



ISSN: 2091-2749 (Print)
2091-2757 (Online)

Correspondence

Dr. Madhu Gywalee
Dept. of Dermatology, Patan
Hospital, Patan Academy of
Health Sciences, Lalitpur, Nepal

Email:

madhugyawalee@pahs.edu.np

Submitted

28 Apr 2023

Accepted

5 May 2023

How to cite this article

Gywalee M, GC KB. Knowledge and practice of sunscreen use among medical students at Patan Academy of Health Sciences, Nepal. Journal of Patan Academy of Health Sciences. 2023Apr;10(1):35-44.

<https://doi.org/10.3126/jpahs.v10i1.54710>

Knowledge and practice of sunscreen use among medical students at Patan Academy of Health Sciences, Nepal

Madhu Gywalee¹✉, Krishna Bahadur GC²

¹Asst. Prof., Dept. of Dermatology, Patan Hospital; ²Asst. Prof., Dept. of Community Health Sciences, Patan Academy of Health Sciences, Lalitpur, Nepal

Abstract

Introduction: Sunscreen is essential in preventing skin damage caused by harmful ultraviolet radiation. Regular and appropriate sunscreen application delays photo-aging and reduces skin cancer risk. This study aimed to assess the general knowledge and practice of sunscreen among medical undergraduates in Nepal.

Method: A cross-sectional, descriptive study was conducted among medical students in Nepal after obtaining ethical approval from the Institutional review committee. The census sampling method was used among all currently enrolled medical students, constituting a sample size of 328. Data regarding knowledge and practice of sunscreen were collected through an electronic survey. A descriptive analysis of the number and frequencies was done. The knowledge scoring and chi-square test were done to see the difference in knowledge between male and female students.

Result: More than half of the students, 122(52.6%), showed poor knowledge about sunscreen. Among them, female students and those who had completed their dermatology posting had higher knowledge than their counterparts ($p < 0.001$). Although those who had dermatological posting exhibited good knowledge, still 1/3rd of them needed better knowledge scores. Only 77(47%) of them applied it every day. When 162(98%) of them applied sunscreen on their face, only 14(8.5%) applied it on all exposed areas, and only 33(20%) used it with the correct timing before sun exposure.

Conclusion: This study found that most medical students lacked knowledge about sunscreen. Adding knowledge on sun-protective behaviour, including sunscreen, might improve their overall understanding and better prepare them for their future roles as healthcare providers.

Keywords: knowledge, medical students, practice, sunscreen

Introduction

Sunscreen is a widely practiced sun-protection method, including seeking shade, wearing protective clothing, sunglasses, and a wide-brimmed hat, and avoiding sun exposure during peak hours.¹

Ultraviolet (UV) light from the sun is a major environmental risk factor for melanoma and non-melanoma skin cancers.¹ Photo-aging, which is more common than skin cancers, also results from high cumulative exposure to solar UV radiation.² If appropriately applied, sunscreens effectively prevent skin cancers and signs of photo-aging, including wrinkles, telangiectasia, and pigmentary alterations induced by UV radiation.^{2,3}

Despite this information, many people do not apply sunscreen regularly and appropriately to prevent skin cancers and photo-aging. The increasing evidence of skin cancer among the Asian population due to UV radiation from the sun makes sunscreen even more essential.^{4,5}

In the United States, the prevalence of sunscreen use was 34.4% among teenagers, with girls more likely to use sunscreen than boys.⁶ Among medical students, 38.1% used sunscreen in Peru; in India, this number was 48.8%, while only 36.6% of Malaysian medical students were using sunscreen despite knowing sunscreen prevents skin cancer.^{7,8} In Nepal, though 75% of the medical students used sunscreen, only 15% were regular users.⁹

This study assessed the knowledge of sunscreen and its use among medical students. Provided they have the appropriate knowledge, these aspiring physicians can be exemplars for promoting healthy sun-protection habits to the general public. The results of this study may help deliver better patient care through education and counselling so they get optimum benefits from sunscreens.

