Received: 23 January 2022 | Accepted: 3 May 2022

DOI: 10.1111/srt.13173

ORIGINAL ARTICLE

WILEY

# The effects of wearing a face mask and of subsequent moisturizer use on the characteristics of sensitive skin

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## Abstract

**Background:** COVID-19 is a serious respiratory disease, and wearing masks has become essential in daily life. Nevertheless, the number of people complaining of skin problems caused by wearing masks is increasing. Therefore, we investigated the characteristics of changes in sensitive skin caused by wearing a mask.

**Materials and methods:** Twenty healthy Korean women with sensitive skin participated in this study. To determine any skin-related changes caused by mask-wearing, we evaluated redness, hydration, transepidermal water loss (TEWL), and moisture at 2.5 mm below the surface before and 4 h after wearing a Korea Filter 94 mask. In addition, we tested whether applying a moisturizer for 30 min after mask removal could reverse any mask-induced changes.

**Results:** Skin redness and TEWL were significantly increased at 4 h after wearing a mask ($p < 0.05$), otherwise skin hydration and the 2.5 mm moisture were significantly decreased ($p < 0.05$). After applying the moisturizer, skin redness and TEWL were significantly decreased compared to their values 4 h after wearing masks ($p < 0.05$), whereas skin hydration and the 2.5 mm moisture were significantly increased ($p < 0.05$). Moreover, after applying the moisturizer, skin redness and TEWL were significantly reduced compared to the pre-masking baseline ($p < 0.05$), whereas skin hydration was significantly increased ($p < 0.05$); the 2.5 mm moisture showed no significant change.

**Conclusion:** We observed that wearing masks causes physiological changes in sensitive skin, whereas applying a moisturizer after removing the mask improved skin conditions.

KEYWORDS
COVID-19, mask, redness, skin hydration, skin moisture, transepidermal water loss

## 1 | INTRODUCTION

Since the outbreak of COVID-19 in Wuhan, China in December 2019, the numbers of confirmed cases and deaths have been increasing exponentially worldwide. The first patient infected with the SARS-CoV-2 virus in Korea was identified in January 2020, and the World Health Organization declared COVID-19 a pandemic on March 11, 2020.[1] Health authorities recommend wearing personal protective equipment such as masks and latex gloves in many countries to avoid virus transmission through the air. Although masks prevent the spread of COVID-19, they have also been associated with the development of acne mechanica, erythema,

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pustules, contact dermatitis, and papules in the perioral skin and cheeks.[2–5]

The skin is one of the largest and most complex organs in the body, consisting of multiple layers and various cell types. It maintains the body's homeostasis and protects it from various external factors such as sunlight; it also plays roles in aging, hormone secretion, and chemical regulation.[6,7] Such functions can be affected by the prolonged wearing of masks; as the perception that wearing a mask affects the skin has become more widespread, interest in investigating such skin changes has increased.[8,9] Although previous studies have shown that wearing a mask causes changes in skin characteristics, the effects of masks on sensitive skin remain unclear.

The first epidemiological study on sensitive skin was conducted in the United Kingdom in 2001. In that study, sensitive skin was defined as that having reduced tolerance to certain environmental factors such as heat, wind, cold, and ultraviolet light as well as to sanitizing agents, cosmetics, water, and stress.[10,11] In a survey conducted by Western cosmetics companies, approximately 40% of consumers responded that they had sensitive skin. Furthermore, the incidence of sensitive skin is increasing worldwide.[11–13]

Owing to the importance of both maintaining healthy skin and wearing masks during the pandemic, we evaluated the changes in the characteristics of sensitive skin caused by wearing a mask. In addition, we investigated whether any such changes are ameliorated with moisturizer use.

## 2 | MATERIALS AND METHODS

### 2.1 | Ethical approval

This clinical research was approved by the Institutional Review Board of the OATC Skin Clinical Trial Center, Inc. on September 27, 2021. The study was conducted according to the Declaration of Helsinki and GCP Guidelines (ICH E6[R1]): Guideline for Good Clinical Practice (E6[R2]).

### 2.2 | Subject recruitment

Sensitive skin was determined based on the degree of irritation caused by administering the lactic acid sting test. The study was explained to 20 Korean women aged 20–60 years with sensitive skin, who consented to participate.

The subjects wore Korea Filter 94 masks under constant indoor temperature (20–24°C) and relative humidity (40%–60%) with no air movement or direct sunlight exposure for 4 h. All skin parameters were measured at baseline, after wearing a mask for 4 h, and at 30 min after applying a moisturizer.

