

Mask-induced dermatoses during the COVID-19 pandemic: a questionnaire-based study in 12 Korean hospitals

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Summary

Background. During the coronavirus disease 2019 (COVID-19) pandemic, various adverse skin reactions to long-term mask wearing have been reported.

Aim. To assess the clinical features of mask-induced dermatoses and to recommend prevention and treatment options.

Methods. From April to August 2020, questionnaires including topics such as demographic information, pre-existing skin disorders, reported mask-related symptoms, daily mask-wearing duration and frequency, types of masks used and whether the participant was a healthcare worker, were distributed to patients in 12 hospitals. Dermatologists assessed skin lesions, confirmed diagnosis and recorded treatments.

Results. Itchiness was the most frequent symptom, mostly affecting the cheeks. The most common skin disease was new-onset contact dermatitis (33.94%), followed by new-onset acne (16.97%) and worsening of pre-existing acne (16.97%). Daily wearing of masks was significantly ($P = 0.02$) associated with new-onset contact dermatitis. More than half of patients with pre-existing skin problems experienced disease worsening while wearing masks. Longer duration of wearing (> 6 h/day, $P = 0.04$) and use of cotton masks ($P < 0.001$) significantly increased acne flare-up. Healthcare workers had a higher incidence of skin disease. Skin lesions were generally mild and well tolerated with topical treatment. The study had some limitations: the effect of seasonal characteristics and other risk factors were not assessed, and the patients were visiting dermatological clinics and had interest in their skin status, thus, there may have been selection bias.

Conclusion. Mask-induced/-triggered dermatoses contribute to increase the dermatological burden during the pandemic.

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Introduction

A novel coronavirus, SARS-CoV-2, was first identified as the pathogen responsible for an outbreak of viral pneumonia in Wuhan, China in January 2020. Since then and to date, the disease, later named coronavirus disease 2019 (COVID-19), has spread globally.¹ Stringent measures have been taken to limit COVID-19 spread.² To combat this highly contagious disease, the wearing of personal protective equipment (PPE), such as a mask that shields respiratory infection is recommended, especially for healthcare workers (HCWs).³ However, there have been increasing reports of prolonged use of PPE causing direct skin damage and worsening pre-existing dermatoses, such as contact dermatitis, seborrhoeic dermatitis and acne, among HCWs.^{4–6} A recent observational study reported that long-term mask wearing appeared to trigger acne and rosacea flares.⁷ Mask-induced Koebner phenomenon was also highlighted, especially in patients with psoriasis.⁸

In spite of the worldwide debate on whether facemasks should be worn by the general population, it is quite clear that protective actions at an individual level can contribute to the reduction of viral transmission and prevention of community outbreak.⁹ Consequently, from the very beginning of the pandemic in February 2020, the Korean public health authority has made the general use of masks obligatory, particularly in crowded public spaces.¹⁰ Since then, with the increase in mask usage time, mask-induced facial dermatosis in the general population has increased; however, there is a lack of a large population-based study on adverse skin reactions due to long-term mask wearing in non-HCWs. Therefore, we aimed to assess the prevalence, clinical features and prescribed options for these mask-induced dermatoses, in order to suggest effective preventive measures.

Methods

The study protocol was designed in accordance with the guidelines of the Declaration of Helsinki and Korean good clinical practice, and approved by the institutional review board of Inje University Seoul Paik Hospital (no. 2020-05-005-005). All patients voluntarily participated in the study, and written informed consent was obtained from all participants of the prospective study after a full explanation of the risks and benefits of the study.

Study design

We conducted a multicentre observational study from April to August 2020 in 12 university or tertiary hospitals. The study population comprised patients who visited the dermatology department of these hospitals. The inclusion criterion was the presence of skin symptoms or skin lesions related to wearing facemasks during the COVID-19 pandemic.

Questionnaires

Questionnaires were used to obtain information from participants regarding their facemask use (Supplementary Data S1, S2), including the type of mask and the frequency and duration of wearing masks. Regarding the type of mask, the survey options included KF94/KF80 (Korean Filter mask certified by the Korean Food and Drug Administration; the number represents the filtration rate of particles), N95, surgical/dental and cotton mask. Demographic information, including sex, age, previous skin disease and history of general disease were also recorded. Dermatologists assessed patients for subjective skin symptoms, objective skin lesions and affected sites of skin reactions, and based on the skin conditions, they confirmed the dermatological diagnosis of the patients. Additionally, treatment methods for the patients were recorded by the dermatologists.

