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Lack of Knowledge and Misperceptions on Photoprotection among Brazilian Youngsters

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Abstract: Daily photoprotection (PhP) is essential in preventing harmful effects from solar ultraviolet radiation (UVR) exposure. For that reason, we interviewed students aged from 4 to 20 years old about their knowledge on sun exposure and PhP habits. Age, sex, family income, and skin phototype were statistically related to the proposed questions. Our results show that Brazilian youngsters do not have the habit of wearing long-sleeved clothing (<15% in summer), sunglasses (0.0%), or hats (2.1%). More than 40% had no knowledge about ultraviolet index (UVI), while another 30% misinterpreted what it is. Less than half of all students wear sunscreen when out in the sun. Despite this low PhP use-rate, more than 90% know that UVR causes skin cancers. Low income was the factor that showed the greatest number of significant relationships with respect to the lack of PhP. The findings suggest that current traditional PhP campaigns are not efficient. We propose that PhP should be part of school curricula from elementary school onwards. After all, the lack of educational programs predisposes these youngsters to an increased chance of skin diseases in the future.

Keywords: young students; public policy; skin cancer prevention; behavior assessment; developing countries

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1. Introduction

Skin cancer (SC) is a public health problem worldwide, especially in tropical regions, due to the high incidence of ultraviolet solar radiation (UVR) [1]. The number of SC cases has increased in recent years, especially in its less common yet more severe form, cutaneous melanoma (CM). According to the GLOBOCAN cancer statistics, more than 324,000 new cases of CM occur globally each year [2]. However, the most common SCs are the nonmelanoma skin cancers (NMSC), constituting 95% of all SC diagnoses. Although less lethal, NMSC is 18 to 20 times more common than CM. Furthermore, NMSC puts a significant economic burden on health systems since treatment costs are high, about seven times higher than for CM treatment [3,4].

By contrast, sun exposure also has beneficial health effects, such as the synthesis of vitamin D, which can prevent some types of cancer and improve mental health and psychological well-being [5,6]. However, it is incorrect to suggest that longer sun exposure will accelerate vitamin D production in regions with high incidences of solar radiation. The UVR levels in tropical regions are sufficiently high for vitamin D to be produced over short, daily exposures during most parts of the year [7].

The ultraviolet index (UVI) is a simple and useful tool recommended by the World Health Organization for preventing UVR overexposure. It is a unitless scale reported on a range of exposure categories from 1 to 11+, as follows: Low (UVI < 2), Medium (3 < UVI < 5), High (6 < UVI < 7), Very high (8 < UVI < 10), and Extreme (UVI > 11). Each

UVI unit is equivalent to 25 mW m^{-2} erythemal action spectrum weighted irradiance. Thus, the UVI shows the wavelength dependence of the effects of harmful UVR by measuring the response of human skin. No sun protection is required for low UVI levels. The use of protection is required for medium and high levels, such as seeking shade around noon and the use of shirt, hat, and sunscreen. In very high and extreme UVI conditions, sun exposure should be avoided at mid-day and extra protection is a must [8,9].

The use of sunscreen, sunglasses, long-sleeved clothing, and caps or hats is an important element for effective photoprotection (PhP) [10,11]. However, educational campaigns are essential in combating the harmful effects of UVR and should be supported by behavioral pattern studies on habits and ways of receiving sun exposure [12,13]. Still, there are not many educational programs on PhP worldwide [14–17]. Furthermore, PhP is normally associated with leisure activities or prolonged sun exposure, and most programs are only emphasized in the summer. In regions with high UVR levels, everyday exposure can lead to long-term damage, and, in general, these educational programs do not address PhP as a necessary daily habit throughout the year.

Studies performed in more developed countries have shown that, regardless of age, profession, and income, PhP habits among individuals are inadequate [18–21]. By contrast, the cosmetics industry has reported increased sales of sun creams, which may be related to aesthetic factors related to excessive exposure to the sun, e.g., photoaging, freckles, and wrinkles [22]. Moreover, increased PhP use is not always reflected in the proper use of sun creams, sunglasses (effective UV protection), or the use of appropriate clothing or hats that cover parts of the body most prone to the development of SC, such as the lips, eyelids, neck, and extremities [23,24].

