Jurnal Biologi Tropis

Original Research Paper

Characteristics of Facial Skin Biophysical Parameters Among Medical Students in University of Mataram

Dedianto Hidajat[1*], Dian Puspita Sari[2], Metta Octora[3], Anak Agung Ayu Niti Wedayani[4]

[1]Department of Dermatology and Venereology, Faculty of Medicine, University of Mataram, Mataram, West Nusa Tenggara, Indonesia;

[2]Department of Medical Education, Faculty of Medicine, University of Mataram, Mataram, West Nusa Tenggara, Indonesia;

[3]Department of Public Health, Faculty of Medicine, University of Mataram, Mataram, West Nusa Tenggara, Indonesia;

[4]Department of Pharmacology, Faculty of Medicine, University of Mataram, Mataram, West Nusa Tenggara, Indonesia;

Article History
Received : May 28th, 2025
Revised : June 04th, 2025
Accepted : August 17th, 2025

*Corresponding Author:
Dedianto Hidajat, Department of Dermatology and Venereology, Faculty of Medicine, University of Mataram, Mataram, West Nusa Tenggara, Indonesia;
Email: dedianto@unram.ac.id

Abstract: Various studies have been widely published regarding the efficacy and adverse effects of facial care products with research populations from adolescent to young adults. However, it is necessary to first identify the characteristics of this parameters in the local population. The purpose of this study is to obtain an overview of the characteristics of the biophysical parameters of facial skin in a population of teenagers and young adults who tend to be active indoors, especially UNRAM medical students. This was an analytical observational study with a cross-sectional approach. Participants filled out questionnaires and followed procedures for examining facial skin biophysical parameters. The results of this study showed that from 147 participants, the average TEWL level was 8,99 g/h/m2; mean degree of erythema was 262,5; the average melanin index was 192,1 and the average sebum level was 192,1. Statistical analysis found that there was an association between gender and all facial skin biophysical parameters, a relationship between age and sebum levels and a relationship between daily activities in an air-conditioned room and the degree of erythema. With the data presented in this study, research related to facial skin biophysical parameters in similar populations can be developed further.

Keywords : Biophysical parameter, Facial skin, Medical student.

Introduction

The adolescent to young adult population is vulnerable to the marketing efforts of various facial care products. This is especially amplified during the COVID-19 pandemic as reported by Mohammed et al (2021) that there is an increased awareness and understanding of facial care products in the adolescent and young adult population which has an impact on increasing their use in the same population. This increase was also reported in a population with similar characteristics but different locations by Nitiyarom, et al who found that there was a significant relationship between age, gender, and education level of a population on the level of knowledge and usage of facial care products (Nitiyarom et al., 2022).

On the other hand, the demographics of skincare product sales have also been shown to be dominated by the adolescent to young adult population (Choi et al., 2022). This makes the trend of selecting the inclusion population of research related to facial care products tend to be carried out in the adolescent to young adult population. To date, numerous studies with adolescent to young adult study populations testing the efficacy to confounding effects of facial care products have been published. There are two main parameters in assessing the level of

skin barrier: mechanical parameters and biophysical parameters. One of the objective parameters that has been widely used in research on the topic is skin biophysical parameters. Skin biophysical parameters consist of transepidermal water loss (TEWL), melanin index, degree of erythema and sebum content (John et al., 2023).

A certain evaporation of water from the skin always occurs as part of normal skin metabolism. However, as soon as the barrier function of the skin is slightly damaged, even with very minor damage that cannot be observed with the naked eye, the TEWL value will increase. This measurement is therefore the basis for all cosmetic and dermatological research. TEWL can be measured with a Tewameter®, e.g. Tewameter® TM 300 and Tewameter® TM Hex (Courage-Khazaka). The mexameter is a device for measuring the amount of the two main components responsible for skin color, which are melanin and haemoglobin. The measurement is based on the absorption and reflection of an active color detection chip. Briefly, melanin is measured using two wavelengths selected according to the different absorption peaks of melanin pigment, while the measure of erythema is used to estimate the level of haemoglobin in the skin (Ariffin et al., 2020).