Statistical analysis

Statistical analyses were performed using SPSS for Windows (V19.0; IBM Corp., Armonk, NY, USA). Demographic characteristics and incidence rates of each disease were analysed using Student *t*-test and Pearson χ^2 test. The significance level was set at 5%, thus $P < 0.05$ was considered statistically significant.

Results

Demographics

The study enrolled 330 patients [65.15% ($n = 215$) women and 34.85% ($n = 115$) men; mean \pm SD age 35.50 ± 14.45 years]. Of the 330 patients, 109 (33.03%) were in their 20s, 89 (26.97%) were in their 30s and 40 (12.12%) were in their 40s. The majority (82.42%; $n = 272/330$) reported having a pre-existing skin dermatosis, and 27.27% ($n = 90/330$) were HCWs (Table 1).

Table 1 Type, frequency or duration of mask-wearing in a hospital population.

Parameter	Patients, n (%) (N = 330)
Mask type	
N95/KF94/KF80	192 (58.18)
Surgical mask	122 (36.97)
Cotton mask	16 (4.85)
Frequency, days/week	
< 7	117 (35.45)
7 (every day)	213 (64.55)
Duration, h/day	
< 6	167 (50.61)
≥ 6	163 (49.39)

KF, Korean Filter.

Reported skin reactions to facemasks

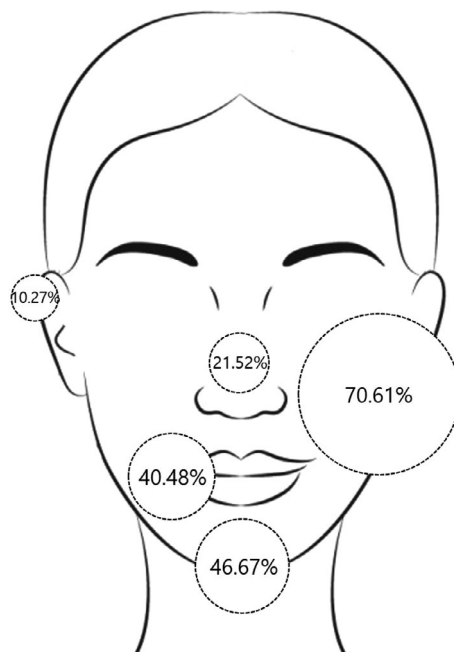
In total, 92.73% of patients ($n = 306/330$) reported subjective skin symptoms, with the most common being itching (66.06%), followed by stinging (31.52%) and dryness (26.36%). Objective skin lesions were found in 93.64% of patients ($n = 309/330$), mainly erythema (60.91%) (Table 2). The cheek was the most commonly affected site (70.61%), and other involved sites were the chin (46.67%), lip and perioral area (40.48%), nose (21.52%) and ear (10.27%) (Fig. 1).

Diagnosis of mask-related skin disease

Where patients had coexistence of > 1 skin disease, the dermatologist classified the skin diseases into major and minor diagnoses. Worsening skin disease was independently defined by distinguishing it from a case of newly occurring skin disease. In addition, the correlation between the incidence of skin disease and variables, including occupation (whether the patient

Table 2 Skin reactions related to facemasks.

Parameter	Patients, n (%) (N = 330)
Skin symptoms ^a	
Itching	218 (66.06)
Stinging	104 (31.52)
Dryness	87 (26.36)
Tightness/pressure	74 (22.42)
Burning	45 (13.64)
Skin lesions ^a	
Erythema	201 (60.91)
Papule	112 (33.94)
Pustule	96 (29.09)
Scale	83 (25.15)
Erosion	28 (8.49)

^aSome participants had more than one lesion type.**Figure 1** Relative proportion of affected sites within the face (%): cheek (70.61%), chin (46.67%), perioral/lip (40.48%), nose (21.52%) and ear (10.27%).

was an HCW or not), mask type and mask-wearing duration, was assessed.

Skin diseases

The most common major diagnosis of skin disease was new-onset contact dermatitis ($n = 112/330$, 33.94%), followed by new-onset acne ($n = 56/330$, 16.97%) and worsening of pre-existing acne ($n = 56/330$, 16.97%) (Table 3). Among patients with pre-existing skin dermatoses, 57.35% ($n = 156/272$) experienced worsening of their pre-existing skin dermatosis (including acne, atopic dermatitis, contact dermatitis, seborrhoeic dermatitis and rosacea). The disease most frequently aggravated by masks was acne ($n = 56/120$, 46.67%).

