Knowledge of the risks of ultraviolet radiation, sun exposure attitudes and practices among Lebanese university students

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ABSTRACT

Background: Exposure to Ultraviolet radiation (UVR) is a major risk factor for skin cancer. Data about UVR risk knowledge and exposure behaviors in the Lebanese population are scarce.
Aim: To evaluate the association between UVR risks knowledge, attitudes, and behaviors among Lebanese university students in the aim of promoting primary prevention of skin cancer.
Methods: We conducted a quantitative cross-sectional study between January and March 2022. An online survey was sent to Saint Joseph University students in Lebanon consisting of 5 sections: sociodemographic data, skin and health status, UVR exposure and protection behaviors, attitudes towards exposure and risks' knowledge. Descriptive analysis was conducted, in addition to bivariate analysis and logistic regression with sunburn and sunbathing as outcomes respectively. Statistical significance was defined as $p < 0.05$.
Results: A total of 385 students responded to our questionnaire with a mean age of 23.59. 62.1 % reported at least one episode of sunburn during the last summer. The most common sun protective measure was sunscreen application; however, its frequency wasn't satisfactory considering the high knowledge level of UVR risks. The most frequent barrier into applying sunscreen was its expensive price (42.4 %). Furthermore, positive attitudes towards tanning, particularly among women, and sunbathing were high. 75.1 % of students sunbathed for at least one day.
Conclusion: Lebanese university students are aware of the risks of UVR risks; however, sunburn and sunbathing are common and protective behaviors are often not applied. Future awareness campaigns for skin cancer and promotion of sun safety are necessary.

1. Introduction

Skin cancer is a major public health issue (Arnold et al., 2022). Malignant melanoma is the most aggressive type due to its high potential for metastasis, and non-melanoma skin cancer (NMSC) is the fifth most common cancer worldwide with over one million new cases in 2022 (Global Cancer Observatory, 2022). This number is probably an underestimation because NMSC, which mainly includes basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), are not always tracked by cancer registries (Ferlay et al., 2019). In addition, over 120 000 deaths due to skin cancer were reported worldwide (Global Cancer Observatory, 2022). In Lebanon, as per the most recent data of the national cancer registry, adjusted standardized incidence risks (ASR) for melanoma and NMSC in 2016 were 2.1 and 20.1 per 100,000 men, and 1.6 and 13.5 per 100,000 women respectively (National Cancer Registry, 2016). Moreover, skin cancer has an important economic impact with an average of $8.1 billion per year of treatment costs in the USA (Guy et al., 2015).

Although Ultraviolet radiation (UVR) has beneficial effects through minimal exposure such as vitamin D production, UVR exposure is a well-known modifiable risk factor for skin cancer. It occurs from the sun and from Ultraviolet tanning devices, and is included in the group one of human carcinogens (El Ghissassi et al., 2009). BCC and melanoma are associated with high intensity intermittent sun exposure and with sunburns, while SCC is linked to long-term cumulative exposure (Gandhi & Kampp, 2015).

Simple measures could be implemented to help reduce the burden due to UVR exposure, thus decreasing skin cancer incidence and morbidity. In accordance to WHO, these include applying broad-spectrum sunscreen with a sun protection factor (SPF) of at least 15,

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wearing protective clothing, sitting in the shade, avoiding mid-day sun, and avoiding the use of indoor tanning beds (Rehfuess & World Health Organization, 2002). It is well known that UVR exposure in young adulthood increases the risk of developing skin cancer later in life, and young adults have a tendency towards excessive sun exposure (Asai et al., 2021). In fact, in Canada, the prevalence of UVR risky behaviors is highest in the youngest age groups (O'Sullivan et al., 2019), thus it is important to target young adults in prevention campaigns. Furthermore, many Americans particularly men and young adults do not follow protective measures when exposed to the sun (Buller et al., 2011). Lack or inadequate knowledge about UVR risks and protection practices, or perceived barriers for applying them, could affect protection behaviors. However, although female university students in Saudi Arabia had a good knowledge level about the harmful effects of sun exposure, only about a quarter were using sunscreen (Almuqati et al., 2019). Similarly, knowledge of risks did not encourage safer sun-related behaviors among UK university students (Kirk & Greenfield, 2017). Their practices were affected by body image perception which promoted tanning (Kirk & Greenfield, 2017).

