

Face mask-induced skin changes: a new common phenomenon during the coronavirus disease 2019 pandemic

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Abstract

Coronavirus disease 2019 is a severe acute respiratory syndrome, and wearing a mask is an important preventive measure. However, long-term use can cause *maskne*, or mask-induced acne. This study evaluated the prevalence, clinical characteristics, and severity of mask-induced acne and its effect on pre-existing dermatosis using an online questionnaire. The questionnaire comprised 15 questions on 6 primary topics: demographic data, type of face mask, dermatological symptoms after using a mask, pre-existing dermatological conditions, the duration of use, and the effects of mask use on existing dermatological conditions. We included 1,025 participants; 48.6% had dermatological symptoms after using masks. The most common symptoms were red papules (33.8%) and itching (27.2%). Individuals who wore masks for more than 4 hours daily experienced more dermatological symptoms, for example, healthcare providers, who had a higher risk of mask-related dermatosis than participants with other occupations. Moreover, masks significantly increased the severity of rosacea, contact dermatitis, and seborrheic dermatitis. These results suggest that board-certified dermatologists should assess patients in larger-scale studies to determine adequate management strategies.

Introduction

Coronavirus disease 2019 (COVID-19) is a severe acute respiratory syndrome (SARS) caused by the SARS coronavirus 2 that has spread globally since December 2019.¹ Wearing a mask is one of the most effective protective measures against COVID-19. Therefore, in Saudi Arabia and many other countries, face masks are mandatory in public places.

During the COVID-19 pandemic, the term “maskne” was coined to describe mask-induced acne from long-term face mask use. Mask-induced acne is acne mechanica produced by mechanical harm (e.g., pressure, friction, and rubbing) and occlusion from wearing a mask. Genetics, environmental circumstances, the mask-wearing duration, the mask style, and previous facial skin illness all influence the incidence of mask-induced acne.²

Mask-induced facial dermatosis has increased in the general population with prolonged mask use. Nevertheless, extensive community-based investigations on adverse skin reactions due to long-term mask-wearing in non-healthcare workers are lacking. Thus, we aimed to determine the prevalence, the clinical characteristics, and the severity of mask-induced dermatological changes and how masks affect pre-existing dermatoses to help dermatologists identify and manage these symptoms. Furthermore, we aimed to provide foundational evidence for preventive measure recommendations.

Materials and Methods

We conducted this cross-sectional study among Saudi Arabian citizens and residents from April 2021 to February 2022 to evaluate the prevalence, intensity, and clinical characteristics of face mask-induced skin changes during the COVID-19 pandemic among the general population. The Imam Mohammed Ibn Saud Islamic University’s Institutional Review Board reviewed and approved this study (no. 125-2021).

We used a validated electronic questionnaire, which contained consent for participation at the beginning. We calculated that the minimum sample size required to achieve significance at the 95th percentile confidence level was 1039 participants. We distributed the electronic survey using the institution’s social media platforms, and participants were encouraged to share the survey with others. We included individuals over 18 years old living in Saudi Arabia and excluded individuals who did not complete

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the entire questionnaire or grant informed consent and those younger than 18 years.

The questionnaire comprised 15 questions on 6 main topics: i) demographic data, ii) the type of mask, iii) the presence of dermatological symptoms after using a face

mask, iv) existing dermatological conditions, v) the face mask use duration, and vi) the effects of a face mask on existing dermatological conditions.

Data were entered into a Microsoft Excel spreadsheet (version 23, Microsoft Corporation, Redmond, WA, USA) and analyzed using SPSS (version 23, IBM Corp., Armonk, NY, USA). We reported categorical variables using descriptive statistics (*i.e.*, frequencies and percentages). Also, we used Pearson's chi-square test to compare the response distributions and categorical variables to evaluate associations between these variables; we reported categorical variables as frequencies and percentages. A P-value of ≤ 0.05 was considered statistically significant.

Results

We included 1,025 participants (we did exclude 14 participants from the original calculated sample size due to contradicting answers and/or missing information). Table 1 presents their sociodemographic profiles. Most participants (54.5%) were younger than 25 years old, women (67.2%), and from the central region (74.1%). Furthermore, most participants had a bachelor's degree (67.0%), were single (70.0%), and unemployed (58.85%). Only 35.2% of participants had active skin disease diagnosed by a dermatologist. Most participants had acne vulgaris (25%; Figure 1).

