

**Knowledge and Practices on Sunscreen Usage and Skin Cancer among General Population: A Multi-Centric Cross- Sectional Study**Ravi Nimonkar<sup>1</sup>, Rahul Thombre<sup>2</sup>, Vishal Sharma<sup>3</sup>, PMP Singh<sup>4</sup>, Rajesh Shetty<sup>5</sup>, Sumeet Singh<sup>6</sup><sup>1</sup>Professor, Dept. of Community Medicine, Armed Forces Medical Services<sup>2</sup>Professor, Dept. of Dermatology and Venereology, Armed Forces Medical Services<sup>3</sup>Professor, Dept. of Dermatology and Venereology, Armed Forces Medical Services<sup>5</sup>Assistant Professor, Dept. of Community Medicine, Armed Forces Medical Services<sup>4</sup>Professor, Dept. of Community Medicine, Armed Forces Medical Services<sup>6</sup>Assistant Professor, Dept. of Community Medicine, Armed Forces Medical Services

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Conflict of interest: Nil

**Abstract:**

**Introduction:** Sunlight, a source of vitamin D, entails both beneficial and harmful effects on the skin, with Ultraviolet (UV) radiation causing acute and chronic dermatological issues. Given the limited literature on UV radiation's role in dermatological disorders in our country, this study aimed to assess the general population's awareness of sun exposure risks and skin cancer, along with studying their sun-protective practices.

**Materials and Methods:** A robust multicentric population-based cross-sectional study was conducted in India, involving 500 adult participants. A semi-structured, self-reported questionnaire, refined through a pilot study, covered informed consent, objectives, procedures, and confidentiality.

Data collection utilized Google Forms, and statistical analyses, including the Chi-square test, were performed. The study adhered to the 1975 Declaration of Helsinki ethical guidelines.

**Results:** Males (51%) and females (49%) comprised the study population, with 47.60% falling in the 18-25 age groups. Of 500 participants, 89.6% were aware of sunlight's harmful effects and sunscreen's photoprotective role. However, only 62.28% knew about sun exposure's carcinogenic effects. Among participants, 26.6% used sunscreen, but many did not follow correct practices.

The mean knowledge score was 13.29 (SD 1.17, range 5-16), and mean practice score was 13.68 (SD 1.14, range 4-15). Knowledge and practice scores were notably low in males, lower education levels, and poor socioeconomic status. Positive predictors of good knowledge and practices were sex, education, and socioeconomic status.

**Conclusion:** Our study's strengths include a sizable sample size and a well-designed questionnaire. However, a limitation is the self-reported nature of sunscreen usage, lacking validation. Additionally, participant responses may be influenced by recall and social desirability biases, with a higher representation of young adults from middle socioeconomic strata. We suggest implementing structured and ongoing education programs in schools and colleges to enhance awareness. Furthermore, we recommend governmental actions, such as strict enforcement of regulations and acts, to control sunscreen prices.

**Keywords:** Sunscreen, Skin cancer, Awareness.

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**Introduction**

Sunlight has several beneficial as well as harmful effects on the skin. Besides, being the main source of vitamin D, Ultraviolet (UV) radiation has many harmful effects on the skin. [1] Only a small part of the electromagnetic radiation spectrum is composed of UV radiation, which is further divided into three subdivisions, viz, UVC (200-290nm), UVB (290-320nm) and UVA (320-400nm). UVA is further subdivided in UVA1 (340-400nm) and UVA2 (320-340nm). Atmospheric ozone absorbs

100% of UVC, approximately 90% of UVB and virtually no UVA. Hence, ozone layer depletion has led to a significant increase in ultraviolet radiation reaching the earth. [2] Only UVA and UVB rays reach the earth's surface because stratospheric gases block UVC.[3] Controlled exposure to UV radiation is beneficial as it plays a role in prevention of autoimmune diseases, syntheses of Vitamin D3. UV radiation is beneficial in skin diseases like psoriasis, vitiligo and increases the serum levels of

endorphins. Many skin diseases are caused by excessive and unprotected sun exposure. High cumulative levels of ultraviolet radiation can damage skin cells, affect the normal growth and appearance. [2]