Students in health faculties are future healthcare professionals, hence will play a major role in primary prevention. One qualitative study conducted in Texas revealed that medical students did not know the importance of skin cancer preventative behaviors, and most students valued tanning to improve their appearance (Nanyes, 2012). Medical students in Australia lacked protective practices towards the sun (Scott et al., 2017). A study among healthcare professionals in Spain revealed that doctors had healthier sun exposure behaviors compared to nurses. However, these were inadequate considering the good knowledge of sun protection recommendations (de Troya-Martín et al., 2016).

Lebanon is a sea-level country with 300 sunny days per year. In 2004, a survey was conducted on a population of Lebanese teenagers to evaluate their behaviors towards sun exposure in the aim of launching a campaign to promote sun protection. It revealed a high frequency of sunburn despite the knowledge of its risks, and an inadequate application of sunscreen (El Sayed et al., 2006). No other recent studies have been conducted in Lebanon particularly among university students. Therefore, the aim of this study was to assess the knowledge of UVR risks in addition to attitudes and behaviors towards sun and sunbed exposure among Lebanese university students. This will help guide future campaigns for skin cancer prevention.

The specific objectives were to: 1- assess the knowledge level regarding risks of UVR exposure in a population of Lebanese university students; 2- investigate their attitudes and the potential barriers into applying protection measures; 3- assess their practices of protection measures, and their behaviors towards sun exposure and indoor tanning; 4- evaluate the association between their knowledge and practices; 5- and compare knowledge and behaviors between students from health and non-health related faculties.

2. Material and methods

2.1. Study design and target population

This study followed a quantitative observational cross-sectional design. The target population was university students in Lebanon. Participants included were students at Saint-Joseph University during our study duration. It has eight campuses; hence it includes students from all over Lebanon. The sampling approach was through non-probability convenience sampling.

The sample size was estimated using the following equation for random sample calculation: $n = z^2 \times p\ (1\text{-}p)/\ e^2$; where $z = 1.96$ for confidence interval of 95 %, P is expected true proportion of sunburn history ($p = 0.5$), e is desired precision (0.05). The sample size n is 385, the minimal number of participants needed to have a representative sample.

2.2. Data collection and ethical considerations

The study tool was an online, self-administered English questionnaire, developed based on relevant literature, previously validated questionnaire, and on both Euromelanoma campaign and WHO recommendations on sun protection (de Troya-Martín et al., 2016; Iglesias-Puzas et al., 2019; Patel et al., 2010; Tanning and Sunbeds | Euromelanoma). A pilot questionnaire was sent to 10 students to evaluate any eventual difficulty. The final questionnaire consisted of 5 sections with a total of 47 questions: 1- sociodemographic data; 2- skin and health status data including skin type (I to VI according to Fitzpatrick's classification on skin reaction to sun exposure (Trakatelli et al., 2017)); 3- UVR-related behaviors, divided into protection behaviors when going to the beach, addressed with a 5-point Likert scale, and exposure practices including sunbathing, indoor tanning, and history of sunburn in the previous summer; 4- sun protection and exposure attitudes; 5- knowledge through 10 true or false statements.

The study met the institution's guidelines for protection of human subjects concerning safety and privacy. An approbation from the ethical committee was obtained by reviewing the study proposal (USJ-2021–259 – supplementary material). Data was collected between January and March 2022. The survey was sent to all university students on their university e-mails via the university diffusion center, with a reminder sent one month later. Consent was obtained prior to the completion of the survey by clicking on a button where they could choose whether to participate or not.

