Preventive Medicine Reports 34 (2023) 102237

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Current practice and beliefs of parents toward sunscreen use for their children: A cross-sectional study

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ARTICLE INFO

Keywords:
Sunscreen
Awareness
Parents
Children
Saudi Arabia

ABSTRACT

Parents are generally influencing the sun protection behaviors of their children, including sunscreen use. In Saudi Arabia, sunscreen use was estimated in adults but not children. The objective was to estimate the prevalence and predictors of sunscreen use among parents and their children. An observational cross-sectional study was conducted in April 2022. Parents who were visiting outpatient clinics at a university hospital in Al-Kharj city, Saudi Arabia, were invited to complete an online questionnaire. A total of 266 participants were included in the final analysis. The mean age of parents was 39.0 ± 8.9 years, and the mean age of children was 8.2 ± 3.2 years. The prevalence of sunscreen use was 38.7% in parents and 24.1% in their children. Females had higher sunscreen use than males in both parents (49.7% versus 7.2%, $p < 0.001$) and in children (31.9% versus 18.3%, $p = 0.011$). The most frequent sunburn protection measures practiced by children were wearing long-sleeved clothes (77.0%), sitting in the shade (70.6%), and wearing hats (39.2%). In multivariable analysis, predictors of sunscreen use in parents included female sex, history of sunburn, and sunscreen use by children. Independent predictors of sunscreen use in children included a history of sunburn, wearing hats, and practicing other sunburn protection measures on risky occasions, and sunscreen use in parents. **S**unscreen use in parents and children in Saudi Arabia is still inadequate or limited. This calls for community/school intervention programs using educational activities and multimedia promotion. Further studies are needed.

1. Introduction

Humans are exposed to two types of ultraviolet radiation (UVR); type A (UV-A), which has a longer wavelength and can penetrate through the dermis, and type B (UV-B), which has a shorter wavelength and affects mainly the epidermis (Yeager & Lim, 2019). Exposure to sunlight for up to 30 min three times per week may be sufficient for adequate vitamin D level (Rhodes et al., 2010). However, excessive exposure to UVR is associated with harmful effects (Krutmann et al., 2021; Quatrano & Dinulos, 2013).

Children who have thinner skin and less protective melanin are especially at risk of the immediate and long-term harmful effects of excessive exposure to UVR (Shafie Pour et al., 2015). Several strategies are used to protect children, including avoiding the sun, especially during noon, seeking shades, wearing hats and long-sleeved shirts, and sunscreen use (Ackermann et al., 2016; Dobbinson et al., 2012). Sunscreen use in children has been shown to significantly reduce the risk of skin cancers later in their life (Sander et al., 2020). Additionally, sunscreen was shown to reduce sunburn and photodamage among children (Yeager & Lim, 2019). A broad-spectrum sunscreen with an SPF of at least 30 is usually recommended (American Academy of Dermatology, 2021). Parents are believed to play a critical role in the sun protection behaviors of their children, including sunscreen use (Day et al., 2017; O'Riordan et al., 2003; K. Thoonen et al., 2019).

In Swiss children, the prevalence of using sunscreen was 69%, seeking shade was 33%, whereas 32% wore a long-sleeved shirt as a sun protective measure (Ackermann et al., 2016). In an Australian study, 58% of school children used sunscreen, 64% used hats, 32% sought

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https://doi.org/10.1016/j.pmedr.2023.102237
Received 23 September 2022; Received in revised form 6 May 2023; Accepted 9 May 2023
Available online 12 May 2023

shades, and 18% covered their hands with sleeves (Dobbinson et al., 2012). A nationwide study in Germany among school children found that 78% of them used sunscreen, and 12.5% used sunglasses (Görig et al., 2021). In a study conducted in Beijing primary school children, 47.8% children used sunscreen, 47.4% used sunshades, 44% used hats, 38% avoid going out in afternoon and 30% used sunglasses (Gao et al., 2022). Parents' perspectives and behaviour are very important towards sun protection for their child. Most parents in Germany used sunscreen in the beach setting (82%), while they used sunscreen to a lesser extent in the outdoor garden setting (Gefeller et al., 2016). Caregivers' attitude was positively associated with children's behaviour; parents who considered themselves role models were five times more likely to use sunscreen on the face (OR = 5.08, $p < 0.001$) (Diehl et al., 2022). Further, it has been reported that parents applied sunscreen and other sun-protective measures in younger children more often; likewise, adolescent boys have less sun-protective behaviour than girls (Karlijn Thoonen et al., 2019). Similarly, a recent study conducted in the United States reported that there are overall 4% increased usage of sunscreen in recent years, however, the mean usage of sunscreen was decreased by 5% as the students get older (Rajagopal et al., 2021). Studies also reported ethnicities differences in sunscreen usage (Cheng et al., 2010; Rajagopal et al., 2021). White and Asian have more knowledge about sun-protective measures than Blacks and Hispanics (Cheng et al., 2010). In Saudi Arabia, sunscreen use has been estimated in general adult populations (Al Robaee, 2010; AlGhamdi et al., 2016; Alsudairy et al., 2019). However, there is almost a lack of data about the use and determinants of sunscreen in children. The objective of the current study was to estimate the prevalence and predictors of sunscreen use among parents and their children.

2. Materials and methods

2.1. Setting

The study was conducted among patients who visited outpatient clinics at Prince Sattam Bin Abdulaziz University (PSAU) hospital in Al-Kharj city, Saudi Arabia. The newly established PSAU hospital is a governmental hospital that serves university students, employees, and their dependents.

