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Body hydration levels and pH measurements of bath soap used among Tarumanagara University medical students: a cross sectional study

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ABSTRACT

Background: The skin has an essential function of protecting the body against external environmental influences. The stratum corneum plays an important role in maintaining skin hydration and pH, which contribute to the skin barrier function. The normal pH of the skin ranges from 4.1 to 5.8, which affects the stability of the microbiome, the hydration of the stratum corneum, and the epidermal barrier function. The use of cleansing products, such as body wash, affects skin pH, where soaps with a high pH (10-11) can damage the stratum corneum lipid layer, leading to dryness, irritation, and decreased hydration levels. This study aims to describe skin hydration levels and pH of body wash used among Tarumanagara medical students class of 2023.

Methods: This descriptive research design involved measuring skin hydration in various body areas using a corneometer and identifying the pH of body skin with a pH meter among medical students.

Results: The results showed that the majority of subjects (68.1%) used soap with an alkaline pH (>8), with the highest prevalence in women compared to men. The right upper arm area showed the highest skin hydration, where 65.7% of subjects had very moist skin. The legs showed the lowest hydration, with 48.8% of subjects having very dry hydration.

Conclusion: This study emphasizes the importance of using pH-balanced soap to support optimal skin hydration. Moisturizer use after bathing and increased mineral water consumption are also recommended to maintain skin hydration balance. The findings provide important insights to raise awareness of skincare habits that support holistic skin health.

Keywords: Body skin hydration, pH balanced soap, pH soap.

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INTRODUCTION

Skin is the body's protective layer against the environment. The stratum corneum is the outermost layer of the skin that contributes to the skin barrier function. The skin barrier is essential for skin health and is influenced by the skin environment. Increased transepidermal water loss (TEWL) will disrupt the enzymatic function for normal desquamation, causing the skin to become dry and flaky. The stratum corneum consists of corneocytes surrounded by an extracellular lipid matrix. Although skin lipids repel water, corneocyte hydration is important to maintain the skin's biological functions. This hydration is influenced by natural moisturising factor (NMF), amino acids, and filaggrin. NMF consists of free amino acids, pyrrolidone carboxylic acids, urocanic acid, lactic acid, and urea. NMF contributes to the homeostasis of water, temperature, and moisture of the stratum corneum.[1]

The skin surface has a pH that is mostly acidic and falls within the range of 5.4 - 5.9, with variations between the face, trunk, and extremities. The presence of natural acidic compounds on the skin surface helps maintain the skin's function as a protective barrier against the environment. A pH level above 5.9 can cause skin dryness. Elevated pH fosters a different microbiome, and the skin's natural protective barrier can be disrupted, causing skin damage.[2] several factors can affect pH changes, namely endogenous and exogenous factors.[3] Of the many exogenous factors that are thought to alter skin pH, skin cleansing products such as body wash can affect skin pH albeit temporarily. It was further shown that soap ingredients, especially surfactant composition, also influence the effect of soap pH on skin surface pH.[4] like skin barrier regeneration and antimicrobial response, are related to the acidic nature of the skin surface pH (ss-pH

The pH value of the cleanser can affect the barrier. Soap can penetrate deeper into the skin due to the high pH value and cause irritation and itching.[5] because irritants and/or antigens can enter the skin relatively easily. Dry skin can activate nerve fibers associated with itching.[6]

This study aims to underline to students that maintaining body hygiene using bath

soap can improve well-being and health, and determine the effect of bath soap pH that affects body skin hydration levels in Medical Faculty students class of 2023 in Universitas Tarumanegara.

METHODS

This study is a descriptive study with a cross-sectional research design, conducted at the Faculty of Medicine, Tarumanagara University, from February to August 2024. The sample consisted of 166 students from the Faculty of Medicine, Tarumanagara University, class of 2023, who met the inclusion criteria. Simple random sampling was used to select participants. Primary data were collected through questionnaire responses and skin hydration measurements using a corneometer.

Subjects Selection

Inclusion criteria in this research were students of the Medical Faculty, Universitas Tarumanagara, class of 2023, who were willing to participate as research subjects as indicated by informed consent and completed the questionnaire fully. Students who were unwilling to participate as research subjects and suffered from atopic dermatitis or xerosis were excluded from this study.