3. Theory and calculation

Descriptive analysis was first conducted. A total knowledge score was calculated over 10 by adding the number of correct answers, representing knowledge level for each participant. Similarly, a total sun protection score was calculated over 30 by adding the points of the Likert scale (from never to always: 1 to 5 respectively) with higher scores representing better protection. Sun protective and knowledge mean scores were compared between genders, lower and higher phototypes (grouped into I-II vs III-IV-V) and between health-related and non-health-related study fields using independent *t*-test. Correlation between each score and age was evaluated.

The association between sun protection behaviors and UVR exposure risks' knowledge was evaluated using Pearson's correlation between the respective scores. The correlation coefficient *r* was computed. Protection behaviors, attitudes and knowledge were compared between different groups using Chi-square test.

3.1. Multivariable analysis

Sunburn and sunbathing represent risky UVR exposure behaviors. Sunbathing represents intentional UVR exposure and sunburn is a known strong risk factor of skin cancer (Bowers et al., 2021). Hence, they were chosen as dependent variables in two models of logistic regression to evaluate the association of demographic characteristics, knowledge and protection scores with these outcomes. Sunburn was recoded into no/never = 0 and yes/1 or more = 1, and sunbathing into no days = 0 and at least one day = 1. The independent variables included were age, gender, educational track, knowledge score, protection score and skin type. The odds ratio (OR) was determined, for a 95 % confidence interval. Statistical significance was considered when p < 0.05.

The data was analyzed using the IBM® statistical software SPSS® version 28.0.

4. Results

4.1. Demographic characteristics of the study participants and health status

A total of 385 students responded to our questionnaire. Mean age was 23.59 years (SD 7.44). 73.5 % of participants were women. The most frequent region of residence was Mount Lebanon (n = 183, 47.53 %), followed by Beirut (n = 92, 23.9 %). We had the highest number of responses from the Faculty of Medicine (n = 55, 14.3 %) and the School of Engineering (n = 55, 14.3 %). In total, we had 134 respondents from health-related faculties (34.9 %) versus 250 from non-health-related (65.1 %). There was no statistically significant difference in demographic data between both fields.

Most students (45.7 %) had a skin type of III, followed by type II (26 %) then IV (17.7 %). Fifty-one (13.2 %) had a personal history of skin disease, most commonly acne. Only 11.2 % (n = 43) had seen a healthcare professional for a mole check once (Table 1). Chi-square didn't reveal any significant difference between health and non-health related faculties.

4.2. Knowledge of UVR exposure risks

98.2 % knew that UVR causes skin cancer. More than half (51.7 %)

thought that when applying sunscreen, they can sunbathe longer. There was a statistically significant higher proportions of correct answers from health vs non-health related faculties in several statements (Table 2).

The mean knowledge score was 7.78 (SD 1.591). There was no significant correlation with age. Women had a significantly higher mean score compared to men (7.92 vs 7.37, p 0.003). Similarly, it was significantly higher in lower relatively to higher phototypes (8.12 vs 7.61, p 0.003) and in health-related vs non-health related faculties (8.22

Table 1
Descriptive statistics of the skin health status of Lebanese university students (N = 385) during our study period (January-March 2022).

		n (%)
Skin type (Fitzpatrick scale)	I: Always sunburns[a], never tans	29 (7.5)
	II: Always sunburns, hardly tans	100 (26)
	III: Sometimes sunburns, usually tans	176 (45.7)
	IV: Sunburns minimally, easily tans	68 (17.7)
	V: Naturally brown skin	12 (3.1)
	VI: Naturally black skin	0 (0)
Personal history of skin cancer	I don't know	6 (1.6)
	No	377 (97.9)
	Yes	2 (0.5)
Personal history of a skin disease (other than skin cancer)	I don't know	20 (5.2)
	No	314 (81.6)
	Yes	51 (13.2)
First-degree family history (parents/ siblings) of skin cancer	I don't know	4 (1)
	No	375 (97.4)
	Yes	6 (1.6)
Family history of skin disease (other than skin cancer)	I don't know	40 (10.4)
	No	315 (81.8)
	Yes	30 (7.8)
Previous healthcare professional consultation for moles check	Never	325 (84.4)
	Yes, once	43 (11.2)
	Yes, more than once	17 (4.4)

[a] Sunburn: Any skin area − even small − that was red, sensitive, and painful to touch for 12 h or more.