The measurement of sebum secretion using a sebumeter on the skin, hair and scalp is an internationally recognized method. The principle of sebumeter measurement is the photometric method, an oily point photometer that is not sensitive to humidity (Courage + Khazaka, 2021). Every human being secretes different amounts of sebum at different anatomical locations. By using a sebumeter, skin type determination becomes more precise and objective (Youn et al., 2002; Pande et al., 2005). Each of these parameters is influenced by various factors both internal and external factors. Some external factors that have been shown to have a significant influence are environmental conditions such as environmental humidity and temperature and internal factors such as age and gender (Ding et al., 2019; Firooz et al., 2012; Sobkowska et al., 2022; Boer et al., 2016).

Research Lee et al., (2013) and Mehta et al., (2018) reported that geographical location strongly influences biophysical parameters especially if the geographical differences involve changes in temperature and humidity which are the main external factors on skin biophysical parameters. Habitual factors are also very influential on skin biophysical parameters, as is quite often found in urban areas today, that is a person's tendency to move indoors, especially air-conditioned rooms. As reported by Jung et al., (2020) that cold air can change skin biophysical parameters, which are TEWL and skin pH (Jung et al., 2020).

Low environmental humidity has also been shown to significantly affect skin biophysical parameters, as reported by Szczepanik et al., (2011). With the consideration of internal and external factors that are able to influence the biophysical parameters of the skin significantly which will then affect the response as well as a person's need for facial care products, the author is interested in identifying the characteristics of facial skin biophysical parameters focused on students of the Faculty of Medicine, University of Mataram (FK UNRAM) to get an overview of the characteristics of facial skin biophysical parameters in the adolescent-young adult population who tend to do indoor activities.

Methods

Time and place of research

This study is an observational analytic with a cross-sectional data collection method by observing and collecting data at one time. Data collection was carried out at the Faculty of Medicine, University of Mataram in December 2024 – February 2025 with research respondents of undergraduate medical education students (pre-clinical stage) at FK UNRAM who were taken using simple random sampling technique.

Inclusion and exclusion criteria

The inclusion criteria for respondents in this study were male and female adolescents aged 17-25 years who were active and willing to be involved in this study. The exclusion criteria for respondents in this study were patients with skin diseases caused by inflammation or infection of facial skin other than acne vulgaris, taking anti-inflammatory drugs or anti-infective drugs for 1 week before data collection, and samples who were using topical therapy for skin inflammation for 1 week before data collection.

Research instruments

This study used several research instruments: (1) a questionnaire to identify patient characteristics containing age (in years), gender, daily activities (most of the time in an air-conditioned room, not air-conditioned or outdoors), and a history of atopy (in oneself and biological parents), (2) Tewameter® TM HEX to measure TEWL levels, (3) Mexameter® MX 18 to measure melanin index and degree of erythema Sebumeter® SM 815 to measure facial skin sebum levels. From these research instruments, several variables were statistically analysed. The data normality test using the Kolmogorov-smirnov test showed that the data were not normally distributed ($p<0.05$) so that the correlation test between variables using the Kruskall-Wallis test with a value of $p<0.05$ was said to be statistically significant.

All research respondents were given an explanation regarding this study and asked to sign a consent form prior to the study. After the respondents understood and agreed, the respondents were asked to refrain from using all facial care products such as moisturizers, sunscreens, creams containing brighteners, creams that cause exfoliation / peeling, oil / sebum control creams, facial cleansers, refreshing toners, essences, and serums for 12 hours before data collection time. Next, respondents fill out questionnaires and measuring using research instruments was carried out in the morning.

Shortly before the measurement, respondents were asked to wash their faces with clean water and dry their faces using paper towels slowly before then the respondents would be asked to rest for at least 30 minutes in a room with a temperature of 23-24ºC and air humidity of 40-60% before the next measurement of biophysical parameters of facial skin with tewameter, mexameter, and sebumeter was carried out sequentially on the sinistra malar region. All measurements were taken in less than 5 minutes according to the manufacturer's manual. This research has received approval from the Health Research Ethics Commission of FK UNRAM with number: 155/UN18.F8/ETIK/2024.

