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Original Research Paper

Post-Swim Facial Skin Hydration and Sebum Levels Among Young Adult Swimmers in Bandung: A Descriptive Cross Sectional Study

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Abstract

Background: Instrument-based descriptions of facial skin condition after swimming are limited in Indonesian populations, but single post swim measurements cannot establish chlorine related effects. **Objective:** To describe post swim facial sebum and hydration categories among young adult swimmers in Bandung. **Methods:** A descriptive cross sectional study included 70 active swimmers aged 18–35 years at two public pools on April 25–26, 2024. Five facial sites were assessed once immediately after swimming using the Runve 45 Skin Analyzer following gentle micellar water cleansing. Data were summarized as frequencies and percentages; no inferential tests were performed. **Results:** Low sebum was most frequent on the nose (72.9%), right cheek (70.0%), and chin (62.9%). Dry hydration was most frequent on the nose (18.6%), right cheek (11.4%), and left cheek/chin (10.0% each). **Conclusion:** Low sebum and dry-skin categories were observed at several facial sites after swimming. Because no pre swim baseline, comparison group, measured chlorine concentration, or standardized post cleansing recovery interval was available, the findings should be interpreted descriptively rather than causally.

Keywords: facial skin; skin hydration; sebum; swimmers; post swim assessment.

Introduction

The skin functions as a dynamic physical and biochemical barrier, and its surface condition is influenced by anatomical site, environmental exposure, and individual physiology[1,2]. Stratum corneum hydration contributes to softness and barrier performance, whereas sebum provides surface lipids that limit water loss and contribute to cutaneous homeostasis[3,4]. Because hydration and sebum vary across facial regions, multi site measurement can provide a more informative descriptive profile than a single point assessment[5].

Swimming is a widely practiced form of exercise, but the pool environment introduces multiple exposures that may affect the skin surface, including prolonged water contact, disinfectants, temperature, humidity, ultraviolet exposure in outdoor settings, and post-swim cleansing practices[6,7]. Prior comparative research has reported changes in skin barrier related parameters after swimming; however, such findings cannot be directly transferred to a descriptive study without a pre swim baseline or non swimmer comparison group[8]. Indonesian evidence on environmental and behavioral factors in skin health likewise supports careful consideration of context rather than attribution to a single exposure[9].

Objective assessment of skin hydration and sebum can reduce reliance on subjective

impressions, but measurement conditions are important. Skin hydration readings are sensitive to ambient conditions and acclimatization, while surface sebum readings may be altered by washing or removal of surface lipids[10,11,12]. Therefore, transparent reporting of measurement timing, cleansing procedures, device categories, and study design is essential when interpreting post exposure skin measurements.

This study addressed the question: what are the post swim facial skin hydration and sebum categories observed among active young adult swimmers in Bandung, Indonesia? The objectives were to describe sebum and hydration categories at five facial sites the forehead, nose, chin, right cheek, and left cheek and to identify which sites most frequently fell into low sebum or dry hydration categories. The study was descriptive and was not designed to estimate causal effects of chlorine, swimming frequency, session duration, or skincare practices.

The findings are intended to provide a site-specific descriptive profile that can guide the design of better controlled studies and support general skin health education for swimmers. They should not be interpreted as evidence that swimming or chlorine caused the observed values. This distinction is especially important because the measurements were obtained once after swimming and after facial cleansing, without a pre-swim baseline, direct chlorine measurement, or a comparison group.

Materials and Methods

Research Design

This study used a descriptive observational cross-sectional design. The design was selected to characterize facial skin hydration and sebum categories at a single post-swim time point without intervention or longitudinal followup[13]. The study was conducted in a recreational dermatology context and was not designed to test exposure response hypotheses or establish causality.

Sample

The target population comprised active young adult swimmers in Bandung, Indonesia. Participants were recruited by non-random consecutive sampling from individuals attending the selected study sites during data collection[14]. Inclusion criteria were age 18–35 years, swimming at least twice per week, willingness to complete the study procedures, and written informed consent. Exclusion criteria were active facial skin disease such as dermatitis, fungal infection, or severe acne; recent use of prescription topical treatment or intensive skincare procedures; and open wounds, active inflammation, or sunburn on the face at examination. Seventy participants were included.

Data Collection Technique

Data were collected at Tirta Lega Swimming Pool and the KONI West Java facility in Bandung on April 25–26, 2024. The Runve 45 Skin Analyzer was used to obtain device generated hydration and sebum readings at five facial sites: forehead, nose, chin, right cheek, and left cheek. According to the original field protocol, each participant's face was gently cleansed with hypoallergenic micellar water before measurement to remove cosmetic or surface residue, and each site was measured once immediately after the swimming session. A structured questionnaire collected basic identity information, swimming frequency, session duration, and facial skincare habits.