Table 2
Ulraviolet radiation exposure knowledge of Lebanese university students based on True/False items, between January and March 2022, descriptive statistics and bivariate analysis between students from non-health and health related-faculties.

		Overall n (%)	Non-Health related faculties n (%)	Health related faculties n (%)	p-value*
Ultraviolet radiation does not cause any health problems.	False √	376 (97.7)	241 (96.4)	135 (100)	–
	True	9 (2.3)	9 (3.6)	0 (0)	
Ultraviolet radiation causes skin cancer.	False	7 (1.8)	7 (2.8)	0 (0)	–
	True √	378 (98.2)	243 (97.2)	135 (100)	
Ultraviolet radiation causes premature aging.	False	39 (10.1)	33 (13.2)	6 (4.4)	0.007
	True √	346 (89.9)	217 (86.8)	129 (95.6)	
Ultraviolet radiation causes sunburn.	False	22 (5.7)	17 (6.8)	5 (3.7)	0.212
	True √	363 (94.3)	233 (93.2)	130 (96.3)	
Ultraviolet radiation causes cataracts.	False	85 (22.1)	58 (23.2)	27 (20)	0.470
	True √	300 (77.9)	192 (76.8)	108 (80)	
A suntan protects you from the sun.	False √	285 (74)	176 (70.4)	109 (80.7)	0.027
	True	100 (26)	74 (29.6)	26 (19.3)	
Clouds protect you from sunburn.	False √	283 (73.5)	177 (70.8)	106 (78.5)	0.102
	True	102 (26.5)	73 (29.2)	29 (21.5)	
Water protects you from sunburn.	False √	282 (73.2)	173 (69.2)	109 (80.7)	0.015
	True	103 (26.8)	77 (30.8)	26 (19.3)	
When you apply sunscreen, you can sunbathe much longer because it is protective.	False √	186 (48.3)	109 (43.6)	77 (57)	0.012
	True	199 (51.7)	141 (56.4)	58 (43)	
If you take regular breaks during sunbathing, you won't get sunburnt.	False √	196 (50.9)	124 (49.6)	72 (53.3)	0.484
	True	189 (49.1)	126 (50.4)	63 (46.7)	

√ Correct answer.

*Chi-square test for bivariate analysis between faculties. p < 0.05 considered significant.

vs 7.54, p < 0.001).

4.3. Attitudes towards UVR exposure and sun protection

Most participants (79 %) agreed that using sun protection is important to them. 42.3 % considered sunscreen too expensive. Sunbathing makes 43.1 % of students happier and 51.2 % preferred being tanned despite that only 8.8 % considered tanning healthy for the skin. When comparing attitudes between genders, Chi-square test revealed a statistically significant difference in several statements (Table 3). More women agreed that sun protection is important to them (82.3 % vs 69 %, p 0.019). More women considered themselves more attractive when tanned (51.9 % vs 42 %, p 0.032). There was no significant difference between study fields.

4.4. UVR protection behaviors

When going to the beach, sunscreen was the most common protective measure (Table 4). More women always apply sunscreen (34.3 % vs 20 %, p 0.027) and less women never applied sunscreen (8.8 % vs 17 %, p 0.027). More men never wear sunglasses (23 % vs 12.7 %, p 0.039).

There was no significant difference between the study fields for each statement.

The mean protection score was 15.77 (SD 3.726) ranging from 7 to 26 over 30. There was a weak positive significant correlation between age and sun protection score (0.198, p < 0.001). Women had a significantly higher score compared to men (16.17 vs 14.67 respectively, p < 0.001). The score was higher in lower relatively to higher phototypes (16.64 vs 15.33, p 0.001). There was no significant difference between health and non-health related faculties. Finally, there was a weak positive significant correlation between knowledge and protection scores (*r* 0.213, p < 0.001).