2.2. Design

The study was an observational cross-sectional study that was conducted on 22 March 2022 to 22 April 2022. The open online survey utilized convenience sampling. The study received all required ethical approvals from the Ethics Committee in Health and Science Disciplines in the college of medicine at the PSAU.

2.3. Population

The target population was parents who visited the PSAU hospital. Parents who have at least one child aged between 6 months and 12 years were eligible to be included in the study. There were no exclusions based on age, sex, or nationality.

2.4. Sample size

According to previous studies, sunscreen use in the general adult population ranged between 8.3% and 35% (Al Robaee, 2010; AlGhamdi et al., 2016; Alsudairy et al., 2019). Assuming a prevalence of 20% with two-sided confidence limits of 5%, 246 participants would be required, using 80% power level and 95% two-sided significance level.

2.5. Sampling

The target participants were recruited using a convenience sampling technique. After reviewing the records, text messages were sent to invite all parents who visited the outpatient clinics of PSAU hospital during the time of the study. The messages direct parents to the Survey Hero website (https://www.surveyhero.com/) to give consent and start the questionnaire. The questionnaire was built on the Survey Hero platform, which is easily accessible, user friendly and can be used on mobile or computer. The participants filled out the form in either Arabic or English language. The site used cookies, and a user can only fill the form once, in this way we avoid duplication. The messages have the link of Survey Hero, and the responses of the parents were exported in excel sheet for statistical analysis. The questionnaire was kept anonymous and no confidential information were asked from the respondent. Moreover, the responses were only visible to principal investigator. The confidentiality of the responses were maintain all levels. No incentives were offered to the participants at any stage of the survey.

2.6. Data collection tool

The data were collected using a structured study questionnaire which was filled out online by the target participants. The questionnaire was based on knowledge, practice and beliefs of sun protection behviour among parents of children 6 months to 12 years old. The questionnaire was divided into four sections and all the questions were closed ended. The questionnaire started with the cover letter and consent form. The participation was completely voluntary and all the respondent who were interested in the study and agreed to participate were directed to the next section. The first part of the questionnaire was about socio-demographic characteristics (age, sex, nationality, marital status, education level, occupation, income etc. The second part consist of eight questions about the use of sunscreen in both the parents and their children, history of sunburn, history of skin cancer in family, the parents' reasons for using and non-using sunscreen, children's sunburn protection measures and children's sunscreen-related factors. The third part of the questionnaire was about skin type. The Fitzpatrick skin type was assessed using questions about the color of skin, eyes, and the reaction to exposure to the sun (Fitzpatrick, 1988). To determine the skin type we included the six picture corresponding to the six skin type for the ease of parents beside a description for the tanning ability. The last part of the questionnaire was used to assess the beliefs of parents about sunscreen usage through 18 questions including duration and time of exposure to the sun, experience of sunburn, protective measures used and occasions when it was used, application of sunscreen (type, amount, reusing, and time), knowledge about Sun Protection Factor (SPF), related allergies, and the amount they pay to buy sunscreen every month..

2.7. Validation of the study questionnaire

The face and content validity of the questionnaire was evaluated by two independent dermatologists. The questionnaire was considerably modified based on the expert suggestions. The questionnaire was created in English, which was then translated into Arabic and back-translated into English by two bilingual translators for validation. The questionnaire was sent out in both Arabic and English versions for convenience. A pilot study was conducted on a sample of 25 participants with very positive feedback. This pilot study was used to test the clarity of the data collection tool, to test the logistics of data collection, and to estimate the duration of data collection.

2.8. Statistical methods

Categorical variables were presented as frequencies and percentages. Continuous variables were presented as means and standard deviations (SD) or median and interquartile range, as appropriate. Demographic characteristics of parents and their children and sunburn-related factors in children were compared between parents and/or their children who

were sunscreen users or non-users. Chi-square or Fisher's exact test, as appropriate, were used to examine differences in categorical variables, while student *t*-test or Mann–Whitney test, as appropriate, were used to examine differences in continuous variables. To detect factors independently associated with sunscreen use by parents and their children, separate multivariable logistic regression analysis models were run after adjusting for the variables that were significantly associated (p-value $<$ 0.05) with sunscreen use in univariate analysis (Tables 1 and 3). Backward elimination was used to allow non-significant variables to leave the model. All P-values were two-tailed. P-value $<$ 0.05 was considered significant. SPSS software (release 23.0, Armonk, NY: IBM Corp) was used for all statistical analyses.

2.9. Disclosure of ethical compliance

The study was conducted in compliance with the institution's and guidelines for the protection of human subjects concerning safety and privacy. The study design obtained the required ethical approvals of the ethical committee of the Prince Sattam bin Abdulaziz University, the consent to participate was a part of the questionnaire.

3. Results

A total of 465 responses were received from 22 March 2022 to 22 April 2022. However, 199 of them were parents who had no children or parents that have children younger than 6 months or older than 12 years and were excluded from the analysis. A total of 266 participants were included in the final analysis. Most of the participants filled Arabic form (98%). It took 10–15 min to fill in the online survey form.

A total 266 of participants were included in the final analysis. As shown in Table 1, the prevalence of sunscreen use was 38.7% in parents and 24.1% in their children. The sunscreen use in both parents and children was 19.2% and was significantly associated together (p $<$ 0.001). The main reasons for using sunscreen in parents were prevention of pigmentation (75.7%), prevention of sunburn (45.6%), and maintenance of a fair skin tone (45.6%). On the other hand, the main reasons for not using sunscreen in parents were not recognizing its importance (41.7%), its higher cost (21.5%), and shortage of time (19.0%).