Table 3 Mask-related skin disease diagnosed by dermatologists.

	Patients, n (%) (N = 330)
Contact dermatitis	112 (33.94)
Acne	56 (16.97)
Worsening of acne	56 (16.97)
Worsening of atopic dermatitis	26 (7.88)
Worsening of rosacea	24 (7.27)
Worsening of contact dermatitis	14 (4.24)
Rosacea	8 (2.42)

Correlations with mask wearing

Occupation as an HCW, use of N95/KF94/KF80 masks and daily wearing of masks were all associated with increased occurrence of contact dermatitis compared with individuals who were not HCWs who wore surgical or cotton masks, or who did not use masks every day (Table 4). HCWs had significantly ($P < 0.01$) more reports of worsening of acne (28.89%) compared with the general public (12.5%).

Patients who wore cotton masks experienced a significantly ($P < 0.001$) increased incidence of acne flares (50.0%) compared with those who wore N95/KF94/KF80 masks (11.98%). Worsening of acne was reported by significantly ($P = 0.04$) more patients who wore masks for > 6 h/day (23.93%) than by those who wore masks < 6 h/day (10.18%).

Treatment

Of the 330 patients, 259 (78.48%) needed further treatment, mainly with antihistamines (42.42%), topical steroids (29.7%) and topical tacrolimus/pimecrolimus (17.58%).

Discussion

This descriptive study investigated the demographics of patients who visited dermatologists with mask-related problems and analysed the possible relevance of disease and mask-wearing patterns. Itching was the most frequent symptom, with the cheek being the most commonly affected site. New-onset contact dermatitis was the most common diagnosis of mask-

related dermatoses. More than half of patients with pre-existing skin problems experienced worsening of their condition while wearing masks, with acne being the most frequently aggravated disease. As expected, HCWs had a higher incidence of skin diseases, such as contact dermatitis or acne flares.

Our results using data from the general public differ from those of previous studies investigating skin damage among HCWs in the following points.^{4,5,11} First, fewer cases of pressure injury due to masks were reported in our study than in HCW-based studies. Second, the most affected area was the cheek, not the nasal bridge as in HCWs. Third, symptoms of dryness/tightness and desquamation were less frequent in our study. These distinctions may be due to the fact that non-HCWs rarely wear multilayer PPE, such as full-face respirators, goggles and face shields, whereas HCWs do. This less stringent protection not only prevents simultaneous compression by masks and goggles, but also reduces the increasing temperature and humidity that occurs inside protective shields.⁵ Moreover, the KF94 and KF80 masks were distributed by the Korean government to the public, who were recommended to wear surgical or cotton masks in order to ease breathing, and these masks are looser-fitting than the N95 masks that HCWs usually wear. Unlike non-HCWs, HCWs also wear tight masks continuously and for longer durations without removing them.

Contact dermatitis was related to healthcare work, the wearing of relatively tight masks and the daily use of masks. HCWs are also more likely to be exposed to the culprit allergens during their work. The allergens associated with facemask contact

Table 4 Analysis of variables associated with contact dermatitis.

Variables	Total	Contact dermatitis		P	P
		n	%		
Study population	330	112	33.94		
Occupation					
Not HCWs	240	73	30.42	0.38	
HCWs	90	49	54.44	$< 0.001^a$	$< 0.001^a$ (vs. general public)
Type of mask					
N95/KF94/KF80	192	82	42.71	0.05	
Surgical	122	28	22.95	0.03 ^a	$< 0.001^a$ (vs. N95/KF94/KF80)
Cotton	16	2	12.50	$< 0.001^a$	$< 0.001^a$ (vs. N95/KF94/KF80)
Duration of wearing					
< 7 days/week	117	30	25.64	0.10	0.02 ^a (vs. 7 days/week)
7 days/week	213	82	38.50	0.28	
< 6 h/day	167	62	37.13	0.48	0.32 (vs. ≥ 6 h/day)
≥ 6 h/day	163	52	31.90	0.65	

HCW, healthcare worker. ^aStatistically significant.

allergy were nickel and *N*-isopropyl-*N'*-phenyl-1,4-phenylenediamine, which were reported as allergens by an occupational skin surveillance scheme between 1993 and 2013.¹² A recent case report demonstrated the presence of formaldehyde and bronopol in a polypropylene surgical mask as a cause of allergic contact dermatitis (ACD) during the COVID-19 pandemic.¹³ In patients with eczematous lesions on the nose and cheeks, areas, which are in contact with facemasks, ACD should be suspected and a confirmative patch test can help in establishing the diagnosis. In addition, wearing tight masks on a daily basis can facilitate allergic sensitization independently, and repeated exposure may cause cumulative disruption of the skin barrier,¹⁴ ultimately resulting in visible skin changes caused by irritant contact dermatitis.¹⁵ In turn, a damaged skin barrier increases exposure to allergens, leading to sensitization and ACD in susceptible individuals.¹⁶