Measurement quality information available in the source documentation was limited. A fixed interval between micellar-water cleansing and measurement, a formal acclimatization period, room temperature and relative humidity, repeated measurements per site, and an independent device calibration or

validation certificate were not documented. Current skin-measurement guidance emphasizes control of ambient conditions for hydration assessment[11], and facial sebum research shows that sebum removal followed by insufficient recovery time can materially lower surface sebum readings[12]. Accordingly, the present sebum results are interpreted as post swim, post cleansing device readings and not as unmanipulated baseline sebum production.

For transparency, the available source record was reviewed specifically for the protocol elements requested during peer review. The post cleansing interval was described only as immediate; a formal acclimatization period and room temperature/relative humidity were not reported; one reading per facial site was documented; and operator standardization procedures were not described in the submitted record. No independent calibration certificate or validation report for the Runve 45 was available in the manuscript materials.

The exact numerical device cut offs used to define Low versus Normal/High sebum and Dry versus Normal/Moist hydration, together with evidence of population specific validation, were also not retained in the submitted study documentation. No missing protocol detail was reconstructed or imputed. These gaps are therefore reported explicitly as limitations and the device categories are interpreted descriptively rather than diagnostically.

Data Analysis Technique

The instrument-generated sebum categories were reported as Low or Normal/High, and hydration categories as Dry or Normal/Moist, consistent with the categories used in the field dataset. The exact numerical manufacturer cut offs and evidence of population specific validation for these categories were not retained in the submitted study documentation; therefore, the categories are treated as device-based descriptive classifications rather than diagnostic thresholds. Frequencies and percentages were calculated for each category at each facial site using SPSS version 25.0. No t test, chi square test, correlation, regression, or other inferential statistical procedure was performed. Questionnaire variables were collected for context but were not used to support exposure-response conclusions.

Ethical Clearance

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee, Faculty of Medicine, Tarumanagara University (No. 428/KEPK/FK UNTAR/X/2024). All participants received an explanation of the study procedures and provided written informed consent. Data were anonymized and handled confidentially.

Results

A total of 70 active swimmers aged 18–35 years were included. All participants met the eligibility criteria and were assessed after a swimming session at one of the two study sites. Table 1 summarizes the participant and measurement characteristics that were documented in the source material. Although sex, session duration, swimming frequency, and skincare habits were collected by questionnaire, their participant-level distributions were not available in the aggregate dataset supplied for this manuscript revision and were therefore not reconstructed.

Table 1. Documented Participant and Measurement Characteristics

Characteristic	Documented information
Participants	70 active swimmers
Age eligibility	18–35 years
Swimming eligibility	At least 2 sessions/week
Study sites	Tirta Lega Swimming Pool; KONI West Java facility, Bandung
Data-collection dates	April 25–26, 2024
Measurement timing	One measurement per site immediately after swimming

Characteristic	Documented information
Facial sites	Forehead, nose, chin, right cheek, left cheek
Pre-measurement procedure	Gentle facial cleansing with hypoallergenic micellar water

Table 2 presents the post-swim, post-cleansing distribution of sebum and hydration categories at the five facial sites. These values are descriptive proportions within the study sample; they do not represent pre-to-post changes and were not tested for statistical significance.

Low sebum was common at all measured sites. The highest proportion occurred on the nose (51/70; 72.9%), followed by the right cheek (49/70; 70.0%), chin (44/70; 62.9%), left cheek (43/70; 61.4%), and forehead (40/70; 57.1%). Because surface lipids were removed during the pre-measurement cleansing step, these proportions should be interpreted as readings under the study protocol rather than as estimates of each participant's usual facial sebum status.

Most hydration readings were classified as Normal/Moist. Dry hydration was observed most frequently on the nose (13/70; 18.6%), followed by the right cheek (8/70; 11.4%), left cheek (7/70; 10.0%), chin (7/70; 10.0%), and forehead (1/70; 1.4%). These findings indicate site-to-site variation in post-swim hydration categories within the sample, but the design does not determine whether the variation was caused by swimming, chlorine exposure, cleansing, ambient conditions, or pre-existing individual differences.

Overall, the most prominent descriptive pattern was the high proportion of Low sebum readings across all five sites, while Dry hydration categories were less frequent and concentrated primarily on the nose and cheeks. No statement of a statistically significant reduction, association, dose response relationship, or chlorine induced effect is made because no inferential analysis, baseline measurement, comparison group, or chlorine concentration measurement was included. Accordingly, these findings should be interpreted strictly as descriptive observations of skin sebum and hydration status among the participants at the time of assessment. Further analytical studies incorporating measured chlorine exposure, appropriate comparison groups, and adjustment for relevant confounding factors are required to determine whether pool water exposure is associated with changes in skin barrier characteristics.

