Turk J Pharm Sci 2024;21(1):1-6
DOI: 10.4274/tjps.galenos.2023.82353

ORIGINAL ARTICLE

Analysis of Surgical Masks Adverse Effects on Facial Skin in Long Term Usage During COVID-19 Pandemic

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ABSTRACT

Objectives: During the coronavirus disease-2019 pandemic, masks have become mandatory for protection against the virus transmitted by breathing. This study examined the impact of surgical masks used daily on civilian facial skin.

Materials and Methods: Moisture, elasticity, pore, melanin, acne, wrinkle, and sensitivity parameters of 83 volunteers were measured numerically using an API-100 skin analyzer and camera recordings. Numerical values were compared following the device's algorithm calibrated according to age, gender, and race. Finally, the obtained data were statistically evaluated and compared with the averages.

Results: Pore, melanin, acne, and wrinkle parameters were higher without gender discrimination, whereas moisture and elasticity parameters were low. While a significant increase was observed in women for sensitivity, the increase was not statistically significant in men.

Conclusion: The negative effects of long-term daily wearing of surgical masks on facial skin were statistically significant. Therefore, taking outdoor breaks during mask use, washing the face intermittently, using moisturizing and purifying cosmetic products, and anti-wrinkle effects have been proposed to reduce the possible defects.

Keywords: Surgical mask, COVID-19, acne, moisture, wrinkle

INTRODUCTION

Social protection methods are being investigated with the coronavirus disease-2019 (COVID-19) pandemic. Because the virus is transmitted through respiration, it is scientifically recommended to use masks and protective equipment. Studies analyzing the effect of masks on the general population have concluded that masks are associated with a reduction in transmission and cases.[1-4] Surgical masks can prevent the inhalation of large droplets. They are useful for avoiding infection by noticing distance. Surgical masks have also been shown to intercept other human coronaviruses during coughing to filter submicron-sized airborne particles.[5,6] It has been stated that the rate of virus transmission is significantly lower in countries with mandatory mask requirements. Furthermore, studies conducted in different countries have reported that the use of masks causes significant decreases in mortality rates.[7-9]

People who work, spend time, and travel in closed places wear masks on their faces for a long time. Long-term use of masks can create negative effects in terms of hindering fresh air ventilation in the areas they cover. In addition, the mask used to prevent the virus from being transmitted through the respiratory tract may cause some undesirable effects on the face because it obstructs the outflow of breath from the mouth and nose simultaneously. The types and duration of masks affect intact

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Received: 22.11.2022, Accepted: 12.02.2023

skin differently. The increased skin temperature and incident adverse effects such as acne, redness or erythema, drying, itching, allergies, burning, and wounds have been reported when covered by masks for a long time.[10-13]

Although the impact of N95 masks on healthcare professionals during the COVID-19 pandemic has been extensively studied, the effect of the surgical mask on the skin has been limited, although it was widely used by civilian users for a prolonged period. Though labor-intensive healthcare staff wear masks longer than civilians, this study was conducted for this purpose. The data were evaluated statistically according to the measurement values by conducting analysis, not based on surveys and observations.

High moisture at the mask-covered facial skin lesion due to low breathability and deficit air ventilation can lead to dermatological disorders due to accumulated sweat, dirt, and oil on the skin surface. The severity is varied by multiple factors, resulting in acne, hyperpigmentation, and irritation as signs of skin problems that can only be investigated clinically using a specific skin analyzer. Therefore, this study aimed to examine the impact of prolonged use of surgical masks in İstanbul metropolitan city civilians, who live and spend a lot of time indoors. The obtained results are expected to deliver the statement and beneficial information for hygienic and preventive practices and suitable skincare and cosmetic products of choice.

MATERIALS AND METHODS

API-100 skin analyzer was used in the scientific evaluation of moisture, elasticity, pores, melanin, acne, wrinkles, and sensitivity parameters on the skin according to age, gender, and race. According to the device algorithm, the parameters can be measured using numerical values and compared with the average of parameters in the same categories. By measuring from the same point on face, it is ensured that the comparison is realistic and optimized.[14-16]

The technical specifications of the API-100 device are given below:

Image Sensor 1/4 inch Color CMOS UXGA (2 mega pixels)

Pixel effective pixel: 1.624 x 1.212 Pixel

Image Capture size WI-FI video streaming VGA (640 x 480) | 2M (1.600 x 1.200)