Excessive UV exposure causes widespread epidermal and dermal cellular damage. The primary molecular target of injury is DNA. This occurs both as a result of both direct UVB absorption and also secondary UVA-induced photosensitization reactions.[4] UV B light is more carcinogenic and mutagenic in comparison to UV A light.[3] In human skin, excessive and unprotected UV radiation causes acute and chronic responses. The acute harmful dermatological effects of ultraviolet rays include DNA damage, apoptosis, erythema, immunosuppression; and increased pigmentation (suntan) due to melanogenesis stimulation.[3],[4]

Long term low-dose UV radiation can cause gene mutations, immunosuppression, increased melanization, pigmentary changes (melasma, freckles, lentigenes) hypercornification, hyper granulosus, enhanced tenascin expression, reduced quantity of type I procollagen, moderately increased lysozyme. Prolonged and repeated exposure to UV radiation also causes photoaging, including the development of spots, wrinkles and photocarcinogenesis (dermatological malignancies). Premature aging of skin occurs due to photoaging, characterized by clinical, histological, and biochemical changes which are different from naturally aged skin which has been protected from the sun.[2],[3],[4]

Loss of skin elasticity, disturbance of natural barrier function of the skins which superimpose on the alterations of biological aging are known as photoaging.[5] UV radiation induces DNA mutations, and oxidative stress, which lead to photoaging, actinic keratosis and DNA damage.[6]

Several studies have reported a rise in the prevalence of dermatological malignancies. This can be attributed to various factors like high doses of UV radiation entering the atmosphere due to the ozone depletion, lifestyle with an increase in exposure to sunlight due to outdoor activities living and traveling in sunny climates, excessive sunbathing, sun bed use, outdoor sports, besides the usage of appliances/devices which emit UV radiation in domestic and industrial settings.[4],[5] Sunscreen is a substance which on topical application protects the treated region from sunburn. Using sunscreen helps the body's defensive mechanisms to ward off solar UV radiation Effectiveness of sunscreen is determined by its ability to either absorb, reflect or scatter solar radiation. Different products with chemicals which absorb or scatter UV radiation provide different levels of protection.[3],[7] The "sun protection factor" or SPF of various sunscreen lotions is a dependable sign of resistance against sunburn.

[3],[8] Keeping in view the role of UV radiation in dermatological disorders and malignancies; and the paucity of literature on the subject in our country, the present study was carried out. Thus, we propose to fill this gap in this research by uncovering such predictors.

The aim and objectives of our study were to assess the level of awareness of the general population regarding sun exposure and the risk of skin cancers, as well as to study their sun-protective practices.

### Materials and Methods

**Study design and study period:** A multicentric population-based cross-sectional study was conducted across various states in India, to assess the awareness of the general population regarding sun exposure and the use of sunscreen among the adult population adults in India. The study was carried out from July 2022 to Mar 2023.

**Sample size :** Based on previous available literature approximately 50% of the general population were using sunscreens<sup>4</sup> The sample size estimation was carried out by assuming a prevalence of 50%, with a 95% confidence level; and d (margin of error)=0.05. The sample size was calculated using the formula:

$$N = (Z_{1-\alpha/2})^2 \times p \times q / d^2$$

Thus the sample size was calculated to be 385; and with design effect

= 1.2, a sample size of 462 participants was obtained. An even larger sample size of 500 participants was taken for the study, thereby greatly increasing the power of our study.

**Study population and eligibility criteria :** Adult general population of Indian nationals residing in the study area during the period of study, employed or unemployed, who could comprehend the questionnaire, and voluntarily gave their consent to participate in the study were chosen as study participants . Children aged <18 years and severely ill patients were excluded from the study as they were unable to comprehend or respond to the questionnaire.

**Study instrument:** On the basis of advice of various experts in the field; and available literature , a semi-structured, self-reported and respondent friendly questionnaire was designed and validated by means of a pilot study among 30 study participants. Besides the authors of the study, the experts included a statistician and an epidemiologist. The questionnaire contained informed consent, short introduction regarding the objectives, procedures, the voluntary nature of participation, declarations of confidentiality and anonymity.

