Original Research Article

Knowledge and Factors Associated with Good Knowledge of Sunscreen Among Pharmacy Undergraduate Students: A Cross-sectional Study

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ABSTRACT

Skin is the largest part of human body, which is constantly exposed to Ultraviolet rays from the sun. Overexposure to the sun without protection increases the risk of skin damage and skin cancer. Sun protection, particularly sunscreen is a crucial first-line defence against skin cancer and sun-induced skin damage. The study aims to determine the level of knowledge and factors associated with good knowledge of sunscreen among pharmacy students. This was a cross-sectional study where a validated questionnaire was used. Descriptive and inferential statistics were used to analyse the study. A total of 296 respondents participated in this study. Overall, two factors were found to be significant in determining good knowledge of sunscreen which are gender and cumulative grade point average (CGPA). Female students and those with CGPA more than 3.5 are associated to good knowledge score compared to their counterparts. Knowledge of sunscreen was observed to be satisfactory, however few elements of sunscreen knowledge can be improvised where majority of the students answered the questions inaccurately. Interventions such as incorporating sunscreen topic in pharmacy curriculum is encouraged.

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1.0 Introduction

Skin is the largest part of the human body, and it is constantly subjected to the dangers of sunlight, notably Ultraviolet radiation (UVR) (1). Melanin, a pigment in the skin, serves as a natural defense mechanism against the harmful effects of the sun. Skin pigmentation has long been thought to be the most significant factor in protecting the skin from the sun's harmful rays because melanin also serves as an antioxidant and a scavenger of free radicals (1). Nevertheless, skin damage and a wide range of skin diseases can result from long periods of unprotected sun exposure (2). Burning and tanning of the skin can occur as a consequence of brief exposure to UVR. In addition, long-term exposure to UV rays can cause chronic skin conditions, such as hyperpigmentation, photoaging, and skin cancer (3).

Skin cancer is often caused by long-term exposure to UVR. It is generally known that prolonged sun exposure during childhood and adolescence raises the risk of developing skin cancer later in life (3). Furthermore, 50-80 percent of the total quantity of UVR is found to be accumulated during these ages, which may be attributable to the vulnerability of youthful skin to UVR (4). The global prevalence of skin cancer has steadily increased. In Canada, non-melanoma skin cancer (NMSC) accounts for at least 40% of new cases (5). Meanwhile, in Malaysia, NMSC was the ten most common cancers (6).

In light of the fact that excessive and prolonged UVR exposure is thought to be responsible for 80-90 percent of later-life skin cancers and other skin diseases, it is important to take preventive measures. Sunscreen, in particular, has been shown to play a crucial role in decreasing the occurrence of human skin disorders such as pigmentation and skin ageing caused by UVR (7). Hence, the application of sunscreen, which shields UVR, is touted as a crucial strategy for avoiding skin cancers. Protecting the skin from sun damage is the primary goal of sunscreens, which work by shielding the skin from harmful UV rays. A higher skin UV tolerance has been found to be associated with the use of sunscreens (8).

Sunscreens comprise one or more UV filters, which can be physical, chemical, or a combination of the two (9). Sunscreens have evolved over the years in tandem with the development of new photoprotective agents (10). In order to meet consumer needs and expectations, a variety of sunscreen formulations, such as emulsions and gels, are currently on the market. However, despite these sunscreen products mushrooming in the market, the effectiveness of the sunscreen should always take priority. UVA protection grade (PA) and sun protection factor (SPF) values are used to assess sunscreen's photoprotective effectiveness (11).