Table 1
Prevalence of the use of sunscreen in parents and their children and the related causes.

	Number	Percentage
Prevalence of sunscreen use		
In parents		
Overall	103	38.7%
Parents without children	52	19.5%
Parents with children	51	19.2%
In children		
Overall	64	24.1%
Children without parents	13	4.9%
Children with parents	51	19.2%
Reasons for using sunscreen by parents		
Prevention of pigmentation	78	75.7%
Prevention of sunburn	47	45.6%
Maintaining a fair skin tone	47	45.6%
Prevention of skin wrinkles	40	38.8%
Recommendation of my physician	25	24.3%
Prevention of skin cancer	16	15.5%
Recommendation of family or friends	10	9.7%
Influence of social media and websites	10	9.7%
Others	4	3.9%
Reasons for not using sunscreen by parents		
I don't see it as important	68	41.7%
It is costly	35	21.5%
Shortage of time	31	19.0%
I haven't heard of it	15	9.2%
It leaves marks when I'm applying	9	5.5%
It is ineffective	8	4.9%
It causes allergy	7	4.3%
Others	23	14.1%

Table 2 shows demographic characteristics of parents. The mean age was 39.0 $\pm$ 8.9 years. The majority of the parents were Saudi (96.6%) married (93.6%) female (74.1%) with University and higher degree (83.5%). More than half (51.9%) of the parents were working, mainly (78.9%) in office or indoor activities. 12.0% of the parents reported history of sunburn and 0.8% had family history of skin cancer. Only 10.2% of the parents have been advised by a healthcare provider to protect their children from the sun. Parents' sunscreen use was significantly associated with female sex (49.7% versus 7.2%, p $<$ 0.001), non-working status (47.7% versus 30.4%, p = 0.004), and history of sunburn (59.4% versus 35.9%, p = 0.011). Children's sunscreen use was significantly associated with higher parents' educational level (48.0% versus 21.6% %, p = 0.011) and advice of healthcare provider to protect children from the sun (51.9% versus 20.9%, p = 0.001).

Table 3 shows demographic characteristics and sunburn related factors of the children. The mean age was 8.2 $\pm$ 3.2 years and the majority (57.5%) were males. The majority (63.2%) of children had skin type IV. The majority (87.1%) of parents believed that their children needs sun exposure to be healthy. The most frequent (50.9%) sun exposure duration was 5–30 min per day and the most frequent (69.1%) sun exposure time was after 3:00 PM. Approximately 9.4% of the children reported a history of sunburn. The majority (93.6%) of children were taking some sunburn protection measures. It was also noted that children who do not use sunscreen have more use of other sunburn protection measures (75.1%). On the other hand, those who use sunscreen have less use of other sunburn protection measures (24.9%). The most frequent measures were wearing long-sleeved clothes (77.0%), sitting constantly in shades or always using umbrellas (70.6%), and wearing hats (39.2%). The most frequent sunburn protection occasions were during all outdoor activities (17.7%), swimming (16.9%), and before going to school (12.0%). Children's sunscreen use was significantly associated with female sex (31.9% versus 18.3%, p = 0.011), history of sunburn (44.0% versus 22.1%, p = 0.015), several other sunburn protection measures, and several sunburn protection occasions.

Table 4 shows the characteristics of sunscreen use among children's users. The majority of the children used sunscreen in sunny days only (85.9%), applied by parents or guardian (70.3%), to all exposed skin areas (51.6%), $<$5 min before going out (51.6%), for one time only during that day (73.4%). Almost half (48.4%) of the parents did not recognize the sun protection factor (SPF) used for their children and 21.9% reported using SPF $>$ 30. The majority (81.3%) of children were using children sunscreen. 53.1% were using broad-spectrum sunscreen (protects against both UVA and UVB) and only 25.0% were using lip balm that contains sunscreen. 57.8% of the parents spent more than 70 SAR per month for sunscreen used in their children and only 3.1% had some allergies to sunscreen.

Table 5 shows the multivariable logistic regression analysis of potential predictors of the sunscreen use in parents and their children. Female sex, having history of sunburn, and having a child who use sunscreen were independent predictors for sunscreen use in parents after adjusting for these factors, and working status. Parents who use sunscreen, children with history of sunburn, children wearing hats, and children who practicing other sunburn protection measures in all outdoor activities, swimming and sporting activities, and before going to school were independent predictors for the sunscreen use in children after adjusting for these factors and parent's education, healthcare provider's advice to protect the child from the sun, child sex, and several child's sunburn protection measures and occasions.

4. Discussion

The current study examined the prevalence and predictors of sunscreen use among parents and their children attending outpatient clinics in a university hospital in Alkharj, Saudi Arabia. The prevalence of

Table 2
Associations between the demographic characteristics of parents and the use of sunscreen in parents and their children.

