Sun exposure and protection practices of Spanish university students of education sciences. Are future teachers protected against skin cancer and other adverse effects?

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Abstract

Background: Excessive sun exposure, together with insufficient protection, is the main risk factor for the onset of Melanoma and Non Melanoma skin cancer, namely the most common cancer in fair-skinned populations across the world, and of several other skin and eye adverse health effects. Epidemiological data show the existence of scant awareness of this risk, and of high rates of sunburn among young people. The main aim of the present study is to examine sun exposure habits and protection behaviour in university students.

Methods: We performed a cross-sectional questionnaire-based study to investigate sun exposure and protection practices in a group of education sciences students at a university in southern Spain. This survey provided data for a descriptive and comparative analysis, by groups and gender, of photoprotection and skin self-examination practices. The reliability and validity of the questionnaire have been analysed.

Results: The questionnaire was completed by 315 students. Most of them (74.6%) have suffered at least one sunburn in the last year. The use of sunscreen or protective clothing is not frequent, and 89.5% of students do not self-examine their skin. The metric properties of the questionnaire showed high values of reliability and validity.

Conclusions: The awareness of solar exposure risk in Spanish university students of Education Sciences is low, self-protection is scant, the potential exposure to dangerous levels of UV radiation is high and most students have suffered one or more sunburns in the last year. Intervention strategies should be introduced in these students to highlight the risks involved and the need of more adequate sun protection practices. Information campaigns should be conducted to address the problem so that, when these students become teachers, they have an adequate knowledge of the risk and of the benefits of a higher attention to this problem, and can translate these competences in health education.

Key words: Skin cancer, Photoprotection habits; Photoexposure, University students, Teachers health sciences

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Introduction

Excessive exposure to solar radiation can induce several adverse health effects, mostly related to the ultraviolet (UV) component. Both, acute and chronic effects are possible, and the skin and the eye are the main target organs [1]. Solar radiation and UV are both classified among Group 1 carcinogens by the IARC [2], and can induce basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), i.e. the most common cancer in fair-skinned populations across the world [3]. Malignant Melanoma (MM) is also correlated with solar UV radiation (UVR). Furthermore, skin cancer is a frequent, even if underreported, occupational disease in outdoor workers [4]. What's more, over the last 30 years the prevalence of all these cancers is continuously increasing in Spain and elsewhere at least, [5, 6]. But UVR exposure is also related to other chronic skin and eye diseases such as photo-aging, actinic keratosis, pterygium, cataract, and possibly macular degeneration, another disease whose incidence is progressively increasing [1, 7].
UV-induced adverse effects are related to a photochemical mechanism that depends on the total dose given by the product between the duration of the exposure and the intensity of the radiation, the so called Principle of Reciprocity of Photobiology, or Bunsen-Roscoe Law of Photobiology. As a consequence, the effect is cumulative along the whole life, and the diseases may appear even several years after the first exposure, when it is too late to implement any adequate prevention [8], Furthermore, the amount of exposure received during the first 20 years of life has a decisive influence on the risk of developing skin cancer in later life. In this respect, sunburn is a critical risk factor: a single episode of sunburn in childhood or adolescence doubles the risk of melanoma [9, 10].

Most of these effects, if not all, can be prevented by an adequate sun-safety education, including knowledge of the differences in sun-sensitivity according to the skin-phototype [11], allowing the adoption of more effective sun protection practices as avoiding exposure at times of maximum incidence of UVR, making use of available shade, wearing adequate hats, sunglasses and appropriate clothing, and regularly applying sunscreen cream with a protection factor of 30 or more [9,10, 12].

Patterns of behaviour concerning sun exposure and protection are usually evaluated by means of questionnaires, but the measurement properties of these instruments (for example, their validity, reliability and sensitivity to change) should be properly tested and confirmed before use [13-15].

With respect to the relationship between sun exposure and protection and the development of skin cancer, there exist very few standardised instruments with which to study these practices [16-18], and the questionnaires that have been used in previous research present great variability in their design and content. Moreover, in many cases they have not been previously validated.

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Epidemiological studies, conducted elsewhere in Spain and also abroad, have confirmed the existence of high rates of sunburn among university students, regardless of their skin type [11], a vulnerability related to risky behaviour regarding sun exposure and protection [19-24]. These findings highlight the need to consider university students as a high-risk group for skin cancer and to design specific prevention strategies for this target group [18]. Interestingly, there is a growing evidence that occupational sun-safety education can be effective in increasing workers' sun-protection habits [25].

The main aim of the present study is to examine the sun exposure and protection behaviour of students of education sciences at a university in southern Spain.

Materials & Methods

Study design and scope

In this cross-sectional observational study, the results obtained by collection of a questionnaire on the sun exposure and protection practices of university students at an education sciences university faculty are presented. The study was carried out during October and November 2019. The study sample was selected for convenience at the University of Cádiz (Spain).

Participants and selection criteria

The survey was conducted on a sample of 315 university students, aged 18- 46 years, belonging to three population groups, according to the faculty in which they were enrolled: GI (Pre-school Education), GII (Primary Education) and GIII (Physical Education).
The following inclusion criteria were applied: students aged 18 years or older, enrolled in one of the faculties of Education Sciences or Physical Activity at the University of Cádiz, with adequate understanding of spoken and written Spanish, who voluntarily agreed to participate in this project and provided signed informed.