In light of the lack of studies on the topic in under- and mid-developed countries, the aim of this study was to carry out a detailed assessment of PhP habits and educational programs for children and adolescents in Brazil. Even though this study was carried out at the local scale, it should serve as a basis for developing educational prevention campaigns aimed especially at children and adolescents in countries with similar population and economic demographics and geographical characteristics, in addition to providing subsidies for strategies to map and mitigate the growing numbers of new SC cases.

2. Materials and Methods

2.1. Sample Characteristics

This study was carried out with children and adolescents aged between 4 and 20 years from public and private schools located in Southeastern Brazil. Brazil is one of the largest countries in area (5th), population (6th), and extreme social inequalities, where the bottom 50% earns 29-times less than the top 10% [25]. Although they do not represent the different regions of the country, we chose four schools with socioeconomic and educational heterogeneous characteristics similar to those commonly found among all over the country. The sample groups comprised kindergarten, elementary, high school, and college prep students in different stages of study.

In the first stage, we conducted visual analysis by taking photographs of the clothing being used, such as short or long-sleeved shirts, pants or shorts, open or closed shoes, caps or hats, and accessories and sunglasses. This visual analysis of the clothing was based on an adapted method [26] and was carried out in the hot season, from mid-September to April, and the cold season, from mid-April to mid-September [27]. The samples numbered 2162 and 2119 students, respectively, totaling about 4300 students in the two periods. We made observations at the beginning of school (7 a.m. and 13 p.m.) and at the end of classes (12 p.m. and 17 p.m.), respectively.

Next, students were given questionnaires that addressed socioeconomic issues [28], a self-assessment of their skin phototype [29], and their knowledge and habits on PhP [18,30]. The skin phototype scale (Table 1) is based on the sensitivity and ability of the skin to sunburn and to tan, respectively [31]. The phototype scale is also correlated to skin cancer occurrence, where the lower the phototype, the higher the risk of skin cancer. Illiter-

ate children were helped by parents or guardians during meetings held at the schools. Of the 2844 questionnaires distributed, 512 (19.2%) were valid because they were completed in full without erasures. The following socioeconomic requirements were assessed: (1) Gender (2 options): male (M) or female (F); (2) Age group (3 options): (a) 4 to 9 years, (b) 10 to 14 years, and (c) 15 to 20 years; and (3) Family income, in terms of the number of minimum monthly wage (MW) (5 options): (a) < 2, (b) 2 to 3, (c) 3 to 5, (d) 5 to 10, and (e) >10. Knowledge on PhP and the effects of UVR were assessed using a questionnaire with 14 questions, divided into 3 blocks: (a) knowledge on UVI and use of sunscreen; (b) habit of using accessories for PhP; and (c) knowledge about the effects of UVR on health. The questionnaires are available in the Supplementary Material section available at: https://doi.org/10.5281/zenodo.7468691 (accessed on 19 Dcember 2022). (One minimum monthly salary in Brazil is a government-defined minimum wage for one worker, defined in terms of a monthly salary, NOT an hourly rate. In 2022, the minimum monthly salary in Brazil was BRL 1212.00. At the exchange rate OF USD 1.00 = BRL 5.10 (23 August 2022), this is approximately USD 237.00 a month.)

Table 1. Fitzpatrick's phototype scale, skin type, and risks.

Phototype	Unexposed Skin	Burn	Tan	MED * (J/m^2)	Skin Cancer Risk
I	White	Always	Never	150–300	Maximal
II	White	Easily	Minimally	250–400	
III	Fair	Moderately	Average	300–500	⇧
IV	Light brown	Minimally	Easily	400–600	
V	Brown	Rarely	Substantially	600–900	
VI	Black	Never	Profusely	900–1500	Minimal

* Minimal erythematous dose (MED) is defined as the least amount of UVB radiation that causes reddening and inflammation of the skin 24–48 h after exposure (i.e., the lowest UV dose that causes sunburn).

2.2. Statistical Analysis

The variances of the answers on PhP behavior and education were analyzed using a three-factor ANOVA arrangement ($2 \times 5 \times 3$) with 512 samples (questionnaires), considering sex (2 levels), income (5 levels), and age (3 levels), according to what was presented in the previous section at 5% probability. Ranking ranged from 1 for a correct and/or expected answer to 6 an incorrect/inappropriate answer, corresponding to the total number of items. In ANOVA, the null hypothesis states that the factors are independent and that there is no interaction among them ($p \geq 0.05$), while the alternative hypothesis states that the factors are dependent and that there is interaction among them ($p < 0.05$). Subsequently, the averages for each factor were submitted to the Tukey test at $\alpha = 5\%$. In the Tukey test, the null hypothesis is that the averages of each level of the nondifferent factors are ($p \geq 0.05$), and the alternative hypothesis is that the averages are different ($p < 0.05$) [32]. A data sheet with the answers is available in the Supplementary Material (https://doi.org/10.5281/zenodo.7468691 (accessed on 19 December 2022)).