Table 2. Facial Sebum and Hydration Categories After Swimming (n=70)

Variable	Facial Area	Category	n (%)
Sebum Level	**Forehead**	Low	40 (57.1%)
		Normal/High	30 (42.9%)
	Nose	Low	51 (72.9%)
		Normal/High	19 (27.1%)
	Right Cheek	Low	49 (70.0%)
		Normal/High	21 (30.0%)
	Left Cheek	Low	43 (61.4%)
		Normal/High	27 (38.6%)
	Chin	Low	44 (62.9%)
		Normal/High	26 (37.1%)
Hydration Level	**Forehead**	Dry	1 (1.4%)
		Normal/Moist	69 (98.6%)
	Nose	Dry	13 (18.6%)
		Normal/Moist	57 (81.4%)
	Right Cheek	Dry	8 (11.4%)
		Normal/Moist	62 (88.6%)
	Left Cheek	Dry	7 (10.0%)
		Normal/Moist	63 (90.0%)
	Chin	Dry	7 (10.0%)
		Normal/Moist	63 (90.0%)

Source: Primary data, 2024

Discussion

This study describes facial skin measurements obtained from regular swimmers at a single time point immediately after swimming. The principal observation was that Low sebum categories were frequent across all facial sites, whereas Dry hydration categories were less common and showed the highest proportion on the nose. The descriptive pattern is compatible with prior literature showing that skin surface parameters can differ after aquatic exercise[8], but the present design cannot determine whether the observed values reflect the swimming session itself, chlorinated water, cleansing, individual skin type, ambient conditions, or a combination of these factors.

Anatomical variation is an important consideration. Facial mapping studies demonstrate that hydration, barrier characteristics, pH, and sebum vary substantially between facial regions[5,15,16]. The nose generally has high sebaceous activity, while the cheeks often show different hydration and lipid profiles. Therefore, site specific results should not be interpreted as evidence of site-specific damage. The high proportion of Low sebum readings on the nose in this study may reflect true post swim surface conditions, the effect of the cleansing protocol, device classification thresholds, or all three.

The pre measurement cleansing procedure is the most important methodological issue for interpreting sebum. Surface sebum measurement is sensitive to recent washing or lipid removal. Liu et al. showed that after deliberate sebum removal, facial sebum requires a recovery period and may remain below its usual surface level even after one hour[12]. In the present study, micellar water was applied before a single immediate measurement and no standardized recovery interval was documented. Consequently, the study cannot separate naturally low post swim sebum from sebum removed by the measurement preparation itself. This limitation does not invalidate the recorded values, but it narrows their interpretation to the specific protocol used.

Hydration results also require methodological caution. International guidance recommends standardized ambient temperature, relative humidity, and acclimatization when measuring stratum corneum water content because these conditions can influence instrument readings[11]. These environmental details were not recorded in the available study documentation. In addition, the Runve 45 categories were analyzed using the device/manufacturer classification used during fieldwork, but the exact numerical reference ranges and population-specific validation evidence were not available for verification. The reported percentages should therefore be understood as distributions of device generated categories, not clinical diagnostic prevalences.

Within the Indonesian literature, environmental and occupational exposures have been linked with a variety of skin complaints, emphasizing the importance of personal factors and exposure context when interpreting dermatologic findings[9]. Other HTJ work has highlighted the role of objective examination in characterizing skin conditions in exposed populations[17], while clinical reports of compromised skin integrity illustrate why persistent skin symptoms warrant appropriate assessment rather than attribution to a single environmental cause[18,19]. These studies support a cautious, context sensitive interpretation of the present swimmer data.

The categorical labels used by the device also require restrained interpretation. A reading classified as Low sebum or Dry hydration is a category generated under the field measurement protocol; it is not equivalent to a clinical diagnosis of barrier dysfunction, xerosis, or dermatitis. Without independently verified cut offs for this population, continuous raw values, repeatability data, and a reference group measured under the same conditions, the percentages are most appropriately treated as descriptive distributions. This distinction preserves the value of the field observations while avoiding diagnostic or mechanistic claims that the study was not designed to test.