Method

Participants were recruited at the beginning of the academic year, in October 2019, and invited to complete a self-administered two-page questionnaire about sun exposure and protection practices. The questionnaire was designed to be completed in 5-10 minutes, and one of the research team was present at all times to resolve any questions that might arise.
To study the metric properties of the questionnaire, the questionnaire was returned to the same students two weeks after the first data collection and re-assessed. Participation to the

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study was completely voluntary. The anonymity was protected assigning a code to each student.

Questionnaire

A self-administered two-page questionnaire on individual sun exposure and protection practices previously validated and published by Glanz et al. [15] was adopted. It was translated from English into Spanish by a group of experts, by consensus on the content of the items translated and adapted for use with university students. In addition, the questionnaire was expanded with some further items recommended in the literature and considered relevant for this research [26-28].

Besides the items included in the questionnaire, the following information was obtained for each respondent: sociodemographic variables (age, sex, university subject studied and family history of skin cancer); sun exposure practices (number of hours exposed to the sun, between 10 am and 4 pm, during the week and at weekends); number of sunburn episodes in the last year (defined as pain and redness of the skin lasting more than one day); sun protection measures when exposed to the sun, such as making use of shade, wearing sunglasses, a cap or hat, a long-sleeved t-shirt and long trousers; type of skin (Fitzpatrick phototype) [11]; use of sunscreen cream, its protection factor and rate of reapplication; regular personal skin examination and visits to a dermatologist; diagnosis, if any, of skin cancer; outdoor physical activity (hours per day); during physical activity, use of sunscreen, its protection factor and rate of reapplication.

The main study variables on sun exposure and protection were presented in the questionnaire as follows:

Questionnaire variables

Sun exposure practices.

Section 1

Sun exposure and protection practices: a) Average time spent in the sun between 10 a.m. and 4 p.m., on weekdays refers to summer exposure b) Average time spent in the sun at the weekend. In both cases, responses were made according to a 6-point Likert scale (0 = less than 30 minutes; 1 = between 31 and 60 minutes; 2 = two hours; 3 = three hours; 4 = four hours; 5 = five hours; and 6 = six hours).

Sunburn: events experienced during the previous year, on a range from 0 to “5 or more”. Sunburn is defined as the presence of blistering and/or reddening and/or pain lasting more than one day.

Sun protection practices, as recommended by the World Health Organization: using sunscreen cream, wearing sunglasses, a long-sleeved T-shirt and a cap or hat, and staying in the shade. As a risk practice, participants were asked about sun exposure performed in order

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to acquire a tan. All responses were recorded on a 4-point Likert scale (1 = rarely or never; 2 = Sometimes; 3 = Often; 4 = Always).

Skin colour: Colour of skin not exposed to sunlight (six response categories: pale; fair; intermediate; moderate brown; dark brown; darkest brown; corresponding to those of the Fitzpatrick phototype) [11].

Section 2:

Skin check-up: The students were asked if they had ever had a medical check-up of their skin (yes/no), and if so, when the last time had been (month and year). They were also asked if they themselves or someone else had examined their skin, including their back, in the past year, to search for spots or lesions. If the answer was affirmative, the number of times such an examination had been made was also recorded.

Section 3:

Physical activity. The following questions were prepared by a group of experts in physical education and sports, and included in the questionnaire.

a. - On average, how many hours of outdoor physical activity do you perform each day?

b. - When you are performing outdoor physical activity, do you usually put sunscreen on your face? If so, what sun protection factor does the sunscreen have?

c. - Do you usually reapply sunscreen throughout the day, how often?

Statistical analysis

A sociodemographic and descriptive analysis was made of all the information obtained from the study sample, using frequency tables for the qualitative data (mean, standard deviation, maximum and minimum) and descriptive statistics for quantitative data.

Chi-square tests were performed to calculate the association between the qualitative variables, assuming a level of significance of 5%.

The metric properties (i.e. the validity and reliability) of the questionnaire were tested by Principal Components Analysis (PCA) with varimax rotation. The validity of the construct was assessed by the factor saturations of the rotated component matrix. The validity of the PCA was evaluated by the Kaiser-Meyer-Olkin (KMO) test and by Bartlett's test of sphericity, and the degree of variance explained was recorded. According to the qualitative or quantitative nature of the items considered, the intraclass correlation coefficient (ICC) and the Kappa coefficient were calculated to determine the reliability-stability of two evaluations performed. Internal consistency, also expressed in terms of reliability, was evaluated by Cronbach's alpha coefficient. All analyses were performed using IBM SPSS v.22 statistical software.

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Ethical considerations

This study was approved by the Research Ethics Committee of the University of Cádiz in March 2018 and Costa del Sol Hospital (n85-05-2019). The study was conducted in full accordance with the Helsinki Declaration and with Spanish legislation on patient confidentiality (Law 41/2002). All data were recorded and stored anonymously, in strict accordance with the currently applicable laws and regulations on data protection and digital rights (EU Regulation Data Protection, 2016/679; Organic Law 3/2018, of 5 December).

Results

The questionnaire was completed by 315 university students from the Faculty of Education Sciences at the University of Cádiz (Spain). By area of specialisation, they were distributed as follows: Pre-school education (39.7%), Primary education (13.7%) and Physical education/secondary education (46.6%). Just over half of the sample (52.2%) were male. The students' average age was 21.23 years (SD: 3.2). The youngest was 18 years old and the oldest was 46. In response to the question about a family history of skin cancer, 96% of the responses made were negative and 12 (4%) were affirmative.