Measurement of Skin Hydration

Skin hydration was measured using the Skin Analyzer (Model CR-302), which quantifies the water content in the stratum corneum, the outermost layer of the skin. Measurements were conducted on three body areas: the upper arm, the forearm, and the lower leg. To ensure accurate readings, the measurement site was cleaned with a cleansing solution and allowed to dry. The analyzer was then activated and placed on the designated skin area until a stable reading was displayed. Hydration levels were recorded as a percentage (ranging from 0% to 100%) and classified into categories: "very dry" (<33%), "dry" (34-37%), "normal" (38-42%), "moist" (43-46%), and "very moist" (>47%). These values were analyzed as interval data, where the percentage value represents the water content within the stratum corneum. The results were categorized and recorded numerically for further statistical analysis.

Measurement of pH of Bath Soap

The pH level of the bath soap was measured using a calibrated pH Meter (PH818). The pH meter was immersed directly into the soap solution, and the pH value was recorded once the reading stabilized. The pH values were categorized as "acidic" (<6), "neutral" (7), and "alkaline" (>8). These values were recorded numerically for subsequent analysis.

Data Analysis

The data obtained from the collection process were transformed into tables and graphs using SPSS (Statistical Product and Service Solutions) software. Univariate analysis was conducted to describe the distribution of research variables, such as skin hydration levels and the pH of the soap used. The results were presented in tables and graphs to illustrate frequency,

Table 1. Characteristics of Subjects

Variable	Frequency
Gender	
Female	121 (72.9%)
Male	45 (27.1%)
Age	
17 years old	1 (6%)
18 years old	37 (22.3%)
19 years old	104 (62.7%)
20 years old	19 (11.4%)
21 years old	2 (1.2%)
22 years old	2 (1.2%)
23 years old	1 (1%)
Type of soap	
Liquid soap	
Antibacterial soap	64 (38.6%)
Moisturizing soap	30 (18.1%)
Natural soap	67 (40.3%)
Bar soap	
Antibacterial soap	5 (3%)
Frequency of Bathing	
1 time/day	20 (12%)
2 times/day	139 (83.7%)
3 times/day	7 (4.2%)
Frequency of moisturizer use	
Not using	50 (30.1%)
1 time/day	36 (21.7%)
2 times/day	70 (42.2%)
3 times/day	9 (5.4%)
>3 times/day	1 (0.6%)
Frequency of sunscreen use	
Not using	55 (33.1%)
1 time/day	63 (38%)
2 times/day	39 (23.5%)
3 times/day	5 (3%)
>3 times/day	4 (2.4%)
Water consumption	
<6 glasses of water	46 (27.7%)
6-8 glasses of water	93 (56%)
>8 glasses of water	27 (16.3%)
Exposure to air conditioner	
<4 hours/day	14 (8.4%)
≥4 hours/day	152 (91.6%)

proportions, and measures of central tendency, such as the mean and median.

RESULTS

Research that has been carried out during the research period from February to August 2024 obtained a total of 166 subjects and students of the Faculty of Medicine, Tarumanagara University who meet the inclusion criteria and can be categorized as the characteristics of the research subjects (Table 1).

The results showed that the majority of subjects were female with a total of 121 subjects (72.9%) out of 166 research subjects. The age of the research subjects varied from 17-23 years old, where most were 19 years old with a total of 104 subjects (62.7%). Based on the use of soap types, the research subjects had a wide variety of soap use, which was dominated by antibacterial soaps (17.5%) and moisturizing soaps (13.3%).

Overview of Bath Soap Ph

Based on Table 2, most of the research subjects used soap with alkaline pH levels (>8), namely 113 research subjects (68.1%), followed by acidic pH 27 (16.3%), and neutral pH 113 (68.1%).

Overview of Body Skin Hydration

The data are shown in Table 3 based on the measurement of skin hydration levels of the right upper arm, left upper arm, right forearm, left forearm, right leg, and left leg. Based on the table above, the right upper arm has the highest hydration levels, with 109 subjects (65.7%) having very moist hydration levels.

Based on the results of the analysis of the measurement of hydration levels. based on age groups, it was found that the frequency of very moist hydration levels was highest in female gender with a total of 41 research subjects (Figure 1). Based on the results of the analysis of the measurement of hydration levels based on age groups, the highest frequency of very moist hydration levels was obtained at the age of 23 years with a total of 42 research subjects (Figure 2).