	Total	Parents' use of sunscreen			Children's use of sunscreen		
		No	Yes	p-value	No	Yes	p-value
Age (years)*	39.0 ± 8.9	39.29	38.2	0.116	39.3 ± 9.0	38.2 ± 8.6	0.395
Sex							
Male	69 (25.9%)	64 (92.8%)	5 (7.2%)	<0.001	56 (81.2%)	13 (18.8%)	0.239
Female	197 (74.1%)	99 (50.3%)	98 (49.7%)		146 (74.1%)	51 (25.9%)	
Nationality							
Saudi	257 (96.6%)	156 (60.7%)	101 (39.3%)	0.489	197 (76.7%)	60 (23.3%)	0.225
Non-Saudi	9 (3.4%)	7 (77.8%)	2 (22.2%)		5 (55.6%)	4 (44.4%)	
Marital status							
Married	249 (93.6%)	153 (61.4%)	96 (38.6%)	0.830	187 (75.1%)	62 (24.9%)	0.377
Not married	17 (6.4%)	10 (58.8%)	7 (41.2%)		15 (88.2%)	2 (11.8%)	
Number of children**	2 (1–3)	2 (1–3)	2 (1–3)	0.401	2 (1–3)	2 (1–3)	0.787
Education level							
Secondary school or lower	44 (16.5%)	30 (68.2%)	14 (31.8%)	0.589	33 (75.0%)	11 (25.0%)	0.011
Bachelor's degree	197 (74.1%)	118 (59.9%)	79 (40.1%)		156 (79.2%)	41 (20.8%)	
Postgraduate degree	25 (9.4%)	15 (60.0%)	10 (40.0%)		13 (52.0%)	12 (48.0%)	
Working status							
Working	138 (51.9%)	96 (69.6%)	42 (30.4%)	0.004	109 (79.0%)	29 (21.0%)	0.228
Not working	128 (48.1%)	67 (52.3%)	61 (47.7%)		93 (72.7%)	35 (27.3%)	
Workplace							
Office/indoor	112 (78.9%)	77 (68.8%)	35 (31.3%)	0.830	87 (77.7%)	25 (22.3%)	0.397
Field/Outdoor	30 (21.1%)	21 (70.0%)	9 (30.0%)		25 (83.3%)	5 (16.7%)	
Monthly income							
<10,000 SAR	118 (44.4%)	67 (56.8%)	51 (43.2%)	0.194	87 (73.7%)	31 (26.3%)	0.590
10,000–19,999 SAR	106 (39.8%)	72 (67.9%)	34 (32.1%)		84 (79.2%)	22 (20.8%)	
≥20,000 SAR	42 (15.8%)	24 (57.1%)	18 (42.9%)		31 (73.8%)	11 (26.2%)	
Ever had sunburn							
No	234 (88.0%)	150 (64.1%)	84 (35.9%)	0.011	182 (77.8%)	52 (22.2%)	0.058
Yes	32 (12.0%)	13 (40.6%)	19 (59.4%)		20 (62.5%)	12 (37.5%)	
Family history of skin cancer							
No	264 (99.2%)	162 (61.4%)	102 (38.6%)	>0.99	201 (76.1%)	63 (23.9%)	0.424
Yes	2 (0.8%)	1 (50.0%)	1 (50.0%)		1 (50.0%)	1 (50.0%)	
Has been told to protect your child from the sun							
No	193 (72.6%)	122 (63.2%)	71 (36.8%)	0.166	156 (80.8%)	37 (19.2%)	0.001
Yes	27 (10.2%)	12 (44.4%)	15 (55.6%)		13 (48.1%)	14 (51.9%)	
Not sure	46 (17.3%)	29 (63.0%)	17 (37.0%)		33 (71.7%)	13 (28.3%)	

All are number and percentage except * mean ± standard deviation, **median (interquartile range).

sunscreen use in the current study was 39% in parents and 24% in their children. The current finding in parents is considered slightly higher than previous studies done in recent years (Al Robaee, 2010; AlGhamdi et al., 2016; AlJasser et al., 2020; Alsudairy et al., 2019). However, we could not compare the current sunscreen use in children due to the lack of previous local studies focused on children. For example, the prevalence of sunscreen use in the general adult population recruited from different Saudi regions was estimated at 24% in 2010–2011 (AlGhamdi et al., 2016) and 35% in 2018 (Alsudairy et al., 2019). On the other hand, only 8% of the general adult population in Qassim Province were using sunscreen in 2010 (Al Robaee, 2010). Interestingly, sunscreen use was higher among healthcare University students (51%) (AlJasser et al., 2020).

The current findings generally indicate inadequate sunscreen use in parents and limited use in children in a country with plenty of sun exposure. The limited sunscreen use in children in the current study was probably compensated by wearing long-sleeved clothes, seeking shades, and wearing hats which were all practiced more frequently than sunscreen use. Additionally, Saudi Arabia is known for its hot desert climate, especially in the summer months; therefore, people tend to avoid direct sun exposure and prefer to participate in indoor activities (Almuqati et al., 2019). A Swiss study reported that wearing covering clothes was significantly related to sunscreen use (Ackermann et al., 2016). Using physical barriers (full sleeves, hats, sunglasses…etc), seeking shade and avoiding sun exposure during peak hours, and sunscreen use; these three measures were recommended to prevent and reduce the chances of skin cancer (Hung et al., 2022).

Sunscreen use among parents and their children in the current study was significantly associated together in both univariate and multivariable analysis. This finding is not surprising given the important role of parents in guiding the sun protection behaviors of their children (Day et al., 2017; O'Riordan et al., 2003; K. Thoonen et al., 2019). Actually, international recommendations encourage parents to educate their children and guide them to adopt sun safety skills and behaviors early in their lives (Görig et al., 2021; Nahar, 2013). More than two third (70%) of sunscreen used in children in the current study was applied by their parents.