Descriptive results

With respect to the students' photoexposure practices, Table 1 shows the descriptive results obtained. Significantly, 40.2% spent three hours or more exposed to the sun between 10 a.m. and 4 p.m. from Monday to Friday (Item 1) and this proportion increased to 57.5% over the weekend (Item 2). 74.6% had experienced at least one sunburn event in the last twelve months (Item 3) and 40% had fair or very fair (pale) skin (Item 10). The tests of dependence among the study variables revealed significant differences by gender for Item 10 ($p < 0.011$). As shown in Table 1, 67.8% of these students were exposed to the midday sun for at least two hours on weekdays, a proportion that rose to 78.9% at the weekend. This level of exposure means that many students received a high level of sun exposure during the year, and were at considerable risk of sunburn if they were not adequately protected. Indeed, in the previous summer 74.6% had experienced at least one painful sunburn.

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Table 1. Sun exposure practices, sunburn events and skin type

	Weekday exposure (Item 1) N (%)	Weekend exposure (Item 2) N (%)		Sunburn events last year (Item 3) N (%)		Skin colour (Item 10) N (%)
0-30 min			**None**			15 (4.8)
0-60 min	101 (32.2)	66 (21.1)		80 (25.4)	**Pale**	
120 min	87 (27.7)	67 (21.4)	**One**	115 (36.5)	**Fair**	116 (36.8)
180 min	66 (21.0)	67 (21.4)	**Two**	73 (23.2)	**Intermediate**	49 (15.6)
240 min	31 (9.9)	68 (21.7)	**Three**	31 (9.8)	**Moderate brown**	99 (31.4)
300 min	19 (6.1)	19 (6.1)	**Four**	6 (1.9)	**Dark brown**	31 (9.8)
360 min	10 (3.2)	26 (8.3)	**Five or more**	10 (3.2)	**Darkest brown**	5 (1.6)

With respect to sun protection, Table 2 shows that almost half of the respondents either did not use sunscreen cream or did so only occasionally. In addition, most of these students rarely or never wore a cap or hat. In items 4, 5 and 9 there are statistically significant differences by gender, with women significantly more likely to respond *often* and *always* to Items 4 and 9 ($p < 0.003$ and $p < 0.000$, respectively) and men more likely to wear a long-sleeved t-shirt (Item 5) ($p < 0.000$). Perhaps the most significant finding reflected in this table is the proportion of regular use (*often/always*) of the following sunscreen measures: thus, sunscreen cream 53.3%, long-sleeved t-shirt 36.6%, cap or hat 10.2%, shade 50.1% and sunglasses 46.7%. This pattern of sun protection is clearly inadequate, and explains the high rates of sunburn reported by the students.

Table 2. Sun protection practices and tanning preferences

	Seldom or never N(%)	Sometimes N(%)	Often N(%)	Always N(%)
Item 4. Use sunscreen cream	58 (18.4)	89 (28.3)	85 (27.0)	83 (26.3)
Item 5. Wear long-sleeved t-shirt	132 (42.0)	67 (21.4)	71 (22.6)	44 (14.0)
Item 6. Wear cap or hat	231 (73.8)	50 (16.0)	20 (6.4)	12 (3.8)
Item 7. Stay in the shade	41 (13.1)	115 (36.7)	105 (33.5)	52 (16.6)
Item 8. Wear sunglasses	89 (28.3)	79 (25.1)	91 (28.9)	56 (17.8)
Item 9. Sunbathe in order to tan	74 (23.5)	69 (22.0)	88 (28.0)	83 (26.4)

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Table 3 shows the descriptive results obtained for sections 2 and 3 of the questionnaire. With respect to self-examination of the skin, Item 12 is not shown, as the information obtained refers to the date, and only applies if an affirmative answer is given to Item 11.

According to the responses made to Item 14 (number of times the student had examined his/her own skin in the last year) – only made if an affirmative answer was given to Item 13 – on average the students had examined their skin 3.2 times in the last year (SD: 2.6). The minimum value stated was 1 and the maximum, 10.

A significant finding revealed in Table 3 is that only 5.4% of the students had had a medical examination of the skin, and only 10.5% had examined their own skin.

According to the students' responses to Section 3 of the questionnaire, on sun protection practices during physical activity outdoors, the average time spent in this respect (Item 15, not shown in the table) was 1.84 hours per day (SD: 1.5), ranging from 0 to 10 hours. Only 17.9% of the students used sunscreen cream on the face, the area of skin that is most exposed to UVR. This inadequate protection is aggravated by the fact that only 10.2% of the students habitually wear a cap or hat as protection against the sun.

Male and female students did not vary significantly in their attitudes towards skin check-ups, but differences in protection practices were observed. Although the majority of students did not use sunscreen for the face, more women than men did so (67% vs. 33%; $p < 0.002$). Similarly, women were more likely to reapply the cream (63% vs. 37%; $p < 0.000$).

Although 76.8% of those who applied sunscreen used one with an adequate protection factor (≥30), only 49.3% reapplied it within two hours. This failure to reapply the necessary protection compromises its effectiveness in preventing sunburn.