Generalizability is likewise bounded by the sampling frame. Participants were regular swimmers aged 18–35 years recruited consecutively at two public swimming facilities in Bandung. The findings therefore characterize the accessible young-adult swimmer population at those sites and dates; they should not be generalized directly to

children, older adults, competitive elite swimmers, people with active facial dermatoses, or swimmers in pools with different water chemistry and environmental conditions. Experimental work involving chlorine-rich water can inform biological plausibility, but animal or laboratory evidence does not establish the cause of the measurements observed in this human descriptive sample[20].

The practical implications are therefore modest. Swimmers who experience dryness, irritation, or sensitivity may reasonably use general skin care measures such as rinsing after swimming, choosing a gentle cleanser, using an appropriate moisturizer, and applying water resistant broad spectrum sunscreen for outdoor swimming[21,22,23]. However, the present study did not test any skincare intervention and cannot estimate the effectiveness of these measures. Similarly, it does not provide evidence for a specific chlorine threshold or a causal relationship between swimming frequency and skin barrier impairment.

Strengths of the study include direct instrument-based measurement, assessment of five facial sites, explicit eligibility criteria, real world data collection at two public swimming facilities, and documented ethical approval. The limitations are substantial and should frame all interpretation: the cross sectional design; absence of pre-swim measurements and a non-swimmer comparison group; no direct measurement of chlorine concentration, water temperature, room temperature, or humidity; no documented acclimatization interval; a single measurement per facial site; pre-measurement micellar-water cleansing that could reduce surface sebum; unavailable numeric manufacturer cut offs and population-specific validation for the device categories; and lack of participant-level summary distributions for sex, session duration, swimming frequency, and skincare habits in the aggregate dataset used for this revision. These limitations also prevent causal or dose-response conclusions and leave substantial potential for confounding in any etiologic interpretation[24].

Future studies should use a standardized pre-swim/post-swim design, include a comparison group where feasible, measure chlorine concentration and water temperature, record ambient temperature and humidity, incorporate a defined acclimatization period, and obtain repeated measurements at each site. For sebum assessment, a prespecified interval after cleansing or sebum removal should be used and justified[11,12,25]. Participant characteristics and skincare behaviors should be reported in full, and inferential analyses should be prespecified only when the study design and sample size support them.

Conclusion

Among 70 active young adult swimmers in Bandung, Low sebum categories were frequently observed at all five facial sites after a swimming session, with the highest proportion on the nose, while Dry hydration categories were less frequent and were also most common on the nose. These findings describe post swim, post cleansing skin-analyzer readings only. They do not establish that chlorine or swimming caused a reduction in sebum or hydration because no pre-swim baseline, comparison group, direct chlorine measurement, standardized recovery interval after cleansing, or inferential analysis was available. The results are best used as descriptive baseline data for future studies employing standardized and controlled skin measurement protocols.

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References

1. Lotfollahi Z. The anatomy, physiology and function of all skin layers and the impact of ageing on the skin. *Wound Pract Res*. 2024;32(1):6-10. doi:10.33235/wpr.32.1.6-10
2. 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):13. doi:10.3390/COSMETICS11010013
3. Verdier-Sévrain S, Bonté F. Skin hydration: a review on its molecular mechanisms. *J Cosmet Dermatol*. 2007;6(2):75-82. doi:10.1111/J.1473-2165.2007.00300.X
4. Del Rosso JQ, Kircik L. The primary role of sebum in the pathophysiology of acne vulgaris and its therapeutic relevance in acne management. *J Dermatolog Treat*. 2024;35(1):2296855. doi:10.1080/09546634.2023.2296855
5. Voegeli R, Gierschendorf J, Summers B, Rawlings A V. Facial skin mapping: from single point bio-instrumental evaluation to continuous visualization of skin hydration, barrier function, skin surface pH, and sebum in different ethnic skin types. *Int J Cosmet Sci*. 2019;41(5):411-424. doi:10.1111/ICS.12562;WGROUP:STRING:PUBLICATION
6. Keuten MGA, Peters MCFM, Daanen HAM, de Kreuk MK, Rietveld LC, van Dijk JC. Quantification of continual anthropogenic pollutants released in swimming pools. *Water Res*. 2014;53:259-270. doi:10.1016/J.WATRES.2014.01.027
7. Ciorba D, Tataru A, Avram A, Almasi A, Moldovan M. Influence Of Environmental Chloroform Concentrations On Biophysics Skin Parameters. *Farmacia*. 2015;63(2).
8. Paciência I, Rodolfo A, Leão L, et al. Effects of Exercise on the Skin Epithelial Barrier of Young Elite Athletes-Swimming Comparatively to Non-Water Sports Training Session. *Int J Environ Res Public Health*. 2021;18(2):653. doi:10.3390/IJERPH18020653
9. Putri ASD. Gambaran Profil Dan Faktor-Faktor Yang Mempengaruhi Kejadian Penyakit Kulit Pada Warga Yang Tinggal Di Sekitar Area Pltu, Kota Palu, Indonesia. *Heal Tadulako J (Jurnal Kesehat Tadulako)*. 2019;5(3):29. doi:10.22487/j25020749.2019.v5.i3.14051
10. Qassem M, Kyriacou P. Review of Modern Techniques for the Assessment of Skin Hydration. *Cosmetics*. 2019;6(1):19. doi:10.3390/COSMETICS6010019
11. Berardesca E, Loden M, Serup J, Masson P, Rodrigues LM. The revised EEMCO guidance for the in vivo measurement of water in the skin. *Ski Res Technol*. 2018;24(3):351-358. doi:10.1111/SRT.12599;SUBPAGE:STRING:ABSTRACT;WEBSITE:WEBSITE:PERICLES;JOURNAL:JOURNAL:16000846;ISSUE:ISSUE:DOI
12. Liu Y, Jiang W, Tang Y, et al. An optimal method for quantifying the facial sebum level and characterizing facial sebum features. *Ski Res Technol*. 2023;29(9):e13454. doi:10.1111/SRT.13454
13. Mann CJ. Observational research methods. Research design II: cohort, cross sectional, and case-control studies. *Emerg Med J*. 2003;20(1):54-60. doi:10.1136/EMJ.20.1.54
14. Etikan I. Comparison of Convenience Sampling and Purposive Sampling. *Am J Theor Appl Stat*. 2016;5(1):1. doi:10.11648/J.AJTAS.20160501.11
15. Luebberding S, Krueger N, Kerscher M. Skin physiology in men and women: In vivo evaluation of 300 people including TEWL, SC hydration, sebum content and

