Original Research Article

The Relationship Between Sports Science Students' Knowledge and Sunscreen Use Behavior for Skin Protection During Outdoor Ultraviolet Exposure in a Tropical University Setting

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Abstract

***Background**: Ultraviolet (UV) radiation increases the risk of skin disorders, particularly among individuals engaged in outdoor activities. Despite the proven effectiveness of sunscreen, the relationship between knowledge and sunscreen use among Sports Science students in Indonesia remains unclear. **Objectives**: This study aims to analyze the relationship between the level of knowledge and sunscreen usage behavior among students of the Sports Science Study Program at Sultan Ageng Tirtayasa University. **Methods**: This research employed an analytical observational study with a cross-sectional design involving 77 students from the Sports Science Study Program at Sultan Ageng Tirtayasa University. Participants were selected using a consecutive sampling technique. Data were collected through a validated questionnaire and analyzed using the Chi-Square test with a 95% confidence level. **Results**: A total of 71.4% of respondents demonstrated good knowledge about sunscreen, and 80.5% exhibited good sunscreen usage behavior. A significant relationship was found between knowledge level and sunscreen use behavior ($p < 0.001$). Students with lower sunscreen-related knowledge had 12.75 times higher odds of demonstrating poor sunscreen use behavior compared to students with higher knowledge levels (OR = 12.75; 95% CI: 3.41 – 47.57). Among the confounding variables analyzed, only gender showed a significant association with sunscreen use behavior ($p = 0.028$). **Conclusions**: Knowledge level is significantly associated with sunscreen usage behavior among Sports Science students. Comprehensive education about sunscreen is essential to enhance protective behavior against UV exposure. Further research is recommended to explore other influencing factors such as attitudes and environmental influences on sunscreen use.*

***Keywords**: Skin health, sports science, sunscreen use, knowledge, ultraviolet radiation.*

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Abstrak

Latar Belakang: Radiasi ultraviolet (UV) meningkatkan risiko terjadinya gangguan kulit, terutama pada individu yang melakukan aktivitas di luar ruangan. Meskipun efektivitas tabir surya dalam mencegah kerusakan kulit akibat sinar UV telah terbukti, hubungan antara tingkat pengetahuan dan penggunaan tabir surya di kalangan mahasiswa Ilmu Keolahragaan di Indonesia masih belum

jelas. **Tujuan**: Menganalisis hubungan antara tingkat pengetahuan dengan perilaku penggunaan tabir surya pada mahasiswa Program Studi Ilmu Keolahragaan Universitas Sultan Ageng Tirtayasa. **Metode**: Penelitian ini merupakan studi observasional analitik dengan desain potong lintang (cross-sectional) yang melibatkan 77 mahasiswa Program Studi Ilmu Keolahragaan Universitas Sultan Ageng Tirtayasa. Sampel dipilih menggunakan teknik consecutive sampling. Data dikumpulkan melalui kuesioner yang telah tervalidasi dan dianalisis menggunakan uji Chi-Square dengan tingkat kepercayaan 95%. **Hasil**: Sebanyak 71,4% responden memiliki tingkat pengetahuan yang baik mengenai tabir surya, dan 80,5% menunjukkan perilaku penggunaan tabir surya yang baik. Hasil analisis menunjukkan adanya hubungan yang signifikan antara tingkat pengetahuan dan perilaku penggunaan tabir surya ($p < 0,001$). Mahasiswa dengan tingkat pengetahuan rendah memiliki risiko 12,75 kali lebih besar untuk menunjukkan perilaku penggunaan tabir surya yang kurang baik dibandingkan mahasiswa dengan tingkat pengetahuan tinggi (OR = 12,75; 95% CI: 3.41 – 47.57). Dari variabel perancu yang dianalisis, hanya jenis kelamin yang memiliki hubungan signifikan dengan perilaku penggunaan tabir surya ($p = 0,028$). **Kesimpulan**: Tingkat pengetahuan berhubungan secara signifikan dengan perilaku penggunaan tabir surya pada mahasiswa Ilmu Keolahragaan. Peningkatan edukasi mengenai penggunaan tabir surya diperlukan untuk mendorong perilaku perlindungan yang lebih baik terhadap paparan sinar UV. Penelitian selanjutnya disarankan untuk mengeksplorasi faktor-faktor lain yang dapat memengaruhi perilaku penggunaan tabir surya, seperti sikap, persepsi, dan pengaruh lingkungan.

Kata Kunci: Kesehatan kulit, Ilmu keolahragaan, penggunaan tabir surya, pengetahuan, radiasi ultraviolet.