As expected, sex strongly influences the use of sunscreen among parents in the current study. For example, sunscreen use was seven times higher in females compared with males (50% versus 7%). All previous local studies consistently documented higher sunscreen use among females (Al Robaee, 2010; AlGhamdi et al., 2016; AlJasser et al., 2020; Alsudairy et al., 2019). Actually, some studies reported up to 10 times differences, irrespective of the history of sunburn or the use of other sun protection measures (AlJasser et al., 2020). The female predominance is observed despite the fact that most Saudi women are likely to have fewer outdoor activities compared to men and are typically wearing clothes that cover most of the body, including, sometimes, the face (Al Robaee, 2010). The higher sunscreen use among women is probably influenced by their concerns about their beauty as well as the peer pressures of family and friends (Abroms et al., 2003; Buller et al., 2011). Consistently, parents in the current study reported using sunscreen to prevent pigmentation and sunburn and to maintain a fair skin tone. In contrast, a recent study reported no significant association between sunscreen use and children's sex (Görig et al., 2021).

In addition to parent's use, sunscreen use in children in the current study was associated with a history of sunburn and the use of other sun protection measures, especially on risky occasions. We could not compare these findings locally as previous studies were focusing only on adults (Al Robaee, 2010; AlGhamdi et al., 2016; AlJasser et al., 2020;

Table 3
Association between the demographic characteristics and sunburn related factors of the children and their use of sunscreen.

	Total	Children's use of sunscreen		p-value
		No	Yes	
Child's age (years)*	8.2 ± 3.2	8.2 ± 3.3	8.5 ± 3.0	0.489
Child's sex				
Male	153 (57.5%)	125 (81.7%)	28 (18.3%)	0.011
Female	113 (42.5%)	77 (68.1%)	36 (31.9%)	
Child's skin type**				
Skin type I or II	25 (9.4%)	15 (60.0%)	10 (40.0%)	0.273
Skin type III	65 (24.4%)	51 (78.5%)	14 (21.5%)	
Skin type IV	168 (63.2%)	130 (77.4%)	38 (22.6%)	
Skin type V or VI	8 (3.0%)	6 (75.0%)	2 (25.0%)	
My child needs sun exposure to be healthy				
No	26 (12.9%)	8 (12.5%)	34 (12.8%)	>0.99
Yes	175 (87.1%)	56 (87.5%)	231 (87.2%)	
Child's exposure to the sun, daily duration				
<5 min	101 (38.1%)	83 (82.2%)	18 (17.8%)	0.168
5–30 min	135 (50.9%)	97 (71.9%)	38 (28.1%)	
1 h or more	29 (10.9%)	21 (72.4%)	8 (27.6%)	
Child's exposure to the sun, daily time				
Before 10 AM	20 (7.5%)	16 (80.0%)	4 (20.0%)	0.123
Between 10 AM and 3 PM	62 (23.4%)	41 (66.1%)	21 (33.9%)	
After 3 PM	183 (69.1%)	144 (78.7%)	39 (21.3%)	
The child ever had a sunburn				
No	240 (90.6%)	187 (77.9%)	53 (22.1%)	0.015
Yes	25 (9.4%)	14 (56.0%)	11 (44.0%)	
Once	18 (72.0%)	9 (50.0%)	9 (50.0%)	0.407
More than once	7 (28.0%)	5 (71.4%)	2 (28.6%)	
Taking any other sunburn protection measures				
No	17 (6.4%)	15 (88.2%)	2 (11.8%)	0.377
Yes	249 (93.6%)	187 (75.1%)	62 (24.9%)	
Other sunburn protection measures				
Wearing long-sleeved clothes	204 (77.0%)	154 (75.5%)	50 (24.5%)	0.803
Sitting constantly in the shade or always uses the umbrellas	187 (70.6%)	138 (73.8%)	49 (26.2%)	0.227
Wearing a hat	104 (39.2%)	65 (62.5%)	39 (37.5%)	<0.001
Wearing sunglasses	73 (27.5%)	46 (63.0%)	27 (37.0%)	0.003
Wearing clothes with added sun protection factor	35 (13.2%)	21 (60.0%)	14 (40.0%)	0.019
Sunburn protection occasions				
In all outdoor activities	47 (17.7%)	21 (44.7%)	26 (55.3%)	<0.001
Swimming time	45 (16.9%)	21 (46.7%)	24 (53.3%)	<0.001
Before going to school	32 (12.0%)	13 (40.6%)	19 (59.4%)	<0.001
Before sporting activities	6 (2.3%)	1 (16.7%)	5 (83.3%)	0.003
Others	11 (4.1%)	10 (90.9%)	1 (9.1%)	0.469

All are number and percentage except * mean ± standard deviation.
**Skin type I: Pale white skin, blue/green eyes, blond/red hair, always burns, does not tan; Skin type II: Fair skin, blue eyes, burns easily, tans poorly; Skin type III: Darker white skin, tans after initial burn;
Skin type IV: Light brown skin, burns minimally, tans easily; Skin type V: Brown skin, rarely burns, tans darkly easily; Skin type VI: Dark brown or black skin, never burns, always tans darkly.{Fitzpatrick, 1988 #18}.

Table 4
Characteristics of sunscreen use among children.