The questionnaire was divided into three sections with a total of 40 questions. The first section collected demographic information of the study participants. Socioeconomic status of the study participants was classified as per modified Kuppaswamy scale.[9] The second section included 16 questions on sun exposure, knowledge regarding sun exposure, sunscreen and skin cancer; and 16 questions on sun protection habits. The third section contained questions pertaining to reason(s) for use of sunscreen, frequency of application, type and sun protection factor (SPF) value of the sunscreen used, and basis of choosing the particular sunscreen. Most questions in the questionnaire were of a closed nature, which were required to be replied to by choosing a single answer from multiple choices. One mark was awarded for each correct response; and zero marks for wrong answer. In the sections on knowledge/practice, overall score more than 12 out of 16 was taken as good knowledge/practice, 8 to 12 was taken as fair knowledge/practice; and less than 8 was taken as poor knowledge/practice. This methodology of awarding marks and grading as good/fair/poor to assess the knowledge and practices has already been validated by previous researchers.[10],[11],[12],[13],[14]

Data collection was carried out using soft copy of the questionnaire which was designed using Google form. The questionnaire was distributed using various messaging apps particularly what's app. Participation in this open study was for all males and females within the assigned age group.

**Statistical instrument:** The overall scores of each study participant were used to obtain mean scores for knowledge and practice. Frequencies of correct knowledge answers and practices were described.

Knowledge and practices scores of different persons according to different socio-demographic characteristics were compared using appropriate statistical tests. Both descriptive and inferential statistical analyses were performed. In the descriptive analyses, qualitative data were described in terms of frequency and percentage. Quantitative data were described using mean and standard deviation. Chi-square test was used to get the level of significance of the difference between groups.

The data analysis was performed using Microsoft Excel 2019 and SPSS version 23.0. Microsoft Excel was used for editing, sorting, and coding. The excel file was then imported into and analyzed using SPSS version 24.0 (IBM, Armonk, NY). Two-tailed P value  $\leq 0.05$  was considered as statistically significant.

#### **Ethics Approval and Consent of Respondents:**

The research protocol, questionnaire, consent statement, and procedures of obtaining informed consent were approved by the Institutional Research Ethics Committee. Respondents were in-

formed in the local language about their rights to voluntarily participate; and to withdraw from the interview at any point of time. The consent form documented the aims, nature, and procedure of the study. Respondents were assured of the anonymity and confidentiality of the data they provided. Anonymity and confidentiality were strictly maintained. The study follows the ethical guidelines of the 1975 Declaration of Helsinki.[15]

#### **Results**

Demographic profile of the study participants is tabulated in Table 1.

Males constituted 255 (51%) while females constituted 245 (49%) of the study population. Majority of the study participants 238 (47.60%) belonged to the age group of 18-25. Out of 500 study participants 259 (51.8%) were single, while 441 (88.2%) were from urban background. Most of the participants were categorized in lower middle socioeconomic status with 340 (68.00) falling in this group, while 253 (50.60) were graduates. Out of 255 males, 103 (40.39%) were office workers, while out of 245 females, 88 (35.925) were home makers.

Assessment of the sun exposure revealed that 453 (90.6%) of the study participants reported daily sun exposure, whereas 47 (9.4%) reported occasional sun exposure. Out of 453 study participants who reported daily sun exposure, 263 (58.05%) had less than one hour of daily sun exposure, while 103 (22.74%) had an exposure of 1- 3 hours per day and 87 (19.21%) reported daily sun exposure of more than three hours. Reasons for exposure to sun and time of exposure to sun are tabulated in Table 2.

Out of 500 respondents, 448 (89.6%) were aware of the harmful effects of excessive exposure to sunlight and use of sunscreen as a photoprotective agent. However out of these 448, only 279 (62.28%) were aware of the carcinogenic effect of excessive exposure to sun. Sources of information of are tabulated in Table 3.