Knowledge of sunscreen can demonstrate the degree of comprehension that could influence the use of sunscreen as a preventative measure against any skin conditions. Pharmacists, specifically community pharmacists must be equipped with good knowledge of sunscreen as this is one of the common over-the-counter products available in pharmacies. Knowledgeable pharmacists then responsible for educating the public on the importance of sunscreen and its accurate technique. However, there is a paucity of data on pharmacy students' knowledge of sunscreen use in Malaysia. A previous study was done by Awadh et al. (12) among medical and pharmacy students, however, the factors associated to its knowledge score were not determined. Another study by Gyawalee and colleagues was conducted in Nepal (13). In their study, they found out that, medical students had poor knowledge about sunscreen. The authors also concluded that adding knowledge about sunscreen will

better prepare them for their future roles as healthcare professionals. Thus, the purpose of this research is to ascertain the factors associated with knowledge score of sunscreens among pharmacy students. Apart from that, this study aims to determine the associating factors that contribute to good knowledge of sunscreen.

2.0 Method

2.1 Sample and setting

This study is an extension of previous study conducted as described in Azmi et al. (14). Full methodology was described in the aforementioned study. The data was taken from a cross-sectional study conducted at three different universities which were Universiti Teknologi MARA (UiTM), KPJ Healthcare University College and Universiti Brunei Darussalam. This study, which used convenience sampling method involved all undergraduate pharmacy students. Demographic characteristics is described in Table 1.

2.2 Instrument

This study used a validated questionnaire which was adopted from Awadh et al (12). The questionnaire was transcribed to Google Form format and distributed among pharmacy students of the three universities through WhatsApp application. The Google Form contained information regarding consent, detailed instructions, and survey's purpose prior to answering the questions. The collected data contained information regarding demographic profile, knowledge, and practice towards sunscreen application.

2.3 Statistical analysis

The data was analysed using Statistical Package for the Social Sciences (SPSS) for Window version 25.0. Both descriptive and inferential statistics were used. A logistic regression was conducted to find factors that correlate with the knowledge of sunscreen among pharmacy undergraduate students. Both univariate and multivariate analysis was conducted to find factors associated with good knowledge. The knowledge score ranged from 0-20 (as there were 20 questions including the sub questions). Respondents who scored 10 and above are considered as having good knowledge, and those scored below than 10 are considered to have poor knowledge (12).

3.0 Results

A total of 296 respondents completed the questionnaire. Table 1 shows the demographic characteristics of the respondents. Majority of the respondents are female (84.8%), with almost 50% of them having father or mother with a university degree. Most of them (44.9%) was given educational loan. Majority of them (46.3%) are third-year students and more than half of them (59.1%) have a cumulative grade pointer average (CGPA) between 3.1-3.5.

Table 2 shows the number of correct responses answered by the respondents. Overall, about five questions were correctly answered by less than half of the total respondents (< 50%). These questions are about how effective sunscreen is at reversing the signs of aging, when sunscreen should be applied before going outside on a sunny day, how much sunscreen an adult need to cover their whole body, the effective SPF value for UVA radiation protection, and the type of UV rays that are more likely to cause skin cancer.

Table 1: Demographic characteristics

Characteristics	Total (N=296)		p-value
	n	%	
Gender			
Male	45	15.2	0.133
Female	251	84.8	
Father's Highest Education Level			
University	146	49.3	0.080*
High school	123	41.6	
Lower school	23	7.8	
No formal education	4	1.4	
Mother's Highest Education Level			
University Graduate	140	47.3	0.103*
High school Graduate	132	44.6	
Lower school Graduate	20	6.8	
No education	4	1.4	
Family Income			
< RM1200 or is equivalent	36	12.2	<0.001
RM1200- RM3000 or is equivalent	60	20.3	
RM3001- RM5000 or is equivalent	55	18.6	
> RM5000 or is equivalent	145	49.0	
Source of education funding			
Self-sponsored	74	25.0	0.000
Scholarship	89	30.1	
Educational loan	133	44.9	
Current Year of Study			
First year	41	13.9	0.005
Second year	71	24.0	
Third year	137	46.3	
Fourth year	47	15.9	
Current Cumulative Grade Point Average (CGPA)			
< 2.0 – 3.0	32	10.8	<0.001
3.1 - 3.5	175	59.1	
> 3.5	89	30.1	