Characteristics	Value
Weather conditions when you use sunscreen for your child	
Sunny and cloudy days	9 (14.1%)
Sunny days only	55 (85.9%)
Body parts where you put the sunscreen on your child's body	
Face only	10 (15.6%)
Face and hands	21 (32.8%)
All exposed skin areas	33 (51.6%)
Person applying the sunscreen for your child	
Child applies sunscreen without parent supervision	1 (1.6%)
Child applies sunscreen with parent Supervision	18 (28.1%)
Parent or guardian applies sunscreen	45 (70.3%)
Time when you put sunscreen for your child before you going out	
<5 min	33 (51.6%)
5–15 min	22 (34.4%)
16–30 min	4 (6.3%)
>30 min	5 (7.8%)
Re-using sunscreen after going out	
Never	47 (73.4%)
Every 2–3 h	5 (7.8%)
After excessive sweating	2 (3.1%)
After shower	9 (14.1%)
After swimming	14 (21.9%)
Sun protection factor (SPF) you use for your child	
<15	13 (20.3%)
16–30	6 (9.4%)
31–50	6 (9.4%)
>50	8 (12.5%)
I do not know	31 (48.4%)
Type of sunscreen used for your child	
Using children sunscreen	52 (81.3%)
Using broad-spectrum sunscreen	34 (53.1%)
Using a lip balm that contains sunscreen	16 (25.0%)
Amount you pay for sunscreen for your child per month	
<75 SAR	27 (42.2%)
75–150 SAR	30 (46.9%)
151–300 SAR	7 (10.9%)
Child develops tan effect after applying sunscreen	
No	45 (70.3%)
Yes	19 (29.7%)
Child has any allergies to sunscreen	
No	62 (96.9%)
Yes	2 (3.1%)

Alsudairy et al., 2019). Nevertheless, the history of sunburn and the use of other sun protection measures were independent predictors of sunscreen use among healthcare University students in Saudi Arabia (AlJasser et al., 2020). Consistent with the current findings, the use of one sun protective measure in children is usually associated with more use of other sun-protective measures (Ackermann et al., 2016; Klostermann & Bolte, 2014). On the other hand, fair/sensitive skin type (Ackermann et al., 2016; Zinman et al., 1995) rather than the history of

Table 5
Univariate and multivariable * logistic regression analysis of potential predictors of the use of sunscreen in parents and their children.

	Reference	Univariate analysis				Multivariable analysis			
		Odds ratio	95% confidence interval		P-value	Odds ratio	95% confidence interval		P-value
			Lower	Upper			Lower	Upper	
Parent's use of sunscreen									
Parent's sex	Female/ male	12.7	4.9	32.8	<0.001	35.3	9.7	129.0	<0.001
Parent's Working status	Yes/no	0.5	0.3	0.8	0.004				
Parent's history of sunburn	Yes/no	2.6	1.2	5.5	0.013	3.7	1.4	9.9	0.010
Child's use of sunscreen	Yes/no	11.3	5.7	22.5	<0.001	21.6	8.1	57.6	<0.001
Child's use of sunscreen									
Parent's postgraduate education	Secondary	2.8	1.0	7.8	0.055				
Parent's history of sunburn	Yes/no	2.1	1.0	4.6	0.062				
Parent's use of sunscreen	Yes/no	11.3	5.7	22.5	<0.001	16.0	6.2	41.4	<0.001
Advised by a physician to protect the child from sun	Yes/no	4.1	1.8	9.2	0.001				
Child's sex	Female/ male	2.1	1.2	3.7	0.011				
Child's history of sunburn	Yes/no	2.8	1.2	6.5	0.018	4.9	1.0	23.4	0.044
Child sunburn protection measures include wearing clothes with added sun protection factor	Yes/no	2.4	1.1	5.1	0.021				
Child sunburn protection measures include wearing a hat	Yes/no	3.3	1.8	5.8	<0.001	5.3	2.1	13.4	0.001
Child sunburn protection measures include wearing sunglasses	Yes/no	2.5	1.4	4.5	0.003				
Child sunburn protection occasions done in all outdoor activities	Yes/no	5.9	3.0	11.6	<0.001	9.5	3.3	27.1	<0.001
Child sunburn protection occasions done in swimming and sporting activities	Yes/no	6.4	3.3	12.4	<0.001	8.3	3.0	23.0	<0.001
Child sunburn protection occasions done before going to school	Yes/no	6.1	2.8	13.3	<0.001	11.6	3.5	38.6	<0.001

* Multivariable logistic regression was done using backward elimination of all variables included in univariate analysis (left side), with p-value < 0.05. R-square was 0.490 in parent's model and 0.666 in children's model.

sunburn (Klostermann & Bolte, 2014; Reinau et al., 2012) was associated with higher sunscreen use in Western children. Increasing sunscreen use probably requires community intervention programs involving multiple components including educational activities, local environmental behaviors, policy changes, and multimedia promotion (Sandhu et al., 2016).

The current study is considered the first study to examine the prevalence and predictors of sunscreen use among parents and their children in Saudi Arabia. Additionally, the questionnaire was more comprehensive than those used in previous similar studies. Both univariate and multivariable predictors were presented. Nevertheless, some study limitations should be acknowledged. The cross-sectional design does not prove causation. The convenience sampling from a university hospital may limit the generalizability of the findings to similar families in Saudi Arabia. The study questionnaire was developed for this study, we only validated our questionnaire using face and content validity, however, reliability had not been assessed. Another limitation of the study is that we did not ask the screening questions about the age of the child, did not include children aged<6 months or more than 12 years and for this reason, 199 forms were excluded from the final analysis. Moreover, data were collected through self-administered questionnaire by the caregiver's proxy reports, therefore they may have overreported or underreported the use of sunscreen in their children and there is a chance of recall bias and social desirability. One more limitation is that we only collected data in one season, although sun protective measures indicated in all seasons. Hence, in future research should be extend to complete one year and include all seasons in the survey.