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INTRODUCTION

Indonesia is a tropical country located along the equator, experiencing intense sunlight exposure throughout the year. Prolonged exposure to ultraviolet (UV) radiation can lead to various forms of skin damage, ranging from erythema to an increased risk of skin malignancies. According to the World Cancer Research Journal (WCRJ) in 2018, approximately 65 to 90% of skin cancer cases in Asia are attributed to UV exposure, with prevalence rates reaching 88% in West Asia, 4.8% in East and Central Asia, and 3.1% in Southeast Asia (Goodarzi et al., 2019).

The intensity of UV exposure is influenced by environmental conditions, particularly ambient temperature and the UV index (Baldermann et al., 2023). Indonesia, including the city of Serang, is located in a tropical region and experiences substantial sunlight exposure throughout the year (Andriyana et al., 2024). The region frequently records a UV index ranging from 8 to 10, which is classified as high according to World Health Organization (WHO) standards (Luccini et al., 2023). Prolonged exposure to high levels of ultraviolet (UV) radiation may increase the risk of adverse skin effects, including sunburn, photoaging, hyperpigmentation, and, over the long term, skin cancer. Therefore, adequate sun protection measures, such as regular sunscreen use, are essential to minimize UV-induced skin damage (Kaiser et al., 2025). These conditions indicate a significant potential risk for UV-related skin damage among the local population. Under these conditions, unprotected skin may develop erythema after as little as 15 minutes of sun exposure (Fauziyyah et al., 2023).

Students in the Sports Science Study Program typically engage in academic activities that are predominantly conducted outdoors (Vist Hagen et al., 2025). This characteristic is inherent to the nature of the Sports Science curriculum, which includes practical components such as physical training, field-based assessments, and outdoor sports education. As a result, students are frequently engaged in outdoor activities and are more likely to experience prolonged exposure to sunlight and ultraviolet (UV) radiation (Cambil et al., 2023). Previous studies have

highlighted the importance of outdoor activity patterns in shaping health-related behaviors and outcomes among adolescents and young adults (Kalari et al., 2025). Such prolonged exposure to external environments, particularly under high UV radiation levels, may increase the risk of skin damage and related health concerns if adequate protective measures are not implemented. Another study by Castro-Maqueda indicated that athletes and sports practitioners who are exposed to intense sunlight have an eightfold higher risk of skin damage compared to the general population (De Castro-Maqueda et al., 2019). This places sports science students at a significantly higher risk of adverse effects from UV exposure.

Sunscreen is widely recognized as one of the most effective methods for preventing UV-induced skin damage (Chavda et al., 2023). Despite this, research conducted by Fernández-Morano revealed that 71.8% of outdoor athletes experienced sunburn, a common skin problem associated with UV exposure. However, only 38.6% of these athletes reported using sunscreen regularly (Fernández-Morano et al., 2017). Similarly, a study by Wadoe on students at Universitas Airlangga found that although 84.61% of students had moderate knowledge about sunscreen, none of the respondents demonstrated proper sunscreen use behavior. These findings highlight a widespread gap between awareness and actual protective practices, emphasizing the need for improved education and behavioral interventions regarding sunscreen use (Wadoe et al., 2020).

The present study is grounded in the Knowledge-Attitude-Practice (KAP) framework, which proposes that knowledge serves as a fundamental determinant of health-related behavior. According to this framework, individuals who possess adequate knowledge about health risks and preventive measures are more likely to adopt protective practices. In the context of sun protection, greater knowledge regarding the harmful effects of UV radiation and the benefits of sunscreen is expected to encourage regular sunscreen use. Although knowledge alone may not guarantee behavioral change, it remains an important factor influencing preventive health behaviors and provides a theoretical basis for examining sunscreen-use practices among university students (Maleknia & Zamani, 2025).

Despite the theoretical assumption proposed by the KAP framework, evidence regarding the relationship between sunscreen-related knowledge and sunscreen use behavior remains limited and inconsistent, particularly among Sports Science students in tropical university settings. Most previous studies have focused on knowledge levels, sunburn prevalence, or general sun-protection practices, while relatively few have specifically examined whether knowledge is associated with sunscreen use behavior among populations with high levels of outdoor activity and UV exposure. This gap is particularly relevant in tropical regions, where environmental conditions may increase the need for effective sun-protection behaviors (Ali & Narapureddy, 2026).

Therefore, this study aimed to examine the relationship between sunscreen-related knowledge and sunscreen use behavior among Sports Science students at Universitas Sultan Ageng Tirtayasa.

METHODS

This study employed an analytical observational design with a cross-sectional approach to assess the association between sunscreen-related knowledge and sunscreen use behavior among undergraduate students. Data on both variables were collected simultaneously at a single point in time. The study was conducted in the Sports Science Study Program, Faculty of Medicine and Health Sciences, Universitas Sultan Ageng Tirtayasa, Serang, Banten, Indonesia, from December 2024 to April 2025.