### 2.3 | Moisturizer

We used KAHI Multi Balm (KOREATECH Co. Ltd., Seoul, Korea) as the test moisturizer in our study. This product contains three types of salmon complex (hydrolyzed collagen, soluble proteoglycan, and sodium DNA) as well as fermented Jeju oil and adenosine to help moisturize the skin and improve wrinkles.

The subjects applied the moisturizer immediately after the mask was removed, then were measured 30 min after applying a moisturizer.

### 2.4 | Instrument-based measurements

#### 2.4.1 | Skin redness

Skin redness was measured using a CR-400 Chroma Meter (Minolta Holdings Ltd, Tokyo, Japan) placed on the cheek. This is a high-precision instrument that measures the $L^*a^*b^*$ values; we evaluated the $a^*$ value, which indicates the degree of redness in the skin.

#### 2.4.2 | Skin hydration

Skin hydration was measured using a Corneometer CM 825 (Courage & Khazaka, Cologne, Germany) placed on the cheek. The instrument measures the capacitance of a dielectric medium to determine the hydration level.

#### 2.4.3 | Transepidermal water loss

Transepidermal water loss (TEWL) was measured using a Tewameter TM 300 (Courage+Khazaka) placed on the cheek. The instrument measures the density gradient of water evaporating off the skin. The TEWL is expressed in $g/h/m^2$.

#### 2.4.4 | Moisture at 2.5 mm below the skin surface

The moisture at 2.5 mm was measured using a Moisturemeter D (Delfin Technologies Ltd., Greenwich, CT, USA). The instrument measures the dielectric constant of the skin, which is directly proportional to the amount of water in the tissues.

### 2.5 | Statistical analysis

Statistical analysis was performed using the SPSS statistical software version 25 (IBM Corp., Armonk, NY, USA), and all results are expressed as the means ± standard deviations. Normality was determined using the Shapiro–Wilk test (and deemed as such if the $p$-value was >0.05). Repeated measures analysis of variance was used to compare the three conditions. A $p$-value < 0.05 was considered statistically significant.

## 3 | RESULTS

A lactic acid sting test was conducted to determine whether the participants had sensitive skin; only subjects with sensitive skin participated

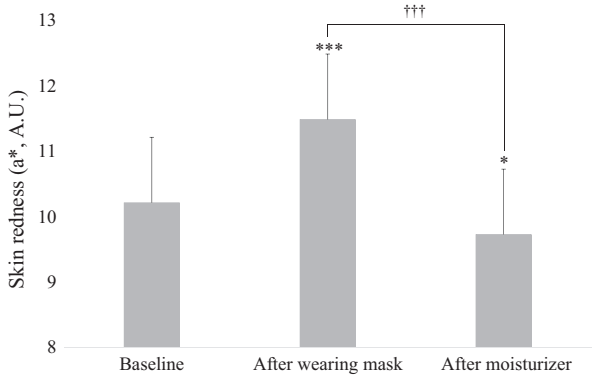


**FIGURE 1** The skin redness ($a^*$ value) measurement during the study showing baseline, 4 h after wearing a mask, and 30 min after applying a moisturizer after removing the mask. $^*p < 0.05$ denotes significant changes compared with the pre-masking baseline, whereas $\dagger p < 0.05$ indicates significant changes after using moisturizer compared with 4 h after wearing a mask. A.U., arbitrary units

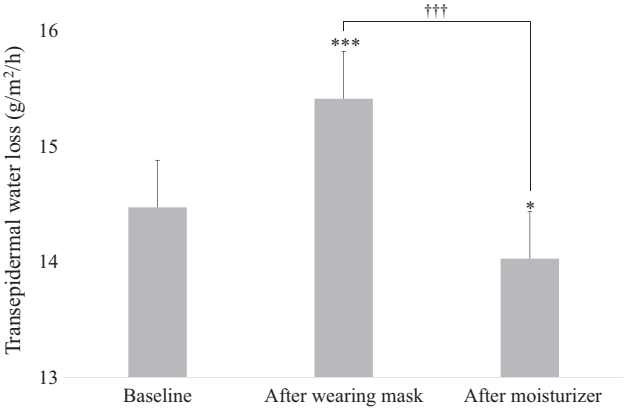


**FIGURE 3** The transepidermal water loss measurement baseline, after 4 h wearing a mask, and after applying moisturizer after removing the mask. $^*p < 0.05$ denotes significant changes compared with the pre-masking baseline, whereas $\dagger p < 0.05$ indicates significant changes after using moisturizer compared with 4 h after wearing a mask