Method

A descriptive cross-sectional study was conducted from July 2021 to October 2022 among currently enrolled medical undergraduates at Patan Academy of Health Sciences (PAHS), Nepal. The study used a set of validated questionnaires, extracted from the study by Awadh Al et al. and Low QJ et al., which were performed in similar settings to ours.^{8,10} It consisted of demographic information, general knowledge about sunscreen, and information about sunscreen practices among medical students. Fifteen questions were related to knowledge assessment, and 12 were related to the use of sunscreen. There were altogether 328 students studying from the first to the final year. All of them were invited to participate in this study. The questionnaire was distributed via email to all 328 medical undergraduates from the first to the fifth year after obtaining ethical approval from the Institutional Review Committee (IRC) of PAHS. The data was collected by contacting the students up to 4 times and sending the reminder email each month up to 3 times. Then the data was analyzed, reporting the remaining students as non-responders.

The e-mail consisted of information about the study and a consent form. Those who gave consent were directed toward the questionnaire in the format of a Google Form. To maintain the confidentiality of the students, no names or emails were obtained during data collection. No incentive was given to them to participate in the study.

Data were analyzed by transferring the data from MS Excel to SPSS software. A descriptive analysis of the number and frequencies was done. The knowledge score was calculated by assigning one point for each correct answer and zero for incorrect and 'not sure' responses in the knowledge section. Knowledge scoring was used to find out the level of knowledge about sunscreen among medical students at PAHS.

A Chi-square test was performed to determine the difference in sunscreen usage between male and female students. A p-value of <0.05 was considered statistically significant. The independent t-test was used to compare knowledge scores between male and female students, and Fischer's exact test was used to find out the association between the level of knowledge and year of study among medical students at PAHS.

Result

Among 328 students, 233(70%) responded to the invitation; one denied consent. Among 232 responders, 129(55.6%) were male, and 103(44.4%) were female. The mean age of the students was 21.67 ± 1.86 (17-28) y. Among them, 67(28.8%) had completed their dermatology rotation (2 w), and 165(71%) had not completed their posting.

For 133(57.3%) students, the first source of information about sunscreen was media, including the internet, television, and social media. When asked about who recommended sunscreen, the most common source was friends 77(46.7%), followed by media 49(30%) and doctors 30(18.2%), Figure 1. There was no statistically significant difference between the genders regarding who recommended sunscreen for the first time.

Medical students' knowledge about sunscreen was low, with the mean \pm SD score being 7.44 ± 3.25 out of a total score of 15. Out of 232 responders, 221(95.3%) and 157(67.7%) knew the preventive effects of sunscreen for sunburn and cancer respectively. Only 64(27.6%) students knew that sunscreen is applied on all exposed areas and even during indoor activities. Only 78(33.6%) students knew the correct required amount, whereas 53(22.8%) knew that reapplication is mandatory during the day to get the optimum benefit of sunscreen.

There was a significant difference ($p < 0.001$) between male and female students in their knowledge of sunscreen, Table 1. Among the

responders, 176(75.9%) could correctly tell the complete form of SPF; 173(74.6%) knew sunscreens with higher SPF would protect skin from UV radiation more effectively. Again, a significant difference was found between male and female students ($p < 0.001$) regarding knowledge of the number of SPF and level of protection.

The level of knowledge varied significantly based on the number of years of study in the medical college, with the fourth-year students exhibiting a higher level of knowledge than second-year students ($p < 0.001$). Those who had completed their dermatology posting had a better understanding than those who were yet to study dermatology ($p = 0.018$), Table 2. However, 22(32.8%) students who had completed dermatology posting still exhibited poor knowledge.

Regarding the students' perception of sunscreen, 55(23.7%) thought that wearing sunscreen interferes with Vitamin D synthesis on the skin, 83(35.8%) did not believe so, whereas 94(40.5%) were unsure about it. Apart from this, while 182(78.4%) students thought sunscreen was necessary for sun protection, 50(21.6%) did not feel it was required.

The age of starting sunscreen use is similar between males and females, with a mean age of 16.82 y. Out of the total respondents, 165(71%) reported using sunscreen, and only 77(47%) applied it every day, with females being more consistent compared to males ($p < 0.001$). While 72(43.6%) applied sunscreen only occasionally, 16(9.7%) stopped using it.

The prescriber did not instruct half of them, i.e., 84(50.9%) students, about the sunscreen application process, whereas 25(15.2%) did not pay attention to it even when instructed. Most read the leaflet before application, while 57(35%) did not, Table 3.