The target population comprised all students enrolled in the Sports Science Study Program. During the study period, the accessible population consisted of 197 active students from the 2021 to 2024 academic cohorts. The minimum sample size was calculated using the Lemeshow formula for categorical data, resulting in a required sample of 65 participants. To account for potential non-response, an additional 10% was added, yielding a minimum target

sample of 72 respondents.

Participants were recruited using a consecutive sampling technique, whereby all eligible students who were available during the data collection period were invited to participate until the required sample size was achieved. Although consecutive sampling is a non-probability sampling method and may introduce selection bias, efforts to minimize this bias included inviting students from all academic cohorts, conducting recruitment over an extended data collection period, and providing equal opportunities for participation through online distribution of the questionnaire.

The inclusion criteria were: (1) active enrollment in the Sports Science Study Program, (2) completion of at least one academic semester, and (3) willingness to participate as indicated by electronic informed consent. Exclusion criteria included: (1) academic leave during the study period, (2) refusal to participate, and (3) diagnosed dermatological conditions that might substantially affect sunscreen use behavior.

A total of 92 students from the Sports Science Study Program were approached and assessed for eligibility during the study period. Eligibility screening was conducted based on the predefined inclusion and exclusion criteria. Four students were excluded because they had diagnosed dermatological conditions, such as chronic skin disorders or photosensitive conditions, which could potentially influence sunscreen use behavior and act as confounding factors. Following this screening process, 88 students met the eligibility criteria.

Among the 88 eligible students, 11 declined to participate after receiving information about the study objectives, procedures, and voluntary nature of participation. No incentives were provided for participation. The remaining 77 students agreed to participate, provided electronic informed consent, and completed the online questionnaire in its entirety.

Therefore, a total of 77 respondents were included in the final analysis. The participant selection process is summarized in the study flow diagram (Figure 1.).

The independent variable was knowledge regarding sunscreen and sun protection, whereas sunscreen use behavior was the dependent variable. Potential confounding variables included age, gender, academic cohort, monthly allowance, personal expenditure allocated to sunscreen products, Fitzpatrick skin phototypes, and previous exposure to educational information related to sun protection.