Out of 500 study participants, 133 (26.6%) were using sunscreen regularly. Out of these 53 (39.85%) were using it only on the face, 58 (43.61%) were using it on face and hands, while 22 (16.54%) were using it on all exposed areas of the skin. Majority of the study participants of our study who reported sun screen usage were not following the correct practice regarding various aspects of sun screen usage, viz, time of application, parts of body where sun screen should be applied, amount of sun screen used per application, amount of sun screen used on the face, practice of reapplication, using a sunscreen that protects against both ultraviolet A and ultraviolet B (UVB) sun rays, use of water resistant sunscreen and using sun screen

with SPF > 30. Above correct practices have been described by Tilwani et al and Gupta.[2],[4] Table 4 illustrates responses of study participants pertaining to various aspects of sunscreen use; and other methods of protection from exposure to sun.

**Scores of Knowledge and Practice:** The mean knowledge score was score of knowledge was 13.29 (SD 1.17, range 5 - 16). The mean score of practice was 13.68 (SD 1.14, range 4 - 15). The percentage of participants having good/fair/poor knowledge and practices are tabulated in Table 5.

**Univariate analysis of factors related to KAP scores:** A statistically significant difference in

knowledge and practices was observed between various sex, education levels and socioeconomic status. Knowledge and practices scores were comparatively low among males, lower education level and poor socioeconomic status.

Comparison of the knowledge and attitude scores across various sociodemographic characteristics of the study participants is tabulated in Table 6.

**Multivariate analysis of factors related to knowledge and practice scores:** Independent positive predictors of good knowledge and practices were sex, education levels and socioeconomic status. These findings are tabulated in Table 7.

**Table 1: Demographic profile of study participants**

<b>Gender</b>	<b>Number (%)</b>
Male	255 (51)
Female	245 (49)
<b>Total (%)</b>	<b>500 (100)</b>
<b>Age group (yrs)</b>	
18-25	238 (47.60)
26-30	088 (17.60)
31-40	093 (18.60)
>40	081 (16.20)
<b>Total (%)</b>	<b>500 (100)</b>
<b>Marital status</b>	
Single	259 (51.80)
Married	216 (43.20)
Others (Divorced/legally separated/widow/widower)	025 (05.00)
<b>Total (%)</b>	<b>500 (100)</b>
<b>Socioeconomic status</b>	
Upper (I)	027 (05.40)
Upper middle (II)	118 (23.60)
Lower middle (III)	340 (68.00)
Upper lower (IV)	010 (02.00)
Lower (V)	005 (01.00)
<b>Total (%)</b>	<b>500 (100)</b>
<b>Social background</b>	
Urban	441 (88.20)
Rural	059 (11.80)
<b>Total(%)</b>	<b>500 (100)</b>
<b>Educational status</b>	
Professional degree	079 (15.80)
Graduate	253 (50.60)
Intermediate/diploma	096 (19.20)
High school	044 (08.80)
Middle school	024 (04.80)
Primary school	004 (00.80)
Illiterate	000 (00.00)
<b>Total (%)</b>	<b>500 (100)</b>
<b>Occupation</b>	
<b>Men</b>	
Office workers	103 (40.39)
Self-employed	71 (27.84)
Students	51 (20.00)
Farmers and labourers	9 (03.53)
Defence personnel	21 (08.24)

<b>Total (%)</b>	<b>255 (100)</b>
<b>Women</b>	
Homemakers	88 (35.92)
Office workers	60 (24.49)
Self-employed	23 (09.39)
Students	54 (22.04)
Farmers and labourers	03 (01.22)
Defence personnel	17 (06.94)
<b>Total (%)</b>	<b>245 (100)</b>

**Table 2: Reasons for exposure to sun and time of exposure to sun**

<b>Reason(s) for exposure to sun:</b>	<b>Number (%)</b>
Transport from residence to the place of occupation	289 (57.80%)
Outdoor work or activity	243 (48.60%)
Leisure/recreational	098 (19.60%)
To get enough vitamin D/medical reasons/advised by doctor	087 (17.40%)
Others (non specific reasons)	004 (00.80%)
<b>Total*</b>	<b>721 (144.2)</b>
<b>Time of exposure to sun:</b>	<b>Number (%)</b>
Between 10 am and 3 pm	316 (63.20%)
Before 10 am or after 3 pm	118 (23.60%)
Whole day	066 (13.20%)
<b>Total</b>	<b>500 (100%)</b>

\* Total of reason(s) for exposure to sun adds up to more than 500 (100%) as several study participants gave more than one reason for exposure to sun.