3. Results

3.1. Wearing Clothing

Table 2 shows the frequency with which certain types of clothes are worn by students.

Table 2. Frequency (%) of wearing PhP clothing and accessories.

Body Part	Clothes or Accessories	Hot Season n = 2162	Cold Season n = 2119	Total n = 4281
Head	Caps, Hats, and Beanies	1.3	2.9	2.1
Upper Members	Sleeveless shirt	1.1	0.6	0.8
	Shor-sleeve shirt	84.8	38.0	61.7
	Long-sleeve shirt	14.1	61.3	37.5
Lower Members	Pants, dresses, skirts, and shorts (to the knees)	33.1	25.8	29.5
	Pants, dresses, skirts, and shorts (below the knees)	66.9	74.2	70.5
Feet	Closed shoe	93.6	99.4	96.4
	Open shoe	6.4	0.6	3.6
Eyes	Sunglasses	0.0	0.0	0.0
Other Parts	Shawls, scarfs, and gloves	0.0	9.4	4.6

In general, the results show that the upper parts of the body are not adequately protected from the sun in day-to-day life in both seasons. For example, sunglasses are important for maintaining eye and eyelid health, and yet sunglasses were not used by the students. The students wore short-sleeved clothing, even in the cold season (~40% of respondents), leaving most of their upper limbs exposed. Accessories which could provide protection for sensitive regions such as the ears, neck, and hands were only used in winter and among less than 10% of the students. By contrast, most respondents (between 67% and 74%) preferred to wear pants, dresses, and shorts below the knee line in both seasons, and closed shoes, worn by almost all students (96%), offering adequate protection for the lower extremities of the body.

3.2. Socioeconomic Aspects and Phototypes

Table 3 shows the distribution of phototypes, sex, income, and age. Of the 512 questionnaires applied, both sexes were represented equally. Most students were between 10 and 14 years old (46.0%) and showed low-income levels ($\leq$2 MW) (57.6%). This distribution is qualitatively close to the sex, age, and income distributions for the last census carried out in Brazil [28]. The predominant phototype is type III (>65% of the sample), followed by phototypes IV (~17%) and II (~15%). These results were also compatible with the distribution of skin color in the region, where 76.9% of the individuals state that they are white (phototypes I to III) and 22.7% brown or black (phototypes IV to VI). Since skin color is an individual subjective metric, we can find important variations in this distribution among different regions in Brazil. Comparisons of this nature are complex and beyond the scope of this study.

Table 3. Characteristics of the population (subanalysis for gender, age group, family income, and skin phototype). Upper numbers indicate absolute responses and numbers in the parentheses indicate relative frequencies (%).

		All	Gender		Age Group (Years Old)			Family Income (MW)				
		n = 512	Male	Female	4–9	10–14	15–20	≤2	2–3	3–5	5–10	>10
Gender	**Male**	260 (50.8)										
	Female	252 (49.2)										
Age group (years old) *	**4–9**	114 (22.3)	57 (21.9)	57 (22.6)								
	10–14	233 (45.5)	113 (43.5)	120 (47.6)								
	15–20	165 (32.3)	90 (34.6)	75 (29.8)								
Family income (MW) **	**≤2**	295 (57.6)	139 (53.5)	156 (61.9)	48 (16.3)	152 (51.5)	95 (32.2)					
	2–3	84 (16.4)	39 (15.0)	45 (17.9)	16 (19.0)	29 (34.5)	39 (46.4)					
	3–5	84 (16.4)	47 (18.1)	37 (14.7)	18 (21.4)	40 (47.6)	26 (31.0)					
	5–10	25 (4.9)	17 (6.5)	8 (3.2)	12 (48.0)	9 (36.0)	4 (16.0)					
	>10	24 (4.7)	18 (6.9)	6 (2.4)	20 (83.3)	3 (12.5)	1 (4.2)					
Skin Phototype ***	**I**	1 (100)	1 (0.4)	0 (0)	1 (0.9)	0 (0)	0 (0)	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)
	II	74 (100)	27 (10.4)	47 (18.7)	23 (20.2)	32 (13.7)	19 (11.5)	43 (14.6)	11 (13.1)	14 (16.7)	5 (20.8)	1 (4.2)
	III	335 (100)	168 (64.6)	167 (66.3)	69 (60.5)	157 (67.4)	109 (66.1)	190 (64.4)	57 (67.9)	55 (65.5)	14 (58.3)	18 (75.0)
	IV	88 (100)	51 (19.6)	37 (14.7)	17 (14.7)	41 (17.6)	30 (18.2)	54 (18.3)	13 (15.5)	14 (16.7)	3 (12.5)	4 (16.7)
	V	14 (100)	13 (5.0)	1 (0.4)	4 (3.5)	3 (1.3)	7 (4.2)	7 (2.4)	3 (3.6)	1 (1.2)	2 (8.3)	1 (4.2)