Table 2. Bath Soap pH Overview

Variables	Frequency (%)
pH of bath soap	
Acidic	27 (16.3%)
Neutral	26 (15.7%)
Alkaline	113 (68.1%)

Table 3. Skin Hydration Levels Based on Measurement Location

Skin hydration	Measurement Location											
	Right upper arm		Left upper arm		Right forearm		Left forearm		Right limb		Left limb	
	N	%	N	%	N	%	N	%	N	%	N	%
Very dry	13	7.8	9	5.4	16	9.6	18	10.8	73	44	80	48.2
Dry	10	6	16	9.6	19	11.4	11	6.6	33	19.9	34	20.5
Normal	20	12	23	13.9	23	13.9	20	12	20	12	22	13.3
Moist	14	8.4	19	11.4	20	12	23	13.9	13	7.8	6	3.6
Very moist	109	65.7	99	59.6	88	53	94	56.6	27	16.3	24	14.5
Total	166	100	166	100	166	100	166	100	166	100	166	100

DISCUSSION

This study involved 166 subjects aged 17–23 years, with the majority being 19 years old (62.7%). This age group exhibited the highest skin hydration levels (56.5%), indicating that young skin has a more optimal skin barrier function compared to older age groups. The decline in skin hydration with age is often associated with decreased production of natural lipids and moisturizing factors in the stratum corneum. This process contributes to an increase in TEWL, which progressively worsens with age, as reported by Firooz et al. This decrease in hydration may also be influenced by hormonal changes and reduced sebaceous gland activity in older individuals, leading to a diminished ability of the skin to retain moisture, making it more prone to dryness and irritation.[7]

The decline in skin hydration observed in older individuals aligns with the findings of a study by Abdulsalam et al., which assessed body hydration status among university students aged 18–25 years in the UAE. In that study, approximately 41.3% of the students experienced body dehydration, with a higher proportion found among females. Although the study primarily focused on overall body hydration, the findings remain relevant to this research, as suboptimal body hydration can affect skin hydration. Both young individuals in their growth phase and older individuals are at risk of experiencing decreased skin hydration, which is directly linked to suboptimal body hydration.[8] sun and heat exposure which is a key element especially in the Gulf region. The aim of this study was to identify the prevalence and the impinging factors of hypohydration among college students in UAE. SUBJECTS AND METHODS: Bioelectrical Analysis Impedance (BIA

As explained by Farage et al, the thinning of the epidermis with age, with a reduction of up to 50% between the ages of 30 and 80, is closely associated with a decreased skin hydration capacity. This epidermal thinning makes elderly individuals more vulnerable to dehydration and other skin issues, such as xerosis and pruritus.[9] In addition to intrinsic factors related to aging, exposure to ultraviolet (UV) rays and air pollution further aggravates the skin hydration condition in elderly individuals with already thinner skin. These findings indicate that environmental factors exacerbate skin hydration issues in