**Table 3: Sources of information**

<b>Source of information</b>	<b>Number (%)</b>
Television	210 (42.00)
Radio	053 (10.60)
Newspaper	233 (46.60)
Books	123 (24.60)
Internet	204 (40.80)
Health personnel	056 (11.20)
Friends and relatives	054 (10.80)
No information	052 (10.40)
<b>Total*</b>	<b>933 (186.60)</b>

\* Total of sources of information adds up to more than 500 (100%) as several study participants gave more than one source of their information. The figures of the last row wherein 52 study participants had no information, has not been taken into account for calculating the total.

**Table 4: Responses of study participants pertaining to various aspects of sunscreen use**

<b>How often do you use sunscreen?</b>	<b>Number (%)</b>
Never	367 (73.40%)
Rarely	040 (08.00%)
Sometimes	038 (07.60%)
Often	033 (06.60%)
Always	022 (04.40%)
<b>Total</b>	<b>500 (100)</b>
<b>The reason(s) for not using sunscreen:</b>	<b>Number (%) (n = 367)</b>
It is expensive	171 (46.59)
It is ineffective	044 (11.99)
It is time-consuming	100 (27.25)
It is inconvenient	097 (26.43)
I have allergy	020 (05.45)
I have not heard about it	052 (10.4%)
<b>Total*</b>	<b>484 (131.88)</b>
<b>The reason(s) for using sunscreen:</b>	<b>Number (%) (n=133)</b>

To avoid skin cancer	24 (18.05)
To avoid sunburns	84 (63.16)
To avoid the development of dark skin spots	95 (71.43)
To avoid skin wrinkling	51 (38.35)
Doctor recommendation	39 (29.32)
Family or friend endorsement	17 (12.78)
Social media guidance	17 (12.78)
Read about it	20 (15.04)
Other	03 (02.26)
<b>Total*</b>	<b>350 (263.16)</b>
<b>When do you apply sunscreen during the day?</b>	<b>Number (%) (n=133)</b>
Only with outdoor activity	38 (28.57)
Only around noon time	14 (10.53)
With outdoor activity and around noon time	37 (27.82)
Whenever I am exposed to the sun	44 (33.08)
<b>Total</b>	<b>133 (100)</b>
<b>Parts of the body to be covered with sunscreen</b>	<b>Number (%) (n=133)</b>
Face only	42 (31.58)
Face and hands	63 (47.37)
All exposed areas of skin	28 (21.05)
<b>Total</b>	<b>133 (100%)</b>
<b>Amount of sunscreen used per application</b>	<b>Number (%) (n=133)</b>
< 5 ml	097 (72.93)
> 5 ml	032 (24.06)
Don't know	004 (03.01)
<b>Total</b>	<b>133 (100%)</b>
<b>The amount of sunscreen applied on your face</b>	<b>Number (%) (n=133)</b>
Less than a quarter of a teaspoon	71 (53.38)
Quarter to half a teaspoon	51 (38.35)
More than a half a teaspoon	11 (08.27)
<b>Total</b>	<b>133 (100%)</b>
<b>When do you reapply sunscreen?</b>	<b>Number (%) (n=133)</b>
Every 2-3 hours	027 (20.30)
After I sweat excessively	012 (09.02%)
After I swim	019 (14.29)
After I take a shower	040 (30.08)
I do not reapply it	077 (57.89)
<b>Total*</b>	<b>175 (131.58)</b>
<b>Do you use a sunscreen that protects against both ultraviolet A and ultraviolet B (UVB) sun rays?</b>	<b>Number (%) (n=133)</b>
Yes	069 (51.88)
No	009 (06.77)
I do not know	055 (41.35)
<b>Total</b>	<b>133 (100%)</b>
<b>Do you use water-resistant sunscreen?</b>	<b>Number (%) (n=133)</b>
Yes	040 (30.08)
No	054 (40.60)
I do not know	039 (29.32)
<b>Total</b>	<b>133 (100%)</b>
<b>Do you know the Sun Protection Factor (SPF) of the sunscreen which you are using?</b>	<b>Number (%) (n=133)</b>
Yes	056 (42.11)
No	077 (57.90)
<b>Total</b>	<b>133 (100%)</b>
<b>Do you know the Sun Protection Factor (SPF) of the sunscreen which you are using?</b>	<b>Number (%) (n=133)</b>
< 30	033 (24.81)
> 30	023 (17.29)