* mean age: 12.1 ± 3.9 (all): 6.1 ± 1.7 (4–9 yr)/12.2 ± 1.3 (10–14 yr)/16.1 ± 1.2 (15–20 yr). ** in terms of number of minimum monthly wages (MW). *** see Table 1.

3.3. PhP Education on the Health Effects of UVR

Table 4 shows the results obtained from the questionnaire on PhP education and the health effects of UVR. For simplicity's sake, this table is a summary of the main results. Complete and detailed results for each factor (gender, age, income, and phototype) are available in the Supplementary Material (https://doi.org/10.5281/zenodo.7468691 (accessed on 19 December 2022)).

Table 4. Questions and answers on knowledge and habits for PhP.

a) Questions 1 to 4—knowledge about UVI and using sunscreen, multiple answers.

		Answers (%)					
Questions		**a**	**b**	**c**	**d**	**e**	**f**
Q1	Did you read in the newspaper that the UV index forecast is 7? Do you think that this radiation level is: (a) Low (5) *; (b) Medium (4); (c) High (1); (d) Very High (2); (e) Extreme (3); (f) I don't know (6)	2.5	16.2	27.3	9.6	1.6	42.8
Q2	When do you use sunscreen? (a) Whenever I leave the house (1); (b) Only when I go outdoors to walk, play sports, etc. (2); (c) Only when I go to the beach or pool (3); (d) Other situations (4); (e) I don't use sunscreen (5)	17.5	15.9	49.7	4.3	12.6	
Q3	How do you use sunscreen? (a) I apply it only before exposing myself to the sun (2); (b) I apply it only when I start to feel the sun heat my skin (3); (c) I apply it before exposing myself to the sun and reapply it while I am exposed (1); (d) I apply only when I feel I starting to get burned (4); (e) I do not apply sunscreen (5)	43.3	5.3	32.9	2.4	16.1	
Q4	When you use sunscreen, what is the sun protection factor (SPF)? (a) I do not use sunscreen (4); (b) SPF between 6 to 15 (3); (c) SPF between 20 to 30 (2); (d) SPF between 30 to 60 (1)	14.3	7.6	23.9	54.2		

b) Questions 5 to 8—Using sun protection accessories

		Yes (1) *	**No (3)**	**Sometimes/I don't know (2)**
Q5	Do you wear any kind of hats or caps when you are outdoors?	17.0	51.8	31.2
Q6	Do you wear sunglasses?	21.1	48.4	30.5
Q7	Are your sunglasses UV rated?	18.4	46.7	35.0
Q8	Do you wear long-sleeved shirts to protect yourself from the sun?	6.4	77.7	15.8

c) Questions 9 to 14—Knowledge on the health effects of UVR

		Yes (3) *	**No (1)**	**I don't know (2)**
Q9	Do you think a tan is beautiful and healthy?	18.4	58.6	23.0
Of all the diseases listed below, which are caused by excessive sun exposure?				
Q10	Low immunity	9.4	29.5	61.1
Q11	Skin cancer	90.8	4.5	4.7
Q12	Eye diseases (cataracts)	30.3	27.7	42.0
Q13	Premature aging (wrinkles)	63.1	16.0	20.9
Q14	Skin blemishes (freckles and spots)	68.8	15.0	16.2

* Values in parentheses indicate the rank of the response, ranging from 1 for the expected response to the total number of items for incorrect or inadequate responses. Answers are in %.