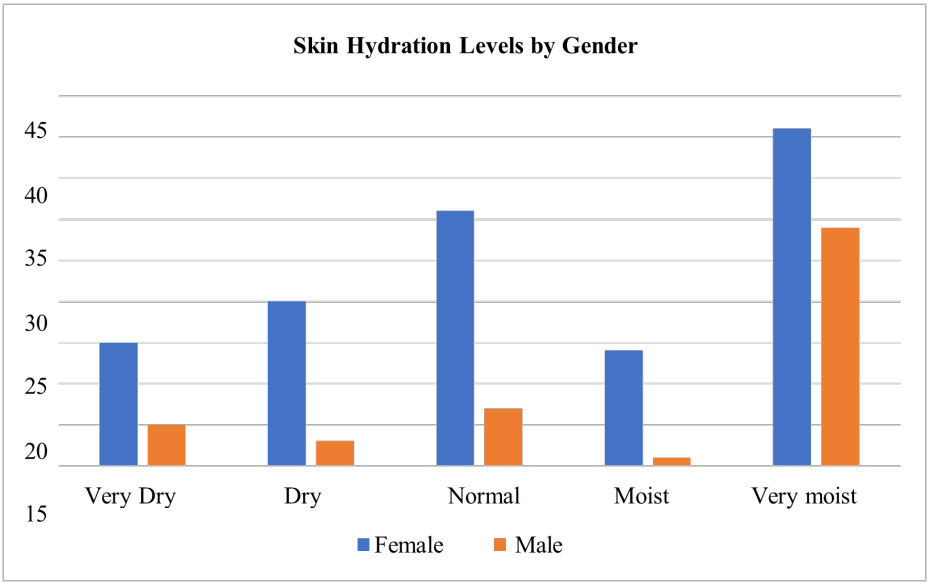

Figure 1. Skin hydration levels by gender

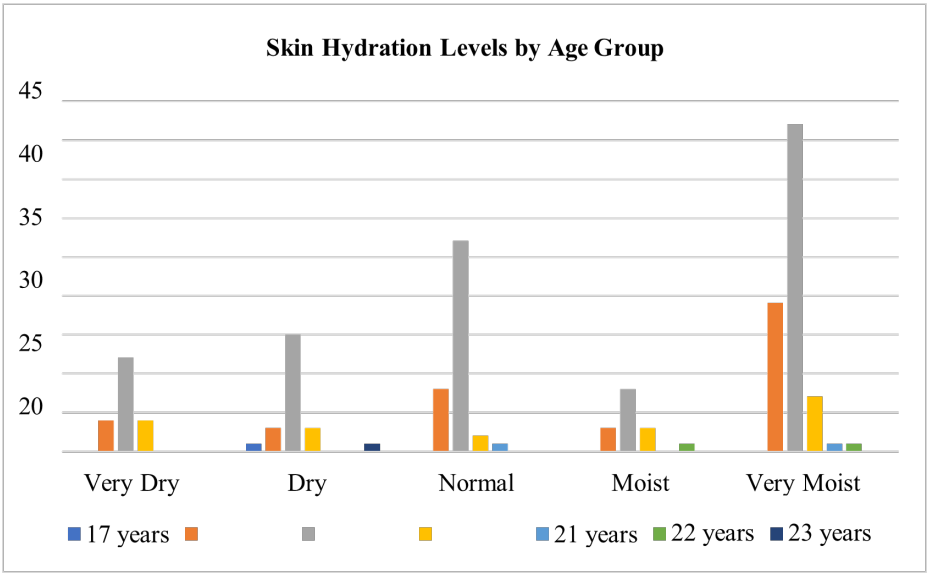

Figure 2. Skin hydration levels by age group

older adults and can significantly impact their quality of life.[10]

The majority of the study (68.1%) used alkaline soaps (pH >8), which can disrupt the skin's pH balance. About 15.7% of the subjects used neutral pH soaps (pH 7), while the remaining 16.3% opted for acidic pH soaps (pH <6). The predominant use of alkaline soaps poses a risk of disrupting the skin's pH homeostasis, potentially leading to irritation and dryness, especially for individuals with sensitive skin. Studies by Khosrowpour et al. and Lukić et al. show that alkaline-based soaps can strip essential lipids such as ceramides and cholesterol from the stratum corneum, which play a crucial role in strengthening the skin's protective barrier.[11,12] including trans-epidermal water loss (TEWL

The study by Hawkins explained that soap with a pH of 5.5, compared to soap with a pH of 7, caused greater skin dryness in subjects after 8 days of use. Conversely, neutral pH soap proved more effective in maintaining skin hydration and reducing TEWL. This indicates that using soaps with excessively low or high pH levels can disrupt the skin's pH balance, increase TEWL, and accelerate skin dryness. Therefore, selecting soaps with balanced pH is highly recommended to maintain skin hydration and protect the skin barrier from damage.[13]

Skin hydration measurements showed that the upper arm had the highest hydration level (mean 50.28%), while the legs had the lowest hydration level (mean 33.53%). The majority of subjects' skin on the upper arm was categorized as very moist (65.7%), whereas most of the skin on the legs was classified as very dry (48.8%). This difference can be explained by factors such as the thickness of the stratum corneum, sebaceous gland activity, and exposure to external factors like temperature and humidity.[14,15] Skin in protected areas, such as the upper arm, tends to be better hydrated compared to areas more frequently exposed to environmental conditions, such as the legs.

The study by Park et al. also revealed differences in skin hydration levels across various body locations, with the forearm showing lower hydration levels compared to other body parts.[16] These findings align with the results of this study, which recorded hydration levels on the forearm (mean 47.9 ± 11.44) as being lower than those on the upper arm (mean 50.28 ± 9.6). This difference highlights the variation in skin hydration between body locations, which several factors, such as the thickness of the stratum corneum, sebaceous gland activity, and exposure to external factors like temperature and humidity may influence.