Image Frame Rate VGA (640 x 480) - 30 frame max 2M (1.600 x 1.200)

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In the evaluation of the elasticity parameter, the skin was categorized by low, normal, and high levels. The looseness of the skin structure and the width of the pores was evaluated. In the graph, moisture and elastic parameters were scored depending on the image and compared with the average age. The state of the porosity structure of the skin was defined as good, normal, and porous. The pores in the camera image were shown as dots and compared with a good skin image of the same age, gender, and race. In the evaluation of melanin, an interpretation was made depending on the width and tone of the black spots. In the acne evaluation, sebum density and brightness were determined. Acne areas were scored and shown by color. Wrinkle assessments were scored according to their depth and intensity. Wrinkle-detected areas were shown as dots. In the sensitivity assessment, the thickness of the skin layer and physical resistance were interpreted. Where the coloration is intense, the sensitivity parameter is scored low.

In the study, healthy subjects with ages ranging from 18 to 61 years were included from domestic and foreign students studying and working at İstinye University. The ratio of Turkish volunteers to foreign attendees was 8.2. The distribution of ages, gender, and nationality is demonstrated in Figure 1, where the percentages of male and female subjects were 16.9% and 83.1%, respectively. The obligatory inclusion criteria were no use of colored cosmetics or dermocosmetic products at the application site throughout the study. The subjects were informed about the research in accordance with the Declaration of Helsinki. People with chronic diseases, those who used drugs, those with COVID-19 infection, and those with cosmetic products on their faces were excluded from the study. Skin measurements were taken at the designated points using an API-100 skin analyzer. Points are shown in Figure 2. Then, data comparison was conducted according to the algorithm of the skin analyzer device. This study was approved by the İstinye University Human Research Ethics Committee (protocol number: 21-103, date: 22.12.2021) informed consent was obtained from all participants.

Statistical analysis

Statistical evaluations were performed using the SAS version 9.4 program. The type I error was accepted as 0.05. In the statistical evaluation, each individual's difference scores (Δ) calculated for hydration, elasticity, pores, melanin, acne, wrinkles, and sensitivity measurements were taken into account. For each category, the difference score of the subjects (Δ) was calculated by subtracting the measurement score of each subject from the average score: $\Delta = X\text{-}X_{mean}$.

Descriptive statistics (n, mean, standard deviation, median, 25th and 75th percentiles) were depending on gender grouping, for difference scores (Δ) for moisture, elasticity, pores, melanin, acne, wrinkles, and sensitivity measurements. Statistical evaluation was performed in the following two sections:

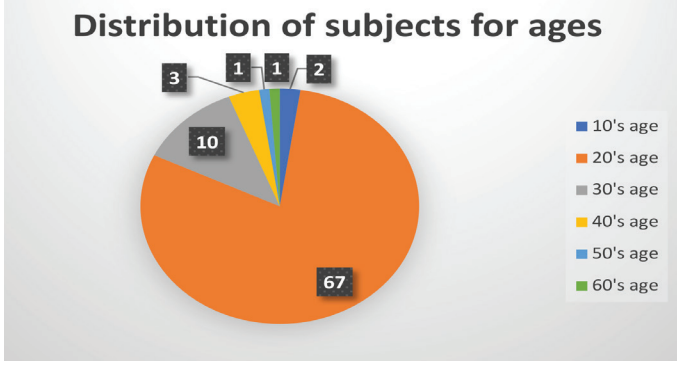

Figure 1. Age distribution of subjects for the skin analysis study

Comparison with the normal value

Depending on the distribution of the data, we investigated whether the mean (arithmetic mean/median) of the difference scores (Δ) of the subjects (n= 83) was different from zero. The evaluation was made with the one-sample *t*-test (arithmetic mean) in the data suitable for normal distribution and with the Wilcoxon signed rank test (median) for non-normally distributed data.

