from a dermatological clinic and therefore cannot be directly equated with the general population, as they are more likely to show skin problems. Compared to the group of HCW, however, this group is better oriented towards the rest of the population.

As hypothesized, the present study reports a highly significant correlation between the duration of wearing face masks and the appearance of symptoms. Compared to non-HCWs, HCWs wore masks for markedly increased periods of time daily, which correlated with increased symptoms. Accordingly, in a recently published survey, Szepletowski *et al.* reported a highly significant correlation between the duration of mask wearing and itching in the general population [14]. In addition, another study reported a correlation between the duration of mask-wearing and adverse skin symptoms in HCWs [15]. Since the COVID-19 outbreak, HCWs are recommended to wear surgical masks during the entire working period, whereas for the general population, masks are only required during certain situations in public. In addition, mandatory mask usage by HCWs in the hospital was introduced on 16<sup>th</sup> March 2020. For the general population in Bavaria, this requirement did not apply until 27<sup>th</sup> April 2020, meaning that at the time of data collection, HCWs were already wearing masks for six weeks longer than the general population.

Comparing genders, men showed a significantly reduced risk of developing symptoms. Consistent with these results, further studies have reported male participants being less affected by adverse skin reactions [16]. This might be explained by a lower threshold for reporting adverse reactions in females or that the facial skin of male participants is accustomed to light skin irritation due to regular shaving and is therefore less susceptible to skin irritation by face masks. Concerning the less affected elderly participants, it should be taken into account that their skin is probably more

“weathered”. Furthermore, they have a different daily routine due to their retired status with reduced public exposure, and thus a reduced duration of daily mask usage.

Of the overall participants, 13.1% reported symptoms. Compared to 49.0% and 74.5% reported in other recent investigations, this prevalence of symptoms is rather low [15, 17]. However, these surveys were performed exclusively on HCWs, whereas this study included both HCWs and non-HCWs. This discrepancy most likely results from the longer mean duration of mask-wearing in HCWs.

In the present study, symptoms were more likely reported by participants using surgical masks compared to cloth masks ( $p=0.014$ ). Hua *et al.* postulated that the extent of symptoms was significantly greater when wearing a N95 mask than a surgical mask ( $p < 0.001$ ) [18]. In contrast to this, another report stated less itch when wearing surgical masks compared to cloth masks or N95 masks [14]. Additionally, differences in the effect size could be explained by differences in duration of mask wearing. Surgical masks are commonly used by HCWs for a longer period and thus more likely associated with symptoms. In contrast, cloth masks are virtually only used by non-HCWs, which report a shorter period of usage. Furthermore, all three types of masks differ concerning their permeability which may also influence the appearance of symptoms [18].

Of the study population, 14.1% reported type IV hypersensitivity. Analysis showed a highly significant correlation between type IV hypersensitivity and symptoms ( $p=0.001$ ). This observation adds to recent cases of contact dermatitis due to surgical and N95 masks reported during the COVID-19 pandemic [19, 20]. Increased temperature, friction and moisture from respiration, combined with the occlusive effect of masks, are common risk factors for irritant and allergic contact dermatitis and can enhance symptoms [21]. Previous studies showed that surgical and N95 masks might contain traces of formaldehyde or other preservatives, which can be another trigger for contact dermatitis [22].

Concerning participants with atopic diathesis, there was no significant difference regarding the appearance of symptoms. Former studies reported that participants with atopic diathesis are more prone to adverse skin reactions [16, 23]. However, these studies were restricted to HCWs, suggesting that symptoms may only be more frequent in individuals with atopic diathesis when masks are worn daily for extended periods of time. The lack of difference observed here might be due to the small size of the study population or the fact that HCWs and non-HCWs were analysed, as mask-wearing periods are relatively short in non-HCWs.



**Figure 2.** A-C) Examples of clinical images of typical face mask dermatitis.

Furthermore, participants with atopic diathesis might be educated to more frequently care for their skin compared to those without this underlying medical condition. This might also prevent adverse skin reactions due to face masks. Participants with pre-existing facial dermatoses, such as rosacea, seborrheic dermatitis and perioral dermatitis were more likely to show skin symptoms. Similarly, Zuo *et al.* reported an increase in pre-existing facial skin symptoms whilst wearing masks [15]. A group of Chinese experts stated the same correlation [24]. The association with perioral dermatitis is consistent with clinical symptoms of face mask dermatitis which show aspects of perioral dermatitis. In the present study, treatment was only reported in 27.3% of the participants with symptoms. This lack of care might

be due to insufficient therapy advice regarding adverse skin reactions induced by face masks.

Besides therapy, preventive measures are even more important to minimize new adverse cutaneous reactions due to face masks. Concerning the hands, skin care is well established among HCWs and its effectiveness is proven [25-27]. Likewise, in the present study, the use of skin care products was found to be significantly more frequent in HCWs than in non-HCWs ( $p=0.001$ ). The European Task Force on Contact Dermatitis recommends the use of hydrocolloid patches at pressure points or points of fixation of masks in order to decrease mechanical friction and thus adverse skin reactions. In addition, it is essential to evaluate the duration of wearing face masks [28]. Moreover, there is further need to establish preventive measures for face mask dermatitis not only in HCWs, but also non-HCWs.

To the best of our knowledge, this is the first study investigating adverse facial skin reactions during the COVID-19 pandemic in HCWs and non-HCWs using the same itemized questionnaire. This study is limited by the relatively small sample size. Further studies should acquire pooled data of large numbers of HCWs and non-HCWs in order to elucidate the occurrence of face mask dermatitis with respect to mask type, duration of mask-wearing, occupational (HCW) vs non-occupational (non-HCW) mask use, correlation with pre-existing type IV hypersensitivities, atopic diathesis and underlying facial dermatoses. In future studies, facial skin care, as a preventive measure, and dermatological treatments must be evaluated to establish validated advice for optimal prevention and treatment of face mask dermatitis in HCWs and the general population. ■

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