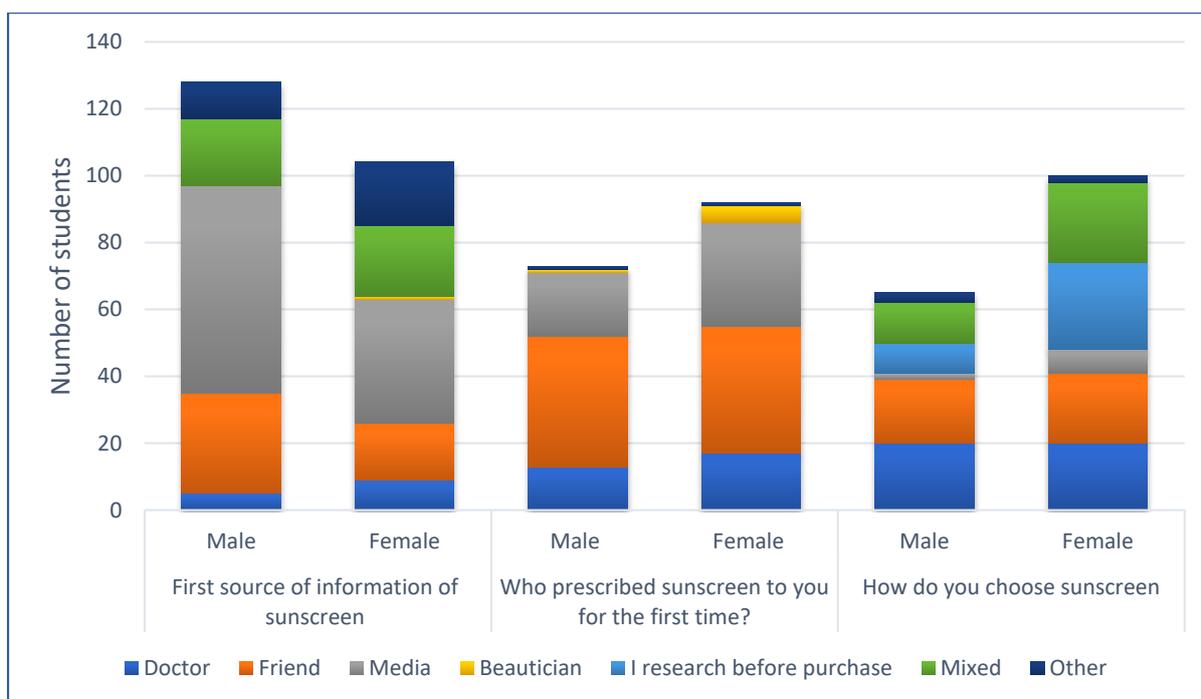


Figure 1. Sources of sunscreen among medical students of PAHS

Table 1. Correct responses on knowledge of sunscreen and knowledge scores among medical students of PAHS (n=232)

Questions	The proportion of correct responses by gender		Total N(%)	p value	
	Female, N(%)	Male, N(%)			
In which season sunscreen needs to be applied?	50(48.5)	19(14.7)	69(29.7)	<0.001	
Which type of activity (indoor and outdoor) requires you to apply sunscreen?	37(35.9)	10(7.8)	47(20.3)	<0.001	
Which skin color is benefitted from sunscreen?	27(26.2)	6(4.7)	33(14.2)	<0.001	
In which parts of your body do need to apply sunscreen?	34(33)	30(23.3)	64(27.6)	0.099	
Do you need to apply sunscreen when it is raining outside?	69(67)	20(15.5)	89(38.4)	<0.001	
Do you need to apply sunscreen when it is cloudy outside?	76(73.8)	35(27.1)	111(47.8)	<0.001	
Sunscreen prevents skin cancer.	84(81.6)	73(56.6)	157(67.7)	<0.001	
Sunscreen prevents sunburn/ tan	97(94.2)	124(96.1)	221(95.3)	0.545*	
Sunscreen prevents wrinkles, premature aging	80(77.7)	61(47.3)	141(60.8)	<0.001	
Children require sunscreen.	67(65)	68(52.7)	135(58.2)	0.058	
Can you fully rely on sunscreen for sun protection?	78(75.7)	102(79.1)	180(77.6)	0.544	
Full form of SPF	87(84.5)	89(69)	176(75.9)	0.006	
Which SPF number provides better protection?	88(85.4)	85(65.9)	173(74.6)	0.001	
How much (amount) sunscreen is required to cover a face and neck at a time?	36(35)	42(32.6)	78(33.6)	0.701	
How frequently do you need to reapply sunscreen to get the optimum benefit of sunscreen?	36(35)	17(13.2)	53(22.8)	<0.001	
Total knowledge, Mean ± SD (min, max)	9.18±3.13 (1,15)	6.05±2.62 (1,13)	7.44±3.25 (1,15)	<0.001#	
Knowledge category	Poor knowledge (<7.5)	29(28.2)	93(72.1)	122(52.6)	<0.001
	Good knowledge (≥7.5)	74(71.8)	36(27.9)	110(47.4)	