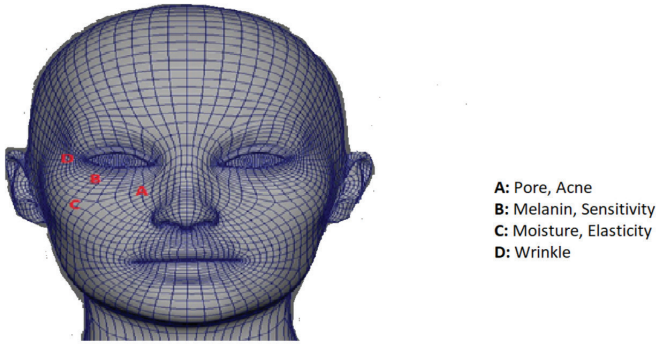

Figure 2. Analyze points for skin parameters

Comparison by gender

Depending on the distribution of the data, a two-sample *t*-test (arithmetic mean) was used for data with normal distributions, and the Wilcoxon rank sum test (median) was used for non-normal distributions. The comparison of the mean (arithmetic mean/median) difference scores of females (n= 64) and males (n= 19).

In case of statistical difference according to gender, separate evaluations were made for the male and female groups when the subtraction scores differed from zero. While comparing the means in these evaluations, the one-sample *t*-test was used for data that were suitable for normal distribution and the Wilcoxon signed rank test was used for non-normal distributions.

RESULTS

Descriptive statistics (n, mean, standard deviation, median, 25th and 75th percentiles) for the difference scores (Δ) of elasticity, pore, melanin, acne, wrinkle, and sensitivity measurements were demonstrated depending on gender grouping (Table 1). The data distribution differed among the studied categories: the pore (Δ) and wrinkle (Δ) scores showed normal distribution ($p > 0.05$), and arithmetic mean values were considered in the

Table 1. Descriptive statistics for difference scores (Δ) for elasticity, pores, melanin, acne, wrinkles, and sensitivity measurements

Parameters		Numbers (n)	Arithmetic mean	SD	Median	75th percentile	75th percentile
Pore (Δ)	Male	19	9.68	11.25	7.0	1.0	19.0
	Female	64	6.12	12.71	7.5	-2.0	15.5
	Total	83	6.93	12.41	7.0	-1.0	16.0
Sensitivity (Δ)	Male	19	19.57	31.48	0.0	-7.0	52.0
	Female	64	-1.42	17.62	-9.0	-9.0	1.5
	Total	83	3.38	23.13	-8.0	-9.0	3.0
Moisture (Δ)	Male	19	-39.53	2.874	-40.0	-40.0	-40.0
	Female	64	-38.02	5.799	-40.0	-40.0	-35.0
	Total	83	-38.36	5.297	-40.0	-40.0	-35.0
Elasticity (Δ)	Male	19	-42.16	5.580	-44.0	-44.0	-44.0
	Female	64	-40.30	8.337	-44.0	-44.0	-35.0
	Total	83	-40.72	7.801	-44.0	-44.0	-38.0
Melanin (Δ)	Male	19	60.15	17.57	65.0	54.0	72.0
	Female	64	59.37	18.15	67.0	50.0	72.0
	Total	83	59.55	17.92	66.0	50.0	72.0
Acne (Δ)	Male	19	52.57	25.46	61.0	43.0	73.0
	Female	64	27.15	34.44	31.5	-4.5	58.0
	Total	83	32.97	34.19	43.0	2.0	61.0
Wrinkle (Δ)	Male	19	33.05	23.69	29.0	23.0	41.0
	Female	64	17.35	18.21	19.0	2.0	35.0
	Total	83	20.95	20.54	23.0	2.0	38.0

SD: Standard deviation

evaluations; in contrast, the other scores were not normally distributed ($p < 0.05$), and the median (median) values were considered in the evaluations.

In the skin analyses performed on 83 volunteers, the images of the two volunteers with the highest and lowest scores of the device were compared. In addition to statistical differences, visual differences were recorded. The highest and lowest humidity comparison profiles determined by the age and gender of the volunteers were demonstrated (Figure 3). The highest and lowest scored elasticity profiles are indicated on the graph (Figure 4). The porous skin with the highest score according to the pore status was compared with the skin that appeared to be better than the average (Figure 5). In the comparison of melanin balance, the skin with the highest score and black pigment, with a large spot area, and healthy skin without significant coloration were observed (Figure 6). Skin with excess sebum turning into acne with porous blackheads *versus* healthy skin with high moisture and sebum balance were compared (Figure 7). Wrinkle assessment is important for the youthful and healthy appearance of the skin. Young and healthy skin should have a low wrinkle score. Low- and high-score wrinkles were compared (Figure 8). In the sensitivity assessment, the thickness of the skin layer was interpreted. A low score indicates high physical resistance. Low- and high-score skin images were compared (Figure 9).

