RESEARCH ARTICLE

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Knowledge, Attitudes, and Practices of Sun Exposure and Sun Protection among the Population of Kazakhstan: A Cross Sectional Study

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Abstract

Objective: The aims of this study were to assess knowledge, attitudes, and practices regarding sun exposure and sun protection among the population of Kazakhstan. **Method:** A cross sectional study was conducted by administering an online questionnaire via social networking sites to residents of Kazakhstan. The questionnaire was designed to determine demographic information as well as knowledge, attitudes and practices regarding sun exposure and sun protection. **Result:** The responses of 249 participants were analysed. Descriptive tests, bivariate analyses, and multiple linear regression were used to statistically analyse the data. The mean age of the participants was 31.7 ± 11.5 (SD) years. Most participants were of Kazakh nationality (88.7%), female (71.0 %), urban residents (93.9 %), and possessed higher education degrees (88.0 %). The level of knowledge and attitudes were found to be moderate amongst the population whilst practices were determined to be low. Knowledge (p=0.002), attitudes (p=0.002), female gender (p=0.002), and having children educated in school about sun safety (p=0.018) were significantly associated with improved sun-protective practices. **Conclusion:** This study has demonstrated low adoption of sun protective practices in the Kazakhstan population, despite the identification of certain characteristics associated with higher rates of practice.

Keywords: Kazakhstan- knowledge- attitude- practice- sunlight- protection

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Introduction

Globally, skin cancer is the most common type of diagnosed cancer and epidemiological studies suggest an increasing incidence worldwide [1, 2]. An estimate of 1.5 million new skin cancers were diagnosed globally in 2020 including 325, 000 new cases of malignant melanoma [1]. Exposure to ultraviolet radiation (UV) is considered the most significant factor contributing to the development of skin cancer [3]. In Kazakhstan, skin cancer is one of the most diagnosed cancer types with 3610 people being newly diagnosed in 2019 [4]. A study conducted in Astana, the capital of Kazakhstan, demonstrated that the incidence of basal cell carcinoma (BCC), squamous cell carcinoma of the skin (SCC) and cutaneous malignant melanoma (CMM) increased significantly over the period 2011 to 2016 [5]. Investigating knowledge, attitudes and practices regarding sun exposure and sun protection in the populationof Kazakhstan is important for determining factors that may be contributing to the increasing incidence of skin cancer in the country. Kazakhstan is a multiethnic country which has a population of approximately 19 million consisting of 70.4% Kazakhs, 15.5% Russians, 3.2% Uzbeks, 2.0% Ukrainians and more than hundred other ethnic groups [6]. Kazakhstan has a continental climate with average maximum summer temperatures of 18°C to 27°C and average winter temperatures of -12°C to -2°C [7]. UV index in Astana, for example, ranges from 1 in the winter to 7 in the summer [7].

Protecting the skin from sunlight can significantly reduce the likelihood of developing skin cancer. The American Cancer Society recommends that individuals wear broad-brimmed hats, long-sleeved clothing, apply sunscreen, avoid outdoor activities during midday, and seek shaded areas [8]. However, the extent to which individuals protect their skin from sunlight depends on their level of awareness regarding the harmful effects of sun exposure and their knowledge of sun-protective measures. Many studies have indicated a low level of knowledge about the harmful effects of UV exposure and a low rate of adopting sun protective measures among populations [9-11].

Globally, there is a need to increase public awareness of the risks associated with sun exposure and encourage

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the widespread adoption of sun-protective practices. This could be achieved to some extent by implementing primary prevention education programmes, some of which have already demonstrated success [12, 13].

The aims of this study were to determine the level of knowledge of the Kazakhstani population regarding the effects of UV exposure on the skin and health, to assess the attitudes of people towards sun-protective measures and determine how frequently people adopt sun protective practices. Also, to identify factors associated with better sun-protective practices among the people of Kazakhstan. To the best of our knowledge no other studies have investigated knowledge, attitudes and practices regarding sun exposure and sun protection in the population of Kazakhstan.