SPF=sun protection factor, *Fisher's Exact test applied, #t-test applied

Table 2. Cross-tabulation of total knowledge score of sunscreen with different socio-demographic variables among medical students of PAHS (n=232)

Characteristics	Categories	Knowledge category		Total	p-value
		Poor knowledge (<7.5) N(%)	Good knowledge (≥7.5) N(%)		
Age category	≤20 years	40(57.1)	30(42.9)	70(100)	0.361
	> 20 years	82(50.6)	80(49.4)	162(100)	
Gender	Female	29(28.2)	74(71.8)	103(100)	<0.001
	Male	93(72.1)	36(27.9)	129(100)	
In which Year are you currently studying?	1 st	42(60.9)	27(39.1)	69(100)	<0.001*
	2 nd	36(67.9)	17(32.1)	53(100)	
	3 rd	21(48.8)	22(51.2)	43(100)	
	4 th	1(5.9)	16(94.1)	17(100)	
	Final	22(44)	28(56)	50(100)	
Have you completed your posting in the Department of Dermatology?	No	95(57.6)	70(42.4)	165(100)	0.018
	Yes	22(32.8)	4 (67.2.)	67(100)	
Total		122 (52.6)	110 (47.4)	232 (100)	

*Fisher's Exact test applied

Table 3. The practice of sunscreen usage among medical students of PAHS (n=233)

Practices	Responses	Gender of respondent		Total N(%)	p-value
		Female N(%)	Male N(%)		
Have you ever applied sunscreen?	No	11(10.7)	56(43.4)	67(28.9)	<0.001
	Yes	92(89.3)	73(56.6)	165(71.1)	
Total		103(100)	129(100)	232(100)	
Age of started sunscreen use	Mean ± SD (min, max)	16.82±3.13 (5,23)	17.21±3.68 (5,26)	16.99±3.38 (5,26)	0.468§
You apply sunscreen	Everyday	61(66.3)	16(21.9)	77(46.7)	<0.001
Did the prescriber instruct you about its application process?	Yes	29(31.5)	27(37)	56(33.9)	0.747
Do you read the leaflet or the packaging before applying sunscreen?	Yes	59(64.1)	49(67.1)	108(65.5)	0.688
Parts sunscreen applied §	Face	91(98.9)	71(97.3)	162(0)	0.069*
	Ear	20(21.7)	14(19.2)	34(0)	
	Neck	57(62)	36(49.3)	93(0)	
	Arms	28(30.4)	27(37)	55(0)	
How much sunscreen do you apply at a time on your face and neck?	1/4th of teaspoon	27(29.3)	27(37)	54(32.7)	0.069*
	1/2 teaspoon	57(62)	33(45.2)	90(54.5)	
	1 teaspoon	8(8.7)	13(17.8)	21(12.7)	
When do you apply sunscreen most of the time?	20-30 min before going out	21(22.8)	12(16.4)	33(20)	0.010
Do you apply it when you are indoor?	Yes	41(44.6)	11(15.1)	52(31.5)	<0.001
Do you apply sunscreen when it is rainy/cloudy outside?	Yes	62(67.4)	19(26)	81(49.1)	<0.001
Do you reapply sunscreen?	Yes	25(27.2)	24(32.9)	49(29.7)	0.426
Total		92(100)	73(100)	165(100)	

#t-test applied, *Fisher's Exact test applied, § Multiple response

Among 232 students, 71(97.3%) applied sunscreen on their faces, followed by their necks and arms. Almost half of them were using the correct amount of sunscreen. While most of the students, 88(53.3%), preferred applying sunscreen 5-10 min before going out, only 33(20%) applied sunscreen properly before going out.