Table 2 describes the face mask habits of the participants; 771 (75.2%) used surgical masks, 132 (12.9%) used cloth masks, 98 (9.6%) used double-layer surgical masks, and 24 (2.3%) used N95 masks. Slightly more people used face masks for less than 4 hours ($n=542$, 52.9%); others used it for more than four hours ($n=483$, 47.1%). Of those with pre-existing skin conditions, 42 (4.1%) reported that their condition significantly worsened, 113 (11%) reported moderate worsening, 98 (9.6%) reported slight worsening, and 108 (10.5%) reported no effect.

Figure 2a shows the incidence of dermatological symptoms after using face masks. Less than half ($n=498$, 48.6%) of the participants experienced at least one dermatological symptom after wearing face masks; 51.4% (527 participants) did not. The most reported symptoms after using face masks were red papules ($n=346$, 33.8%), followed by itching ($n=279$, 27.2%), and redness ($n=256$, 25%) (Figure 2b). The least reported symptoms were swelling ($n=29$, 2.8%), rash ($n=57$, 5.6%), and pain, numbness, and tingling ($n=70$,

6.8%). The overall and individual symptom incidence rates were higher in participants who wore face masks for more than four hours (Table 3).

The province was significantly associated with the incidence of dermatological symptoms after using a face mask ($P=0.008$; Table 4). The highest dermatological symptoms incidence rate was in the southern region (78.6%), while the lowest was in the central region (46.1%). The type

of work was also significantly associated with the incidence of dermatological symptoms after wearing a face mask ($P=0.004$). Also, healthcare workers had a notably higher incidence rate than other workers/those not working (56.7% vs. 46.1%, respectively). Additionally, having a dermatological disease was significantly associated with cutaneous symptom development ($P<0.001$), and those with skin diseases had a notably higher incidence rate

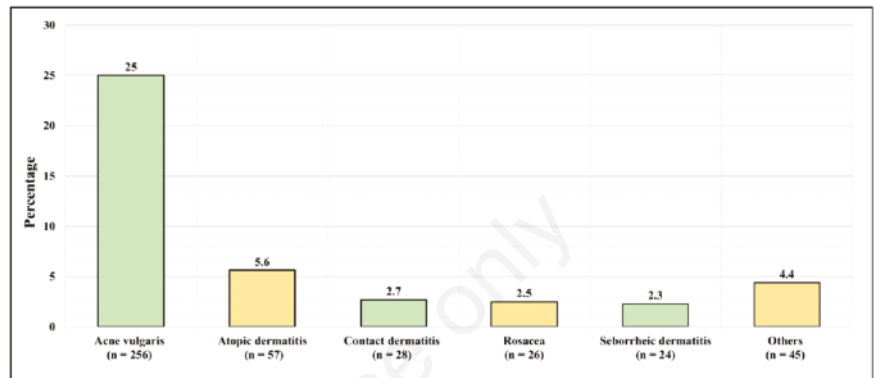


Figure 1. The skin diseases affecting the participants.