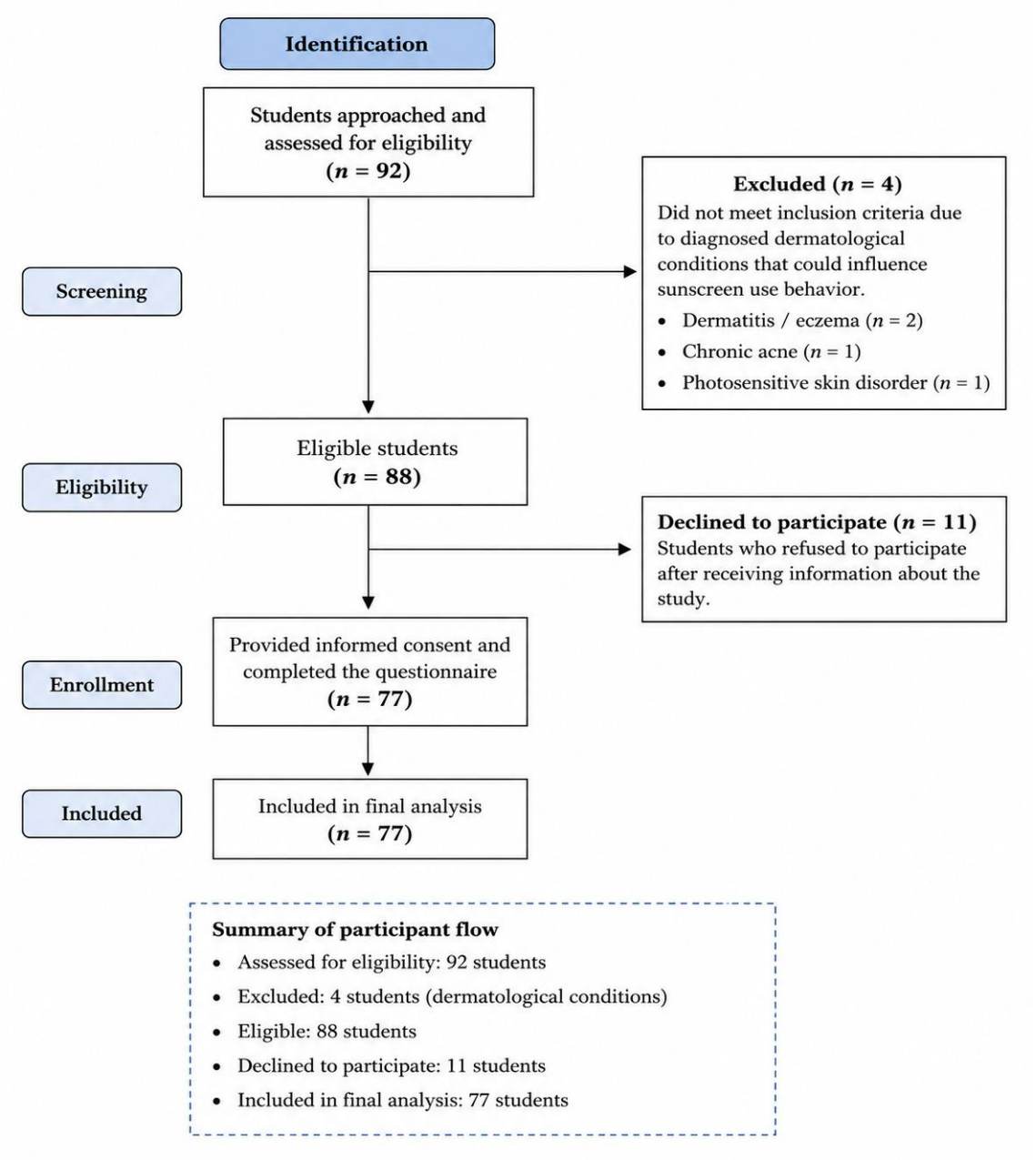

Figure 1. Flow Diagram of Participant Recruitment and Selection Process

Data were collected using a structured questionnaire adapted from Ahnafani et al. (2024). The adapted instrument consisted of 20 items, including 10 knowledge questions and 10 behavior statements. The knowledge section assessed respondents' understanding of ultraviolet radiation, sunscreen functions, recommended application practices, Sun Protection Factor (SPF), and sunscreen product characteristics. The behavior section evaluated the frequency and consistency of sunscreen use during daily and outdoor activities using a four-point Likert scale ranging from "never" to "always".

The knowledge section consisted of 10 multiple-choice questions. Each correct answer was assigned a score of 1, whereas incorrect answers were scored 0, resulting in a total possible score ranging from 0 to 10. Knowledge level was categorized as good if respondents achieved at least 75% of the total score (≥8 points) and poor if the score was below 75% (<8 points).

The sunscreen use behavior section consisted of 10 statements measured using a four-point Likert scale ranging from 1 (never) to 4 (always), yielding a total score ranging from 10 to 40. Sunscreen use behavior was categorized as good when respondents achieved at least 75% of the maximum possible score (≥30 points) and poor when the score was below 30 points.

Prior to implementation, the questionnaire underwent a cultural adaptation and validation process. Content validity was assessed by a panel of three experts in dermatology, public health, and health promotion, who evaluated item relevance, clarity, and comprehensiveness. Revisions were made based on expert recommendations to ensure suitability for the study population. Construct validity was subsequently evaluated through pilot testing among students with characteristics similar to the study population. Item validity was assessed using corrected item–total correlation analysis, and all items demonstrated correlation coefficients exceeding the minimum acceptable threshold ($r > 0.30$), indicating satisfactory validity. Reliability testing showed good internal consistency, with a Cronbach's alpha coefficient of 0.82 for the overall instrument, exceeding the recommended threshold of 0.70 for health research instruments.

The questionnaire was administered electronically using Google Forms. Before participation, respondents received information regarding the study objectives, procedures, benefits, risks, voluntary participation, and confidentiality of data. Electronic informed consent was obtained from all participants prior to questionnaire completion.

This study adhered to the ethical principles outlined in the Declaration of Helsinki and received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sultan Ageng Tirtayasa (Ethical Clearance No. 30/UN.43.20/KEPK/2025; approved on 11 February 2025).

Data were analyzed using IBM SPSS Statistics version 30. Univariate analysis was performed to summarize respondents' demographic characteristics and describe the distribution of sunscreen knowledge and sunscreen use behavior. Bivariate analysis was conducted to evaluate the association between sunscreen use behavior and the study variables. Fisher's Exact Test was used to assess the relationships between sunscreen use behavior and knowledge level, age, gender, monthly pocket money, sunscreen budgeting, and previous exposure to sun protection information because the assumptions required for the Chi-square test were not met, particularly due to expected cell counts of less than five. The Chi-square test was used to examine the associations between sunscreen use behavior and academic cohort as well as skin type, as these variables satisfied the assumptions of the test. Statistical significance was established at $p < 0.05$, and all analyses were interpreted at a 95% confidence level.

RESULT

Characteristics of Respondents

A total of 92 undergraduate students were assessed for eligibility. Following the screening process, 4 students were excluded because they did not meet the inclusion criteria. Among the 88 eligible students, 11 declined to participate. Therefore, 77 students provided informed consent, completed the questionnaire, and were included in the final analysis. The flow of participants through the study is shown in Figure 1.