Most respondents, 113(68.5%), did not apply sunscreen indoors, while 84(50.9%) did not use sunscreen on a rainy or cloudy day. Most of them, 116(70.3%), did not reapply during the day.

Like the knowledge part on sunscreen, a significant difference ($p < 0.05$) in sunscreen application was found between males and females. The male students' practice lagged mainly in using sunscreen, its application consistency, timing, and application during rainy/cloudy days and indoors, Table 3.

Discussion

This study found that despite recognizing the importance of sunscreen in preventing sunburn and skin cancer, only 77(46.7%) of the students were applying sunscreen every day. Among them, 22% were male and 66% were female. It shows a gap in their knowledge regarding the application of sunscreen. Other studies also reported similar findings among medical students.^{9,7,11} They lacked knowledge of sunscreen application, mainly in the areas of season, place, skin color, and body parts to be applied and its frequency of application. Compared to ours, the students from Indonesia had better knowledge regarding these parameters.¹¹ This better knowledge could have resulted because their study population constituted more females, 68(76%), compared to ours, 103(44.3%).

In this study, female students had a significantly higher mean knowledge score than their male counterparts. Such gender disparities in awareness and usage of sunscreen among medical students and the

general population were also found in other studies.^{7,9, 12} These gender differences may have resulted from cultural norms and societal expectations for females to have fair skin, which led them to prevent suntan.¹³ On top of that, females are cosmetically more aware and concerned with their outlook than their counterparts.

Our study also found that students who had completed their dermatology posting had higher knowledge scores than those who were yet to study dermatology. But about 1/3rd of them still lacked knowledge in terms of sunscreen use. Attending a sunscreen workshop in the last year was associated with increased sunscreen use among Peruvian medical students.¹⁴ Similarly, adding a one-week sun awareness curriculum to first-year medical students on sun awareness increased their level of knowledge regarding the risks of sun exposure and sun protection in Canada.¹⁵ Various other intervention programs like appearance-based education or sun protection teaching have improved sun protection knowledge and UV exposure behavior, reducing the skin cancer risk.¹⁶⁻¹⁸

Furthermore, our study revealed that the majority 133(57.3%), of participants relied on media as primary source of information about sunscreen. Interestingly, friends 77(46.7%), were the most common source of sunscreen recommendation. The role of healthcare professionals 30(18.2%) seemed less significant than that of friends and media. The influence of media on the purchase of sunscreen varied across different studies, ranging from 17.6% to 40%.^{7,8,10,19,20} Meanwhile, the influence of friends was lower, ranging 27% to 34% in other studies.^{8,10,19} In today's digital era role of media cannot be ignored, in raising awareness of sunscreen as suggested by other study participants.¹⁹

The face was the most commonly preferred site for sunscreen application in this study. It was found that 162(98%) students selected the face, followed by neck 93(57%) as the most preferred site for sunscreen application.

Still, a significant proportion of students applied sunscreen on other areas exposed to the sun, like in other studies from Indonesia and Jordan.^{11,19} However, it was interesting to find only 164(63.4%) of students from Poland²¹ applied sunscreen on their face and 97(39.9%) on their necks. Since sun-exposed parts are the most common site of melanoma and non-melanoma skin cancer,^{1,22} they can incorporate a sun-protective behaviour by acquiring the knowledge regarding harmful effects of UV radiation.

In our study, only 33(20%) of the students knew the correct time to apply sunscreen before going out as most 132(80%) preferred to apply sunscreen a few minutes before or just before going out. This is supported by findings from other studies, where only 23% of the students answered correctly to this question.^{7,11} According to the American Academy of Dermatology(AAD) and the US Food and Drug Administration(FDA), sunscreen must be applied 15 minutes before sun exposure to let the skin absorb the sunscreen and give adequate protection. And sunscreen must be reapplied every 2 hours or immediately after swimming or sweating.^{23,24}

Among the respondents, 90(54.5%) used ½ teaspoon and 54(32.7%) used ¼ teaspoon to cover their face and neck, and only 21(12.7%) used one teaspoon to cover their face and neck. A similar less amount was used in a study in Indonesia.²⁰ This less application of sunscreen could be because sunscreens are considered cosmetics and are pricy, and some dislike the unattractive whitercast it leaves behind on the skin.