4.5. UVR exposure practices

Only 24.9 % of students did not sunbathe during the last year. 90.4 % never did any type of artificial indoor tanning (Table 5). Younger students had significantly more episodes of sunburn (p 0.015). Women spent significantly more time sunbathing than men: one to three hours 22.3 % vs 12 % respectively (p 0.003). There was no significant difference between genders in sunburn history. Students with higher phototypes spent more time sunbathing (p < 0.001) but there was no significant difference in sunburn history. There was no significant difference in sunbathing and sunburns history between study fields.

4.6. Multivariable analysis

4.6.1. Sunburn as a dependent variable
62.1 % of students had at least one episode of sunburn during the last summer, sunburn being any skin area that was red, sensitive, and painful to touch for 12 h or more. Gender, age, phototype and educational track were not associated with the history of sunburn. A higher sun protection score was significantly associated with a lower risk of sunburn (OR 0.900 [0.833–1.109]), p < 0.001). A higher knowledge score was not associated with a lower risk.

4.6.2. Sunbathing as a dependent variable
Most students (75.1 %) sunbathed for at least one day in the last summer. Variables significantly associated with sunbathing were female gender (OR 1.858 [1.064–3.242], p 0.029), higher phototypes (OR 3.394 [2.051–5.618], p < 0.001) and a higher sun protection score (OR 0.906 [0.844–0.972], p 0.006). Knowledge score was not associated with sunbathing.

Table 3
Attitudes towards Ultraviolet radiation exposure and protection in Lebanese university students between January and March 2022, descriptive statistics and bivariate analysis between women and men.

		Overall n (%)	Women (%)	Men (%)	p-value*
Using sun protection is important to me.	Disagree	28 (7.3)	17 (6)	11 (11)	0.019
	Undecided	53 (13.8)	33 (11.7)	20 (20)	
	Agree	304 (79)	233 (82.3)	69 (69)	
Sunbathing makes me happier.	Disagree	113 (29.4)	78 (27.6)	34 (34)	0.003
	Undecided	106 (27.5)	69 (24.4)	37 (37)	
	Agree	166 (43.1)	136 (48.1)	29 (29)	
I prefer being tanned.	Disagree	101 (26.2)	70 (24.7)	31 (31)	0.030
	Undecided	87 (22.6)	57 (20.1)	29 (29)	
	Agree	197 (51.2)	156 (55.1)	40 (40)	
Tanning is healthy for my skin.	Disagree	226 (58.7)	175 (61.8)	50 (50)	0.117
	Undecided	125 (32.5)	85 (30)	39 (39)	
	Agree	34 (8.8)	23 (8.1)	11 (11)	
I am more attractive when I am tanned.	Disagree	104 (27)	79 (27.9)	25 (25)	0.032
	Undecided	91 (23.6)	57 (20.1)	33 (33)	
	Agree	190 (49.4)	147 (51.9)	42 (42)	
It is worth burning to get a good tan.	Disagree	275 (71.4)	202 (71.4)	71 (71)	0.757
	Undecided	58 (15.1)	41 (14.5)	17 (17)	
	Agree	52 (13.5)	40 (14.1)	12 (12)	
Being tanned is a sign of skin damage.	Disagree	128 (33.2)	92 (32.5)	35 (35)	0.543
	Undecided	137 (35.6)	105 (37.1)	31 (31)	
	Agree	120 (31.2)	86 (30.4)	34 (34)	
I forget to use sun protection methods.	Disagree	208 (54)	164 (58)	43 (43)	0.020
	Undecided	84 (21.8)	53 (18.7)	30 (30)	
	Agree	93 (24.2)	66 (23.3)	27 (27)	
Sunscreen is too expensive.	Disagree	109 (28.3)	88 (31.1)	21 (21)	0.157
	Undecided	113 (29.4)	80 (28.3)	32 (32)	
	Agree	163 (42.3)	115 (40.6)	47 (47)	
Darker skinned individuals do not	Disagree	282 (73.2)	228 (80.6)	52 (52)	<0.001

(continued on next page)

Table 3 (*continued*)