The demographic and individual characteristics collected from the participants included age group, gender, academic cohort (year of entry), monthly financial allowance, personal budget allocated for sunscreen, Fitzpatrick skin phototype classification (Types I–VI), and self-reported exposure to sun protection education or media campaigns.

Table 1. Characteristics Distribution of Respondents

Variables	Frequency (n=77)	Percentage (%)
Age		
18-21 years old	60	77,9
>21 years old	17	22,1
Gender		
Male	53	68,8
Female	24	31,2
Academic Cohort		
2021-2022	25	32,5

Variables	Frequency (n=77)	Percentage (%)
2023-2024	52	67,5
Monthly Pocket Money		
<1.000.000	58	75,3
>1.000.000	19	24,7
Budgeting		
No	10	13,0
Yes	67	87,0
Skin Type		
Bright Skin	23	29,9
Dark Skin	54	70,1
Information Exposure		
Yes	65	84,4
No	12	15,6

Based on the data presented in Table 1, the study sample was predominantly composed of young adults aged 18 to 21 years, accounting for 77.9% of the total respondents. The gender distribution indicated most male participants, representing 68.8% of the sample. Additionally, a substantial proportion of the respondents belonged to the academic cohorts of 2023 and 2024, collectively comprising 67.5% of the participants.

In terms of socioeconomic status, 75.3% of respondents reported receiving a monthly allowance below IDR 1,000,000. Despite this relatively limited income, a notable 87.0% of participants allocated a dedicated budget specifically for purchasing sunscreen products, reflecting a general awareness of the importance of skin protection. Furthermore, all respondents (100%) reported no history of dermatological conditions that could potentially affect the use of sunscreen.

Regarding skin phototype, classification according to the Fitzpatrick scale showed that 70.1% of respondents possessed darker skin types. This distribution is particularly relevant considering the natural photoprotective properties of increased melanin against ultraviolet (UV) radiation. Moreover, 84.4% of respondents reported exposure to information related to sunscreen use, indicating a relatively high level of awareness within the study population.

Knowledge Level Regarding Sunscreen

An assessment of respondents' knowledge regarding sunscreen was conducted to evaluate their understanding of key concepts related to sun protection and the potential health risks of ultraviolet exposure.

Table 2. Frequency Distribution of Respondents Based on Level of Knowledge about Sunscreen

Level of Knowledge	Frequency (n=77)	Percentage (%)
Low	22	28,6
High	55	71,4

In this study, most respondents (71.4%) demonstrated a high level of knowledge about sunscreen, while 28.6% had a low level of knowledge. Analysis of the knowledge questionnaire responses revealed that most participants correctly identified the definition of sunscreen (70.1%) and recognized the chronic effects of UV exposure, including the risk of skin cancer (66.2%). However, more than half of the respondents answered incorrectly on questions related to the UV index scale range (68.8%) and the appropriate type of sunscreen texture for oily skin (61.0%).

Behavior Regarding Sunscreen Use

A comprehensive assessment of respondents' sunscreen use behavior was undertaken to quantify the prevalence of appropriate sun protection practices and to elucidate the primary factors impeding consistent sunscreen application.

Table 3. Frequency Distribution of Respondents Based on Sunscreen Use Behavior

Sunscreen Use Behavior	Frequency (n=77)	Percentage (%)
Poor	15	19,5
Good	62	80,5

In this study, most respondents (80.5%) demonstrated good sunscreen use behavior, while 19.5% exhibited poor behavior. Analysis of the behavioral questionnaire items showed that 36.3% of respondents always used sunscreen during outdoor activities, but only 29.8% used it regularly daily. The main obstacles to sunscreen use included accessibility, as 48.05% of respondents reported not using sunscreen because the place of purchase was far away, perceptions of its importance, with 46.7% considering sunscreen use non-obligatory and cost factors, since 35.06% indicated they did not use sunscreen regularly because it was considered expensive.

Relationship between Confounding Variables and Sunscreen Use Behavior

An analysis was conducted to assess the impact of potential confounding variables and to identify the factors that significantly influence sun protection practices among respondents.