Though there was no significant difference between male and female students regarding reapplication in this study, only 49(29.7%) of participants reapplied sunscreen. Similar, less reapplication of sunscreen was reported from New Jersey, Jordan and Indonesia.^{12,19,20} However, despite the low adherence to sunscreen, 50.4% of the adolescents and 43 % of the medical students reapplied the sunscreen in Malasia and Italy respectively.^{8,25}

Application and reapplication of sunscreen were found to be associated with females, higher social class, higher levels of education, and outdoor activities.²⁶ Even outdoor sportspersons' applied sunscreen inadequately and reapplied infrequently. Considering increased risk of skin cancer and other harms by UV radiation, their rate of reapplication was better compared to our students.^{27,28} Evidence suggests that early reapplication of sunscreen before sun exposure can significantly reduce the number of missed areas and increases the amount of sunscreen used to ensure sufficient protection against UV radiation.²⁹

Our other observation revealed that most, 52(31.5%), did not apply sunscreen indoors or on rainy or cloudy days 81(49.1%), which is similar to students from Peru¹⁴ and Jordan¹⁹ but contradicts the Indonesian¹¹ finding where 62% of the students applied sunscreen indoors. Moreover, there were significant gender differences in sunscreen application, indicating a possible lack of awareness about the potential harm caused by UV radiation in these conditions. The sun emits harmful UV rays throughout the year. Even on cloudy days, up to 80% of the sun's harmful UV rays can penetrate the skin. A sunscreen is an effective tool in preventing harmful effects of UV rays like premature aging and skin cancer. Along with UV rays, sunlight also contains visible light and infrared rays (IR) which penetrate even deeper into the skin and contribute to dermal aging.^{30,31} So it is advisable to apply sunscreen every day.³²

Our study found that 149(64.2%) had a misconception about applying sunscreen interferes with vitamin D production on the skin. A similar thought was expressed by 15% and 25% of the participants in Australia.^{33,34} Contrary to this finding, in another Australian study, 80% of the participants thought that protecting skin from sunlight won't prevent them from getting enough Vitamin D.³⁵ The reason for such a contradiction in knowledge might have resulted from the difference in the type study sample, as later were older, office worker with higher education and the former

general population; our study population was younger students with little experience. However, evidence suggests that frequent use of sunscreen does not affect the Vitamin D levels in the body. In a study in New Zealand, it was found that around 10% of skin exposure (face, neck, and hands) when exposed to sub erythema dose of sunlight, for about 3 minutes per day in the summer is sufficient to maintain normal Vitamin D level.³⁶ A study from India where sunscreen with SPF 50+ was used on the face, along with physical photo-protection advice to patients with melasma for 3 months did not change the serum Vitamin D concentration.³⁷

Conclusion

Most medical students had poor knowledge about sunscreen. Male students, pre-clinical year students, and those who had not gone through dermatology postings had significantly poorer knowledge than their counterparts. Although those who had dermatological posting exhibited good knowledge, 1/3rd of them still lacked adequate knowledge. Further studies on if a focused education or training on sunscreen incorporated into the curricula of undergraduate medical education can help improve their knowledge and if they can be put into practice are needed to prepare them for advocacy.

Acknowledgement

The authors would like to thank all the medical students from the Patan Academy of Health Sciences for their active participation in the study.

Conflict of Interest

None

Funding

None

Author Contribution

Concept, design, planning: MG, KBGC; Literature review: MG; Data collection/analysis: MG, KBGC; Draft manuscript: MG,

KBGC; Revision of the draft: MG; Final manuscript: MG, KBGC; Accountability of the work: MG, KBGC.