Table 3. Skin check-up and sun protection during outdoor activity

	Skin check-up		N	%
Section 2	Item 11. Medical examination	No	297	94.6
		Yes	17	5.4
	Item 14. Self examination of skin	No	280	89.5
		Yes	33	10.5
Sun protection during outdoor activity				
Section 3	Item 16. Sunscreen on face	No	253	82.1
		Yes	55	17.9
	Item 17. Factor ≥ 30	No	69	23.2
		Yes	229	76.8
	Item 18. Reapplication	No	151	50.7
		Yes	147	49.3

Metric properties

Table 4 shows the results obtained from the principal component analysis. The KMO test confirmed the adequacy of this analysis (0.577) and the Bartlett sphericity test confirmed the

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relevance of the factor model ($p < 0.000$). Four factors that accounted for 63.06% of the variance were extracted: the first of these, *Hours of sun exposure*, was strongly correlated with Items 1 and 2. Factor 2*, Avoid sun exposure,* was positively correlated with Items 5 and 7 (*Wearing protective clothing; Staying in the shade*) and negatively correlated with Item 9 (*Sunbathing in order to tan*). Factor 3, *Protective measures*, correlated with Items 4, 6 and 8 (*Sunscreen, Headgear, Sunglasses*), while Factor 4, *Sunburn and type of skin*, was positively correlated with Item 3 (*Sunburn history)* and negatively with Item 10 (*Skin colour*).

Table 4. Correlations between questionnaire items and factors

	Factor 1	Factor 2	Factor 3	Factor 4
ITEM 1 Weekday exposure	**.906**	-.066	-.033	.035
ITEM 2 Weekend exposure	**.896**	-.128	.035	-.001
ITEM 3 Sunburn history	.172	.019	-.209	**.839**
ITEM 4 Use sunscreen cream	-.111	-.157	**.712**	-.142
ITEM 5 Wear long-sleeved t-shirt	-.057	**.751**	-.060	.091
ITEM 6 Wear cap or hat	-.051	.135	**.652**	.054
ITEM 7 Stay in shade	-.173	**.655**	.273	-.153
ITEM 8 Wear sunglasses	.174	.138	**.572**	.040
ITEM 9 Sunbathe in order to tan	.006	**-.821**	-.017	.044
ITEM 10 Colour of skin	.245	.120	-.422	**-.653**

A Principal Component Analysis with varimax rotation was performed on the items with proven reliability, i.e. absolute agreement according to Cohen's kappa coefficient (Items 11, 13, 16, 17 and 18). Although from the formal standpoint of principal component analysis, the variables should be quantitative, this approach can also be used with dichotomous variables (as is the present case) to determine patterns of relationships between the variables. In this analysis, we obtained two main components that accounted for 53.89% of the variability of the data. The KMO test confirmed the adequacy of the factor analysis (0.528) and Bartlett's test of sphericity confirmed that of the factor model ($p < 0.000$). The first component correlated positively with Items 11 (Professional skin check-up) and 13 (Personal skin check-up), with correlations of 0.854 and 0.826, respectively; the second component correlated with Items 16 (Protection during outdoor activity), 17 (Sun protection factor >30) and 18 (Reapplication of sunscreen cream), with correlations of 0.48, 0.747 and 0.684, respectively. These results are coherent with the questionnaire construct.

Table 5 shows the results obtained from our evaluation of the reliability of the instrument using the ICC or the kappa coefficient concerning absolute agreement and the Cronbach alpha coefficient for internal consistency. In general, good results were obtained, thus confirming the reliability of the instrument.

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Table 5: Reliability with respect to stability (ICC and Kappa) and internal consistency (Cronbach's alpha)

Item	ICC	Cronbach's alpha
1 , 2 (sun exposure)	0.88	0.897
3 (sunburns)	0.91	0.906
4-9 (sun protection)	0.52	0.560
10 (skin colour)	0.97	0.974
12 (Last time Doctor)	0.96	0.962
14 (skin self examin.)	0.73	0.735
15 (Physical Activity)	0.90	0.91
Item	Kappa	S.E.
11 (Medical chek)	0.65	0.095
13 (self chek)	0.75	0.064
16 (sunscreen face)	0.68	0.055
17 (Prot. factor >30)	0.68	0.051
18 (reapplication)	0.67	0.043

Discussion

Sunburn, especially in young age, is considered a main risk factor for malignant melanoma, the most aggressive form of skin cancer, but also for non melanoma skin cancer as BCC, the most frequent skin cancer type. Our findings show that university students are alarmingly exposed to sunburn, with nearly 75% experiencing such a lesion during the previous year. This rate is similar to that found in the USA, where 76% of university athletes had had 1-3 sunburns in the previous year [29], and in Brazil, where 67% of university students had suffered this experience [30]. Nevertheless, even higher rates have been observed in other contexts, for example the 87% reported for nursing students in Spain [19].

In this study, we analyse the sun exposure and protection practices of Spanish university students, using an adaptation of the questionnaire on the prevention of skin cancer in adults proposed by Glanz et al. [31]. When applied to university students, this questionnaire has good metric properties in terms of reliability and validity. Questionnaires provide an effective means of measurement in population studies and are commonly used in health research. [18].

The adverse UVR skin effects not only depend to the on the of exposure duration, but also, and largely, to the skin type: Fitzpatrick photo-types 1 and 2, representing very fair skin, are the most sensitive to UV damage for both acute and long-term effects [11]. In general, there are no differences between the sexes in this respect, although women are more likely than men to take protective measures factors such as the frequent use of sunscreen cream and wearing suitable headgear [32].