Table 4. Relationship between Confounding Variables and Sunscreen Use Behavior

Confounding Variable	Sunscreen Use Behavior						Odds Ratio	Confident Interval (CI)	p-value
	Poor		Good		Total				
	n	(%)	n	(%)	n	(%)			
Age									
18-21 years old	12	20,0%	48	80,0%	60	100%			
>21 years old	3	17,6%	14	82,4%	17	100%	1,167	0,288 – 4,723	1,000
Total	15	19,5%	62	80,5%	77	100%			
Gender									
Male	14	26,4%	39	73,6%	53	100%			
Female	1	4,2%	23	95,8%	24	100%	8,256	1,018 - 66,964	**<0,028***
Total	15	19,5%	62	80,5%	77	100%			
Academic Cohort									
2021-2022	7	28,0%	18	72,0%	25	100%			
2023-2024	8	15,4%	44	84,6%	52	100%	2,139	0,675 – 6,776	<0,226
Total	15	19,5%	62	80,5%	77	100%			
Pocket Money						100%			
<1.000.000	11	19,0%	47	81,0%	58	100%			
>1.000.000	4	21,1%	15	78,9%	19	100%	0,878	0,243 – 3,168	1,000
Total	15	19,5%	62	80,5%	77	100%			
Budgeting						100%			
No	4	40,0%	6	60,0%	10	100%			
Yes	11	16,4%	56	83,6%	67	100%	3,394	0,820 –14,051	<0,097
Total	15	19,5%	62	80,5%	77	100%			
Skin Type						100%			
Light Skin	6	26,1%	17	73,9%	23	100%			
Dark Skin	9	16,7%	45	83,3%	54	100%	1,765	0,545 – 5,709	<0,359
Total	15	19,5%	62	80,5%	77	100%			
Information Exposure						100%			
Yes	11	16,9%	54	83,1%	65	100%			
No	4	33,3%	8	66,7%	12	100%	0,407	0,104 – 1,594	<0,234
Total	15	19,5%	62	80,5%	77	100%			

- **Note: Significant (p<0.05)**

Based on the analysis presented in Table 4, among all the confounding variables assessed, namely age, gender, academic cohort, monthly pocket money, sunscreen budget, Fitzpatrick skin type, and exposure to information, only gender demonstrated a statistically significant association with sunscreen use behavior ($p = 0.028$). Female students exhibited better sunscreen use behavior than their male counterparts, with 95.8% of females showing good behavior compared to 73.6% of males. The calculated Odds Ratio of 8.256 indicates that female students are 8.256 times more likely to engage in good sunscreen use behavior than male students. This finding is further supported by the 95% confidence interval (CI: 1.018–66.964), which does not cross the null value of 1, confirming the statistical significance of the association ($p < 0.05$).

Relationship between Knowledge Level and Sunscreen Use Behavior

The relationship between respondents' knowledge levels and their sunscreen use behavior was further examined to determine the strength and significance of the association, with the aim of assessing whether knowledge level is associated with healthy sun protection practices among respondents.

Table 5. Relationship between Knowledge Level and Sunscreen Use Behavior

Level of Knowledge	Sunscreen Use Behavior						Odds Ratio	Confidence Interval (CI)	p-value
	Poor		Good		Total				
	n	(%)	n	(%)	n	(%)			
Low	11	50,0%	11	50%	22	100,0%			
High	4	7,3%	51	92,7%	55	100,0%	12,750	3,4 - 47,57	**<0,001***
Total	15	19,5%	62	80,5%	77	100,0%			

- **Note: Significant (p<0.05)**

Based on Table 5, the analysis revealed a statistically significant relationship between knowledge level and sunscreen use behavior ($p < 0.001$). Among the 55 respondents with a high level of knowledge, the majority (92.7%) demonstrated good sunscreen use behavior, while only 7.3% exhibited poor behavior. In contrast, among the 22 respondents with low knowledge, only 50% demonstrated good sunscreen use behavior, with the remaining 50% exhibiting poor behavior. An Odds Ratio (OR) of 12.75 indicates that students with low levels of knowledge are 12.75 times more likely to exhibit poor sunscreen use behavior compared to students with high levels of knowledge.

DISCUSSION

The results of this study showed that most respondents (71.4%) had a good level of knowledge about sunscreen. These findings are in line with the study conducted by Choirunniswah among Sports Coaching Education students at Universitas Negeri Malang, which reported that 73% of respondents demonstrated a good level of knowledge regarding sunscreen (Choirunniswah et al., 2023). Nevertheless, the similarity in findings should be interpreted with caution, as differences in institutional context, educational environment, and student characteristics may influence knowledge levels across study populations.

Despite being conducted at different universities, both studies involved students enrolled in sport-related academic programs. Students in these disciplines are generally exposed to frequent outdoor activities and may have greater awareness of the health risks associated with ultraviolet (UV) radiation compared to students from other academic backgrounds. Such academic and environmental characteristics may contribute to higher levels of sunscreen-related knowledge among students in sports-oriented programs.

The relatively high proportion of respondents demonstrating good knowledge in the present study may also be associated with broad access to information regarding skincare and UV protection. This assumption is supported by empirical data indicating that 84.4% of respondents reported having been exposed to information about sunscreen from various

sources, including mass media, healthcare professionals, and social networks (Darsini et al., 2019). In addition, institutional factors such as health education initiatives, the availability of health information resources, and the emphasis placed on health promotion within university settings may influence students' opportunities to acquire sunscreen-related knowledge. According to Darsini et al. (2019), knowledge constitutes a fundamental domain in the development of individual behavior, serving as a cognitive foundation for the formation of attitudes and health-related practices.