Don't know	077 (57.90)
<b>Total</b>	<b>133 (100%)</b>
<b>What sunscreen preparation do you prefer to use?</b>	<b>Number (%) (n=133)</b>
Cream	113 (84.96)
Lotion	016 (12.03)
Spray	011 (08.27)
Stick	001 (00.75)
<b>Total*</b>	<b>141 (106.02)</b>
<b>How many tubes (or bottles) of sunscreen do you use per month?</b>	<b>Number (%) (n=133)</b>
One	117 (87.97)
Two	011 (08.27)
Three	003 (02.26)
Five	001 (00.75)
More than five	001 (00.75)
<b>Total</b>	<b>133 (100%)</b>
<b>Since how long have you been using sunscreen?</b>	<b>Number (%) (n=133)</b>
< 1 year	051 (38.35)
1 – 2 years	047 (35.34)
2 – 3 years	027 (20.30)
3 – 5 years	005 (03.76)
> 5 years	003 (02.26)
<b>Total</b>	<b>133 (100%)</b>
<b>Reasons for choosing a particular sunscreen</b>	<b>Number (%) (n=133)</b>
It is cheap	89 (66.92)
It is easily available	36 (27.07)
It is effective	41 (30.83)
No reason in particular	05 (03.76)
<b>Total*</b>	<b>171 (128.57)</b>
<b>What other methods of protection from exposure from sun do you use?</b>	<b>Number (%) (n=133)</b>
Headcover (Other than cap/hat)	427 (85.40)
Face cover	352 (70.40)
Long sleeved clothes	404 (80.80)
Sunglasses	314 (62.80)
Umbrella	047 (09.40)
Cap/Hat	464 (92.80)
<b>Total*</b>	<b>2008 (401.60)</b>

\* Total of reasons for not using sunscreen and reasons for using sunscreen adds up to more than 500 (100%) and more than 133 (100%) respectively, as several study participants gave more than one reason regarding these aspects of sunscreen use. Total of when the study participants reapply sunscreen also adds up to more than 133 (100%) as several study participants gave more than one reason regarding reapplication of sun screen. Total of type of sun screen preparation used adds up to more than 133 (100%) as several study participants were

using more than one type of sun screen preparation depending on availability.

Total of reasons for choosing a particular sunscreen adds up to more that 133 (100%) as several study participants gave more than one reason for choosing a particular sun screen.

Total of other methods of protection from exposure to sun adds up to more than 133 (100%) as several study participants were using more than one other method of protection from exposure to sun.

**Table 5: Percentage of participants having good/fair/poor knowledge and practices**

Variable	Level	Frequency n	Percentage %
Knowledge	Good	400	080.00
	Fair	048	009.60
	Poor	052	010.40
Total		500	100.00
Practices	Good	37	27.69
	Fair	83	62.76
	Poor	13	9.55
Total		133	100.00

**Table 6: Mean scores of knowledge and practice pertaining to sun screen usage and skin cancer among the study participants**

Sociodemographic characteristic	n	Knowledge score mean (SD)	p value	Practice score mean (SD)	p value
Sex			< 0.01		< 0.01
Male	255	12.99 (1.32)		12.75 (1.44)	
Female	245	13.74 (1.05)		14.1 (0.87)	
Educational status			< 0.01		< 0.01
Intermediate/diploma and above	428	13.83 (0.96)		14.13 (0.84)	
High school and below	072	(12.09) (1.8)		12.66(1.59)	
Socioeconomic status			< 0.01		< 0.01
Upper and upper middle (I and II)	145	13.83 (0.93)		14.07 (0.84)	
Lower middle, Upper lower and lower (III, IV and V)	355	(12.03) (1.71)		12.09 (1.8)	
Total (%)	500 (100)				

**Note:** Educational status professional degree, graduate, and intermediate/diploma were clubbed into one group, while educational status high school, primary school and illiterate were clubbed into another group for the purpose of this analysis. Socioeconomic status upper (I), and upper middle (II) were clubbed into one group, while socioeconomic groups lower middle (III), upper lower (IV) and lower (V) were clubbed into another group for the purpose of this analysis.