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In the present study, the participants were university students, taking degrees in three aspects of education science. Analysis of the findings obtained confirmed our initial hypothesis that, possibly due to their youth, these students took insufficient measures of sun protection and were at serious risk of developing skin lesions and cancer.

The university of Cádiz is located in SW Spain, where levels of UVR are high throughout the year. In some respects, the sun is beneficial to healthy living, for example in contributing to the supply of vitamin D, as indicated by studies carried out with nurses [33. 34]. However, prolonged exposure to the sun presents a tangible risk to health [35]. According to our study, 60% of the students considered are exposed to UVR for 1-3 hours between 10 a.m. and 4 p.m. during the week, and this figure rises to 63% at the weekend. This degree of solar exposure is intensive and potentially harmful.

To our knowledge, no previous studies of the sun exposure and protection practices of university students have focused on the area of education sciences; our review of the literature shows that most have analysed students of health sciences, other areas of science or the humanities [19,22-24,30,36], while an Italian study focused on professional high school students of the agricultural and construction sectors [37]. The overall conclusion of almost all these studies is coherent with the findings of the present study, highlighting that the students' sun protection behaviour and practice are largely inappropriate.

A notable finding of the present study is that well over half of the respondents (59.7%) had suffered one or more sunburns during the previous year, following sun exposure in order to get a tan. This result corroborates earlier research conducted in this area [38].

In general, these students made inadequate use of means of sun protection. Thus, 46.7% do not use sunscreen cream at all, or do so only rarely. This result is alarming and highlights the need to promote the use of sunscreen (moreover, emphasising the need to reapply it regularly, especially after contact with water or following exertion resulting in a significant degree of perspiration) [39]. When outdoor physical activity is performed, the situation is even more critical; in this situation, 82.1% of the participants in our study do not use sunscreen on the face.

The inadequate use of sunscreen is accompanied by problems in other areas, too. Thus, 73.8% of the students in our analysis never or only rarely wear a hat or cap to protect their skin from the sun. Indeed, this practice is the least commonly adopted by the respondents. Previous studies have reported similar findings [34, 39, 40], observing also that, within this minority of users, men are more likely than women to wear protective headgear.

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Another important deficiency concerns the insufficient use of sunglasses, which provide an important degree of protection against UV rays and can even prevent injuries such as cataracts. Over half of the participants in this study (53.7%) rarely or never wear sunglasses, although the women do so more frequently than the men. These results corroborate previous reports [37, 40] and are significant for two reasons: because of the cancer risk to the persons directly involved, and because in the near future these men and women will be teaching children and adolescents and should provide them with a positive role model, exemplifying good practices. In this respect, studies have shown that many primary and secondary school teachers in Spain do not protect themselves properly from UVR [28]. We believe it necessary to raise awareness of the seriousness of the present situation and of its possible consequences for future generations. Therefore, these students of education sciences need to be informed of the dangers they face and urged to improve their sun protection practices.

Focusing on the proportion of respondents who visit a dermatologist, the numbers are shocking. Thus, 94.6% have never checked their skin for spots or lesions, although this simple act is one of the most effective measures they can take to detect skin lesions caused by exposure to UVR. [41].

Another worrying finding is that most of our respondents (89.5%) do not perform a self-examination of their skin to detect sun-related injuries. This suggests there is a low level of awareness of the personal risk of skin cancer. The failure to examine one's own skin, or to have this done by a dermatologist, may result in a delayed diagnosis of cancer and possibly a poorer prognosis. This aspect of our study corroborates previous research conducted with young athletes [26, 27].

Test-retest reliability was confirmed by the kappa coefficients and the ICC obtained. The Cronbach's alpha coefficient obtained also reflected good internal consistency, with values ranging from 0.374 to 0.65 [42]. These values are not especially high, which is a good sign, as a high coefficient may denote redundancy in the information collected. The lowest values were obtained for Items 16, 17 and 18 (related to physical activity and sun protection), which are dichotomous and therefore only require us to calculate the Kuder-Richardson KR-20 coefficient [43]. The values obtained suggest there may be unrelated subconstructs [44, 45].

The factor analysis performed revealed four underlying dimensions in the information compiled: duration of sun exposure (factor 1); avoiding sun exposure (factor 2); effective protection (factor 3); and lesions caused by sun exposure (factor 4).

The results obtained in this study show that the university students surveyed do not protect their skin effectively from UVR. The use of sunscreen cream alone is not sufficient to protect the skin; further actions must be taken, such as making use of available shade, wearing sunglasses and suitable headgear, and wearing a long-sleeved shirt and long trousers.

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Accordingly, efforts should be made to promote changes in students' attitudes towards sun exposure and protection [46]. It has been shown that focused interventions can increase the use of sunscreen cream, and that the image presented by the teacher is of crucial importance in transferring a good understanding of these issues to subsequent generations of students, thus enhancing their sun protection practices [47], and that there is a growing evidence that sun-safety education can be effective in increasing sun-protection habits [25,48].

Strengths and limitations

The main strength of the present study resides in the solid theoretical foundations of the questionnaire used, which is based on the recommendations of experts in the field such as Glanz et al. In consequence, the results obtained provide good internal consistency and stability. The data presented are significant in two respects: on the one hand, we highlight the risk of skin cancer currently faced by these university students. On the other, these same students will in the near future become teachers themselves, responsible for educating young people in these and other matters.