Nevertheless, a notable 28.6% of respondents were found to have insufficient knowledge regarding the use of sunscreen. This finding underscores the necessity for more comprehensive and targeted educational interventions to raise awareness about the importance of sunscreen application, particularly among students of sports science, whose routines predominantly involve outdoor physical activity (Snyder et al., 2020). Consistent with this, research conducted by Snyder highlights that individuals engaged in outdoor sports are at an elevated risk of prolonged exposure to harmful UV radiation, which may increase their vulnerability to various skin conditions, including sunburn, photoaging, and skin cancer (Snyder et al., 2020).

The results of this study showed that the majority of respondents (80.5%) demonstrated good sunscreen use behavior. This finding differs substantially from the study conducted among students at Universitas Airlangga, in which 36.92% of respondents exhibited poor sunscreen use behavior and none were categorized as having good sunscreen use behavior (Wadoe et al., 2020). However, direct comparisons between these findings should be interpreted with caution due to differences in study populations and institutional contexts.

Several factors may account for this discrepancy. Differences in educational exposure, health promotion activities, awareness campaigns, and curriculum emphasis on skin health and ultraviolet (UV) radiation protection may influence sunscreen use behavior among university students (de Menezes-Júnior, 2025). Furthermore, the present study was conducted exclusively among Sports Science students at Universitas Sultan Ageng Tirtayasa, whereas the study by Wadoe et al. included students from various academic disciplines. Sports Science students are more frequently engaged in outdoor physical activities and are therefore more likely to experience direct sun exposure, which may increase awareness of sun-related health risks and encourage protective behaviors such as sunscreen use (Wang et al., 2023).

In addition, institutional and environmental factors should be considered when interpreting differences across studies. Variations in university health promotion programs, availability of information regarding UV protection, campus culture, geographic location, and the extent to which outdoor activities are integrated into academic programs may contribute to differences in sunscreen use behavior. Therefore, the higher prevalence of good sunscreen use behavior observed in this study may reflect the specific characteristics of Sports Science students and the institutional context of Universitas Sultan Ageng Tirtayasa rather than indicating differences that are universally applicable to all university student populations.

Sports Science students are frequently involved in outdoor academic and practical activities, resulting in greater exposure to sunlight and UV radiation (Wang et al., 2023). This increased exposure may enhance their awareness of the potential adverse effects of UV radiation and the importance of adopting preventive measures, including regular sunscreen use. Previous research has demonstrated that greater awareness of the risks associated with excessive UV exposure can encourage individuals to engage in protective behaviors, such as the consistent use of sunscreen (Fernández-Morano et al., 2017). Therefore, the higher prevalence of good sunscreen use behavior observed in the present study may be partly explained by the greater relevance of sun protection practices within the daily activities of Sports Science students.

Despite the overall positive findings, this study identified that 19.5% of respondents exhibited poor sunscreen use behavior. This finding suggests that adequate sunscreen use is influenced not only by knowledge but also by various personal and contextual factors Bahashwan, 2024). Previous research has shown that sunscreen use behavior is affected by

individuals' beliefs regarding the effectiveness of sunscreen, perceived comfort during application, and personal priorities related to self-care practices (Salsabila et al., 2023). Furthermore, some athletes may avoid using sunscreen due to discomfort experienced during physical activity, such as a sticky sensation on the skin and increased perspiration, which may interfere with performance or cause distraction during exercise and training sessions (De Castro-Maqueda et al., 2019). Therefore, although individuals may possess adequate knowledge regarding the benefits of sunscreen, practical barriers and personal preferences may still hinder the consistent adoption of sunscreen use behavior.

In this study, among the seven potential confounding variables analyzed, gender was the only variable found to be significantly associated with sunscreen use behavior. Female respondents were 8.26 times more likely to demonstrate good sunscreen use behavior than male respondents. This finding is consistent with the study conducted by Hafizhah Lee, which also reported a significant association between gender and sunscreen use behavior. In that study, male students tended to exhibit poorer sunscreen application practices, whereas female students were more likely to use sunscreen appropriately and consistently (Hafizhah, 2023).

Several factors may explain the observed gender differences in sunscreen use behavior. According to Siregar et al., women generally have greater interest in seeking information about sunscreen and skincare, are more frequently exposed to sunscreen-containing cosmetic products, and tend to exhibit better personal hygiene and skincare practices. Women may also be more aware of the harmful effects of ultraviolet radiation, particularly its impact on skin appearance and facial health (Siregar et al., 2024). Similarly, Gyawale and GC suggested that gender differences in sunscreen use may be influenced by social norms and expectations, as skincare practices are often more strongly associated with femininity than masculinity (Gyawalee & GC, 2023).