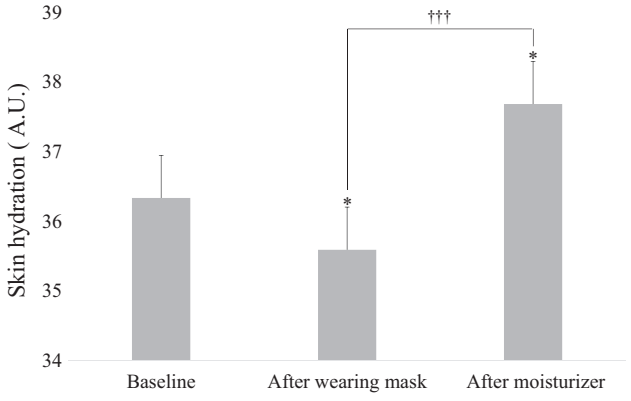


**FIGURE 2** Measured skin hydration value changes during the study showing baseline, 4 h after wearing a mask, and after applying a moisturizer after removing the mask. $^*p < 0.05$ denotes significant changes compared with the pre-masking baseline, whereas $\dagger p < 0.05$ indicates significant changes after using moisturizer compared with 4 h after wearing a mask. A.U., arbitrary units

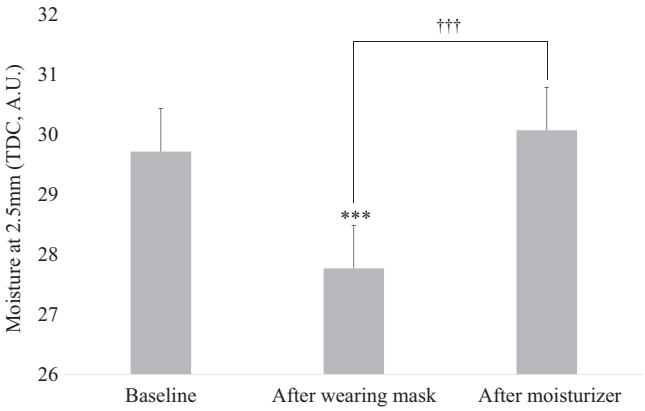


**FIGURE 4** The moisture at 2.5-mm measurement at each study time point. $^*p < 0.05$ denotes significant changes compared with the pre-masking baseline, whereas $\dagger p < 0.05$ indicates significant changes after using moisturizer compared with 4 h after wearing a mask. TDC, tissue dielectric constant

in this study. Ultimately, we included 20 healthy Korean women aged 20–60 years (mean age: 49.30 ± 7.61 years).

Skin redness significantly increased after 4 h of mask-wearing compared to that at baseline ($p < 0.05$). Conversely, it significantly decreased after applying moisturizer than that after 4 h of wearing a mask ($p < 0.05$). On comparing the skin characteristics after applying the moisturizer to the pre-masking baseline, skin redness significantly decreased ($p < 0.05$) (Figure 1).

On the other hand, skin hydration significantly decreased after 4 h of wearing a mask compared to that at baseline ($p < 0.05$), whereas significantly increased after 30 min of applying the moisturizer than that after 4 h of wearing a mask ($p < 0.05$). After the application of moisturizer, skin hydration was significantly higher than that at baseline ($p < 0.05$) (Figure 2).

TEWL was significantly higher after 4 h of wearing mask than that at baseline ($p < 0.05$), whereas significantly lower after applying the moisturizer than that after 4 h of wearing a mask ($p < 0.05$). On comparison of TEWL between post-application of moisturizer and pre-masking baseline, there was a significant decrease ($p < 0.05$) (Figure 3).

Moisture at 2.5 mm was significantly lower than that at baseline after 4 h of wearing a mask ($p < 0.05$); however, it significantly increased after applying the moisturizer than that after 4 h of wearing a mask ($p < 0.05$). After applying the moisturizer compared to that at baseline, moisture at 2.5 mm showed no significant change (Figure 4).