5. Conclusion

In conclusion, the prevalence of sunscreen use was 39% in parents and 24% in their children and was significantly associated with each other in both univariate and multivariable analyses. The history of sunburn was independently predicting sunscreen use in both parents and children. The knowledge of parents about the importance of sunscreen use in children is not necessarily translated into sunscreen use in their children. Children using other sun protection measures, especially on risky occasions, are more likely to be sunscreen users. The inadequate/limited sunscreen use in parents and children in the current study calls for community/school intervention programs using educational activities and multimedia promotion.

Funding

This publication was supported by the Deanship of Scientific Research at Prince Sattam bin Abdulaziz University, Alkharj, Saudi Arabia (Project number PSAU/2023/R/1444).

7. Ethics approval and consent to participate

The study design obtained the required ethical approvals of the ethical committee of the Prince Sattam bin Abdulaziz University, the consent to participate was a part of the questionnaire.

8. Availability of data and materials

The datasets used and analyzed during the current study are available on reasonable request from the corresponding author or from a third party (the ethical committee of the Prince Sattam bin Abdulaziz University) Email: irb-sciences@psau.net

9. Authors' contributions

Dr. Alsaidan had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design*: Alsaidan, Alsohaimi, Alanazi Z, Alnefaiy, Algraene, and Alanazi R *Analysis and interpretation of data*: Alsaidan. Data collection: Alsaidan, Alsohaimi, Alanazi Z, Alnefaiy, Algraene, and Alanazi R *Drafting of the manuscript*: Alsaidan, Alsohaimi, Alanazi Z, Alnefaiy, Algraene, and Alanazi R *Critical revision of the manuscript for important intellectual content*: Alsaidan, Alsohaimi, Alanazi Z, Alnefaiy, Algraene, and Alanazi R *Statistical analysis*: Alsaidan. *Administrative, technical, or material support*: Not applicable. *Study supervision*: Alsaidan.

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.

Data availability

Data will be made available on request.

References

Abroms, L., Jorgensen, C.M., Southwell, B.G., Geller, A.C., Emmons, K.M., 2003. Gender differences in young adults' beliefs about sunscreen use. Health Educ. Behav. 30 (1), 29–43. https://doi.org/10.1177/1090198102239257.

Ackermann, S., Vuadens, A., Levi, F., Bulliard, J.L., 2016. Sun protective behaviour and sunburn prevalence in primary and secondary schoolchildren in western Switzerland. Swiss Med. Wkly 146, w14370. https://doi.org/10.4414/smw.2016.14370.

Al Robaee, A.A., 2010. Awareness to sun exposure and use of sunscreen by the general population. Bosn. J. Basic Med. Sci. 10 (4), 314–318. https://doi.org/10.17305/bjbms.2010.2678.

AlGhamdi, K.M., AlAklabi, A.S., AlQahtani, A.Z., 2016. Knowledge, attitudes and practices of the general public toward sun exposure and protection: A national survey in Saudi Arabia. Saudi Pharm. J. 24 (6), 652–657. https://doi.org/10.1016/j.jsps.2015.04.002.

AlJasser, M.I., Aljumah, A., Alzaydi, M., Alassaf, A., Alassafi, S., Alassafi, M.T., Almedlej, M., Masuadi, E., 2020. Sunscreen Use among a Population of Saudi University Students. Dermatol. Res. Pract. 2020, 1–6.

Almuqati, R.R., Alamri, A.S., Almuqati, N.R., 2019. 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. 5 (2), 105–109. https://doi.org/10.1016/j.ijwd.2018.11.005.

Alsudairy, F.K., Alharbi, T.I., Qadi, A.B., Almutairi, S.M., Asiree, H.H., 2019. Awareness of Sun Exposure and use of sunscreen among adults in Saudi Arabia, 2018. Int. J. Med. Dev. Countries 3 (4), 389–394.

American Academy of Dermatology. (2021). Sunscreen. URL: https://www.aad.org/media/stats-sunscreen (Last accessed June 20, 2021).

Buller, D.B., Cokkinides, V., Hall, H.I., Hartman, A.M., Saraiya, M., Miller, E., Paddock, L., Glanz, K., 2011. Prevalence of sunburn, sun protection, and indoor tanning behaviors among Americans: review from national surveys and case studies of 3 states. J. Am. Acad. Dermatol. 65 (5), S114.e1–S114.e11.

Cheng, C.E., Irwin, B., Mauriello, D., Hemminger, L., Pappert, A., Kimball, A.B., 2010. Health disparities among different ethnic and racial middle and high school students in sun exposure beliefs and knowledge. J. Adolesc. Health 47 (1), 106–109. https://doi.org/10.1016/j.jadohealth.2009.12.028.

Day, A.K., Stapleton, J.L., Natale-Pereira, A.M., Goydos, J.S., Coups, E.J., 2017. Parent and Child Characteristics Associated with Child Sunburn and Sun Protection Among U.S. Hispanics. Pediatr. Dermatol. 34 (3), 315–321. https://doi.org/10.1111/pde.13136.

Diehl, K., Thoonen, K., Breitbart, E.W., Pfahlberg, A.B., Görig, T., 2022. Sun Protection and Tanning Behaviors in Caregivers: Prevalence, Determinants, and Associations with Children’s Behaviors. Int. J. Environ. Res. Public Health 19 (11).

Dobbinson, S., Wakefield, M., Hill, D., Girgis, A., Aitken, J.F., Beckmann, K., Reeder, A.I., Herd, N., Spittal, M.J., Fairthorne, A., Bowles, K.-A., 2012. Children's sun exposure and sun protection: prevalence in Australia and related parental factors. J. Am. Acad. Dermatol. 66 (6), 938–947.