Nevertheless, the magnitude of the observed association should be interpreted with caution. Although the odds ratio indicated a strong relationship between gender and sunscreen use behavior, the corresponding 95% confidence interval was notably wide (1.018–66.964), suggesting limited precision of the estimate. This imprecision may be attributable to the unequal distribution of participants between gender groups (24 females versus 53 males) and the very small number of female respondents who exhibited poor sunscreen use behavior (n = 1). Such sparse cell frequencies can result in unstable odds ratio estimates and wider confidence intervals. Therefore, while the findings suggest that gender may play an important role in influencing sunscreen use behavior, further studies with larger and more balanced samples are needed to obtain more precise estimates and confirm the strength of this association.

In this study, the results of the analysis demonstrated a significant relationship between knowledge about sunscreen and sunscreen usage behavior. Students with good knowledge of sunscreen were significantly more likely to exhibit appropriate sunscreen use behavior, with 92.7% of knowledgeable students demonstrating good behavior, compared to only 50% of students with poor knowledge. This finding highlights the crucial role of adequate knowledge in fostering effective sun protection practices among students. It aligns with the study by Salsabila, which found a significant association between knowledge and sunscreen usage behavior ($p = 0.001$). The research demonstrated that students with higher levels of knowledge about sunscreen were more likely to engage in proper and consistent sunscreen use (Salsabila et al., 2023).

Knowledge represents a fundamental domain in shaping individual health-related behaviors and compliance, as it directly influences awareness, perception, and motivation to engage in healthy practices (Aqila et al., 2025). Possessing adequate knowledge about a subject, such as sunscreen use, plays a crucial role in fostering both awareness and a deeper understanding of its significance (Sanjiwani & Aryadi, 2025). Specifically, comprehensive knowledge encompasses awareness of the importance of applying sunscreen regularly, familiarity with the correct methods of application, and an appreciation of the protective benefits sunscreen offers against the harmful effects of UV radiation, including prevention of

sunburn, premature skin aging, and skin cancer (Darsini et al., 2019). This well-rounded understanding not only informs individuals about the risks associated with UV exposure but also empowers them to adopt and maintain consistent and appropriate sunscreen use behaviors, thereby promoting better skin health and reducing long-term dermatological risks (Darsini et al., 2019).

The Odds Ratio of 12.75 indicates that students with a low level of knowledge are 12.75 times more likely to exhibit poor sunscreen use behavior compared to those with a high level of knowledge. This finding underscores the critical importance of education and health promotion initiatives focused on sunscreen use to effectively enhance protective behaviors against harmful UV radiation (Darsini et al., 2019).

This study presents several limitations that should be acknowledged when interpreting the findings. First, the cross-sectional design restricts the ability to infer causality, as it only captures the relationship between variables at a single point in time. Second, the use of a consecutive sampling technique limits the generalizability of the results, as the sample may not fully represent the broader student population. Third, the assessment of knowledge and sunscreen use behavior was conducted using self-reported questionnaires, which are susceptible to response bias; participants may have provided answers that they perceived as socially desirable rather than entirely accurate. Lastly, this study did not account for additional psychosocial or contextual factors, such as motivation, attitudes, peer influence, or environmental availability, that may also influence sunscreen use behavior. Future research incorporating these variables is recommended to obtain a more comprehensive understanding of sun protection practices among university students.

CONCLUSION

The results of this study indicate that most Sports Science students at Universitas Sultan Ageng Tirtayasa possess a good level of knowledge about sunscreen, with 71.4% demonstrating adequate understanding. Correspondingly, 80.5% of the students exhibited good sunscreen use behavior. A statistically significant relationship was found between knowledge level and sunscreen use behavior, with students having good knowledge being 12.75 times more likely to demonstrate proper sunscreen use compared to those with lower knowledge levels. Among the confounding variables analyzed, only gender showed a significant relationship with sunscreen use behavior, with female students displaying better sunscreen use practices than their male counterparts.

These findings emphasize the important role of knowledge in shaping sunscreen use behavior among Sports Science students, a population that is particularly vulnerable to ultraviolet (UV) exposure due to frequent outdoor activities. However, the study also identified several barriers to regular sunscreen use, including perceptions that sunscreen application is not mandatory, concerns regarding product cost, and limited accessibility to sunscreen products. Therefore, efforts to improve sunscreen use behavior should not only focus on increasing knowledge through targeted educational programs but also address these practical barriers. Universities and health promotion stakeholders may consider integrating sun-protection education into sports-related curricula, providing affordable sunscreen products on campus, and promoting sunscreen use as a routine component of personal protective practices during outdoor physical activities. Such multifaceted interventions may contribute to improving the consistency and effectiveness of sunscreen use among students.

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