Results and Discussion

Respondents Characteristics

A total of 147 respondents were involved in this study with characteristics that can be seen in table 1. Most (81.6%) of the respondents were female based on the similar ratio of males and females in the study population, FK UNRAM students. Although the gender ratio in this study cannot describe the gender ratio that exists in the Indonesian population as a whole as published by the Central Statistics Agency (BPS) (2020) population census which states that the percentage of the male population in Indonesia is 50.5% and women are 49.5%, these results are similar to the ratio of users of facial skin care products published by several studies related to the use of facial skin care products which tend to be dominated by the female gender (Alsharif et al., 2022; Girdwichai et al., 2018) . This trend, as reported in a study by Alsharif et al (2022), is due to perceptions related to facial care products that differ between men and women.

The difference, in those studies, ware strongly influenced by the general public's perception of the different facial appearance between men and women, especially in the aspect of tolerance for facial characteristics such as skin color, oily skin, dry skin, and others. In addition, a study conducted in a population with a similar age range in a different geographical location also reported that the level of knowledge related to facial care products and their functions was not significantly different in men and women, but there was a significant difference in the level of use, such as men tended not to use facial care products even though they already understood the effects of use and the risks if they did not use facial care products due to social perceptions of the use of facial care products that differed between men and women (Nitiyarom et al., 2022). The mean age of the respondents in this study was 19.9 years, which is an age demographic that matches the tendency of using facial care products as reported in various studies related to this topic (Mohammed et al., 2021; Nitiyarom et al., 2022; Choi et al., 2022).

Table 1. Respondent characteristics

Characteristics	Total (n=147)
Gender *(n,%)*	
Male	27 (18,4%)
Female	120 (81,6%)
Age *(mean, SD)*	19,9 (0,8)
History of Atopy *(n,%)*	

History of atopy	99 (67,3%)
No history of atopy	48 (32,7%)
History of daily activities	
Air-conditioned indoor activities	84 (57,1%)
Non-air conditioned indoor activities	59 (40,1%)
Outdoor activities	4 (2,7%)

There was a history of atopy in either the respondent, mother, father, or siblings of the respondent in 99 (67.3%) respondents in this study. The percentage obtained in this study tends to be higher when looking at several previous epidemiological studies that observed a history of atopy in populations with a similar age range (Pedersen et al., 2020; Thomsen et al., 2015; Becerril-Angeles et al., 2023). This difference is thought to be due to the different definitions of atopy history used in this study and previous studies. This study considers respondents who have a mother, father, or sibling who has a history of atopy as a history of atopy in the respondent while previous studies only included a history of atopy that occurred in their respondents as a definition of atopy history.

This decision was based on the different socioeconomic conditions associated with access to health services, especially screening or diagnosis of atopy diseases, which differed between this study and previous studies. As the screening and diagnosis coverage in the study population was low due to the fact that screening for atopic conditions is not covered by the health insurance that is widely used in the study area, we assumed that the underdiagnosis rate of atopy diseases in the study population was high and therefore it was necessary to include a history of atopy or atopy symptoms in the respondent's mother, father, and siblings as the definition of atopy history.

Respondents' daily activities were dominated by indoor activities with a percentage of 57.1%, with the second highest percentage being non-air-conditioned indoor activities at 40.1%. This illustrates that in this population, the tendency for both in air-conditioned and non-air-conditioned indoor daily activities is not much different. This result is different compared to the results of previous studies, where most activities in populations with similar age ranges were carried out in air-conditioned rooms.[22,23] This fact may affect the biophysical parameters of the skin because in addition to sun exposure, temperature and humidity play a major role, as do environmental factors such as refrigerated and non-cooled rooms (Jayabal et al., 2021).

Overview of biophysical parameters such as TEWL level, degree of erythema, melanin index, and sebum content of facial skin

Table 2 provides an overview of the results of the measurement of skin biophysical parameters that is carried out in this study. The biophysical parameters of the skin in the study respondents tended to vary greatly. In the TEWL parameter, there was an average of 8.99 g/h/m2 in the entire study population which into the very healthy category (Courage-Khazaka, 2021). These results are similar to those reported by Du, et al., (2022) who observed TEWL parameters in the Indonesian population.