The first question (Q1—Table 4a) asked an arbitrary question about what UVI = 7 meant, asking students to cite the potential harm of UVR as per the WHO [33]. The results showed a general lack of knowledge surrounding WHO recommendations that seek to increase public awareness about the risks of excessive UVR exposure and to alert them about the need for adopting protective measures. More than 30% of the answers were considered wrong, and 42.8% did not know what UVI stood for. Only 25% of students correctly answered that UVI = 7 represents a high potential health risk. In questions Q2 to Q4, which addressed the

use of sunscreen lotions, we observed that half of the students only use sunscreen when they go to the beach or pool, and less than 20% use sunscreen daily. Only 1/3 of the interviewees reapply sunscreen regularly, while 1/4 of the students do not use sunscreen at all or use it incorrectly. A total of 54.2% of students use sunscreen with SPF > 30, as recommended by the medical societies of dermatology [34].

Table 4b shows the questions and answers on using clothing and accessories for sun protection. Hats, sunglasses, and long-sleeved shirts are not used as a form of protection by 52%, 48%, and 78% of the students, respectively. Furthermore, some respondents (15 to 30%) admitted to using accessories only sporadically. These students probably do not view these accessories as being an effective PhP measure, but rather as an aesthetic accessory. Another interesting point, which again highlights the general lack of knowledge on the topic, is that less than 20% of students admitted to knowing if their glasses had UVR protective lenses. It is important to note that the results of this survey coincide with the photographic assessment in Section 3.1 and indicate that these accessories are not regularly used by students when they are outdoors.

The last sequence of questions (Table 4c) addressed knowledge on the health effects of UVR. More than 90% of students responded that they knew that there was some association between skin cancer and excessive sun exposure. Premature aging and skin spots were cited by 63 and 69% of all respondents, respectively. The greatest gap in knowledge was related to dissociated skin effects, such as diseases of the eye and immunosuppression. Only 30% and less than 10% of all students made this association, respectively. Another interesting aspect, possibly associated with fashion trends, was that approximately 60% of all students did not think that a tan was a desirable or healthy aesthetic quality.

3.4. PhP Education on the Health Effects of UVR

Table 5 shows the probability of the F-test from the ANOVA analyses and the average comparison between the variation factors (sex, income, and age) using the Tukey test. For brevity's sake, the values presented in this table are average rankings for the answers referring to each question in the questionnaire (Q1 to Q14). Ranks close to 1.00 indicate answers closer to the correct or expected answer for the question.

The Income factor showed the greatest number of statistically significant relationships (10) in explaining student knowledge and behavior on PhP ($p < 0.05$), followed by age (8) and sex (5). The highest-income-level students (MW > 10) gave answers strongly associated with the expected answers for the three categories of questions presented in Table 4, i.e., the highest-income-level-students sample gave answers closer to the correct and/or expected answers for PhP habits and for knowledge on UVI and the health effects of UVR.

Although higher income classes had the lowest mean values (ranks) for responses (2.58 for >10 SM and 3.62 for 4 < SM < 10), it is important to highlight limitations in knowledge surrounding the meaning of the UVI = 7 scale (Q1). Most responses had high ranks, between 3 and 4, indicating that they partially understood the harmful effect of high UVR exposure levels. Underestimating the harmful effects of high UVR exposure levels was corroborated in answers to questions Q2 to Q4 (about the use of sunscreen) and Q5 to Q7 (about using accessories for sun protection). For Q2, the answers had an average rank of 2.65 ($\pm$0.28), confirming that sunscreen use is strongly associated with leisure and outdoor activities, regardless of age and gender. Inadequate PhP knowledge was also observed for questions on using accessories for sun protection (Q5–Q8) and was more concerning for lower income classes.

Table 5. Comparison of the averages for each variable (Q1 to Q14) showing the differences between the levels for each variation factor (gender, income and age). F-test probability values from the variance analysis for the fourteen questions in Table 4.

