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journals.uoz.edu.krd

Science Journal of University of Zakho

Vol. 12, No.3, pp.336–339 July-September, 2024

p-ISSN: 2663-628X
e-ISSN: 2663-6298

IMPACT OF GENDER DIFFERENCES AND BODY MASS INDEX ON SKIN BIOPHYSICAL PARAMETERS OF CORONAVIRUS PATIENTS

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Received: 23 Apr., 2024 / Accepted: 9 July., 2024 / Published: 30 July., 2024. https://doi.org/10.25271/sjuoz.2024.12.3.1306

ABSTRACT:

Once the pandemic started, there were no clues regarding overall COVID-19 infections. There are no studies that demonstrate the effects of COVID-19 on skin surface pH, moisture, sebum, and temperature in terms of gender differences and body mass index (BMI) among infected people. The goal of this study was to investigate some of the skin biophysical scores of patients infected with COVID-19 and evaluate the impact of gender differences and the body mass index on them. Skin surface sebum, pH, temperature, and hydration (moisture), were measured in 30 COVID-19 patients using employing non-invasive portable devices. Insignificant effects of gender differences and BMI on skin biophysical properties were observed. In addition, females showed higher skin biophysical characteristics than males. Moreover, obese patients had higher skin biophysical parameter values than normal-weight patients. However, all the study results were statistically insignificant ($p > 0.05$). Further investigations are required to recognize other skin biophysical parameters such as transepidermal water loss and elasticity that may aid in the early identification of skin damage in COVID-19 patients.

KEYWORDS: Body mass index, COVID-19, coronavirus, gender, patients, skin moisture

1. INTRODUCTION

The skin as the largest organ of the human body consists of a set of complex layers that provide protection and sensory functions. The skin performs some vital functions in the human body by protecting it from external harms such as pathogens, chemical and mechanical impacts, and temperature. Moreover, the skin carries sorts of receptors that produce afferent information associated to temperature, pain, and touch.

The skin biophysical properties, namely sebum (oil) content, skin moisture, pH, and temperature can be used to indicate skin condition. For instance, lower sebum content, moisture (Firooz et al., 2007) and higher skin pH (Rippke et al., 2004) are related to atopic dermatitis. On the other hand, increased sebum content (Choi et al., 2013) and skin pH (Prakash et al., 2017) are associated with acne. Moreover, reduced skin hydration is found in patients with various types of diabetes (Sekijima et al., 2018; Horikawa et al., 2021). Additionally, it is shown that obesity alters skin hydration (Ye et al., 2022). Therefore, the skin's biophysical properties might be helpful in the management of skin diseases with a proper approach.

The biophysical characteristics of the skin might also be related or influenced by some other parameters such as body mass index (BMI), gender differences, age, and lifestyle. Zhao et al. (2021), observed that the biophysical properties of the skin are influenced by gender, age, and unhealthy lifestyles. In contrast, studies by Jacobi et al. (2005), Kim et al. (2006), Man et al. (2009), and Luebberding et al. (2013) observed higher pH values in females than males. Additionally, Kim et al. (2006) found significant gender differences in skin sebum content.

The effects of BMI on skin biophysical parameters have been investigated. Rodrigues et al. (2017), reported that skin moisture was higher for overweight and obese individuals than normal-weight individuals. Yosipovitch et al. (2007) observed that higher skin pH is associated with individuals who are obese.

Since the outbreak of the deadly coronavirus 2019 (COVID-19) epidemic, as far as we know, none of the studies have been focused on the relationship between the impact of BMI and skin biophysical parameters. In this study, the authors aimed to assess the effects of BMI and gender differences on the skin (epidermis layer) biophysical scores of coronaviruses 2019 patients.

2. MATERIALS AND METHODS

2.1 Study Protocol

30 COVID-19 patients (14 males and 16 females with an age range between 27 and 90 years (average 64 years) participated in this study. The protocol of the study was approved by the directory of the COVID-19 hospital in the Duhok Governorate as well as the Ethics Committee at the University of Duhok. Written consent forms were obtained from all patients before data was collected. All the study measurements were done at the COVID-19 hospital in the Duhok Governorate under standard environmental conditions (relative humidity = 40-60% and temperature = 20-23°C).

Skin sebum, temperature, moisture, and pH were measured from patients infected with COVID-19. It is important to note that patients with severe cases were not targeted in the present investigation. All preventive measures related to COVID-19 were applied throughout the recordings.