Calculated by Fisher's Exact Test

Table 2: Responses of each question

Question	n (%)
1. Sunscreen is effective at preventing sunburn	
True (Correct answer)	280 (94.6)
False	6 (2)
Don't know	10 (3.4)
2. Sunscreen is effective at enhancing a tan	
True	52 (17.6)
False (Correct answer)	157 (53)
Don't know	87 (29.4)
3. Sunscreen is effective at preventing skin cancer	
True (Correct answer)	275 (92.9)
False	8 (2.7)
Don't know	13 (4.4)
4. Sunscreen is effective at preventing signs of aging	
True (Correct answer)	263 (88.9)
False	5 (1.7)
Don't know	28 (9.5)
5. Sunscreen is effective at reversing the signs of aging	
True (Correct answer)	99 (33.4)
False	91 (30.7)
Don't know	106 (35.8)
6. Sunscreen provides better protection when the protection order is higher	
True (Correct answer)	245 (82.8)
False	14 (4.7)
Don't know	37 (12.5)
7. Sunscreen is needed on a cloudy/rainy day	
True (Correct answer)	190 (64.2)
False	66 (22.3)
Don't know	40 (13.5)
8. Sunscreen should be applied for the conditions listed below	
a. Going for outdoor activities during sunny day	
Absent	1 (0.3)
Present (Correct answer)	295 (99.7)
b. Going for outdoor activities during cloudy day	
Absent	80 (27)
Present (Correct answer)	216 (73)
c. Swimming at the pool, beach, waterfall, etc	
Absent	28 (9.5)
Present (Correct answer)	268 (90.5)
d. Attending lectures, attachments at the hospital, or other indoor activities	

Absent	102 (34.5)
Present (Correct answer)	194 (65.5)
e. Attending any occasions at night	
Absent (Correct answer)	250 (84.5)
Present	46 (15.5)

9. Before going out on a sunny day, when should you apply sunscreen?	
a. At least 10 minutes before	100 (33.8)
b. At least 30 min before (Correct answer)	90 (30.4)
c. Apply just before going out	106 (35.8)

10. How often should you reapply sunscreen when you are outdoors?	
a. No reapplication	56 (18.9)
b. Every 6 hours	67 (22.6)
c. Every 2 to 4 hours (Correct answer)	173 (58.4)

11. For an adult, to cover the entire body with sunscreen, how much sunscreen do you think is needed?	
a. 30 ml (Correct answer)	92 (31.1)
b. 15 ml	135 (45.6)
c. 5 ml	69 (23.3)

12. What do you think SPF stands for?	
Sun protection factor (Correct answer)	236 (79.7)
others	60 (20.3)

13. Product A has an SPF of 30 while product B has SPF of 15. Which product is more effective as protection against UVB radiation?	
a. Product A (Correct answer)	233 (78.7)
b. Product B	23 (7.8)
c. Don't know	40 (13.5)

14. Product A has an SPF of 15 while product B has SPF of 30. Which product is more effective as protection against UVA radiation?	
a. Product A (Correct answer)	55 (18.6)
b. Product B	179 (60.5)
c. Don't know	62 (20.9)

15. Sunscreen provides better protection when the protection order is	
a. Higher (Correct answer)	246 (83.1)
b. Lower	12 (4.1)
c. Don't know	38 (12.8)

16. Which of these has more risk of causing skin cancer?	
a. UVA	65 (22)
b. UVB (Correct answer)	104 (35.1)
c. Don't know	127 (42.9)

Overall, 262 students have good knowledge where they scored 10 to 20 marks. Meanwhile, a few students (n=34) had poor knowledge with scores less than 10. Table 3 shows factors associated with good knowledge. In univariate analysis, only gender shows significant association, where female shows significantly higher knowledge as compared to male respondents (unadjusted OR=2.7, p-value=0.017). Similarly, with multivariate analysis, female is seen to contribute to good knowledge (adjusted OR 2.94, p-value 0.027). In addition to that, as compared to CGPA 2.0-3.0, respondents with CGPA >3.5 shows significant association with good knowledge (unadjusted OR=3.28, p-value=0.041). Other factors were found to be not statistically significant in determining good knowledge. However, this factor is not significant in multivariate analysis (p-value=0.143).