Reference

- Centers for Disease Control and Prevention (US). UV Radiation. National Center for Environmental Health [Internet]. 2022 July 5. | [Weblink](#) |
- Flament F, Bazin R, Qiu H, Ye C, Laquieze S, Rubert V, et al. Solar exposure(s) and facial clinical signs of aging in Chinese women: impacts upon age perception. *Clin Cosmet Investig Dermatol*. 2015 Feb;75. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Randhawa M, Wang S, Leyden JJ, Cula GO, Pagnoni A, Southall MD. Daily use of a facial broad spectrum sunscreen over one-year significantly improves clinical evaluation of photoaging. *Dermatol Surg*. 2016 Dec;42(12):1354–61. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Sng J, Koh D, Siong WC, Choo TB. Skin cancer trends among Asians living in Singapore from 1968 to. *J Am Acad Dermatol*. 2009;61(3):426-432. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Arab KA, AlRuhaili A, AlJohany T, AlHammad RS. Melanoma and non-melanoma skin cancer among patients who attended at King Khalid University Hospital in Riyadh, Saudi Arabia from 2007 - 2018. *SMJ*. 2020;41(7):709-714. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Geller AC, Colditz G, Oliveria S, Emmons K, Jorgensen C, Aweh GN, Frazier AL. Use of sunscreen, sunburning rates, and tanning bed use among more than 10000 US children and adolescents. *Pediatrics*. 2002;109(6):1009–1014. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Tilwani MR, Sameen F, Manzoor S, Nabi N, Hassan A, Qazi I. Sunscreen awareness in medical undergraduates. *Int J Contemp Med Res IJCMR*. 2018 Oct;5(10). | [DOI](#) | [Full Text](#) |
- Awadh A, Jamshed S, Elkalmi R, Hadi H. The use of sunscreen products among final year medicine and pharmacy students: A cross-sectional study of knowledge, attitude, practice, and perception. *J Res Pharm Pract*. 2016;5(3):193. | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Chapagain K, Prasad Rauniar G. Sunscreen use among medical undergraduate students in a medical college: A Descriptive Cross-sectional Study. *J Nepal Med Assoc*. 2022 Jan 23;60(245). | [DOI](#) | [PubMed](#) | [Full Text](#) |
- Low QJ, Teo KZ, Lim TH, Cheo SW, Yap WYE. Knowledge, attitude, practice and perception

- on sunscreen and skin cancer among doctors and pharmacists. *Med J Malaysia*. 2021 Mar;76(2):212–7. | [PubMed](#) | [Full Text](#) |
11. Roren RS, Mario Christopher P, Novia Jayadi N. Photoprotection knowledge and photoprotective behavior of university students: A Cross-sectional Study in Indonesia. *Int J Dermatol Venereol*. 2022 Sep;5(3):140–8. | [DOI](#) | [Full Text](#) |
 12. Wang SQ, Dusza SW. Assessment of sunscreen knowledge: a pilot survey. *Br J Dermatol*. 2009 Nov;161:28-32. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 13. Mak AKY. Advertising Whiteness: An assessment of skin color preferences among urban Chinese. *Vis Commun Q*. 2007 Nov;14(3):144–57. | [DOI](#) | [Google Scholar](#) |
 14. Rodríguez-Gambetta P, Moscoso-Porras MG, Taype-Rondan A. Factors associated with regular sunscreen use by medical students of a Peruvian university. *J Prev Med Hyg*. 2016 Sep;57(3):E172–7. | [PubMed](#) | [Full Text](#) |
 15. Liu KE, Barankin B, Howard J, Guenther LC. One-Year Followup on the Impact of a Sun Awareness Curriculum on Medical Students' Knowledge, Attitudes, and Behavior. *J Cutan Med Surg Inc Med Surg Dermatol*. 2001 Jun 6; 5(3):193–200. | [DOI](#) | [Full Text](#) |
 16. Williams AL, Grogan S, Clark-Carter D, Buckley E. Appearance-based interventions to reduce ultraviolet exposure and/or increase sun protection intentions and behaviours: A systematic review and meta-analyses. *Br J Health Psychol*. 2013 Feb;18(1):182–217. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 17. Mahler HIM, Kulik JA, Gerrard M, Gibbons FX. Long-term effects of appearance-based interventions on sun protection behaviors. *Health Psychol*. 2007;26(3):350–60. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 18. Chaudhry SB, Armbrrecht ES, Gibbons M, Council ML, Knutson A, Lickerman S. Sun Protection Outreach Teaching by Students (SPOTS)—Evaluating the Efficacy of Skin Cancer Prevention Education for Adolescents. *Dermatol Surg*. 2021 Jul;47(7):926–30. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 19. Al-Qarqaz F, Marji M, Bodoor K, Al alshiyab D, Muhaidat J, Al Ghamdi S. Awareness about proper use of sunscreen in people of color: A Jordanian-based survey. *J Cosmet Dermatol*. 2020 May;19(5):1131–6. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 20. Novitasari T, Prajitno S, Indramaya DM. Behavior of Sunscreen Usage Among Medical Students. *Berk Ilmu Kesehat Kulit Dan Kelamin*. 2020 Nov 30;32(3):174. | [DOI](#) | [Full Text](#) |
 21. Łyko M, Kruzel M, Kuś A, Maj J, Szepietowski JC, Jankowska-Konsur A. Sun protection among university students in Poland: a survey of awareness and attitudes. *Postepy Dermatol Alergol*. 2021 Dec;38(6):961-966. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 22. Katiyar SK, Matsui MS, Mukhtar H. Kinetics of UV light-induced cyclobutane pyrimidine dimers in human skin in vivo: an immunohistochemical analysis of both epidermis and dermis. *Photochem Photobiol*. 2007 May 1;72(6):788–93. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 23. American Academy of Dermatology AA of D. How to apply sunscreen. 2023. | [Weblink](#) |
 24. Food and Drug Administration US. Sunscreen: how to help protect your skin from the sun [Internet]. 2022. | [Weblink](#) |
 25. de Giorgi V, Gori A, Grazzini M, Janowska A, Rossari S, Papi F, et al. Sun exposure and children: What do they know? An observational study in an Italian school. *Prev Med (Baltim)*. 2011 Feb;52(2):186-7. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 26. Al Robaee AA. Awareness to sun exposure and use of sunscreen by the general population. *Biomol Biomed*. 2010 Nov.20;10(4):314-8. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 27. Buller DB, Andersen PA, Walkosz BJ, et al. Compliance with sunscreen advice in a survey of adults engaged in outdoor winter recreation at high-elevation ski areas. *J Am Acad Dermatol*. 2012;66(1):63–70. | [DOI](#) | [PubMed](#) | [Google Scholar](#) |
 28. Purim KS, Leite N. Sports-related dermatoses among road runners in Southern Brazil. *An Bras Dermatol*. 2014 Jul-Aug;89(4):587–592. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 29. Diffey BL. When should sunscreen be reapplied? *J Am Acad Dermatol*. 2001 Dec;45(6):882-5. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 30. Krutmann J, Bouloc A, Sore G, Bernard BA, Passeron T. The skin aging exposome. *J Dermatol Sci* . 2017 Mar;85(3):152–61. | [DOI](#) | [Full Text](#) |
 31. Bonté F, Girard D, Archambault JC, Desmoulière A. Skin Changes During Ageing. In: Harris J, Korolchuk V. (eds) *Biochemistry and Cell Biology of Ageing: Part II Clinical Science: Subcellular Biochemistry*; vol. 91. | [DOI](#) | [PubMed](#) | [Full Text](#) |
 32. American Academy of Dermatology. Sunscreen FAQs [Internet]. 2023. | [Weblink](#) |
 33. Janda M, Kimlin M, Whiteman D, Aitken J, Neale R. Sun protection and low levels of vitamin D: are people concerned? *Cancer*