**Table 7: Independent predictors of knowledge, and practices in multivariate logistic regression**

Characteristic	Predictor of good knowledge		Predictor of good practices	
	Crude odds ratio (95% CI), p value	Adjusted odds ratio (95% CI), p value	Crude odds ratio (95% CI), p value	Adjusted odds ratio (95% CI), p value
Sex				
Male	1		1	
Female	1.17, (1.07-1.29), p < 0.05	1.08, (1.02 – 1.20), p < 0.05	1.32 (1.14 – 1.44), p < 0.05	1.26 (1.17 – 1.38), p < 0.05
Education level				
Professional degree	1	1	1	1
Graduate	0.93 (0.84 – 0.99), p < 0.05	0.87 (0.81 – 0.93), p < 0.05	0.90 (0.81 – 0.96), p < 0.05	0.86 (0.80 – 0.95), p < 0.05
Intermediate/diploma	0.88 (0.84 – 0.92), p < 0.05	0.86 (0.81 – 0.91), p < 0.05	0.87 (0.80 - .0.94), p < 0.05	0.83 (0.76 - .0.90), p < 0.05
High school	0.78 (0.70 – 0.86), p < 0.01	0.73 (0.67 – 0.79), p < 0.05	0.72 (0.67 - .0.77), p < 0.01	0.69 (0.62 – 0.73), p < 0.01
Middle school	0.63 (0.55 – 0.68), p < 0.01	0.59 (0.53 – 0.65), p < 0.01	0.62 (0.57 - .0.67), p < 0.01	0.55 (0.52 – 0.58), p < 0.01
Primary school	0.59 (0.53 – 0.65), p < 0.01	0.55 (0.52 – 0.61), p < 0.01	0.58 (0.53 - .0.63), p < 0.01	0.55 (0.51 – 0.59), p < 0.01
Illiterate	-	-	-	-
Socioeconomic status				
Upper (I)	1	1	1	1
Upper middle (II)	0.93 (0.86 – 0.97), p < 0.05	0.89 (0.84 – 0.97), p < 0.05	0.92 (0.86 – 0.98), p < 0.05	0.90 (0.84 – 0.96), p < 0.05
Lower middle (III)	0.89 (0.83 – 0.95), p < 0.05	0.86 (0.81 – 0.91), p < 0.05	0.88 (0.82 – 0.94), p < 0.05	0.84 (0.78 – 0.93), p < 0.05
Upper lower (IV)	0.79 (0.73 – 0.85), p < 0.05	0.76 (0.71 – 0.84), p < 0.05	0.75 (0.69 – 0.84), p < 0.05	0.72 (0.68 – 0.76), p < 0.05
Lower (V)	0.69 (0.64 – 0.77), p < 0.01	0.66 (0.61 – 0.71), p < 0.01	0.62 (0.57 – 0.67), p < 0.01	0.60 (0.57 – 0.66), p < 0.01

**Discussion**

Sunscreens reflect, absorb, or scatter the UV rays from the layers of the skin. Hence, they are rec-

ommended for protection from the harmful effects of sunlight.[1], [16],[17]

Our population-based survey documents adequate knowledge regarding the harmful effects of solar



radiation in general population. However, a much lesser proportion were aware of the fact that excessive exposure to sun light causes skin cancer. Besides, even in respondents with adequate knowledge, there exists a significant gap in translating the knowledge to practice. The findings of our study are in consonance with the studies carried out by Tilwani et al, and Gillani et al wherein they reported that 86.66% and 84% respectively of the study participants were aware of the harmful effects of excessive exposure to sunlight.[2],[3]