Materials and Methods

Study Design

A cross-sectional study investigating knowledge, attitudes, and practices of a sample of the Kazakhstan population regarding sun exposure and protection was conducted. This cross-sectional study allowed for assessment of variables at a specific point in time and allowed for comparisons between groups e.g., male, female, ethnicity etc. The survey was administered online from March to June 2021. Recruitment messages were disseminated through social networks and email. The inclusion criteria for participants were being 18 years of age or older and having a good comprehension of either Kazakh or Russian language.

Sampling Technique and Sample Size

A pilot study with 50 participants was conducted to test the clarity and comprehensibility of the translated knowledge, attitudes and practice questions which were adopted from previous published studies. Significant modifications were made to the final questionnaire. Convenience and snowball sampling techniques were used to distribute the final questionnaire via social networks (WhatsApp, VKontakte, Telegram) and G-mail. Participants were asked to distribute the invitation letter to their contacts. The approach was cost-effective and expedient. We were successful in collecting 249 responses. The responses offer valuable insights into knowledge, attitudes, and practices of the study population regarding sun exposure and sun protection.

Data Collection Instrument

The variables of interest were the level of knowledge regarding the effects of UV exposure on the skin and health, attitudes towards sun protection and sun protective practices. After reviewing existing literature on public awareness of sun protection in various countries a questionnaire based on existing validated questionnaires was created and enhanced the validity of the study outcomes [11, 14].

The questionnaire consisted of 35 questions divided into four sections. Section one provided participants demographic data. Section two comprised 8 questions designed to determine the population's knowledge about the effects of sunlight exposure on the skin and health. Answer options were "Yes," "No," or "I don't know". Each "Yes" answer earned 1 point, giving a maximal possible score of 8 points for the knowledge section. Section 3 included 5 likert scale questions to evaluate attitudes toward sun-protective behaviors. Answer options were "Strongly agree," "Agree," "Neither agree nor disagree," "Disagree," and "Strongly disagree", which scored 4, 3, 2, 1 or 0 points respectively, yielding a maximum of 20 points for the attitudes section. Section 4 contained 6 questions to determine the frequency of sun-protection practices amongst the population, with "Always," "Often," "Sometimes," and "Never" answer choices scoring 3, 2, 1, or 0 points respectively, for a maximum of 18 points for the practice section. The total possible score for the questionnaire was 46 points.

The questionnaire was accessible to respondents in Kazakh, and Russian languages. Only 3 of the questionnaires were completed in Kazakh, while the remaining were completed in Russian. Reliability assessment for the knowledge, attitude, and practice sections of the questionnaire involved calculating Cronbach's alpha. After excluding the 3 responses in Kazakh, Cronbach's alpha values for these sections were 0.55, 0.7, and 0.7 respectively, indicating acceptable internal consistency of the questionnaire.

Data analysis

Basic descriptive tests were conducted on personal characteristics, sun exposure levels, knowledge, attitudes, and sun-protective practices. Bivariate analysis, specifically using the student t-test and one-way ANOVA test, was employed to identify associations between specific personal characteristics and levels of knowledge, attitudes, and practice.

A multiple linear regression model was created to identify factors influencing sun-protective practices. Backward selection of independent variables was employed to construct the final regression model. Variables with p-values not surpassing the threshold value of 0.1 from bivariate analysis were included (due to the relatively small size, adopting a more conservative cut-off of $p<0.05$ might risk overlooking statistically significant predictors). P-values below 0.05 denoted statistical significance in the final regression model. The goodness of fit of the final model was confirmed using the Partial F-test. The data was analyzed using "Stata 16.0" statistical software.

Ethical Considerations

Participants were aged 18 years or over. Email or IP addresses were not collected, and the questionnaire did not contain any potentially identifying questions. Participants were asked to provide informed consent prior to completing the survey. Informed consent for internet surveys was used. The research was approved by Nazarbayev University Institutional Research Ethics Committee as NUSOM-IREC-JAN-2021-#01, on 15.02.2021.

Results

Participant Characteristics

In total 291 responses were collected, however responses of people younger than 18 years and those who had not completed half of the questionnaire were excluded from the analyses. Therefore, the responses of 249 participants were statistically analysed. A description of the personal characteristics of the participants is shown in Table 1. The average age of the respondents was 31.7 ± 11.5 (SD) years, ranging from 18 to 81 years, with over seventy percent falling within the age groups below 34 years. Among the participants, 71.0% identified as female, 93.9% resided in urban areas, and 88.0% possessed higher education qualifications (Bachelor's degree (50.0%) and Master's/PhD (38.3%)). Kazakh nationality comprised the majority of participants at 88.7%, followed by Russian at 6.5%. Only 2 participants (0.8%) had experienced skin cancer previously, and 7 participants (2.8%) had a family history of skin cancer.