		Sex		Income						Age			
	p	M	F	*p*	<2 MW	2–3 MW	3–5 MW	4–10 MW	>10 MW	*p*	4–9 Age	10–14 Age	15–20 Age
Q1 *	0.31			0.00	4.14b	3.22ab	3.90b	3.62ab	2.58a	0.00	3.26a	4.39b	3.49a
Q2	0.00	2.93b	2.61a	0.00	2.93b	2.58ab	2.67ab	2.25a	2.29a	0.00	2.48a	2.66a	3.11b
Q3	0.98			0.00	2.00b	1.89b	1.86ab	2.12b	1.41a	0.02	1.80a	1.91ab	2.01b
Q4 **	0.00	2.01b	1.62a	0.00	1.97b	1.72b	1.70b	1.45ab	1.08a	0.00	1.48a	1.77b	2.12c
Q5	0.00	2.13a	2.57b	0.01	2.37b	2.44b	2.33b	2.20ab	1.87a	0.21			
Q6	0.00	2.45b	2.09a	0.00	2.28b	2.26b	2.40b	2.17ab	1.83a	0.20			
Q7	0.42			0.00	2.40b	2.21b	2.19b	2.08b	1.62a	0.00	2.27ab	2.21a	2.41b
Q8	0.13			0.28						0.07			
Q9	0.84			0.21						0.00	1.35a	1.66b	1.67b
Q10	0.30			0.78						0.88			
Q11	0.25			0.00	1.19b	1.07a	1.05a	1.08a	1.00a	0.42			
Q12	0.20			0.52						0.13			
Q13	0.45			0.00	1.69b	1.38ab	1.33ab	1.25a	1.08a	0.00	1.21a	1.56b	1.70b
Q14	0.00	1.55b	1.37a	0.00	1.55b	1.46b	1.32ab	1.25ab	1.00a	0.00	1.16a	1.63c	1.42b

Values refer to original data, transformed using the Box–Cox transformation [35]. Means values followed by different letters differ from each other by the Tukey test at 5%. Letters were assigned in ascending order for each variable and variation source. Empty columns are nonsignificant variation sources by the F-test ($p \geq 0.05$). Gray cells were not significant variation sources. * Interaction between the variation sources sex vs. age at a 0.05 significance level. ** Interaction between the variation sources gender vs. income at a 0.05 significance level.

Regarding the age group factor, the answers closest to the correct answer were for younger students (4–9 years). This could reflect parental concerns about PhP in younger children (Q2 to Q4). By contrast, regarding aesthetic tanning (Q9), the results show that students older than 10 were more interested in this aspect. However, most answers did not draw any association between tanning and beauty, thus resulting in a desired prevention aspect.

Finally, the five questions that were significant for gender (Q2, Q4–Q6, and Q14) were answered correctly by female students, except for Q5. Females showed greater concern (and answers closer to the correct answer) regarding questions related to using sunscreen (Q2 and Q4), wearing glasses (Q6), and skin spots, such as freckles and moles (Q14). For males, this was true of using accessories such as caps and hats (Q5). Using accessories for PhP (Q5 and Q6) was sporadic and below the desired level for both genders in the questionnaire (rank > 2) and for the on-site observations (Table 2). There was no gender significance for questions on knowledge surrounding the health effects of UVR (Q9 to Q13), except for an association between sun and skin spots.

Only three questions (Q8, Q10, and Q12) were not statistically significant ($p > 0.05$) for any of the three factors considered in this study (gender, income, and age). Long-sleeved shirts (Q8), lowered defenses against infections (Q10), and visual diseases (cataracts) (Q12) were poorly associated with PhP (Tables 2 and 4). There was also no significant relationship between sex, age, and income in the two questions, and the answers indicated less knowledge about diseases caused from excessive sun exposure sun, immunosuppression (Q10), and eye diseases (Q12).

The inter-relationships between sex, age, and income were also analyzed. There were no statistically significant interactions for the three factors. Interactions between two factors were only observed for questions 1 (gender vs. age) and 4 (sex vs. age and sex vs. income) (see Tukey Test Supplementary Table at https://doi.org/10.5281/zenodo.7468691 (accessed on 19 December 2022)). Similar behavior was observed for both questions in the responses for males and females in younger age groups. By contrast, there was a significant difference between the responses of male and female adolescents (15–20 years). For Q4, there was a significant difference between genders in the responses of groups with MW < 5, as women seemed to understand SPF more than men. For income groups above 5 MW, the responses were homogeneous among both sexes close to the expected/correct values for properly using high SPF sunscreen.

4. Discussion

This study sought to evaluate the knowledge degree on PhP among Brazilian children and adolescents. Overall, the findings corroborate the evidence on the limited effectiveness of one-off PhP campaigns for adolescents and adults [36,37]. Here, we would like to emphasize that there is a lack of knowledge regarding the PhP habits and solar overexposure effects among Brazilian youngsters. Our findings were similar to several other studies performed around the world [13,38,39].