Comparison with normal value

Medical mask use induced significant changes, including an increase in pore size, melanin, and wrinkles, but a reduction in

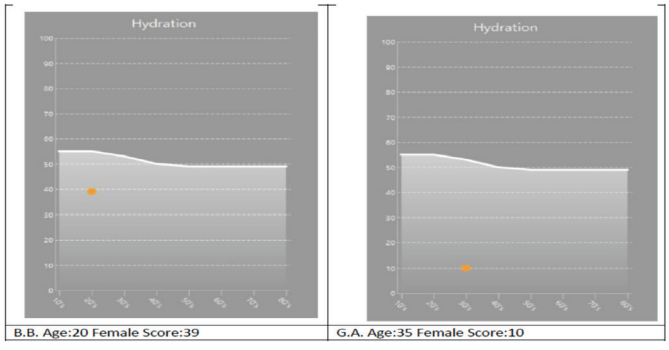

Figure 3. Best and worst scored hydration analysis of volunteers

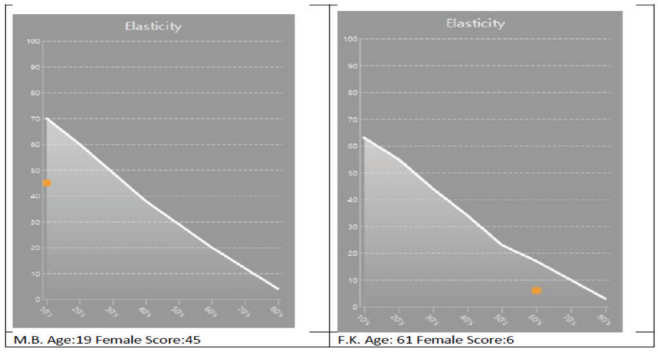

Figure 4. The best and the worst scored elasticiy analysis of volunteer

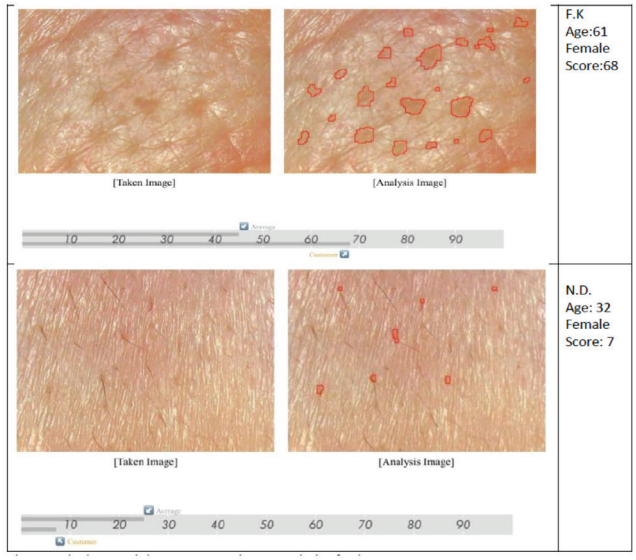

Figure 5. Best and worst scored pore analysis of volunteers

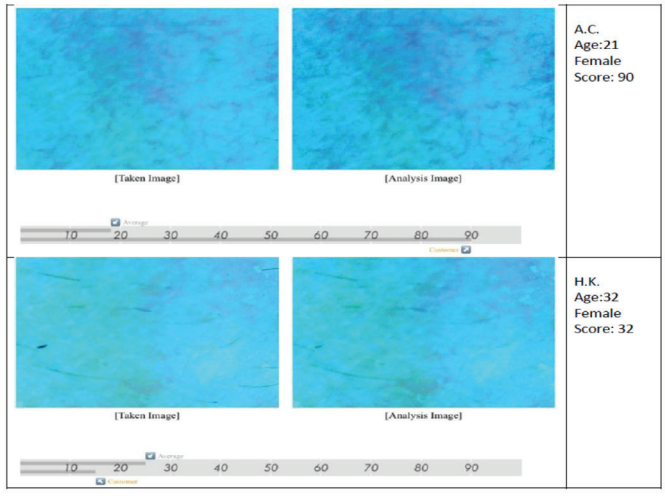

Figure 6. Best and worst scored melanin analysis of volunteers

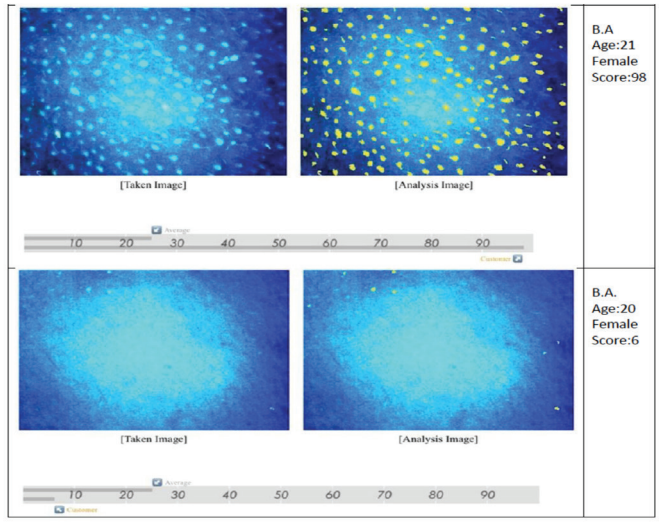

Figure 7. Best and worst scored acne analysis of volunteers

the moisture and elasticity of facial skin. The arithmetic mean values of the pore (Δ), melanin (Δ), acne (Δ), and wrinkle (Δ) scores were 6.93, 66.0, 43.0, and 20.95, respectively, which statistically increased and differed from zero ($p < 0.05$). The median values of moisture (Δ) and elasticity (Δ) scores were -40.0 and -44.0, respectively, which statistically decreased and differed from zero ($p < 0.05$). In contrast, the median sensitivity (Δ) of -8.0 indicated the change with no statistical difference from zero ($p > 0.05$) (Table 1).

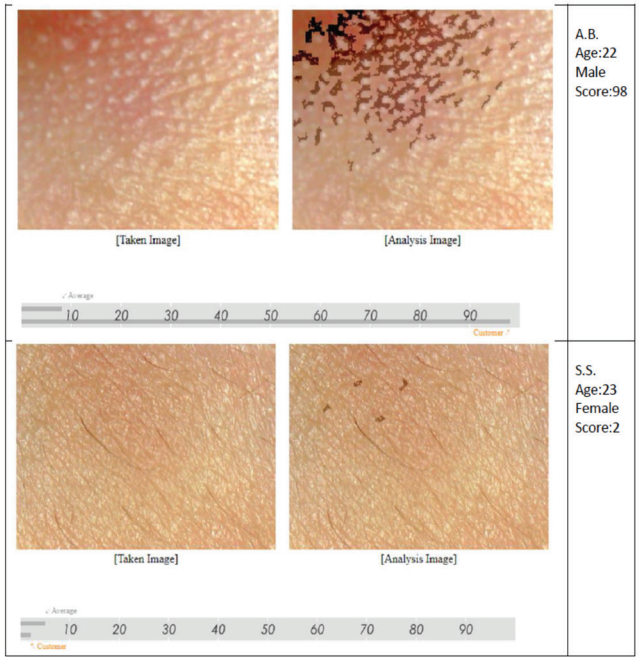

Figure 8. Best and worst scored wrinkle analysis of volunteers

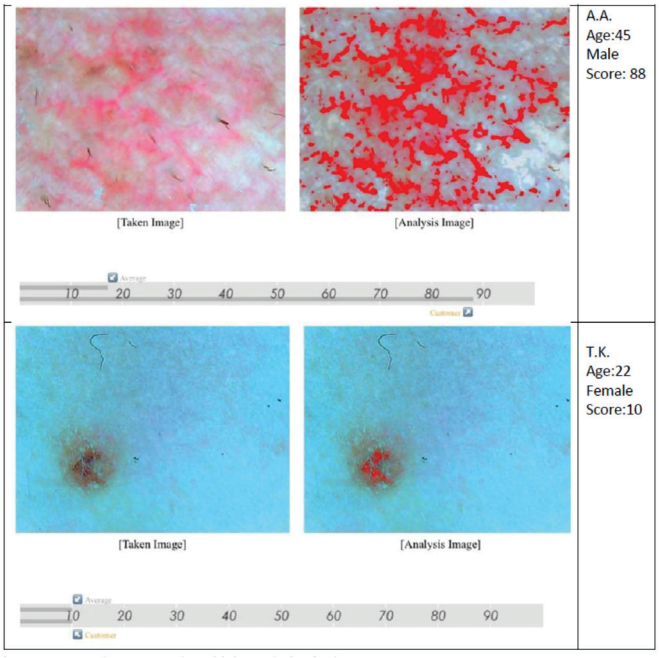

Figure 9. Best and worst scored sensitivity analysis of volunteers

Gender comparison

The impact of surgical mask use between male and female groups was significantly different for sensitivity, acne, and wrinkles. Long-term surgical mask wearing induced acne and wrinkle development in both male [with zero-different (Δ) scores of 61.0 and 33.05, respectively] and female facial skin (with Δ scores of 31.5 and 17.35, respectively); however, in male rather than female groups; while there was no significant change on facial skin sensitivity in both genders.