Knowledge findings

Table 2 presents the percentages of correct responses to questions in the knowledge section, along with their gender-based comparison. In comparison to men, women were more informed about the ability of sun exposure to cause skin aging (45.8% and 68.8%, respectively, p=0.001) and hyperpigmentation (47.2% and 71.6%, respectively, p<0.001). Conversely, men exhibited better knowledge regarding the positive health effects of sun exposure, such as improved health (58.3% and 45.5%, respectively, p=0.066) and elevated vitamin D levels (87.5% and 73.3%, respectively, p=0.015). Only 58.9% of respondents were aware that sun exposure could lead to skin cancer development. Notably, all 249 participants indicated unfamiliarity with the meaning of the abbreviation "SPF" on sunscreen products.

The results of bivariate analysis are shown in Table 5. The respondents' mean knowledge score was 3.9 ± 1.4 points, out of a possible 8. Younger age groups exhibited higher knowledge scores compared to older groups (p=0.052). Those with postgraduate degrees demonstrated the highest knowledge scores, while participants without higher education had the lowest (p=0.016). Individuals with a self-reported family history of skin cancer displayed greater knowledge (p=0.039). Furthermore, those who spent 15 to 30 minutes or 30 minutes to 1 hour outside during 10 am to 3 pm had higher knowledge scores than those who spent less or more time outdoors (p=0.014).

Attitude findings

The distribution of participants' attitudes toward sun-protective measures is presented in Table 3. It is worth noting that merely 56.9% of individuals agreed that sunscreen with an SPF of at least 15 would protect them from the sun. Only 9.1% of respondents consistently apply sunscreen to exposed body parts, while 32.4% never do so.

The mean attitude score of the participants was 14.1 ± 3.1 points, out of a possible 20 (Table 5). The mean score for attitude was higher in men compared to women (p=0.015). Also, a significant association was found

Table 1. Characteristics of the Study Participants (n=249)

Variable	Mean ± SD (Range)
Age	31.7 ± 11.5 (18-81)
	n (%)
Age group	
18-24 years	73 (35.1)
25-34 years	75 (36.1)
35-44 years	25 (12.0)
>45 years	35 (16.8)
Gender	
Female	176 (71.0)
Male	72 (29.0)
Residence	
City	232 (93.9)
Village	15 (6.1)
Education	
High school	21 (8.5)
College degree	8 (3.2)
Bachelor's degree	124 (50.0)
Master's/PhD	95 (38.3)
Nationality	
Kazakh	220 (88.7)
Russian	16 (6.5)
Ukrainian	3 (1.2)
Tatar	3 (1.2)
Uzbek	1 (0.4)
Other	5 (2.0)
Skin type	
Very fair skin, always burns, never tans (Type I)	17 (6.9)
Fair skin, always burns, tans minimally or with difficulty (Type II)	82 (33.1)
Darker white skin, initially burns and then tans (Type III)	95 (38.3)
Light brown to dark brown or black skin, burns minimally, tans readily (Type IV-VI)	54 (21.8)
Personal history of skin cancer	
Yes	2 (0.8)
No	246 (99.2)
Family history of skin cancer	
Yes	7 (2.8)
No	241 (97.2)
Job type	
Indoors	228 (93.1)
Outdoors	5 (2.0)
Both	12 (4.9)
Daily time spent outside in summertime from 10 am to 3 pm	
<15 min	54 (21.8)
15-30 min	71 (28.6)
30 min -1 h	62 (25.0)
1-2 h	45 (18.2)
>2 h	16 (6.5)

Table 1. Continued

Variable	Mean ± SD (Range)
Sunbathing with intention to tan	
Very often	1 (0.4)
Often	18 (7.3)
Rarely	163 (65.7)
Never	66 (26.6)
Solarium use (ever)	
Yes	17 (6.9)
No	231 (93.2)
Sunburns during last year	
Never	179 (72.2)
1-5 times	66 (26.6)
6-10 times	1 (0.4)
>10 times	2 (0.8)
Are your children being educated in school about sunlight protection?	
Yes	8 (5.5)
No	66 (45.5)
I do not know	71 (49.0)

SD, standard deviation.

between mean attitude score and time spent outside in the summer between 10 am and 3 pm and number of sunburns experienced during the previous summer ($p<0.1$).