2.2 Instrumentation

Skin surface sebum, moisture, temperature, and pH were measured usingthree different portable devices. A digital moisture sensor (SK-IV, Riuty- China) was used to record skin

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sebum and moisture. This sensor operates based on the latest technology of bioelectric impedance analysis and can record skin moisture in the range of 0 to 99.9%. The skin temperature was recorded using an infrared thermometer instrument (EFT-162-China). Finally, skin pH (SK-IV, Riuty- China) was monitored using a pH meter which has an accuracy of ±0.1pH, employing a high precision probe, and corrosion resistance.

2.3 Statistical Analysis

The Mann-Whitney U test, as an ordinal statistical test was employed for the purpose of comparison between two independent samples (male and female) for all skin physiological characteristics. Differences among patients concerning BMI for all parameters were analyzed using the one-way repeated measures analysis of variance (ANOVA) and multiple pairwise comparisons using Sidak correction. IBM SPSS Statistics was used to perform the statistical analyses.

3. RESULTS

3.1 Effects of Gender on Skin Biophysical Parameters

Skin moisture data for over 30 patients with respect to gender are shown in Figure 1A. Even though females have a larger median skin moisture value than males, the observed findings were statistically insignificant ($p > 0.05$). On the other hand, the data for skin sebum are shown in Figure 1B for all 30 coronavirus patients from both groups. The skin sebum of females is higher than that of males. However, Mann-Whitney U analysis indicated that this difference was insignificant ($p > 0.05$).

Furthermore, the data for skin pH with respect to gender are presented in Figure 1C. The data reveal that the median value of skin pH in females is higher than that of males; however, this finding was not significant ($p > 0.05$).

Results for the skin temperature are presented in Figure 1D. Inspection of the figure shows that females had a higher skin temperature than males; however, these findings were not significant ($p > 0.05$).