- Causes Control. 2007 Aug 8;18(9):1015–9. | [DOI](#) | [PubMed](#) | [Full Text](#) |
34. Tran V, Janda M, Lucas RM, McLeod DSA, Thompson BS, Waterhouse M, et al. Vitamin D and Sun Exposure: A Community Survey in Australia. *Curr Oncol*. 2023 Feb 18;30(2):2465–81. | [DOI](#) | [Full Text](#) |
35. Vu LH, Van der Pols JC, Whiteman DC, Kimlin MG, Neale RE. Knowledge and attitudes about vitamin D and impact on sun protection practices among urban office workers in Brisbane, Australia. *Cancer Epidemiol Biomarkers Prev*. 2010 July;19:178-9. | [DOI](#) | [Google Scholar](#) | [Full Text](#) |
36. McKenzie R, Liley B, Johnston P, Scragg R, Stewart A, Reeder A, et al. Effects of measured UV exposure on vitamin D status of New Zealanders: implications for seasonal exposures required. NIWA UV Workshop; 15-17 April, 2014; Auckland: National Institute of Water and Atmospheric Research. | [Google Scholar](#) | [Full Text](#) |
37. Singh S, Jha B, Tiwary N, Agrawal N. Does using a high sun protection factor sunscreen on face, along with physical photoprotection advice, in patients with melasma, change serum vitamin D concentration in Indian conditions? A pragmatic pretest-posttest study. *Indian J Dermatol Venereol Leprol*. 2019;85(3):282. | [DOI](#) | [PubMed](#) | [Full Text](#) |