Practice findings

Table 4. provides a description of the respondents' sun protective practices. The mean practice score of the participants was 8.2 ± 3.5 points, out of a maximum of 18 points (Table 5). Respondents with postgraduate degrees had the highest practice score and respondents without higher education got the lowest score ($p=0.003$). Also, mean practice score was higher in females compared to males ($p<0.001$), higher in urban compared to rural residents ($p=0.07$) and higher in age groups from 25 to 34 years and from 35 to 44 years compared to participants aged 18 to 24 and older than 45 ($p<0.001$).

The primary barriers to not using sunscreen were "I want to but forget" (33.3%) and "I do not think I am exposed to enough sunlight" (25.6%). The most common sources of information about sun protection were social media (37.1%) and TV (14.2%). Surprisingly, only 1.3% of respondents received such information from hospitals,

Table 2. Knowledge about the Health Effects of Sun Exposure and Its Distribution by Gender

Do you attribute following health effect to sun exposure:	Correct responses n (%)	Men n (%)	Women n (%)	p-value†
Sunburn	202 (81.5)	61 (84.7)	141 (80.1)	p = 0.397
Skin aging	154 (62.1)	33 (45.8)	121 (68.8)	p = 0.001**
Skin cancer	146 (58.9)	44 (61.1)	102 (58.0)	p = 0.647
Hyperpigmentation	160 (64.5)	34 (47.2)	126 (71.6)	p < 0.001***
Increased health and well-being	122 (49.2)	42 (58.3)	80 (45.5)	p = 0.066*
Increased vitamin D levels	192 (77.4)	63 (87.5)	129 (73.3)	p = 0.015**
Do you know meaning of SPF on sunscreen products?	0 (0)	0 (0)	0 (0)	

SPF, sun protection factor; † Student's t-test for independent samples; p-values for the comparison between genders; * p<0.1; **p<0.05; ***p<0.001

Table 3. Distribution of Aattitudes towards Sun-Protective Practices among Participants

Do you think that following behaviors protect you from the sun?	Positive attitude n (%)	Neutral attitude n (%)	Negative attitude n (%)
Wearing broad-brimmed hats	207 (83.5)	23 (9.3)	18 (7.3)
Apply sunscreen with SPF of at least 15?	141 (56.9)	61 (24.6)	48 (19.4)
Stay in the shade away from the sun?	172 (69.4)	36 (14.5)	40 (16.1)
Wear appropriate clothing that protects the skin (long sleeves, etc.)?	207 (83.5)	32 (12.9)	9 (3.6)
Use proper sunglasses (With UV absorbent coating)?	170 (68.6)	44 (17.3)	35 (14.1)

SPF, sun protection factor; UV, ultraviolet.

Table 4. Distribution of sun-protective practices among participants

When you are exposed to the sun, do you …	Always	Often	Sometimes	Never
Wear a hat / cap?	32 (13.3%)	87 (36.1%)	99 (41.1%)	23 (9.5%)
Wear a long-sleeved shirt / protective clothing?	17 (7.1%)	55 (22.8%)	127 (52.7%)	42 (17.4%)
Put sunscreen on your face?	64 (26.7%)	56 (23.3%)	57 (23.8%)	63 (26.3%)
Put sunscreen on the parts of your body exposed to the sun (arms, legs, etc.)?	22 (9.1%)	40 (16.6%)	101 (41.9%)	78 (32.4%)
Wear sunglasses with UV filters?	33 (13.7%)	56 (23.2%)	87 (36.1%)	65 (27.0%)
Try to stay in the shade?	56 (23.2%)	133 (55.2%)	50 (20.8%)	2 (0.8%)
Put sunscreen on your children when they are exposed to the sun?	36 (19.05%)	37 (19.58%)	47 (24.87%)	69 (36.51%)