		Overall n (%)	Women (%)	Men (%)	p-value*
need sun protection.	Undecided	63 (16.4)	35 (12.4)	28 (28)	
	Agree	40 (10.4)	20 (7.1)	20 (20)	
I do not like applying sunscreen.	Disagree	226 (58.7)	181 (64)	43 (43)	0.01
	Undecided	61 (15.8)	40 (14.1)	21 (21)	
	Agree	98 (25.5)	62 (21.9)	36 (36)	
I do not have enough time to apply sunscreen.	Disagree	278 (72.2)	212 (74.9)	65 (65)	0.159
	Undecided	57 (14.8)	37 (13.1)	19 (19)	
	Agree	50 (13)	34 (12)	16 (16)	

*Chi-square to compare between women and men. p < 0.05 is considered statistically significant.

Table 4

Descriptive statistics of sun protection measures among Lebanese university students during our study duration between January and March 2022.

		n (%)
Applying sunscreen (at least SPF 15)	Never	42 (10.9)
	Sometimes	86 (22.3)
	Half of the times	52 (13.5)
	Most of the times	87 (22.6)
	Always	118 (30.6)
Wearing a hat	Never	95 (24.7)
	Sometimes	156 (40.5)
	Half of the times	52 (13.5)
	Most of the times	46 (11.9)
	Always	36 (9.4)
Wearing long sleeves or sun protective clothing	Never	262 (68.1)
	Sometimes.	81 (21)
	Half of the times	17 (4.4)
	Most of the times	8 (2.1)
	Always	17 (4.4)
Wearing sunglasses	Never	59 (15.3)
	Sometimes	106 (27.5)
	Half of the times	50 (13)
	Most of the times	96 (24.9)
	Always	74 (19.2)
Sitting in the shade	Never	22 (5.7)
	Sometimes	125 (32.5)
	Half of the times	114 (29.6)
	Most of the times	93 (24.2)
	Always	31 (8.1)
Avoiding sun exposure in mid-day (10 am – 4 pm)	Never	99 (25.7)
	Sometimes	145 (37.7)
	Half of the times	49 (12.7)
	Most of the times	68 (17.7)
	Always	24 (6.2)

5. Discussion

The incidence of melanoma has been increasing in the last decades and is estimated to increase to 510,000 new cases and 96,000 deaths by 2040, most likely due to increased exposure to UVR mainly in fair-

Table 5

Ultraviolet radiation exposure practices Lebanese university students during our study duration between January and March 2022.

		Overall n (%)	Mean age (SD)	p-value*
How many days did you sunbathe during the last year?	None	96 (24.9)	23.64 (7.1)	0.769
	1–5	141 (36.6)	24.14 (7.24)	
	6–15	89 (23.1)	23.28 (8.69)	
	16–30	37 (9.6)	22.54 (6.03)	
	> 30	22 (5.7)	22.95 (7.444)	
How much time do you spend sunbathing?	None	76 (19.7)	22.88 (6.41)	0.654
	< 30 min	92 (23.9)	23.88 (7.82)	
	30 min – 1 h	107 (27.8)	23.81 (8.18)	
	1 – 3 h	76 (19.7)	24.22 (7.05)	
	> 3 h	34 (8.8)	22.32 (7.13)	
How often did you get a sunburn last summer?	None	146 (37.9)	24.66 (7.9)**	0.015
	1–2	199 (51.7)	23.45 (7.54)	
	3–5	33 (8.6)	20.58 (3.55)**	
	>5	7 (1.8)	19.71 (1.5)	
Have you ever done any type of artificial indoor tanning (sunbeds, sun lamps..)?	None	348 (90.4)	23.15 (7.1)	0.002
	1–5 times	28 (7.3)	27.86 (9.28)	
	5–10	3 (0.8)	31.67 (8.96)	
	10–15	4 (1)	29 (4.9)	
	> 15	2 (0.5)	18 (0)	

*ANOVA test was conducted to compare mean age between groups.
**Post Hoc analysis statistically significant.
p < 0.05 is considered significant.

skinned populations (Arnold et al., 2022). Lebanon is a Mediterranean country where the population is exposed to high levels of UVR. The Lebanese population skin types were reflected in our study where most students had a type III followed by II. This indicates relatively lower phototypes that are more sensitive to UVR. These types, in addition to type I, have an increased melanoma risk compared to type IV (Raimondi et al., 2020).