The findings of our study differ from the study carried out by Gupta and Fabris et al, wherein they observed that 80.3% and 94.3% of study participants respectively were aware of the harmful effects of excessive exposure to UV rays, while only 46.33% and 80.8% of study participants respectively were aware that sun exposure causes skin cancer.[4], [18]

The findings of our study are similar to the study carried out by Alsudairy et al, AlGhamdi et al and Almuqati et al wherein they observed that approximately 35%, 23.7% and 23% of the study participants respectively were using sunscreen.[5], [19],[20]

Regarding the aspect of usage of sunscreen, the findings of our study differ from those carried out by Alshalan et al, Tilwani et al; and Gillani et al wherein they observed that 64%, 48.88%, 72% of the study respondents respectively used sun screen.[1],[2],[3]

The findings of our study also differ from those carried out by Gupta, Yurtseven et al and Alrobaee wherein they reported that 52%, 90.6% and 8.3% respectively were using sunscreen.[4],[21],[22]

Regarding other methods of protection from exposure to sun, the findings of our study are similar to the study carried out by Alsudairy et al wherein their study participants were also using other methods of protection from exposure to sun viz, head cover, face cover, full sleeved clothes, sunglasses and umbrella.[5]

In our study we observed a statistically significant difference in knowledge and practices between male and female sex. This can be because, women are more concerned about cosmetics, skin care; and the effects of excessive exposure to sunlight on their skin. These findings of our study are in consonance with those carried out by Alshaalan et al, Tilwani et al and Gillani et al wherein they also reported that women were more likely to use sunscreen as compared to men.[1],[2],[3],[22]

In the present study we also observed a statistically significant association between knowledge and practices and educational status of the study participants. The level of knowledge and practice increased significantly from 18 - 25 years to 26 - 30

years and then reduced significantly in the higher age groups of 31 – 40 years and > 40 years. Similar findings have been reported by Tilwani et al and Gillani et al in their study on 450 and 528 study subjects respectively.[2],[3]

In our study we observed a statistically significant association between knowledge and practices and socioeconomic status of the study participants. These findings of our study are similar to the studies carried out by Alsudairy et al, Alrobaee, Whiteman et al, Yan et al and Naylor et al.[5],[23],[24], [25], [26]

### Conclusion

Being an online survey, our study has several strengths. We could obtain samples from different states and cities of the county; and thus the study was multicentric. Besides, another robustness of our study was the large sample size; and a well-structured questionnaire. On the other hand, our study is not without limitations. Young adults and people from the middle socioeconomic strata outnumbered the participants from other age groups and other socioeconomic strata. Hence, the study may not be truly representative of the general population. The usage of sunscreen was self-reported by the study participants and could not be validated by the researchers. Replies by the study participants may also be subject to recall bias and social desirability bias. Questionnaires were filled during the summer months of July 2022 to Mar 2023 which may not reflect sunscreen use practices throughout the year.

Our study has shown knowledge and practices related to harmful effects of exposure to sun and sun protective behavior vary significantly with sex, educational status and socioeconomic status of the study population. However, use of sunscreen among the study participants was low with only 133 (26.6%) out of 500 study participants reporting sun screen usage. Besides, even among those who reported sunscreen usage, an evident lack of appropriate sunscreen application behavior was observed.

Proper education of the masses regarding the adverse effects of sun exposure and the use of various photoprotective measures including sunscreens is of paramount importance. It is imperative to generate awareness among the general population about various aspects of sun screen usage, so as to facilitate informed purchase and adequate sun protection habits. This suggests a need for proper education and training for general public health education programs. Notwithstanding widespread availability of databases and other sources of information about sun exposure and the use of sunscreen, population awareness and practices need improvement.

A more structured and continuous education programme is required to improve the sunscreen and skin cancer knowledge. With adequate knowledge regarding sun protection and skin cancer, the information can be disseminated to the general population to mitigate the detrimental effects of sunlight on human skin.

Therefore, we recommend that this education be made a part and parcel of the responsibilities of schools and colleges which form a part of the education system of the nation. Besides, since majority of the study participants are not using sun screen as they find it expensive, we also recommend that government efforts be channelized in capping the price of sun screen by way of bringing in various regulations and acts; and strictly enforcing them.

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