The arithmetic mean/median of pores (Δ), moisture (Δ), elasticity (Δ), and melanin (Δ) did not significantly differ between the groups of males and females ($p > 0.05$). The arithmetic mean/median of the pore (Δ), moisture (Δ), elasticity (Δ), and melanin (Δ) were 9.68, 6.12, and -40.0 - 40.0 for males and -44.0, -44.0, 65.0, and 67.0 for females, respectively (Table 1).

The statistically significant difference between the arithmetic mean/median of sensitivity (Δ), acne (Δ) and wrinkle (Δ) scores depending on gender ($p < 0.05$) was exhibited with the arithmetic mean/median sensitivity (Δ), acne (Δ) and wrinkle (Δ) of 0.0, 61.0, and 33.05 for the male group and -9.0, 31.5, and 17.35 for the female group, respectively.

Since sensitivity (Δ), acne (Δ) and wrinkle(Δ) scores statistically differed in terms of gender, comparison with normal values was performed separately for males and females. The arithmetic mean/median increase in sensitivity (Δ) and acne (Δ) and wrinkle (Δ) in females were -9.0, 31.5, and 17.35, respectively, compared with the normal value. It was found to be significantly different from zero ($p < 0.05$). In males, the difference for sensitivity (Δ) was found to be 0.00, and it was not significantly different from zero ($p > 0.05$); the median for acne (Δ) and mean for wrinkle (Δ) were 61.0 and 33.05, respectively, and both were significantly different from zero ($p < 0.05$) (Table 1).

DISCUSSION

The influence of surgical masks on long-term use in 83 volunteers during the COVID-19 pandemic was demonstrated. The overall results indicated that prolonged surgical mask usage could cause superficial maceration and damage the skin barrier. The adverse effects were detected as a significant increase in skin pore numbers and acne formation, which was presumed to be anticipated by skin cell damage associated with limited air ventilation during surgical mask wearing, followed by oil and bacteria deposits. Thus, the enlargement of skin pores and the formation of pimples, acne, and blackheads have developed. Furthermore, increased melanin pigment represented skin-darkening induction. In addition, a relationship between parameters of decreation in skin elasticity and higher wrinkles was suggested. Interestingly, a more significant influence on males than on females was found.

CONCLUSION

The obtained results suggest the undesirable effects of prolonged mask usage, which could lead to more severe dermatological and cosmetic problems depending on wearing duration and personal hygiene factors. Furthermore, the

significant increase in skin pore numbers, melanin pigment, and acne formation suggests a disorder of dermal physiology throughout the dermis and epidermis layers. In addition, melanin pigment inscription has indicated the potential for skin blemishes. Therefore, preventive practices are crucial, including periodic unmasking in open environments between prolonged usage, cleansing facial skin, and applying skin barrier creams to prevent skin deterioration. In addition, suitable choices of skincare and cosmetic products are also important: facial skin washing every morning and night with an oil-free, fragrance-free cleanser and treatment with non-comedogenic facial moisturizers or gels one hour before being on masks are recommended. Conversely, skincare and cosmetic products with high contents of oils and pigments should be avoided to avert skin pore formation and obstruction worsening.

Acknowledgement

We would like to thank Nacar Group for its support for the supply of the API-100 skin analyzer.

Ethics

Ethics Committee Approval: This study was approved by the İstinye University Human Research Ethics Committee (approval number: 21-103, date: 22.12.2021).

Informed Consent: Informed consent was obtained from all participants.

Authorship Contributions

Design: A.L.A., K.S., Data Collection or Processing: A.L.A., K.S., Analysis or Interpretation: K.Y., Literature Search: A.L.A., Writing: A.L.A.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: This study was carried out in the Pharmaceutical Technology Laboratory of the Faculty of Pharmacy at İstinye University.

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