Table 5. Bivariate Analysis of the Associations between Mean Knowledge, Attitudes and Practice Scores and Participants' Characteristics

	Mean knowledge score ± SD Max=8	p-value	Mean attitudes score ± SD Max=20	p-value	Mean practice score ± SD Max=18	p-value
All Participants	3.9 ± 1.4		14.1 ± 3.1		8.2 ± 3.5	
Age Group						
18-24	4.1 ± 1.3	0.052[a]**	13.6 ±3.0	0.220[a]	6.7 ± 3.2	<0.001[a]***
25-34	4.1 ± 1.4		14.2 ± 3.3		9.2 ± 3.3	
35-44	4.0 ± 1.1		14.3 ± 3.4		10.2 ± 3.3	
>45	3.4 ± 1.6		14.9 ±2.6		8.2 ± 3.6	
Gender						
Male	3.8 ± 1.5	0.527[b]	14.8 ± 2.9	0.015[b]**	7.0 ± 3.4	<0.001[b]***
Female	4.0 ± 1.4		13.8 ± 3.2		8.7 ± 3.5	
Residence						
Urban	4.0 ± 1.4	0.128[b]	14.1 ± 3.1	0.567[b]	8.3± 3.5	0.070[b]*
Rural	3.4 ± 1.5		13.6 ± 3.8		6.7 ± 3.2	
Personal History of Skin Cancer						
Yes	4.5 ± 0.7	0.568[b]	14.0 ± 2.8	0.980[b]	7.0 ± 1.4	0.613[b]
No	3.9 ± 1.4		14.1 ± 3.1		8.3 ± 3.5	
Family History of Skin Cancer						
Yes	2.9 ± 1.9	0.039[b]**	14.1 ± 1.5	0.941[b]	9.9 ± 3.6	0.221[b]
No	4.0 ± 1.4		14.1 ± 3.2		8.2 ± 3.5	
Education						
High school education/College	3.4 ± 1.6	0.016[a]**	13.8 ± 2.58	0.877[a]	6.3 ± 2.5	0.003[a]**
Bachelor's degree	3.8 ± 1.5		14.0 ± 3.1		8.2 ± 3.6	
Master's degree or PhD	4.2 ± 1.2		14.1 ± 3.3		8.9 ± 3.5	
Nationality						
Kazakh	3.9 ± 1.4	0.639[a]	14.0 ± 3.2	0.763[a]	8.1 ± 3.4	0.089[a]**
Russian	4.1 ± 1.3		14.5 ± 2.6		8.3 ± 3.7	
Other	3.6 ± 1.6		14.4 ± 2.0		10.4 ± 4.4	
Skin type						
Type I	4.2 ± 1.6	0.802[a]	13.4 ± 2.7	0.753[a]	7.9 ± 4.9	0.886[a]
Type II	3.9 ± 1.4		14.2 ± 3.3		8.5 ± 3.3	
Type III	3.9 ± 1.4		13.9 ± 3.0		8.1 ± 3.0	
Type IV-VI	3.9 ± 1.5		14.2 ± 3.3		8.2 ± 4.2	
Employment						
Indoors	4.0 ± 1.4	0.176[a]	14.0 ± 3.1	0.422[a]	8.3 ± 3.6	0.350[a]
Outdoors	2.8 ± 2.3		12.8 ± 1.3		6.0 ± 3.5	
Both	3.8 ± 1.7		14.9 ± 3.7		8.5 ± 2.9	
Daily Time Spent Outside from 10 am to 3 pm						
<15 min	3.9 ± 1.5	0.014[a]**	14.0 ± 3.6	0.075[a]*	7.5 ± 3.7	0.195[a]
15 min – 30 min	4.2 ± 1.4		13.8 ± 3.0		8.7 ± 3.2	
30 min – 1 h	4.1 ± 1.2		15.0 ± 3.0		8.8 ± 3.5	
1-2 h	3.6 ± 1.3		13.3 ± 2.5		7.7 ± 3.4	
>2 h	3.1 ± 1.6		13.9 ± 3.5		8.6 ± 4.6	
Frequency of Sunbathing						
Never	3.8 ± 1.4	0.396[a]	13.9 ± 3.3	0.252[a]	9.0 ± 3.8	0.006a**
Rarely	4.0 ± 1.4		14.1 ± 3.0		8.2 ± 3.4	
Often	3.6 ± 1.7		14.4 ± 3.2		6.7 ± 3.8	
Very often	3.0 ± 0		20.0 ± 0		0 ± 0	
Sunburns Last Summer						
Never	3.9 ± 1.5	0.362[a]	13.7 ± 3.1	0.045[a]**	8.0 ± 3.6	0.292[a]
1-5 times	4.1 ± 1.2		14.8 ± 3.1		9.0 ± 3.4	
6-10 times	6.0 ± 0		18.0 ± 0		8.0 ± 0	