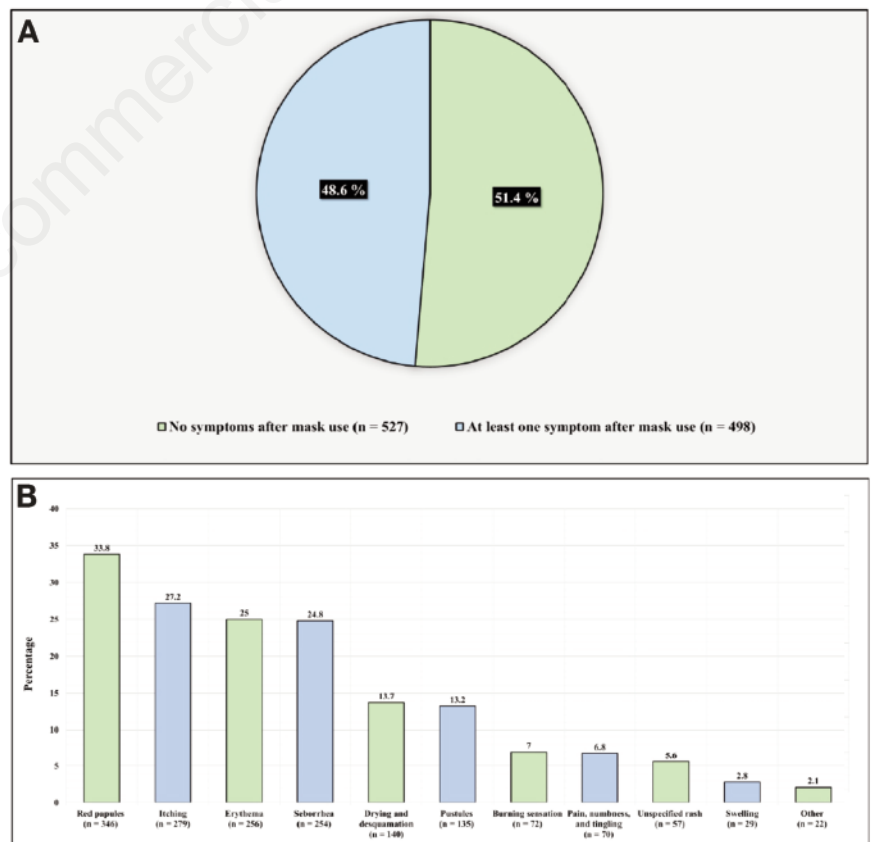


Figure 2. A) The incidence of dermatological symptoms after face mask use; B) The reported dermatological symptoms after face mask use.

than those without a skin disease (58.2% vs. 43.4%, respectively). The mask use duration was also significantly associated with the incidence of cutaneous symptoms ($P < 0.001$). Those who wore masks for more than 4 hours had a notably higher rate of symptoms than those who wore masks for less than 4 hours (56.7% vs. 41.3%, respectively). Age, gender, education, and the mask type were not associated with the incidence of symptoms after wearing masks.

Table 5 compares the effects of masks on dermatological diseases. The severity of rosacea, contact dermatitis, and seborrheic dermatitis significantly differed after wearing a mask compared to other skin diseases overall ($P = 0.039$, $P = 0.005$, $P = 0.004$, respectively). The severity of acne vulgaris also significantly differed after wearing a mask compared to other types of dermatosis ($P = 0.025$). However, those with acne had a lower significant worsening rate than other skin conditions (10.2% vs. 15.2%, respectively).

Discussion

Face masks prevent viral particle transmission via respiratory droplets.³ However, this comes at a cost to skin health.^{4,5} The most common adverse reactions to face masks are itching, irritation, allergic contact dermatitis, papulopustular rosacea, acne, and seborrheic dermatitis.⁶⁻⁸ Since the pandemic began, the effects of mask-wearing on the skin health of healthcare workers have been studied extensively.^{5,7-12} However, there is scant research that includes the general public.^{4,6,13,14} To our knowledge, only 2 studies have assessed healthcare workers and the general population.^{12,15} Therefore, we assessed the prevalence of skin changes, we identified the clinical characteristics and severity, and we evaluated the effects on pre-existing dermatosis after wearing masks in healthcare workers and the general public.

The skin microbiome is influenced by both intrinsic (*e.g.*, age, gender, ethnicity, genetics, and physiological and psychological stressors) and extrinsic (temperature, nutrition, medications, and alcohol intake) factors, all of which can be altered by wearing a mask and retaining biofluid.^{16,17} Furthermore, disrupting the cutaneous microbiome “dysbiosis” causes new dermatoses and exacerbates pre-existing ones.¹⁷ In our study, 35.2% of the participants had a previous skin disease, such as acne, atopic dermatitis, contact dermatitis, rosacea, and seborrheic dermatitis. However, other dermatological diseases,

such as psoriasis, urticaria, vitiligo, and tinea, were reported less frequently. Moreover, the presence of dermatological conditions was significantly associated with a higher rate of cutaneous symptom development ($P < 0.001$, 58.2% vs. 41.8%, respectively); Choi *et al.* and Inan Dogan *et al.* reported similar findings.^{13,15}

In this study, 48.6% of participants developed cutaneous symptoms: red

papules and itching were the most common symptoms (33.8% and 27.2%, respectively). Pain and itching (6.8%), unspecified facial rash (5.6%), and swelling (2.8%) were the least reported. However, Choi *et al.* reported the opposite in Korea. Itching (66.1%) and a stinging sensation (31.5%) were the most common.¹⁵ This disparity may be partly explained by the mask type. In Saudi Arabia, most participants wore sur-

Table 1. Socio-Demographic characteristics (n=1,025).

Demographic characteristics	n	%
Age (years)		
≤25	559	54.50
26 to 35	263	25.70
36 to 45	114	11.10
46 to 55	52	5.10
>55	37	3.60
Gender		
Female	689	67.20
Male	336	32.80
Region		
Central	760	74.10
Western	143	14.00
Northern	35	3.40
Southern	14	1.40
Education		
Bachelor's degree	687	67.00
High school	177	17.30
Higher education	122	11.90
Diploma & other unspecified	23	2.20
Elementary and middle school	16	1.60
Marital Status		
Single	718	70.00
Married	275	26.80
Divorced	32	3.10
Occupation		
Student	497	48.50
Employee	397	38.70
Non-employee	106	10.30
Freelancer	25	2.40
Type of work		
Not working	603	58.83
Healthcare worker	238	23.22
Other	184	17.95

Table 2. Face mask use (n=1,025).