Fitzpatrick, T.B., 1988. The validity and practicality of sun-reactive skin types I through VI. Arch. Dermatol. 124 (6), 869–871. https://doi.org/10.1001/archderm.124.6.869.

Gao, Y.-S., Lai, D.-H., Cheng, S.-W., Li, Q., Hao, J.-C., 2022. Investigation on the Awareness and Behavior of Primary School Students on Sunscreen Use in Beijing. Clin. Cosmet. Investig. Dermatol. 887–894. https://doi.org/10.2147/CCID.S365856.

Gefeller, O., Uter, W., Pfahlberg, A., 2016. Protection from Ultraviolet Radiation during Childhood: The Parental Perspective in Bavaria. Int. J. Environ. Res. Public Health 13 (10), 1011.

Görig, T., Södel, C., Pfahlberg, A.B., Gefeller, O., Breitbart, E.W., Diehl, K., 2021. Sun protection and sunburn in children aged 1–10 years in Germany: Prevalence and determinants. Children 8 (8), 668.

Hung, M., Beazer, I.R., Su, S., Bounsanga, J., Hon, E.S., Lipsky, M.S., 2022. An Exploration of the Use and Impact of Preventive Measures on Skin Cancer. Healthcare (Basel) 10 (4). https://doi.org/10.3390/healthcare10040743.

Klostermann, S., Bolte, G., 2014. Determinants of inadequate parental sun protection behaviour in their children–results of a cross-sectional study in Germany. Int. J. Hyg. Environ. Health 217 (2–3), 363–369. https://doi.org/10.1016/j.ijheh.2013.07.013.

Krutmann, J., Schalka, S., Watson, R.E.B., Wei, L., Morita, A., 2021. Daily photoprotection to prevent photoaging. *Photodermatology, Photoimmunology & Photomedicine*. Photodermatol. Photoimmunol. Photomed. 37 (6), 482–489.

Nahar, V.K., 2013. Skin cancer prevention among school children: a brief review. Cent. Eur. J. Public Health 21 (4), 227–232. https://doi.org/10.21101/cejph.a3864.

O'Riordan, D.L., Geller, A.C., Brooks, D.R., Zhang, Z., Miller, D.R., 2003. Sunburn reduction through parental role modeling and sunscreen vigilance. J. Pediatr. 142 (1), 67–72. https://doi.org/10.1067/mpd.2003.mpd039.

Quatrano, N.A., Dinulos, J.G., 2013. Current principles of sunscreen use in children. Curr. Opin. Pediatr. 25 (1), 122–129. https://doi.org/10.1097/MOP.0b013e32835c2b57.

Rajagopal, G., Talluri, R., Chuy, V.S., Cheng, A.L., Dall, L., 2021. Trends in Sunscreen Use Among US Middle and High School Students, 2007–2019. Cureus 13 (7), e16468.

Reinau, D., Meier, C., Gerber, N., Hofbauer, G.F., Surber, C., 2012. Sun protective behaviour of primary and secondary school students in North-Western Switzerland. Swiss Med. Wkly 142, w13520. https://doi.org/10.4414/smw.2012.13520.

Rhodes, L.E., Webb, A.R., Fraser, H.I., Kift, R., Durkin, M.T., Allan, D., O'Brien, S.J., Vail, A., Berry, J.L., 2010. Recommended Summer Sunlight Exposure Levels Can Produce Sufficient (≥20ngml−1) but Not the Proposed Optimal (≥32ngml−1) 25 (OH)D Levels at UK Latitudes. J, Invest. Dermatol. 130 (5), 1411–1418.

Sander, M., Sander, M., Burbidge, T., Beecker, J., 2020. The efficacy and safety of sunscreen use for the prevention of skin cancer. Can. Med. Assoc. J. 192 (50), E1802–E1808. https://doi.org/10.1503/cmaj.201085.

Sandhu, P.K., Elder, R., Patel, M., Saraiya, M., Holman, D.M., Perna, F., Smith, R.A., Buller, D., Sinclair, C., Reeder, A., Makin, J., McNoe, B., Glanz, K., 2016. Community-wide Interventions to Prevent Skin Cancer: Two Community Guide Systematic Reviews. Am. J. Prev. Med. 51 (4), 531–539.

Shafie Pour, N., Saeedi, M., Morteza Semnani, K., Akbari, J., 2015. Sun Protection for Children: A Review [Narrative Review]. J. Pediatr. Rev. 3 (1) https://doi.org/10.5812/jpr.155.

Thoonen, K., Schneider, F., Candel, M., de Vries, H., van Osch, L., 2019a. Childhood sun safety at different ages: relations between parental sun protection behavior towards their child and children's own sun protection behavior. BMC Public Health 19 (1), 1044. https://doi.org/10.1186/s12889-019-7382-0.

Thoonen, K., Schneider, F., Candel, M., de Vries, H., van Osch, L., 2019b. Childhood sun safety at different ages: relations between parental sun protection behavior towards their child and children's own sun protection behavior. BMC Public Health 19 (1), 1044. https://doi.org/10.1186/s12889-019-7382-0.

Yeager, D.G., Lim, H.W., 2019. What's New in Photoprotection: A Review of New Concepts and Controversies. Dermatol. Clin. 37 (2), 149–157. https://doi.org/10.1016/j.det.2018.11.003.

Zinman, R., Schwartz, S., Gordon, K., Fitzpatrick, E., Camfield, C., 1995. Predictors of sunscreen use in childhood. Arch. Pediatr. Adolesc. Med. 149 (7), 804–807. https://doi.org/10.1001/archpedi.1995.02170200094015.