Skin cancer prevention and screening programs are lacking in Lebanon. Cases could be reduced by improving primary prevention through limiting UVR exposure. In fact, excessive exposure is the main cause of 75.7 % of melanoma cases (Obeng-Kusi & Abraham, 2022). Young adults must be targeted because UVR exposure in this age group leads to a higher risk of skin cancer later in life (Glade, 2021). Moreover, young adults tend to practice excessive sun exposure (Asai et al., 2021). On that account, our survey was intended to reach university students.

5.1. Sun protection behaviors and attitudes

The results of this study show that despite knowing the risks of UVR exposure, sun protection practices are often not applied. This discrepancy was described in other populations (Forsea et al., 2012). In our sample, 98.2 % knew that UVR causes skin cancer. However, their high

knowledge level was not reflected by their behaviors. Although 79 % considered using sun protection important to them, only 30.6 % always applied sunscreen when going to the beach, which was the most common protection measure. Sunscreen application is important, applying it regularly among adults helps prevent SCC and melanoma (Green et al., 2011).

The most frequent barrier into applying sunscreen was its expensive price. This could be affected by the economic crisis in Lebanon. In addition, more than half considered that when applying sunscreen, they can sunbathe longer, giving them a sense of safety. In fact, sunscreen should not be used to prolong intentional sun exposure (Raimondi et al., 2020). Applying it alone will delay sunburn occurrence, therefore, it is not enough for protecting against UVR particularly in mid-day sun (Isvy et al., 2013). Thus, it is important to enhance the education about the correct use of sunscreen. In addition, we should increase the awareness about the necessity of other sun protection methods such as protective clothing. Wearing long-sleeve clothes was the less frequently reported in our population, in contrary to a German study where it consisted as the most common measure (Görig et al., 2018).

Increasing shade at recreational areas should also be considered. Only 8.1 % always sit in the shade when exposed to the sun. A survey conducted among medical university student in Northeast China showed that a frequent sun protection method used in the Chinese population was the sun umbrella (Gao et al., 2014). Therefore, sun protection could be affected by the cultural background.

In our study, women had a higher knowledge score compared to men which is consistent with previous literature (Patel et al., 2010). Moreover, more women always apply sunscreen and more men do not like applying it. Men may consider it as a cosmetic practice specific to women. This goes in line with findings of previous studies, done in Turkey, Spain and Australia, where women tend to use protection methods more frequently particularly sunscreen (Baykal Selcuk et al., 2019; Cercato et al., 2015; Scott et al., 2017).

5.2. Sunburn history and sunbathing

As stated previously, BCC and melanomas are more associated with a history of sunburn and SCC is linked to long-term cumulative sun exposure (Gandhi & Kampp, 2015). Despite having a good knowledge about UVR risks, 62.1 % had at least one episode of sunburn during the last summer which is higher than in other studies (Bowers et al., 2021). Sunburn is strongly associated with skin cancer by causing DNA damage (Bowers et al., 2021). Sunburn history, particularly in the first few decades, is a known risk factor of melanoma (Asai et al., 2021; Dallazem et al., 2019). Multivariable analysis did not reveal an association between knowledge score and the history of sunburn, nor with sunbathing. Similarly, Venning et al. concluded that the perception of the risk of skin cancer did not predict sun exposure behavior nor a lower rate of sunburn (Venning et al., 2020).

Other factors affecting UVR exposure are the positive attitudes towards tanning. These include preferring being tanned and the attractiveness associated with the suntan. The proportion of women was statistically higher than men for both statements and women were more associated with sunbathing.

These attitudes were reported despite that more than half disagreed that tanning is healthy for the skin. This may suggest that even with the known long-term effects of UVR exposure on physical appearance including photoaging and skin cancer, immediate short term benefits on body image resulting from tanning are preferred (Venning et al., 2020). Furthermore, some students thought that a suntan protects them from the sun. It is in fact a sign of DNA damage, as is the case with sunburn, which increases the risk of skin cancer (Bowers et al., 2021).