Question	n	%
Type of mask		
Surgical	771	75.2
Cloth	132	12.9
Double-layer surgical	98	9.6
N95	24	2.3
Daily mask use duration		
0–4 hours	542	52.9
More than 4 hours	483	47.1
The effects of a face mask on existing dermatological diseases		
Without dermatological diseases	664	64.80
No effect	108	10.50
Symptoms slightly worsened	98	9.60
Symptoms moderately worsened	113	11.00

gical masks (75.2%), followed by cloth masks (12.9%); N95 masks (2.3%) were used the least. Conversely, in Korea, more than 50% of participants used N95 masks, and less than 5% used cloth masks.

Overall, 35.2% of participants had an active skin disease. Of them, 10.5% did not observe any changes in their disease activity. Furthermore, 9.6%, 11.0%, and 4.1% reported slight, moderate, and significant worsening of their skin disease, respectively. Inan Dogan *et al.* and Zuo *et al.* reported similar findings.^{12,13}

Healthcare workers had a significantly higher risk of developing cutaneous symptoms than those who did not work or performed other types of work ($P=0.004$:

Table 3. Symptom distribution based on the duration of use.

Symptoms	Duration of face mask use	
	4 hours or less n=542 (%)	More than 4 hours n=483 (%)
Itching	118 (21.8)	161 (33.3)
Erythema	109 (20.1)	147 (30.1)
Unspecified rash	27 (5)	30 (6.2)
Drying and desquamation	65 (12)	75 (15.5)
Burning sensation	30 (5.5)	42 (8.7)
Swelling	11 (2)	18 (3.7)
Pain, numbness, and tingling	30 (5.5)	40 (8.3)
Seborrhea	106 (19.6)	148 (30.6)
Red papules	127 (23.4)	219 (45.3)
Pustules	55 (10.1)	80 (16.6)
Other symptoms	224 (41.3)	274 (56.7)

Table 4. Associations with dermatological symptoms after using a face mask.

Factor	Dermatological symptoms after using a mask		P-value
	No (%)	Yes (%)	
Age (years)			0.058
≤25	279 (49.9)	280 (50.1)	
26 to 35	127 (48.3)	136 (51.7)	
36 to 45	66 (57.9)	48 (42.1)	
46 to 55	29 (55.8)	23 (44.2)	
>55	26 (70.3)	11 (29.7)	
Gender			0.078
Male	186 (55.4)	150 (44.6)	
Female	341 (49.5)	348 (50.5)	
Region			0.008*
Eastern	39 (53.4)	34 (46.6)	
Western	62 (43.4)	81 (56.6)	
Northern	13 (37.1)	22 (62.9)	
Southern	3 (21.4)	11 (78.6)	
Central	41 (53.9)	350 (46.1)	
Education			0.882
Elementary and middle school	8 (50)	8 (50)	
High school	86 (48.6)	91 (51.4)	
Bachelor's degree	354 (51.5)	333 (48.5)	
Higher education	66 (54.1)	56 (45.9)	
Diploma & other unspecified	13 (56.5)	10 (43.5)	
Occupation			0.155
Student	244 (49.1)	253 (50.9)	
Employee	205 (51.6)	192 (48.4)	
Non-employee	65 (61.3)	41 (38.7)	
Freelancer	13 (52)	12 (48)	
Type of work			0.004*
Healthcare worker	103 (43.3)	135 (56.7)	
Other or Unemployed	424 (53.9)	363 (46.1)	
Type of mask			0.134
Surgical	410 (53.2)	361 (46.8)	
N95	10 (41.7)	14 (58.3)	
Double-layer surgical	41 (41.8)	57 (58.2)	
Cloth	66 (50)	66 (50)	
Dermatological conditions?			<0.001*
Yes	151 (41.8)	210 (58.2)	
No	376 (56.6)	288 (43.4)	
Mask use duration			<0.001*
0-4 hours	318 (58.7)	224 (41.3)	
More than 4 hours	209 (43.3)	274 (56.7)	

*Statistically significant ($P<0.05$).

Table 5. The effects of wearing a mask on dermatological diseases.