4.0 Discussion

4.1 Knowledge of sunscreen

Overall, majority of the students have good knowledge with regards to sunscreen. Besides, most of the knowledge questions were answered correctly by more than half of the respondents. The following questions; sunscreen is effective in at preventing sunburn and skin cancer, sunscreen should be applied before going out on sunny days, before going to the pool, beach or waterfall obtained more than 90% of correct responses. However, few questions were answered wrongly by most of the respondents. Firstly, this study found that most students were unaware that sunscreen can help reverse the effects of aging. This result contradicts with a previous study by Awadh et al. (12), which found that approximately 66.7% were aware that sunscreen can reverse the signs of ageing. According to the findings of a study conducted by Wang and Leyden (15), sunscreen will not just to protect the skin but

also has the ability to reverse the effects of photoaging, such as wrinkles and dark spots. This is supported by evidence that shows improvements in skin tone, texture, and fine lines after daily application of a moisturizer with SPF 30 sun protection. Besides, in their study, the participants' skin clarity and texture improved by 100% and their sunspot appearance decreased by 52% after one year.

Apart from this question, many students were unaware of the best time to apply sunscreen before going outside on a sunny day. Our study found only 30.4% of the pharmacy students managed to answer correctly. Applying sunscreen 15 to 30 minutes before venturing out into the sun is a recommendation from dermatologists (16). This is to ensure that the sunscreen will fully absorb into the skin and can therefore offer the optimum protection. The application of sunscreen may be less effective if not applied in accordance with the proper guidelines.

A low correct response rate was also seen for the question about the amount of sunscreen needed to cover the entire body. Sunscreen is only effective if it is used on a regular basis and in sufficient quantity (2.0 mg/cm2), approximately 30 ml to protect all exposed areas (17). This information is critical for achieving the optimal level of protection as indicated on the product label. Proper education on the correct amount of sunscreen is important to be emphasized apart from the importance of using sunscreen.

Additionally, the majority of students correctly answered that a higher SPF value will provide greater protection. Nevertheless, this did not imply that the students comprehended the relationship between SPF and UVA/UVB. The majority of the students falsely belief that using products with a higher SPF value offered the best protection against UVA rays. This is displayed with a very low number of pharmacy students who answered correctly with regards to this. On the other hand, the students were unaware

Table 3: Factors associated with good knowledge

Factors	Good knowledge	Poor knowledge	Unadjusted		Adjusted	
			OR (95%CI)	P-value	OR (95%CI)	P-value
Gender						
Male	35	10	1		1	
Female	227	24	2.7 (1.19 – 6.13)	0.017	2.94 (1.13-7.65)	0.027
Father's Highest Education Level						
University graduate	126	20	1		1	
High school graduate	114	9	2.01 (0.88-4.59)	0.098	2.08(0.69-6.28)	0.195
Lower school graduate	19	4	0.75 (0.23-2.45)	0.638	1.19(0.23-6.27)	0.832
No education	3	1	0.48 (0.05-4.81)	0.529	1.33(0.002-755.613)	0.929
Mother's Highest Education Level						
University graduate	124	16	1		1	
High school graduate	118	14	1.09 (0.51-2.33)	0.829	0.88(0.29-2.66)	0.818
Lower school graduate	17	3	0.73 (0.19-2.77)	0.645	0.621(0.09-4.38)	0.633
No education	3	1	0.39 (0.04-3.95)	0.423	1.15(0.002-578.04)	0.964
Family income						
<RM1200	32	4	1		1	
RM1200-RM3000	52	8	0.81(0.23-2.91)	0.750	0.617(0.13-2.87)	0.539
RM3001-RM5000	48	7	0.86(0.23-3.17)	0.817	0.67(0.12-3.67)	0.646
>RM5000	130	15	1.08(0.34-3.49)	0.893	0.95(0.17-5.50)	0.958