The size of corneocyte cells and the regeneration rate of the epidermal layer also influence the skin's ability to retain moisture. Skin in more protected areas, such as the upper arm, exhibits faster epidermal cell proliferation and produces smaller corneocytes. Although smaller corneocytes may be more prone to water loss, the skin in these areas, which is more frequently hydrated and shielded from external factors, maintains better hydration levels. In contrast, body parts such as the lower legs, which have a thicker stratum corneum and larger corneocytes, are better equipped to retain hydration.

However, these areas are more exposed to friction, which can reduce overall hydration levels.[17]

Various factors, including the use of moisturizers, bathing frequency, sunscreen application, and water intake, influence skin hydration. This study found that the use of moisturizers significantly supports skin hydration, aligning with the findings of Cardona et al., who stated that bathing more than twice a day without moisturizer can reduce skin hydration.[18] Butarbutar and Chaerunisaa (2020) also recommend applying moisturizer immediately after bathing to maximize its hydrating effects. Sunscreen containing glycerin helps maintain skin hydration by protecting against UV rays while increasing water content in the stratum corneum.[19] Adequate water intake also plays a vital role in maintaining skin hydration. In this study, 27.7% of subjects consumed less than six glasses of water per day, indicating suboptimal body hydration. Akdeniz et al. recommend consuming six to eight glasses of water per day to support optimal skin hydration, which contributes to improved elasticity and reduced skin dehydration scores.[20]

Choosing a pH-balanced soap is crucial for maintaining the skin's pH balance, especially for individuals with sensitive skin. In this study, most participants used soaps with an alkaline pH, which can disrupt the skin barrier, increasing the risk of irritation and dehydration. This is consistent with previous studies that show alkaline soaps can strip essential lipids, such as ceramides and cholesterol, from the stratum corneum, which are vital for strengthening the skin barrier. Therefore, soaps with a neutral or slightly acidic pH are recommended, as they are more likely to maintain skin hydration and protect the skin barrier.[12]

This study has several limitations. First, selection bias was minimized as the sample size met the minimum requirement based on the sample size calculation, and the study was conducted cross-sectionally at a single time point. Second, participants were fully informed about their involvement, and only those who consented to participate completed the questionnaire, which likely influenced respondents to provide more accurate and reliable answers. However, skin hydration measurements were taken only once at a specific time point (rather than periodically), which may introduce informational bias regarding hydration levels.

CONCLUSION

Choosing a pH-balanced soap is essential for maintaining the skin's pH balance, particularly for individuals with sensitive skin. Soaps with excessively high or low pH can disrupt this balance, increasing the risk of irritation and dehydration. In contrast, soaps with a neutral or slightly acidic pH are recommended to preserve skin hydration and support the integrity of the skin barrier. Additionally, other factors such as selecting the appropriate moisturizer, protecting the skin from UV exposure, and ensuring adequate water intake are crucial for maintaining optimal skin hydration. Education on proper skincare and clear labeling of soap pH can assist individuals in making informed choices, ultimately promoting better skin health.

ETHICAL CLEARANCE

This study has been approved and authorized based on the consideration of the Health Research Ethics Committee of the Faculty of Medicine, Tarumanagara University (No. 356/KEPK/FK UNTAR/I/2024).

CONFLICT OF INTEREST

The authors declared no conflict of interest regarding publication.

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None.

AUTHOR CONTRIBUTIONS

All authors contributed to the reference search, manuscript preparation, and publication.