To our knowledge, this is the first study of its type to be conducted with a population consisting of Spanish university students of Education Sciences, who will subsequently be teachers in three areas of education in Spain – pre-school, primary and secondary. If these students are targeted today with campaigns informing them about sun exposure and effective measures of protection, this will greatly contribute to their transmitting this information to future generations of students, aged from 3 to 18 years.

Our study also has certain limitations. Firstly, the use of a questionnaire to obtain the study data means that there is no objective measurement of the variables considered, such as the sun protection measures taken. Nevertheless, Glanz et al. [15] observed a good correlation between self-reported data and measurements obtained of UV exposure. Another weakness of the present research is that the questionnaire used was not subjected to a strict process of validation.
There is no mention to the statistical power of the study to detect differences by gender or others factors. It would be interesting to evaluate results by skin colour/tanning ability as this may influence the student´s sun exposure and protection practices.

Conclusions

In conclusion, the results of our study indicate that Spanish university students are potentially exposed to dangerous levels of UV radiation, do not adopt adequate sun protection habits, and that many have suffered one or more sunburns in the last year. Therefore, intervention strategies should be designed and applied to highlight the risks involved, to improve sun

protection practices and to encourage skin examination. In turn, this will raise awareness of the relationship between excessive exposure to the sun and the development of skin cancer. This paper reports the currently excessive levels of sun exposure and the inadequate sun protection practices observed among Spanish university students of Education Sciences. Information campaigns should be conducted to address this problem so that when these students become teachers and have students of their own they may describe and demonstrate the benefits of skin care and provide a good foundation in health education. Public health campaigns will have to balance the message around both issues, the health risks and benefits with the synthesis of vitamin D for example.

References

1. Lucas, R.; McMichael, T.; Smith, W.; Armstrong, B. In: Environmental Burden of Disease Series, No. 13. Solar Ultraviolet Radiation: Global Burden of Disease from Solar Ultraviolet Radiation. Prüss-Üstün, A.; Zeeb, H.; Mathers, C.; Repacholi, M.; editors. World Health Organization; Geneva, Switzerland: 2006. (accessed on 25 November 2020). Available online: http://www.who.int/uv/health/solaruvradfull_180706.pdf.
2. International Agency for Research on Cancer (IARC) Radiation Volume 100 D. A Review of Human. Carcinogens. WHO Press; Lyon, France: 2012. [accessed on 25 November 2020]. Available online: https://www.ncbi.nlm.nih.gov/books/NBK304362/pdf/Bookshelf_NBK304362.pdf
3. Loney, T.; Paulo, M.; Modenese, A.; Gobba, F.; Tenkate, T.; Whiteman, D.C.; Green, A.C.; John, S.M. Global evidence on occupational sun exposure and keratinocyte cancers: a systematic review. *Br J Dermatol*. 2020, Apr 22. doi: 10.1111/bjd.19152.
4. Gobba, F.; Modenese, A.; Jon, S.M. Skin cancer in outdoor workers exposed to solar radiation: a largely underreported occupational disease in Italy. *J Eur Acad Dermatol Venereol*. 2019, Nov;33(11):2068-2074. doi: 10.1111/jdv.15768.
5. Jemal, A.; Devesa, S.S.; Hartge, P.; Tucker, M.A. Recent trends in cutaneous melanoma incidence among whites in the United States. 2001, *J Natl Cancer Inst*. 93(9) :678-683. doi: 10.1093/jnci/93.9.678.
6. Forsea, A.M.; Del Marmol, V.; De Vries, E.; Bailey, E.E.; Geller, A.C. Melanoma incidence and mortality in Europe: new estimates, persistent disparities. *Br J Dermatol*. 2012, 167(5) :1124-1130. doi: 10.1111/j.1365-2133.2012.11125.x.
7. Modenese, A. Gobba, F. Macular degeneration and occupational risk factors: a systematic review. *Int Arch Occup Environ Health*. 2019, Jan;92(1):1-11. doi: 10.1007/s00420-018-1355-y.
8. Modenese, A.; Korpinen, L.; Gobba, F. Solar Radiation Exposure and Outdoor Work: An Underestimated Occupational Risk. *Int J Environ Res Public Health*. 2018, Sep 20;15(10):2063. doi: 10.3390/ijerph15102063.