Skin disease	The effect of wearing a mask, n (%)			P-value	
	Significantly worsened	Moderately worsened	Slightly worsened		
Acne vulgaris	26 (10.2)	91 (35.5)	70 (27.3)	69 (27)	0.025*
Other	16 (15.2)	22 (21)	28 (26.7)	39 (37.1)	
Rosacea	5 (19.2)	8 (30.8)	11 (42.3)	2 (7.7)	0.039*
Other	37 (11)	105 (31.3)	87 (26)	106 (31.6)	
Atopic dermatitis	12 (21.1)	18 (31.6)	13 (22.8)	14 (24.6)	0.099
Other	30 (9.9)	95 (31.3)	85 (28)	94 (30.9)	
Contact dermatitis	9 (32.1)	8 (28.6)	6 (21.4)	5 (17.9)	0.005*
Other	33 (9.9)	105 (31.5)	92 (27.6)	103 (30.9)	
Seborrheic dermatitis	8 (33.3)	6 (25)	7 (29.2)	3 (12.5)	0.004*
Other	34 (10.1)	107 (31.8)	91 (27)	105 (31.2)	

56.7% vs. 46.1%, respectively). However, using other personal protective equipment could improve this phenomenon. People wore face masks for varying lengths of time; 52.9% used them for less than 4 hours, while 47.1% used them for more than 4 hours daily. Although the skin reacts to wearing a face mask after as soon as one hour due to increased temperature, redness, and hydration,¹⁸ a longer duration (4+ hours) was significantly associated with a higher rate of symptoms ($P < 0.001$) in our study. This finding confirms other previous results,^{4,6,12} and contradicts Yaqoob *et al.*, who reported no association between the frequency and duration of wearing a face mask with cutaneous symptoms.¹¹

Moreover, we analyzed the effect of mask-wearing on different dermatoses, finding that the severity of rosacea, contact dermatitis, and seborrheic dermatitis significantly increased compared to other dermatoses ($P = 0.039$, $P = 0.005$, $P = 0.004$, respectively). Acne also significantly worsened with mask-wearing. However, the effect was less severe when compared to other dermatoses ($P = 0.025$; 10.2% vs. 15.2%, respectively).

This study lacks the clinical evaluation of participants and the location of the affected areas on the face, which are limitations. However, this study is strengthened by the large sample size and the comparative assessment of healthcare and non-healthcare workers for more generalizable results.

Until the COVID-19 pandemic ends, face masks are one of the most effective protective measures for healthcare workers and the public. Thus, face masks will remain obligatory, especially in close spaces, and we expect more skin reactions, especially considering the summer heat in the Middle East. Hence, dermatologists and other clinicians should anticipate this phe-

nomenon, educate their patients (especially those at higher risk), and provide a prevention and treatment plan.

Scarano *et al.* demonstrated that skin temperature drops one minute after removing a face mask and returns to normal after only five minutes.¹⁹ Thus, taking mask breaks is a powerful preventive measure. Furthermore, we support the following preventive measures: i) use a gentle antibacterial ingredient to avoid skin microbiome disturbance, ii) apply a non-comedogenic moisturizer, iii) follow the manufacturer's recommendations for mask reuse and cleaning, and iv) avoid using sanitizer on the face.²⁰ However, the treatment plan should be tailored individually based on each patient's severity and general health. Therefore, we propose new nomenclature for this group of cutaneous diseases: mask induced dermatoses. This new group can include acneiform eruptions (*e.g.*, maskne and rosacea), dermatitis disorders (*e.g.*, seborrheic dermatitis, perioral dermatitis, irritants, and allergic contact dermatitis), and facial folliculitis. Future research should focus on treatment guidelines, which are currently lacking, to provide an evidence-based recommendation for management during the COVID-19 pandemic and possible future similar pandemics or epidemics.

Conclusions

We found that 41.8% of dermatological diseases were significantly associated with a higher rate of cutaneous symptom development, and the typical symptoms include red papules and itching. Furthermore, healthcare employees had a much higher probability of acquiring cutaneous symptoms than those in other professions. Moreover, masks significantly increased the

severity of rosacea, contact dermatitis, and seborrheic dermatitis compared to other dermatoses. Finally, wearing a mask for longer than 4 hours daily considerably affected the frequency of dermatological symptoms and was significantly associated with a higher complaint rate. Therefore, in future studies, board-certified dermatologists should clinically evaluate study participants and assess the specific facial location of the most affected areas of the face to provide the best guidance for treatment and prevention.

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