Table 5. Continued

	Mean knowledge score ± SD Max=8	p-value	Mean attitudes score ± SD Max=20	p-value	Mean practice score ± SD Max=18	p-value
Sunburns Last Summer						
>10 times	4.0 ± 1.4		15.0 ± 0		7.0 ± 0	
Children Educated in School						
Yes	3.25 ± 1.3	0.445[a]	13.5 ± 4.5	0.394[a]	11 ± 4.1	0.027[a]**
No	3.9 ± 1.3		13.5 ± 3.5		9.3 ± 3.2	
I don't know	3.8 ± 1.4		14.2 ± 2.7		8.2 ± 3.2	

SD, standard deviation; [a], ANOVA test; [b], Student's t-test for independent samples; * p <0.1; ** p <0.05; *** p < 0.001

Table 6. Multiple Linear Regression Analysis between Total Practice Score and Personal Characteristics (Adjusted R squared = 0.323, F=6.49, p <0.001)

	b*	95% Confidence Interval	ß**	p-value
Knowledge	0.651	0.248, 1.054	0.258	0.002
Attitudes	0.27	0.098, 0.441	0.26	0.002
Age	-0.039	-0.088, 0.010	-0.132	0.117
Gender				
Male	Ref			
Female	2.009	0.784, 3.234	0.283	0.002
Education				
High school/College	Ref			
Bachelor's degree	0.697	-1.071, 2.465	0.107	0.436
Master's degree or PhD	1.475	-0.303, 3.253	0.226	0.103
Children educated at school about sun protection				
No	Ref			
I do not know	-0.323	-1.394, 0.748	-0.05	0.551
Yes	2.651	0.457, 4.844	0.194	0.018
Barrier: *"I do not like how it feels on my skin"*				
No	Ref			
Yes	-2.777	-4.521, -1.034	-0.26	0.002
Barrier: *"I do not think I am exposed to the sun enough"*				
No	Ref			
Yes	-1.784	-3.154, -0.414	-0.215	0.011

*, Unstandardized coefficients; **, Standardized coefficients

while 24.2% did not receive any information at all (data not shown in tables).

Interestingly, participants who reported that their children are being educated in school about sunlight protection obtained significantly higher mean practice score compared to other participants (p=0.027). Participants who answered that they do not like how sunscreen feels on their skin (p=0.006) and those who do not think they are exposed to the sun enough (p=0.026) had significantly lower mean practice score compared to other people. Participants who answered that they obtain information about sunlight protection from social media (p=0.037) and other sources (p=0.003) had a significantly higher mean practice score compared to others. The mean practice score was also significantly associated with nationality (p=0.089) and frequency of sunbathing (p=0.006).

Further analysis

Based on the outcomes of the bivariate analysis, several variables namely, knowledge, attitude, age, gender, type of residence, education, nationality, having children educated about sunlight protection, avoiding sunscreen due to skin discomfort, avoiding sunscreen due to perceived inadequate sun exposure, obtaining sun protection information from social media and other sources were associated with participants' overall practice scores. However, following adjustment for confounding factors in the multiple linear regression analysis, only some of the variables retained their statistical significance and independent associations with the total behavior score (Table 6). Both higher knowledge (ß=0.258, p=0.002) and attitude (ß=0.260, p=0.002) scores associated with higher practice scores. Females reported a greater tendency to adopt sun-protective measures than males (ß=0.283, p=0.002). Parents whose children received sun protection education at school exhibited a more pronounced sun-protective behavior compared to parents whose children did not receive similar education (ß=0.194,

p=0.018). Participants who cited skin discomfort as their reason for not using sunscreen displayed less frequent sun-protective behavior than others (ß=-0.260, p=0.002). Likewise, participants who believed that their sun exposure was insufficient for sunscreen use demonstrated lower total practice scores compared to those with a higher perception of sun exposure (ß=-0.215, p=0.011). Age and education were retained in the final multiple regression model for face validity.