skin surface pH. *Int J Cosmet Sci*. 2013;35(5):477-483. doi:10.1111/ICS.12068;ISSUE:ISSUE:DOI

16. Youn SW. Sebum secretion, skin type, and ph. *Pathog Treat Acne Rosacea*. Published online November 1, 2013:299-303. doi:10.1007/978-3-540-69375-8_41/SAVE-RESEARCH
17. Panjaitan JSG, Suhartomi S, Tarigan J. Hubungan antara gambaran ruam dengan hasil pemeriksaan KOH pada pemulung di Kota Medan. *Heal Tadulako J (Jurnal Kesehat Tadulako)*. 2024;10(4):573-581. doi:10.22487/HTJ.V10I4.1314
18. Ezra D, Sofyan A, Setyawati T. Cellulitis in the anterior tibia and posterior sinistra region. *Heal Tadulako J (Jurnal Kesehat Tadulako)*. 2022;8(2):132-137. doi:10.22487/HTJ.V8I2.192
19. Pondang J, Prakoeswa FRS. Incidence of Bullous Pemphigoid After Herpes Zoster Treatment with Acyclovir: A Rare Case Report in a Rural Area. *Heal Tadulako J (Jurnal Kesehat Tadulako)*. 2026;12(2):376-385. doi:10.22487/W3R3ZP17
20. Rahman MH, Fadriquela A, Bajgai J, et al. Long-Term Skin Safety Effect of Chlorine-Rich Water Treatment on C57BL/6 Mice. *Processes*. 2023;11(7). doi:10.3390/PR11071914
21. Proksch E, Brandner JM, Jensen JM. The skin: an indispensable barrier. *Exp Dermatol*. 2008;17(12):1063-1072. doi:10.1111/J.1600-0625.2008.00786.X
22. Wang SQ, Lim HW. Current status of the sunscreen regulation in the United States: 2011 Food and Drug Administration's final rule on labeling and effectiveness testing. *J Am Acad Dermatol*. 2011;65(4):863-869. doi:10.1016/j.jaad.2011.07.025
23. Sukmawati Tansil Tan, Alexander Halim Santoso, Ernawati Ernawati, Yohanes Firmansyah, Joshua Kurniawan, Jasmine Syabania Noviantri. Community Service Activities – Education And Skin Hydration Screening For Productive Age Group. *Perigel J Penyul Masy Indones*. 2023;2(2):06-14. doi:10.56444/PERIGEL.V2I2.727
24. Szklo M, Nieto FJ. *Measuring Associations Between Exposures and Outcomes*.; 2014.
25. Prakoso ZZ, Tan ST. Gambaran Tingkat Hidrasi dan Kadar Sebum Wajah Pada Perenang. *J Muara Sains, Teknol Kedokt dan Ilmu Kesehat*. 2025;9(2):7-12. doi:10.24912/KMFFR972