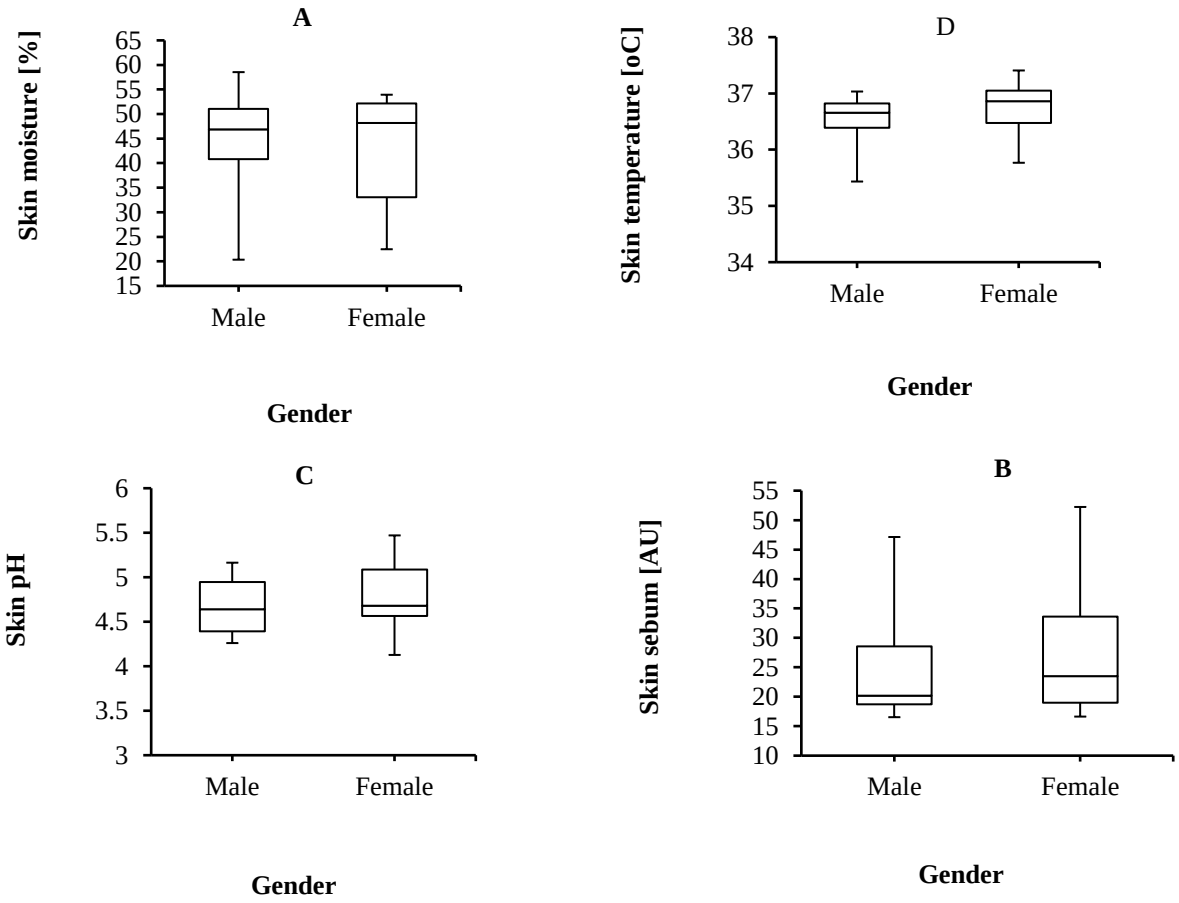

Figure 1: The box plot shows (A) skin moisture, (B) skin sebum, (C) skin pH, and (D) skin temperature of coronavirus patients (n=30) regarding gender

3.2 Effects of BMI on Skin Biophysical Parameters

Figure 2A shows variations in median values of skin moisture across the three groups (normal, overweight, and obese) based on their BMI for 30 coronavirus patients. In addition, skin moisture is higher for the obese group compared to other groups. However, when data on skin moisture were statistically analyzed, an insignificant ($p > 0.05$) difference among the groups was found as revealed by ANOVA analysis.

The findings for skin sebum across the different patient groups are shown in Figure 2B. Skin sebum was reduced for both overweight and obese patients compared to the normal group. However, once ANOVA was carried out, an insignificant ($p > 0.05$) difference among the three groups was observed. The error bars shown in Figure 2B represent the minimum and maximum of skin sebum obtained from overweight patients. The error is not due to uncertainty in the recorded data but it is rather due to individual differences as the skin sebum data were gathered from a diverse group of patients.

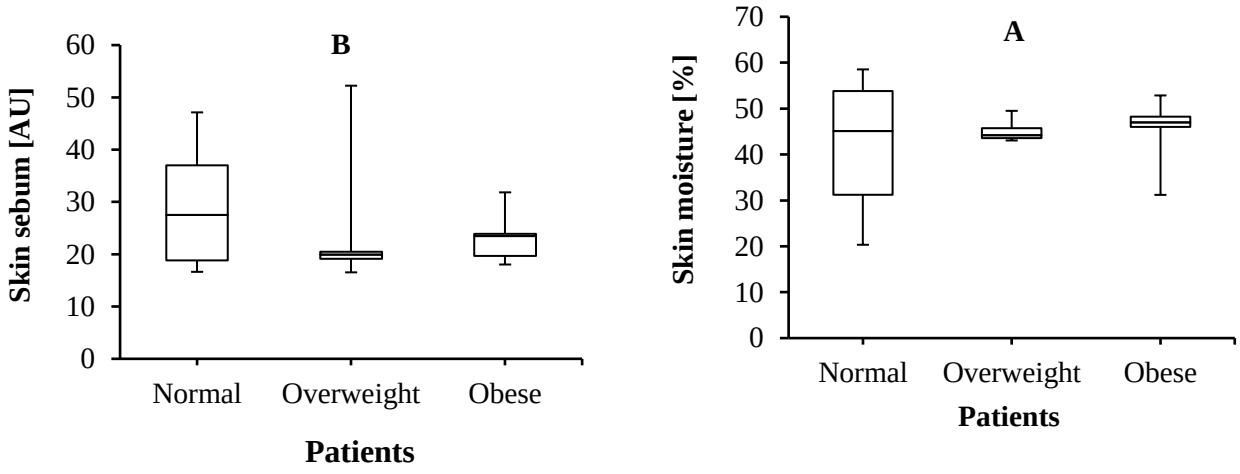

Figure 2: The box plot shows (A) the skin moisture, and (B) the skin sebum of the three groups concerning BMI (normal, overweight, and obese).

Skin pH also changed across different patient groups, as seen in Figure 3. Moreover, skin pH was higher for overweight and obese patients compared to the normal group. However, these variations were insignificant ($p > 0.05$).

Based on Figure 3B, the skin temperature increased with increasing BMI of overweight and obese patients. However, ANOVA analysis showed that the obtained findings were statistically insignificant ($p>0.05$).