9. Molho-Pessach, V.; Lotem, M. Ultraviolet radiation and cutaneous carcinogenesis. *Curr Probl Dermatol*. 2007, 35:14-27. doi: 10.1159/000106407.
10. Armstrong, B.K.; Kricker, A. The epidemiology of UV induced skin cancer. *J Photochem Photobiol B.* 2001, 62(1-3):8-18. doi: 10.1016/s1011-1344(01)00198-1.
11. Fitzpatrick, T.B. The validity and practicality of sun-recreative skin types I through VI. *Arch. Dermatol*. 1998, 124,869-871. doi: 10.1001/archderm.124.6.869.
12. Autier, P.; Boniol, M.; Dore, J.F. Sunscreen use and the increased duration of intentional sun exposure: still a burning issue. *Int J Cancer*, 2007, 121:1-5. doi: 10.1002/ijc.22745.
13. Green, A.; Williams, G.; Neale, R. et al. Daily sunscreen application and betacarotene supplementation in prevention of basal-cell and squamus cell carcinoma of the skin: a randomised controlled trial. *Lancet.* 1999, 354:723-729. doi: 10.1016/S0140-6736(98)12168-2.
14. Creech, L.L.; Mayer, J.A. Ultraviolet radiation exposure in children: a review of measurement strategies. *Ann Behav Med*. 1998, 19, 399-407. doi: 10.1007/BF02895159.
15. Glanz, K.; Mayer, J.A. Reducing ultraviolet radiation exposure to prevent skin cancer methodology and measurement. *Am J Prev Med*. 2005, 29(2):131-142. doi: 10.1016/j.amepre.2005.04.007.
16. Bränstrom, R.; Kasparian, N.A.; Chang, Y.M. et al. Predictors of sun protection behaviors and severe sunburn in an international online study. *Cancer Epidemiol Biomarkers Prev*. 2010, 19: 2199-2210. doi: 10.1158/1055-9965.EPI-10-0196
17. Kristjansson, S.; Ullen, H.; Helgalson, A.R. The importance of assessing readiness to change sun protection behaviours: a population based study. *Eur J Cancer*. 2004, 22273-22280. doi: 10.1016/j.ejca.2004.08.027
18. De Troya-M,artín M.; Blázquez-Sánchez, N.; Rivas-Ruiz, F.; Fernández-Canedo, I.; Rupérez-Sandoval, A.; Pons-Palliser, J.; Perea-Milla, E. Validación de un cuestionario en español sobre comportamientos, actitudes y conocimientos relacionados con la exposición solar: "Cuestionario a pie de playa". *Actas dermosifiliogr*. 2009, 100:586-595. PMID: 19715643
19. Puzas-Iglesias, A.; Méndez-Iglesias, M.; Diéguez, M.P.; Florez, A. Assessment of sun-related behaviour, knowledge and attitudes among nursing students. *Photodermatol Photoinmunol Photomed*. 2019, 35(5):304-312 doi: 10.1111/phpp.12466.
20. Ponce, S.; Jódar, A.; Borrego, L.; Saavedra, P. Behaviors, attitudes, and knowledge related to sun exposure among medical students at the Universidad de Las Palmas de Gran Canaria. *Actas Dermosifiliogr*. 2019, 110(5):372-384. doi: 10.1016/j.ad.2018.10.002.
21. Almuqati, R.R.; Alamri, A.S.; Almuqati, N.R. Knowledge, attitude, and practices toward sun exposure and use of sun protection among non-medical, female,

university students in Saudi Arabia: A cross-sectional study. *Int J Womens Dermatol*. 2019, 5 (2):105-109. doi: 10.1016/j.ijwd.2018.11.005.

22. Shahnam, A.; Samarawickrema, I.; Ali, S. Sun-protection practices among undergraduates at an Australian University. *Australas J Dermatol*. 2017, 58(2):93-98. doi: 10.1111/ajd.12388.
23. Kirk, L.; Greenfield, S. Knowledge and attitudes of UK university students in relation to ultraviolet radiation (UVR) exposure and their sun-related behaviours: a qualitative study. *BMJ.* Open Mar. 2017, 13;7(3):e014388. doi: 10.1136/bmjopen-2016-014388.
24. Zuba, E.B; Francuzik,W.; Malicki, P.; Osmola-Mańkowska, A.; Jenerowicz, D. Knowledge about ultraviolet radiation hazards and tanning behavior of cosmetology and medical students. *Acta Dermatovenerol Croat*. 2016, 24(1):73-77. PMID: 27149135
25. Reinau, D.; Weiss, M.; Meier. C.R. Outdoor workers' sun-related knowledge, attitudes and protective behaviours: a systematic review of cross-sectional and interventional studies. *Br J Dermatol.* 2013, 168: 928-940. doi: 10.1111/bjd.12160.
26. De Castro-Maqueda, G.; Gutierrez-Manzanedo, J.V.; Ponce-González, J.G.; Fernandez-Santos, J.R.; Linares-Barrios, M.; De Troya-Martín, M. Sun Protection Habits and Sunburn in Elite Aquatics Athletes: Surfers, Windsurfers and Olympic Sailors. *J Cancer Educ*. 2020, Apr;35(2):312-320. doi: 10.1007/s13187-018-1466-x. PMID: 30637576.
27. De Castro-Maqueda, G.; Gutierrez-Manzanedo, J.V.; Lagares-Franco, C.; Linares-Barrios, M.; de Troya-Martin, M.; Photoprotection practices, knowledge and sun-related skin damage in Spanish beach handball players. *Peer J*. 2019a, Jun 18;7:e7030. doi: 10.7717/peerj.7030. eCollection 2019.
28. Castro-Maqueda, G.; Gutierrez-Manzanedo, J.V.; Fernandez-Santos, J.R.; Linares-Barrio, M.; Troya-Martín, M. Sun Protection Habits and Sun Exposure of Physical Education Teachers in the South of Spain. Photochem Photobiol. 2019b, Nov;95(6):1468-1472. doi: 10.1111/php.13147. Epub 2019 Oct 8. PMID: 31407345.
29. Wysong, A.; Gladstone, H.; Kim, D.; Lingala, B.; Copeland, J.; Tang, J.Y. Sunscreen use in NCAA collegiate athletes: identifying targets for intervention and barriers to use. *Prev Med*. 2012, 55(5):493-496. doi: 10.1016/j.ypmed.2012.08.020.
30. Dallazem, L.N.; Benvegnú, A.M.; Stramari, J.M.; Beber, A.A; Chemello, R.M. Beck, M.O. Knowledge and habits of sun exposure in university students: a cross-sectional study in Southern Brazil. *An Bras Dermatol*. 2019, 94(2):172-181. doi: 10.1590/abd1806-4841.20197507
31. Glanz, K.; Yaroch, A.L.; Dancel, M.; Saraiya, M.; Crane, L.A; Buller, D.B.; Manne, S.; O´Riordan, D.L.; Heckman, C.J.; Hay, J.; Robinson, J.K. Measures of sun exposure and sun protection practices for behavioural and epidemiologic research. *Arch Dermatol.* 2008, 144(2):217-222. doi: 10.1001/archdermatol.2007.46.