REFERENCES

1. Spada F, Barnes TM, Greive KA. Skin hydration is significantly increased by a cream formulated to mimic the skin's own natural moisturizing systems. Clin Cosmet Investig Dermatol. 2018;11:491–7. DOI: 10.2147/CCID.S177697
2. Tarun J, Susan J, Suria J, Susan VJ, Criton S. Evaluation of pH of bathing soaps and shampoos for skin and hair care. Indian J Dermatol. 2014;59(5):442–4. DOI: 10.4103%2F0019-5154.139861
3. Farage MA, Hood W, Berardesca E, Maibach H. Intrinsic and Extrinsic Factors Affecting Skin Surface pH. In Surber C, Abels C, Maibach H, editors. In: Current Problem in Dermatology [Internet]. Basel: Karger. 2018 [cited 2024 Feb 15]:33–47. Available from: https://www.karger.com/Article/FullText/489516
4. Blaak J, Staib P. The Relation of pH and Skin Cleansing. In Surber C, Abels C, Maibach H, editors. Current Problem in Dermatology [Internet]. Basel: Karger. 2018 [cited 2024 Feb 16]:132–42. Available from: https://www.karger.com/Article/FullText/489527
5. Évora AS, Adams MJ, Johnson SA, Zhang Z. Corneocytes: Relationship between structural and biomechanical properties. Skin Pharmacol Physiol. 2021;34(3):146–61. 10.1159/000513054
6. Yosipovitch G, Misery L, Proksch E, Metz M, Ständer S, Schmelz M. Skin barrier damage and itch: Review of mechanisms, topical management and future directions. Acta Derm Venereol. 2019;99(13):1201–9. 10.2340/00015555-3296
7. Firooz A, Sadr B, Babakoohi S, Sarraf-Yazdy M, Fanian F, Kazerouni-Timsar A, et al. Variation of biophysical parameters of the skin with age, gender, and body region. Sci World J. 2012;2012:1–5. DOI:10.1100/2012/386936
8. Abdulsalam R, Alsadah A, Alkhuboli M, Muala D, Hussein A, Elmoselhi AB. Hydration status assessment and impinging factors among university students in the UAE. Eur Rev Med Pharmacol Sci. 2022;26(18):6451–8. DOI: 10.26355/eurrev_202209_29744
9. Farage MA, Miller KW, Maibach HI. Textbook of Aging Skin. Textb Aging Skin. In: Farage MA, Miller KW, Maibach HI, editors. Textbook of Aging Skin [Internet]. Berlin, Heidelberg: Springer. 2017 [cited 2025 Jan 2]:15–30. Available from: http://link.springer.com/10.1007/978-3-662-47398-6_4
10. Parrado C, Mercado-Saenz S, Perez-Davo A, Gilaberte Y, Gonzalez S, Juarranz A. Environmental Stressors on Skin Aging. Mechanistic Insights. Front Pharmacol. 2019;10(July):1–17. DOI:10.3389/fphar.2019.00759
11. Khosrowpour Z, Ahmad Nasrollahi S, Ayatollahi A, Samadi A, Firooz A. Effects of four soaps on skin trans-epidermal water loss and erythema index. J Cosmet Dermatol. 2019;18(3):857–61. DOI: 10.1111/jocd.12758
12. Lukić M, Pantelić I, Savić SD. Towards optimal ph of the skin and topical formulations: From the current state of the art to tailored products. Cosmetics. 2021;8(3):1-18. DOI: 10.3390/cosmetics80330069

13. Hawkins S, Dasgupta BR, Ananthapadmanabhan K. Role of pH in skin cleansing. Int J Cosmet Sci. 2021;43(4):474–83. DOI: 10.1111/ics.12721
14. Załęcki P, Rogowska K, Wąs P, Łuczak K, Wysocka M, Nowicka D. Impact of Lifestyle on Differences in Skin Hydration of Selected Body Areas in Young Women. Cosmetics. 2024;11(1):1-11. DOI: 10.3390/cosmetics11010013
15. Dewi DAR, Pangkahila W. Addition of 5% Saccharide Isomerates in Moisturizing Formulation Increases Skin Hydration Higher than Regular Moisturizers. Eduvest - J Univers Stud. 2022;2(8):536–51. DOI: 10.59188/eduvest.v2i8.562
16. Park JH, Choi Y, Jung YJ, Lee T, Kim H, Cho Y, et al. Skin hydration Measurement: Comparison Between Devices and Clinical Evaluations. Ann Dermatol. 2024;36(5):275–81. DOI: 10.5021/ad.23.103
17. Tagami H. Location-related differences in structure and function of the stratum corneum with special emphasis on those of the facial skin. Int J Cosmet Sci. 2008;30(6):413–34. DOI: 10.5021/ad.23.103
18. Cardona ID, Stillman L, Jain N. Does bathing frequency matter in pediatric atopic dermatitis? Ann Allergy, Asthma Immunol. 2016;117(1):9–13. DOI: 10.1016/j.anai.2016.05.014
19. Butarbutar MET, Chaerunisaa AY. Peran Pelembab dalam Mengatasi Kondisi Kulit Kering. Maj Farmasetika. 2020;6(1):56–69. DOI: 10.24198/mfarmasetika.v6i1.28740
20. Akdeniz M, Tomova-Simitchieva T, Dobos G, Blume-Peytavi U, Kottner J. Does dietary fluid intake affect skin hydration in healthy humans? A systematic literature review. Ski Res Technol. 2018;24(3):459–65. DOI: 10.1111/srt.12454