Source of education funding						
Self-sponsorship	62	12	1		1	
Scholarship	79	10	1.53(0.62-3.77)	0.357	0.77(0.24-2.47)	0.659
Educational loan	121	12	1.95(0.83-4.59)	0.126	1.75(0.62-4.94)	0.291
Current year of study						
First year	35	6	1		1	
Second year	66	5	2.26(0.65-7.9)	0.202	2.21(0.53-9.18)	0.276
Third year	119	18	1.13(0.42-3.07)	0.806	1.32(0.39-4.37)	0.649
Fourth year	42	5	1.44(0.41-5.12)	0.573	1.64(0.39-6.94)	0.499
Current CGPA						
2.0-3.0	25	7	1		1	
3.1-3.5	155	20	2.17 (0.83-5.66)	0.113	1.39(0.44-4.35)	0.573
>3.5	82	7	3.28 (1.05-10.25)	0.041	3.01(0.69-13.14)	0.143

that there was insufficient information regarding which products with a higher SPF value offered the best protection against UVA rays. In order to know the exact protection against UVA, the UVA protection grade (PA) must be determined. This indicated that the students were incapable of distinguishing between UVA and UVB protection. The SPF of a sunscreen is a main indicator of the UVB protection but also, to a smaller extent, UVA2 protection (18). UVA protection grade (PA) is generally used to assess sunscreen's photoprotective effectiveness against UVA radiation (11). PA+, PA++, PA+++, and PA++++ are the labels granted to sunscreens based on the level of UVA (PA) protection. A high level of UVA protection is represented by the PA+++ and PA++++ symbols, which denote products that contain more than eight UVA filters (19).

In terms of which type of UV radiation is most likely to cause cancer, about one-third of the students managed to answer this correctly. They were able to identify that UVB rays are more likely to cause skin cancer compared to UVA rays due to their shorter wavelength (280-315nm) and slightly higher energy (20). UVB rays are more likely to cause sunburn because they can directly disrupt the DNA in skin cells and may directly lead to skin malignancies (21).

4.2 Factors associated to good knowledge

In general, there was a significant difference in knowledge between the male and female pharmacy students who participated in this study (Multivariate analysis, $p = 0.027$). This is comparable to another study conducted by Low et al. (22) which demonstrated a statistically significant association ($p = 0.011$) between the percentage of correct answers provided by female respondents and that of male respondents. It was also found that female students scored significantly higher on knowledge tests ($p = 0.027$) in another study by Awadh et al (12). This could have been due to the fact that women are generally more conscious about protecting themselves from the sun and are more likely to use sunscreen than men.

Moreover, this study found a significant difference in pharmacy students' CGPAs in terms of their knowledge about sunscreen. Our study has identified a potential relationship between higher CGPA and increased knowledge of sunscreen use. Nevertheless, additional investigations are necessary to establish the robustness of this connection.

4.3 Limitation

This study has its own limitations where the data collected were based on self-reports, hence there is a tendency of social desirability bias to occur. However, previous studies conducted to determine the knowledge of sunscreen utilized a similar method. Secondly, the study involved only three pharmacy schools with two in Malaysia and one in Brunei. More universities involvement in the future may produce better findings in determining the knowledge level of sunscreen.

5.0 Conclusion

Overall, the knowledge of pharmacy students about sunscreen is satisfactory. However, improvements in certain aspects are highly needed. Misunderstanding about SPF value, PA value, the amount of sunscreen to be used and when sunscreen should be used necessitate future educational interventions. These educational interventions such as sunscreen workshops or incorporating sunscreen topic in the syllabus of pharmacy school may have a great impact on students' knowledge, which subsequently

lead to good practice of sunscreen. It is hoped that by adding this to the syllabus, it could strengthen the future pharmacists' knowledge and could prepare them better to serve the role as one of healthcare professionals. They should be equipped with sufficient knowledge; hence they can advise patients on the amount, frequency of reapplications, and the proper application methods. Aside from that, further research should be done on medications that have the potential to increase photosensitivity (23) as well as the role pharmacists in educating patients about this.