Table 2. Measurement results of biophysical parameters of facial skin

Measurement	***Result*** *(n=147)*
Transepidermal water loss *(g/h/m²)*	
Mean (SD)	8,99 (0,33)
Minimum	1,0
Maximum	23,08
p-value	**0,0001**
Erythema degree	
Mean (SD)	262,5 (6,7)
Minimum	86
Maximum	579
p-value	**0,0003**
Melanin index	
Mean (SD)	192,1 (4,2)
Minimum	75
Maximum	364
p-value	**0,0002**
Sebum level	
Mean (SD)	192,1 (4,2)
Minimum	75
Maximum	364
p-value	**0,0001**

This fact illustrates that the condition of skin biophysical parameters, especially TEWL in this study population is similar to the condition of the Indonesian population in general so that the TEWL characteristics obtained in this study should be able to represent skin biophysical parameters in the Indonesian population in general. The parameter of the degree of erythema, the mean was 262.5 which is classified

as minimal erythema while the melanin index was 192.1 which is classified as phototype III (Ariffin et al., 2020). These results also support that the population involved in this study is able to represent the Indonesian population in general because epidemiologically, Asian races tend to have skin phototype types III and IV.26 The mean sebum level of all respondents was 192.1 which is classified as oily.

Relationship between respondent characteristics and biophysical parameters of facial skin

Table 3 presents the results of the analysis of the relationship between the variables of skin biophysical parameters (TEWL, degree of erythema, melanin index, and sebum content) and the variables of sample characteristics (gender, age, activity, and history of atopy). There was a statistically significant relationship between gender and all biophysical parameters of facial skin. This relationship is in line with the results of previous studies which found that in aspects of biophysical parameters, there are significant differences between men and women (Firooz et al., 2012; Rahrovan et al., 2018). This is thought to be due to fundamental differences in the anatomy and physiology of men and women that influence internal factors of skin biophysical parameters such as hormones as well as external factors such as activities and habits (Chen et al., 2010).

Table 3. Relationship between respondent characteristics and biophysical parameters of facial skin

	Gender	Age	Activity	Atopy history
TEWL	0,000	0,790	0,283	0,296
Erythema degree	0,003	0,410	0,04	0,921
Melanin indeks	0,000	0,331	0,065	0,284
Sebum level	0,000	0,013	0,517	0,787

The aspect of age, there is only a significant relationship to the measurement of sebum levels with a p-value of 0.013. The results of the measurement of skin biophysical parameters that are not meaningful, especially TEWL, are thought to be because as a person ages and especially as a person's skin ages, TEWL tends not to change (Kottner et al., 2013). This is also supported by the results of Luebberding et al., (2013) who observed quantitative changes in skin barrier function with age. That study, like this one, also found a low correlation between age and TEWL measurements.

On the other hand, in contrast to previous studies, the melanin index and degree of erythema in this study did not have a significant relationship with the age of the respondents (Vashi et al., 2016). This difference in results is thought to be a result of the narrow age range of the population in this study to be able to observe changes in melanin index and degree of erythema in respondents. However, another aspect that needs to be highlighted here is the fact that different races have different rates of melanin index decline as a result of aging (Skoczyńska et al., 2017). Especially as reported by the study that Asians tend to be able to maintain their melanin index when compared to other races (Vashi et al., 2016).

Daily activity, especially in an air-conditioned room, was found to have a significant relationship with the degree of erythema (p=0.04). This is in line with previous research which reported that activities that tend to be carried out in an air-conditioned room can increase the degree of erythema due to the effect of low air humidity as a result of the work of air conditioner (AC). This process is mainly due to the increased susceptibility of the skin to mechanical stress as a result of decreased temperature and humidity and the release of proinflammatory cytokines and cortisol by keratinocytes in response, which can trigger redness or erythema.

Conclusion

This study provides an overview of the characteristics of biophysical parameters of facial skin in FK UNRAM students. The results of the analysis conducted in this study found that there was a statistically significant relationship between gender and all skin biophysical parameters, between age and sebum levels, and daily activity in a refrigerated room with the degree of erythema. It is hoped that with the data in this study, further research related to skin

biophysical parameters in similar populations can be developed.

Acknowledgement

The Authors gives special gratitude to everybody that has been involved in the process of constructing this paper including the people and also the institutions that has been involved.

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