Pre-existing acne vulgaris was worsened by prolonged wearing of masks for > 6 h/day. This mask-related acne has earned the term 'maskne', and is a well-recognized dermatological comorbidity due to PPE.⁷ Mechanical rupture of comedones by pressure and friction may provoke inflammation.⁴ The high temperature inside the mask because of resistance to airflow and buildup of facial heat raises the risk of acne flare, as sebum excretion increases by 10% for each 1 °C rise.^{17,18} In particular, squalene is known to form a larger proportion of surface lipids when the temperature increases.¹⁹ Furthermore, increased ambient humidity can also worsen acne by causing occlusion of pores and damage to the upper portion of the pilosebaceous duct. Sweating and increased humidity may contribute to swelling of keratinocytes, thereby obstructing the follicles.²⁰ Moreover, changes in skin surface sebum composition, elevated CO₂ levels under the mask and the humid environment are conducive to proliferation of the bacteria that can induce acne. As our results demonstrate, multiple reusing of cotton masks without adequate sterilization can promote bacterial growth.

Our research is important in that it includes large-scale data that reflect the obligatory long-term mask wearing both in the general population and the HCWs in Korea. Based on the effects of the strong preventive measures in Korea, we can forecast the likely potential dermatological problems as prolonged and generalized mask-wearing becomes more common worldwide during the COVID-19 pandemic. These data can be utilized for public education to pre-emptively avoid mask-related adverse skin reactions.

In addition, by expecting the occurrence of such reactions, clinicians can take proactive measures to mitigate the potential risks in people who have a history of dermatological disease. The high-risk population with pre-existing irritant or contact dermatitis can be educated to apply a prophylactic dressing or add a piece of cotton or gauze inside the mask to avoid direct contact of the mask with the face.^{15,21,22} Additionally, patients with dermatological conditions known to be associated with Koebner phenomenon, such as psoriasis or vitiligo, should be educated about avoidance of pressure and friction.⁸ As patients with a disrupted skin barrier due to conditions such as atopic dermatitis or rosacea can easily experience dryness and scales, they are recommended to apply highly potent moisturizers both before and after wearing masks to prevent discomfort.⁴ For acne-prone skin, a disposable mask is preferred to a reusable cotton mask. Scarano *et al.* reported that mask removal rapidly decreased skin temperature after 1 min, returning to baseline levels after 5 min,¹⁷ thus taking a break during mask wearing should alleviate acne flare. Non-comedogenic and oil-controlling moisturizers should be applied by acne-prone individuals before and after wearing masks.

There are some limitations to our study. First, we administered the questionnaire from April to August 2020, and seasonal characteristics, such as temperature and humidity during this period, could affect skin conditions. Second, the study group included patients who visited dermatological clinics and therefore had an interest in their skin status, while at-risk populations such as patients with cancer had limited access to dermatologists during the pandemic,² and therefore, the study may be subject to selection bias. Third, we did not investigate possible risk factors in participants' daily lives other than their mask-wearing habits.

Nevertheless, in light of the results reported in our study, it should be helpful for dermatologists to notice and expect mask-related skin problems, such as irritation, contact dermatitis or acne flares. Although most cases are clinically mild, the increased likelihood of hand-to-face and hand-to-surface contact because of such lesions is concerning, given the increased likelihood of viral transmission.²³ As the role of face touching and surface contact in viral spread has been highlighted, clinicians should actively attempt to alleviate the source of itch or irritation.²⁴ Based on our data, both clinicians and patients can be reassured that these conditions are easily managed, mostly with topical agents. Along with actively relieving the symptoms, dermatologists should encourage patients to

wear masks in their usual lives without fearing skin problems.

Conclusion

Long-term mask wearing by the general population during the COVID-19 pandemic may lead to development of new and distressing skin problems, and to worsening of pre-existing dermatoses. It is important for dermatologists to be aware of and actively manage these conditions in order to encourage correct and rational mask wearing, which is an essential means of prevention against COVID-19.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Data S1 Mask dermatosis questionnaire (in Korean).

Data S2 Mask dermatosis questionnaire (in English).