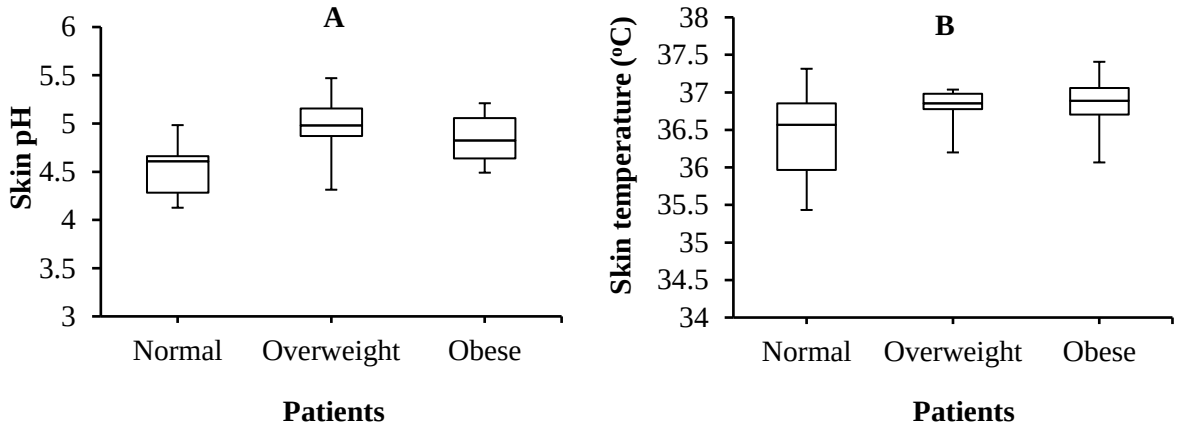

Figure 3: The box plot shows (A) the skin pH, and (B) the skin temperature of the three groups concerning BMI (normal, overweight, and obese).

4. DISCUSSION

In this work, the impacts of BMI and gender-related differences on the epidermal biophysical properties of coronavirus patients were investigated. Although the effects of both BMI and gender were observed, the results were statistically insignificant.

Regarding gender, higher median skin moisture was observed in females than in males. These results are in agreement with Firooz et al. (2012), Luebberding et al. (2013), and Zhao et al. (2021), who also found that skin hydration (moisture) was higher in female subjects.

Females also on average showed higher skin sebum than males, but this difference insignificant. In some studies, such as Wilhelm et al. (1991) and Mehta et al. (2018), no changes in sebum content between men and women was observed, while some other studies Kim et al. (2013), Man et al., (2009), and Firooz et al. (2012) reported higher sebum production in males. These conflicting findings could be due to differences in sample size and whether the participants were healthy or not as in our study unhealthy (coronavirus patients) were enrolled. Generally, gender differences in skin sebum are attributed with differences in the hormones of males and females (Rahrovan et al., 2018).

Gender differences were also observed in skin pH and temperature. Females showed a higher skin pH than males. These findings were also supported by Zhao et al. (2021), Man et al. (2009), Jacobi et al. (2005), Luebberding et al. (2013), and Kim et al. (2006). Such difference in pH between women and men might be due to differences in hormonal status (Jacobi et al., 2005), and also biochemical differences (Luebberding et al., 2013). In this study, female coronavirus patients also showed higher skin temperature than male patients. Such differences between the both genders could be due to the biological differences between males and females.

Overall, the underlying mechanisms leading to the differences in the epidermal biophysical properties of men and women are still unclear and need further investigations in future studies.

Likewise, the effects of BMI on skin biophysical parameters were also observed, but were insignificant. Skin moisture increased with BMI, with obese patients showing higher skin moisture than normal-weight patients. These findings agree with the findings of Rodrigues et al. (2017), who also observed same results. Skin sebum decreased in overweight and obese patients (Figure 2B). On the other hand, the skin pH and temperature

increased with increased BMI, but the differences were statistically non-significant. Yosipovitch et al. (2013) and Yosipovitch et al. (2007) also reported that the skin pH is higher in individuals who are obese. This could be due to many sweat glands, mainly apocrine, and because skin humidity elevates skin surface pH (Yosipovitch et al., 1993).

CONCLUSIONS

The biophysical characteristics of the skin, such as sebum, moisture, temperature, and pH, were slightly higher in females compared to males, but the difference was not statistically significant. Similarly, these parameters showed insignificant changes with increasing BMI, associated with obesity. While this study did not find significant alterations in COVID-19 patients' skin properties, further research is necessary to explore additional biophysical parameters like transepidermal water loss (TEWL) and elasticity for early detection of skin damage in COVID-19 patients.

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