Compared to baseline, the change rate of skin redness was 12.46% and 4.76%, respectively, after 4 h of mask-wearing and after using the moisturizer. The change rate of skin hydration was 2.05% and 3.71% and TEWL was 6.50% and 3.06%, respectively. In addition, the moisture at 2.5 mm was 6.56% and 1.19%, respectively. It showed that

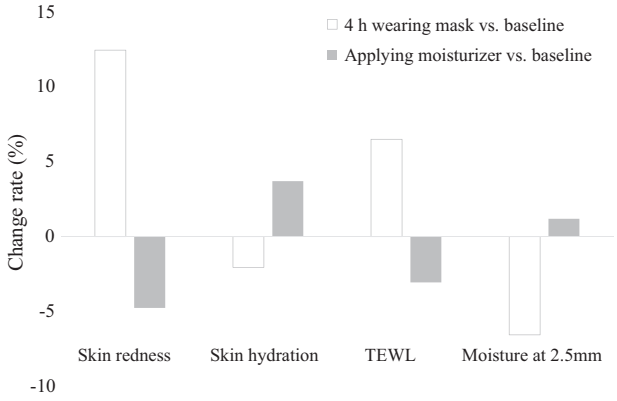


**FIGURE 5** The change rate of skin parameter value according to the time of 4 h wearing mask (T1) and applying moisturizer compared with baseline (T2)

the moisturized skin showed significantly decreased skin erythema and TEWL compared to that at baseline, and skin hydration increased significantly (Figure 5).

## 4 | DISCUSSION

In this study, we strove to understand the changes that occur in sensitive skin after wearing a mask and to determine if applying a moisturizer ameliorates any such changes. We focused on the fact that sensitive skin reddens and dries quite readily and, therefore, evaluated redness, hydration, TEWL, and moisture at 2.5 mm. We found that patients with sensitive skin indeed experienced adverse dermatological changes after wearing a mask.

COVID-19 has no immediate cure, and populations worldwide continue to become infected regardless of vaccination status. This has resulted in the imposition of mask mandates in many localities, especially as new variants of the SARS-CoV-2 viruses have emerged.[2,14] However, wearing masks for a prolonged period of time reportedly causes adverse dermatological changes.

The skin primarily protects our body from external stimuli and maintains homeostasis; however, the number of people complaining of skin problems caused by wearing a mask during the current pandemic is also increasing.[1,4,9,15] Research of skin sensitivity according to race revealed a relatively high rate of sensitive skin among Korean women[16]; accordingly, the pandemic and mask-wearing habits have raised interest in understanding and treating mask-induced changes in this population.

In this study, we found that skin redness and TEWL significantly increased 4 h after wearing a mask on sensitive skin, whereas skin hydration and moisture at 2.5 mm below the skin surface decreased significantly. These changes are believed to be caused by physical friction with the mask material as well as elevated temperature around the perioral area.[17,18]

After applying the moisturizer, however, skin redness and TEWL were significantly improved compared to their statuses after 4 h of mask-wearing, as were skin hydration and moisture at 2.5 mm. In addition, these parameters were significantly better than their baseline (pre-mask) values except for the moisture at 2.5 mm, indicating that an exposure to the agent longer than 30 min may be required.

These results indicate that the use of moisturizers can have a positive effect on sensitive skin that develops temporary redness or dryness caused by wearing a mask. As such, periodically applying moisturizers to sensitive skin can prevent these afflictions.

In our previous study, we investigated the effects of the use of moisturizer on wearing a mask for a long duration by separating the test and control groups within the mask-wearing area. We confirmed that using moisturizer while wearing the mask for a long time helps in reducing skin wrinkles and pores.[19] The result showed that the long-term use of moisturizer helps skin condition. Nevertheless, the number of participants with skin conditions caused by wearing masks is increasing. Therefore, we focused on the sensitive skin and performed a study on the effects of short-term use of moisturizer on sensitive skin.

In further studies, we plan to investigate and compare the use of moisturizer and skin self-recovery in short durations. Further, we plan to investigate additional effects of mask-wearing on sensitive skin as well as to compare sensitive and nonsensitive skin types.

## 5 | CONCLUSION

Our data showed that wearing a mask increases redness and TEWL (an indicator of skin barrier function) in sensitive skin. It also reduces skin epidermal hydration and moisture at 2.5 mm. However, the use of a moisturizer can reverse these changes, as it decreases skin redness and TEWL, whereas significantly increased epidermal hydration; subcutaneous moisture also tends to be improved. These findings indicate that, while wearing a mask does lead to adverse changes in sensitive skin, the use of moisturizers can ameliorate these conditions.

### CONFLICTS OF INTEREST

The authors declare no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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**How to cite this article:** Yoo MA, Kim SH, Han HS, Byun JW, Park KH. The effects of wearing a face mask and of subsequent moisturizer use on the characteristics of sensitive skin. Skin Res Technol. 2022;1–5. https://doi.org/10.1111/srt.13173