32. Day, A.; Oxlad, M., Roberts, R. Predictors of sun-related behaviors among young women: Comparisons between outdoor tanners, fake tanners, and tan avoiders. *J Am Coll Health*. 2013, 61:315-322. doi: 10.1080/07448481.2013.806926
33. Wilcox, A. Sun exposure. *Practice Nursing*. 2008, 19:449-452.
34. Simon, K.C.; Munger, K.L.; Ascherio, A. Vitamin D and multiple sclerosis; epidemiology, inmunology and genetics. *Curar Opin Neur*. 2012, 25: 246-251. doi: 10.1097/WCO.0b013e3283533a7e.
35. Kasparian, N.A.; McLoone, J.K.; Meiser, B. Skin cancer-related prevention and screening behaviours: a review of the literature. *J Behave Medic*. 2009, 32: 406-428. doi: 10.1007/s10865-009-9219-2
36. Othaman-Bahakim, N.A.; Alanazi, B.G.; Alead, M.Y.; Alaql, A.B.; Al-Ogail, N.A.; Al-ghulaydhawi, F.A. Sun exposure behaviours, attitudes and protection practices among Prince Sattam Bin Abdulaziz university students - A survey study. *J Pak Med Assoc*. 2016, 66 (12):1528-1534. PMID: 27924960.
37. Modenese, A.; Loney, T.; Ruggieri, F.P.; Tornese, L.; Gobba, F. Sun protection habits and behaviors of a group of outdoor workers and students from the agricultural and construction sectors in north-Italy. *Med Lav*. 2020, Apr 30;111(2):116-125. doi: 10.23749/mdl.v111i2.8929.
38. Gerbert. B.; Johnston, K.; Bleecker, T.; McPhee, S. Attitudes about skin cancer prevention: a qualitative study. *J Cancer Educ*. 1996, 11:96-101. doi: 10.1080/08858199609528403
39. Bowen, D.; Jabson, J.; Haddock, N.; Hay, J.; Edwards, K. Skin care behaviors among melanoma survivors. *Psycho-Oncology*. 2012 2, 1: 1285-1291. doi: 10.1002/pon.2017.
40. Lagerlund, M.; Dixon, H.G.; Simpson, J.A.; Spittal, M.; Taylor, H.R.; Dobbinson, S.J. Observed use of sunglasses in public outdoor setting around Melbourne, Australia. 1993 to 2002. *Prev Med.* 2006, 42: 291-296. doi: 10.1016/j.ypmed.2006.01.003
41. Haluza, D.; Cervinka, R. Perceived relevance of educative information on public (skin) health: a cross-sectional questionnaire survey. *J Prev Med Public Health*. 2013, 46:82-88. doi: 10.3961/jpmph.2013.46.2.82
42. Cronbach, L.J. Coefficient alpha and the internal structure of tests. *Psychometrika.* 1951, 16(3):297-334. doi: 10.1007/BF02310555
43. Kuder, G.F.; Richardson, M.W. The theory of the estimation of test reliability. *Psychometrika*. 1937, 2(5), 151-160. doi: 10.1007/BF02288391
44. Rubin, H.R. (2002). Psychometrics or psycho metrics? Alpha abuse
45. Pérez-Gil, J.A.; Chacón-Moscoso, S.; Moreno-Rodríguez, R. Validez de constructo: el uso del análisis factorial exploratorio-confirmatorio para obtener evidencias de validez. *Psicothema*. 2000, 12(2), 442-446

46. Day, A.K.; Wilson, C.J.; Hutchinson, A.D; Roberts, R.M. The role of skin cancer knowledge in sun-related behaviours: a systematic review. *J Health Psychol*. 2014, 19(9):1143-1162. doi: 10.1177/1359105313485483
47. Ally, M.S.; Swetter, S.M.; Hirotsu. K.E; Gordon, J.; Kim, D.; Wysong, A.; Donnelly, L.; Li, S.; Nord, K.M. Promoting sunscreen use and sun-protective practices in NCAA athletes: Impact of SUNSPORT educational intervention for student-athletes, athletic trainers, and coaches. *J Am Acad Dermatol*. 2018, 78(2):289-292.e2. doi: 10.1016/j.jaad.2017.08.050.
48. Doncel-Molinero, D. Ruiz, Paulano, M.; Rivas-Ruiz, F.; Blázquez-Sánchez, N. Gálvez-Aranda, M.V.; de Castro-Maqueda. G.; de Troya-Martín, M. Sun Protection Behaviour and Sunburns in Spanish Cyclists. J Cancer Educ. 2020, Oct 27. doi: 10.1007/s13187-020-01906-y. Epub ahead of print. PMID: 33108803.