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Conflict of interest

All the authors have no conflict of interests in this study.

References

1. Brenner M, Hearing VJ. The protective role of melanin against UV damage in human skin. Photochem Photobiol. 2008; 539–49.

2. McKenzie RL, Liley J Ben, Björn LO. UV radiation: Balancing risks and benefits. Photochem Photobiol. 2009;85(1):88–98.

3. Polefka TG, Meyer TA, Agin PP, Bianchini RJ. Effects of Solar Radiation on the Skin. J Cosmet Dermatol. 2012; 134–43.

4. Leonardi GC, Falzone L, Salemi R, Zanghì A, Spandidos DA, Mccubrey JA, et al. Cutaneous melanoma: From pathogenesis to therapy (Review). Int J Oncol. 2018; 1071–80.

5. Schadendorf D, van Akkooi ACJ, Berking C, Griewank KG, Gutzmer R, Hauschild A, et al. Melanoma. Lancet. 2018; 971–84.

6. Azizah AM, Hashimah B, Siti Zubaidah AR, Puteri NA, Nabihah A, Sukumaran R, et al. Malaysia National Cancer Registry.2019; 1–116.

7. Sambandan DR, Ratner D. Sunscreens: An overview and update. J Am Acad Dermatol. 2011; 748–58.

8. Geoffrey K, Mwangi AN, Maru SM. Sunscreen products: Rationale for use, formulation development and regulatory considerations. Saudi Pharm J. 2019; 1009–1018.

9. Sabzevari N, Qiblawi S, Norton SA, Fivenson D. Sunscreens: UV filters to protect us: Part 1: Changing regulations and choices for optimal sun protection. Int J Women Dermatol. 2021; 28–44.

10. Singer S, Karrer S, Berneburg M. Modern sun protection. Curr Opin Pharmacol. 2019; 24–8.

11. Thi L, Ngoc N, Tran V Van, Moon J, Chae M, Park D. Rec Trend Sunscreen. Cosm. 2019; 1–15.

12. 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.

13. Gyawalee M, GC KB. Knowledge and practice of sunscreen use among medical students at Patan Academy of Health Sciences, Nepal. J Patan Acad Health Sci. 2023 May 16;10(1):35-44.

14. Azmi N, Manan MM, Ismail FF. Knowledge and Practise Towards Sunscreen Application among Pharmacy Students: A Cross-sectional Study in Universities. In The Virtual 3rd International Research Network Initiative (IRNI) Symposium 2022.

15. 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. Dermatologic Surg. 2016;42(12):1354–61.

16. Sander M, Sander M, Burbidge T, Beecker J. The efficacy and safety of sunscreen use for the prevention of skin cancer. Cmaj. 2020;192(50):802–808.

17. Donglikar MM, Deore SL. Sunscreens: A review. Pharmacog J. 2016;171–179.

18. Heerfordt IM. Sunscreen use at Danish beaches and how to improve coverage. Dan Med J. 2018;65(4):1–13.

19. Solano F. Photoprotection and skin pigmentation: Melanin-related molecules and some other new agents obtained from natural sources. Molecules. 2020;25(7):1–18.

20. Watson M, Holman DM, Maguire-Eisen M. Ultraviolet Radiation Exposure and Its Impact on Skin Cancer Risk. Seminars in Oncology Nursing. 2016; 241–54.

21. American Cancer Society. Ultraviolet (UV) Radiation. 2019; 1–11.

22. 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;76(2):212–7

23. Blakely KM, Drucker AM, Rosen CF. Drug-induced photosensitivity—an update: culprit drugs, prevention and management. Drug safety. 2019 Jul 1;42:827-47.