The cultural background affecting social perceptions and beauty standards, can be associated with these attitudes. Young adults are influenced by their social circle and can be susceptible to what the media portrays as attractive. The case in Lebanon goes in line with other

Western countries where tanned skin is linked to attractiveness particularly among young people (Dallazem et al., 2019; Isvy et al., 2013; Kirk & Greenfield, 2017; Venning et al., 2020). However, these cultural norms vary from one country to another. In a population of Saudis university students, a suntan was not considered to increase attractiveness (Almuqati et al., 2019). Educational campaigns should not only focus on increasing the knowledge about UVR risks but also towards changing the perceptions around tanning particularly among women.

Artificial indoor tanning users were relatively low in our sample. This could be associated with a greater awareness about the effects of artificial UVR on the skin. However, other studies, such in Brazil, revealed a lower use of tanning booths (5 %) among university students, linked to laws forbidding their aesthetic (Dallazem et al., 2019). More efforts should be directed in Lebanon towards restricting the use of sunbeds and regulating them as medical devices, since they are a known risk factor for skin cancer and classified in group 1 of human carcinogens (El Ghissassi et al., 2009). In fact, ever exposure to indoor tanning increases the risk of cutaneous melanoma by 20 %, and by 59 % when the first exposure is before 35 years of age (Raimondi et al., 2020). It also increases the risk of having a NMSC (Raimondi et al., 2020).

5.3. Health vs non-health related faculties students

Students of health faculties, being future healthcare professionals, play an important role in raising awareness about skin cancer prevention and detection. Although having a significantly higher mean knowledge score than non-health related, there was no significant difference in protection behaviors, attitudes, sunbathing and sunburn history between both fields.

In line with our study, practices of French medical students towards sun exposure were almost similar as the general population (Isvy et al., 2013). Similarly, Australian medical students had deficient sun safety practices with a tendency towards tanning and sunburn (Scott et al., 2017). In contrast, Polish medical students had more awareness about photoprotection with more common sunscreen use (Łyko et al., 2021). This group of students represent a key target for whom tackling the importance of protection from UVR is essential. Incorporating more prevention materials in their curriculum is necessary.

5.4. Early detection

Melanoma is not uncommon in young patients with an increasing incidence in successive generations in the age group 20–29 years since 1950 (Sung et al., 2019). Similarly, the incidence of BCC is rising in people younger than 40 mainly due to the increase in UVR exposure (Ferrucci et al., 2012). In our analysis, 84.4 % have never seen a healthcare professional for a mole check. This raises the necessity of increasing awareness about self-skin assessment to look for signs suspicious of cancer. Public health measures should be implied to increase primary detection by dermatologists or by family physicians particularly in at-risk patients, such as people with fair skin or with a history of sunburn, to detect early skin cancer which could be then treated in early stages.

5.5. Limitations

Limitations include recall biases since we used a questionnaire to evaluate participants' behaviors. In addition, we only evaluated sun exposure and protection when going to the beach without evaluating other causes of intentional or unintentional UVR exposure through recreational or occupational activities.

6. Conclusion

This is the first study that evaluates the knowledge of UVR risks and protective behaviors in Lebanese university students. They have a good

knowledge of its long-term cutaneous risks; however, protective measures are often not applied, and sunburns and sunbathing are common. Body image perception often motivates their practices particularly in women. Future campaigns should focus on increasing risk perception and awareness about protection measures, and on reducing tanning behaviors by decreasing its cultural and social appeal.

Current and future healthcare professionals play a major role in promoting primary prevention of skin cancer. Health-related university students didn't show better protective behaviors relatively to other students.

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CRediT authorship contribution statement

Rym Afiouni: Writing – review & editing, Writing – original draft, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Josiane Helou:** Writing – review & editing, Validation, Supervision. **Ibrahim Bou-Orm:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102900.

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