In summary, the UVI is not well-known among Brazilian students even though it is the main tool for publicizing information on the harmful health effects of the sun. Sunscreens are basically only used during leisure activities, and only 1/5 of all students use it daily. When it is used, sunscreen cream is often applied inadequately. In addition to a lack of a culture of awareness surrounding skin protection, one other variable may be the high cost of products [40]. It is worth noting that, despite the lack of sun protection habits, most students knew about the main harmful effects caused by sun overexposure, i.e., skin cancer and aging. These results lead us to conclude that the current methods of PhP policies are inefficient.

The use of physical sun blockers was also lower than expected, perhaps due to the local climate that favors short clothes, but also due to the lack of knowledge about the importance of the protection offered by long clothes, hats, and sunglasses. After all, these physical sun blockers may be more effective than sunscreens [41]. Our findings also showed that these garments are used differently in Brazil than in Europe and the US [18,37]. While the US and Europe have a temperate climate and harsh winters, Brazil is a vast country with equatorial, tropical, and subtropical climates [42]. These climatic characteristics, with mild winters and higher temperatures for most of the year, can lead people to wear shorter clothes that expose the body to more sunlight. However, further studies are needed to evaluate the relationship between clothes' use and thermal comfort in the different Brazilian regions [43]. Furthermore, not all clothes can protect from UVR [44]. Thus, we also recommend further analysis on the use of sun-protective clothing among the population.

Statistical analysis allowed us to assess the relationships among the age, gender, and income age of respondents. Younger age groups more adequately used PhP, even though it was still less than ideal. This may be due to the concerns of teachers and parents about the health of the children. Females also more adequately used PhP, possibly because of their concern with aesthetics, which is a pattern found in other studies [45,46]. It is worth noting that in our study, the differences between sunscreen use habits among students of both sexes tend to increase with decreased wage incomes, i.e., teenagers of both sexes with higher incomes had similar concerns about PhP, while sunscreen use was higher for women in lower income groups. The main result of this assessment was that higher family income levels were associated with greater student knowledge on the evaluated questions.

Our study has strengths and limitations. The strengths include a statistically significant sample of students in a place where there is a high incidence of solar radiation and growing numbers of new SC cases diagnosed annually [1,47]. Although we relied on youngsters' self-report, we attempted to reduce response variability and bias by utilizing an anonymous and standardized survey. The studied groups covered age groups from childhood to adolescence, mostly characterized by individuals with low purchasing power and phototypes greater than or equal to 3. However, Brazil is a country of continental dimensions and with great social, cultural, and phototype differences. Thus, our study sample may not be fully representative of youth in some Brazilian regions. Anyway, our study offers a new assessment of the influences of habits, climate, and socioeconomic characteristics to provide greater support and specificity for PhP campaigns. Additionally, data collection for this study occurred in two different seasons, which avoid recall bias about PhP behaviors previously practiced [37].

We recommended that PhP policies take cultural habits, geographic characteristics, and specific socioeconomic aspects into account for the places where these campaigns will be applied. Merely disclosing information about UVI or simply recommending that people

use sunscreen, without educational support, is inefficient in changing the behavior of future generations and, consequently, mitigating skin cancer.

At last, education makes important contributions to building social norms that promote positive health-related behaviors [48]. Thus, primary school may be a critical time for building PhP as a daily habit [49,50]. For this reason, a culture of knowledge surrounding sun protection should be part of education curricula starting in primary school, since there are significant lacks of knowledge on the subject for children and adolescents. Furthermore, recent studies show that tanning as an aesthetic factor in young people may be related to relationship or fashion factors, while for adults, concerns over premature aging discourages aesthetic tanning [51]. Thus, campaigns should broaden interest in PhP beyond factors related to aesthetics, more comprehensively encompassing issues related to public health and incorporating cheaper accessories. This is the only way to broaden interest mainly among men and low-income population groups.

Supplementary Materials: The following supporting information can be downloaded at: https://doi.org/10.5281/zenodo.7468691 (accessed on 19 December 2022), Table T1: Supplementary Tukey Table, Questionaires: FORM—English and Portuguese versions, Dataset: Photoprotection Knowledge-Survey Data.xlsx.

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