Discussion

This cross-sectional study is the first in Kazakhstan to assess population knowledge about the health effects of sun exposure, attitudes towards sun-protection, and the frequency of adoption of sun protective measures. The findings demonstrated that knowledge and attitude levels were moderate in the population sample. Practices, on the other hand, were determined to be low, although characteristics such as female gender and having children educated at school about sun safety were associated with improved practices.

Whilst knowledge levels were moderate amongst the population, fewer than sixty percent of participants recognized the connection between sun exposure and the development of skin cancer. This finding aligns with studies conducted in Saudi Arabia (2010 and 2016) [9, 15] and China [16], while being slightly lower than a more recent study conducted in a sample of the Saudi Arabian population (2021) [17]. Greater preoccupation with their appearance among women could explain their better knowledge of the effects of sunlight exposure on skin aging and hyperpigmentation, but overall gender-based knowledge score difference was insignificant. In our study higher education correlated with better knowledge, in line with other studies [9, 10, 17]. Remarkably, none of the participants understood the meaning of "SPF" on sunscreens, indicating limited sunscreen usage and understanding of SPF differences. This knowledge gap highlights the need for increasing public awareness.

Attitudes toward sun-protective behaviors was moderately positive among the sample population and this aligns with a study conducted on high school students in Iran [11]. In our study, most participants tended to believe that wearing broad-brimmed hats and appropriate protective clothing could effectively shield them from sunlight. However, there was more skepticism towards the efficacy of sunscreen with SPF of at least 15. This skepticism could potentially be attributed to the insufficient understanding of the meaning of SPF that we observed among the population.

Despite positive attitudes, the level of sun-protective behavior among Kazakhstan's population was low. Most sun-protective behaviors were found to be practiced always or often by less than half of the participants. Furthermore, applying sunscreen to body parts exposed to the sun, except the face, was the least commonly observed behavior, with only a quarter of participants reporting sunscreen application to those areas always or often. On the other hand, half of the participants reported applying sunscreen to their faces always or often. This may suggest that facial sunscreen application could be driven more by aesthetic considerations rather than concerns about skin cancer.

There is also a concerning trend among parents in our study. Over a third reported never applying sunscreen to their children, and only nineteen percent applied it always when their children were in the sun.

It is well established that knowledge and attitudes are important modifiable determinants of health behavior [18-21], and our study supports this finding by demonstrating a significant association between knowledge and attitudes towards sun protection and actual sun protective practices. This finding highlights the importance of encouraging more positive behaviors by modifying attitudes through education.

Females exhibited better sun-protective behavior, despite the more favorable attitudes of males toward sun protection and the similar levels of knowledge among both genders. Better sun-protective behavior among females was also observed in other studies [9, 11, 14, 22, 23]. According to the American Academy of Dermatology, females are more susceptible to developing skin cancer than males before the age of 50. After 50, however, males have a higher incidence of skin cancer [24]. This could be attributed to the more outdoor activities and sun exposure that males often engage in due to work requirements, coupled with their lesser use of protective measures compared to females. While theories exist, that women may protect their skin from the sun to avoid wrinkles and skin aging, no definitive explanation for this gender disparity has been established in the current literature [25]. In terms of beauty standards fair skin is preferable to tanned skin in Kazakhstan. Therefore, women who may be more concerned about their appearance than men may be more inclined to avoid tanning. Targeting men for sun protection could involve strategies like providing sunscreen in workplaces and outdoor settings to encourage more consistent use.

The study on skin cancer incidence in the different population groups in Astana, indicated that the incidences of BCC, SCC and CMM were higher among the Russian and other European/Caucasian groups in comparison to the Kazakh and other Turkic/Asian nationalities [5]. The authors suggested that this could be due to differences in skin phototypes or differences in the use of sun protective measures between the two groups. Despite our sample being predominantly composed of Kazakh (88.7%) and Russian (6.5%) participants, we did not observe a significant difference in sun protective behavior between these two nationalities. However, it may be that we were not able to reveal significant differences due to the small sample size of the Russian population group.

Having children educated about sun protection at school has been associated with better sun protective behavior among parents, suggesting the transmission of knowledge from children to parents. Similar findings were observed by Ilunga Tshiswaka et al (2018), who conducted a systematic review and meta-analysis of 9 articles and showed that parental knowledge about stroke significantly improved after stroke education interventions targeting their children [26]. This highlights

the importance of integrating sun protection education into school curriculums. Such education could not only benefit children's understanding of sun exposure risks and protective measures but may also extend to their parents. The significance of sun protection education in schools is underscored by the vulnerability of children's and adolescents' skin and eyes to the harmful effects of ultraviolet radiation (UVR), and excessive sun exposure during this period increases the risk of future skin cancer [27]. Given the link between lower educational attainment and lower rates of sun protection use, it prompts consideration of the need to integrate sun protection education at lower grade levels, fostering positive behaviors in a higher proportion of children.

We also found an association between not using sunscreen due to an unpleasant feeling on the skin and poorer sun protective behavior. This barrier to regular sunscreen use was also the most common barrier in the cross-sectional study by Weig et al. (2020) (33.7 % of non-users, n = 429) [28]. In the study by Diehl et al. (2021), (36.2% (n = 223) of non-users, reported that they find sunscreen too sticky or oily/greasy and 19.7% (n=85) believed that sunscreen has an unpleasant odor [29]. This highlights the importance of developing sun protection products that are not only effective but also comfortable and pleasant to use.

We observed an association between not using sunscreen due to beliefs about insufficient sun exposure and poorer sun protective behavior. This could be attributed to varying sun exposure needs among individuals. On the other hand, perceptions of sun exposure can be subjective and influenced by regional climate differences. Another study has confirmed that personal perception of susceptibility to sun exposure significantly influences sun protective behavior [30]. The people of Kazakhstan have a rich nomadic heritage and are accustomed to a lifestyle that involves outdoor activities that are viewed as being beneficial for health and wellbeing. This cultural influence may hinder concerns about the negative effects of sun exposure. We suggest that future educational interventions should focus on informing people about personal risk factors for skin cancer.

Our study has several limitations. Firstly, our survey was conducted online, potentially introducing coverage bias as individuals without internet access were unable to participate. Secondly, the survey distribution through social networks may have led to the inclusion of mainly close contacts of the survey distributors, causing selection bias. This resulted in a larger proportion of young respondents with higher educational degrees and urban residences, which does not accurately reflect the diversity of the Kazakhstan population. Survey responses may also be inaccurate as participants may not accurately report their knowledge, attitudes, and practices e.g., due to recall bias. They may provide answers that are socially desirable rather than true. However, as participants were assured of anonymity and no identifiable information was collected social desirability bias would have been minimized. Furthermore, a larger sample size would have increased the power of the study to detect true differences between groups and the cross-sectional study design is a measurement at one point of time and allows us to observe associations between variables but restricts our ability to establish causal relationships. Strengths of the study are that it is the first to report and provide a valuable assessment of knowledge, attitudes and practices regarding sun exposure and sun protection in a sample of the Kazakhstan population. Furthermore, the results of Cronbach's alpha calculation demonstrated internal consistency and reliability of the survey instrument and the study employed rigorous statistical analysis adding depth and reliability to the findings.

In conclusion, we observed that the level of knowledge concerning the negative effects of sun exposure and attitudes toward sun protection behaviors are moderate among the sample population, while the adoption of these behaviors is low. Higher rates of sun protective practices were significantly associated with female gender, knowledge, attitude, and having children educated about sun protection in school. Conversely, lower adoption of sun protective measures was significantly associated with an unpleasant feeling of sunscreen on the skin and a low perception of sun exposure. The incidence of skin cancer is increasing worldwide, and the World Health Organisation has attributed this to an increase in recreational exposures and outdoor activities. Educational sun protection programmes in schools and public forums in Kazakhstan should be implemented to help reduce the incidence of skin cancer in the country.

Author Contribution Statement

Study conception and design: all authors; data collection: all authors; analysis and interpretation of results: AM, PM, RA TS; draft manuscript preparation: AM, PM, RA. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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