RESEARCH ARTICLE

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Behavior and Knowledge of the Citizens about Ultra Violet Radiation in a Semi-arid Region in Iran

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Background & Aims of the Study: Ultraviolet Radiation (UVR) emitted by the sun can lead to health problems, such as cataracts, skin cancer, prostate cancer, premature aging, and damage to DNA. This study aimed to investigate the knowledge, attitude, and practice level of citizens in Qom, Iran.
Materials and Methods: This cross-sectional study was conducted between 22 December 2013, and 23 August 2014. A standard questionnaire was distributed among citizens in Qom (a semi-arid region of Iran) who were selected randomly from all four regions of this city. The obtained data were analyzed using SPSS software (version 16.0).
Results: In terms of knowledge, only 7.3% of the participants had a good level of knowledge, whereas only about 20% of them had a suitable attitude and practice. Furthermore, females gained higher total Knowledge, attitude, and practice scores, compared to males. The majority of the participants (77.1%) knew the meaning of SPF (Sun Protection Factor); however, 60.4% of them did not have enough information about "the appropriate amount of SPF" item. The television was selected as a proper method (94%) for making the public informed of UVR. In addition, females were more likely to use sunscreen than males (P<0.001). Additionally, it was found that in the majority of the seasons, more than 50% of men and women used sunscreen fewer than three times a week. In total, 78% of the participants (88 male vs. 103 female) used sunscreen in order to prevent sunburn (P=0001).
Conclusion: In general, the level of knowledge and practice was not satisfactory in this study. Therefore, it is inevitable to design and implement a comprehensive training program in public health centers, universities, schools, and other educational centers.

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Background

Radiation is divided into two categories, namely ionizing and non-ionizing radiation. Ultraviolet (UV) is one of the electromagnetic radiations. The UV light has frequencies within the ranges of 100-280 nm (UV_C), 280-315 nm

(UV_B), and 315-400 nm (UV_A) (1). The percentage of UV_A and UV_B radiation reaching the Earth's surface has been estimated to be around 95% and 5%, respectively. It is because the ozone layer prevents the penetration of all UV_C along with large quantities of the UV_B radiation (2). The intensity of Ultraviolet Radiation (UVR) on earth is dependent on such factors as latitude, elevation from sea level, and month or season of the year (3). The UVR emitted by the sun has potential health effects on human societies. Numerous studies have confirmed that UV exposure is associated with skin cancer (Basal Cell Carcinoma, Squamous Cell Carcinoma, and Malignant melanoma) (2-6). Melanoma is the most dangerous form of cancer among other forms of skin malignancies (7). Approximately, 60%-95% of melanoma cases are caused by excessive exposure to UVR (8). According to the World Health Organization (WHO), 2-3 million and about 132,000 people are affected with non-melanoma and melanoma cancers annually and globally, respectively (9).

In a study conducted in Iran, the incidence rate of skin cancer was reported to be 15% of all cancers (10). Moreover, it has been found that UVR is effective in the prevalence of premature skin aging (11, 12), cataract (13-16), damage to DNA (17-19), erythema (20, 21), dry eye and pain (22), as well as immune system disorders (23, 24).

Knowledge, attitude, and practice (KAP) regarding UV protection constitute an important issue, which has led to many studies in this regard. In 2008, the Environmental Protection Agency reported that 2 to 4 dollars out of treatment costs of the public can be saved provided that one dollar is spent to educate and raise the knowledge of UVR. Some behaviors can reduce the risk of health-related effects of UVR. For instance, the use of sunscreen with "sun protection factor (SPF)'' label, appropriate clothing with a "UV Protection Factor (UPF)'' label, as well as suitable hats, and sunglasses which have labels showing "UV absorption up to 400 nm'' (25). To this end and to improve public knowledge, the Ultraviolet Index (UVI) was introduced in the training programs focusing on UV protection.

The target population of this study in Qom, Iran, is in the region that is exposed to direct sunlight due to its geographical location. Accordingly, skin cancer caused by UV is predictable in this area. In addition, to the best of the authors' knowledge, no similar study has ever been carried out about public knowledge and practice related to UVR radiation in Qom. Therefore, the current study aimed to investigate the KAP of citizens in Qom, Iran, about UVR.

Materials & Methods

This cross-sectional study was carried out on citizens in Qom, Iran, between 22 December 2013 and 23 August 2014. This city is the capital of Qom Province located at 34° 44' 37" N, to 55° 33' 27" E. The average elevation of the city is 950 meters above the sea level. The annual mean temperature and precipitation are 18.1°C and 161 mm, respectively. Qom is an arid and semi-arid city in the central part of Iran (26-29). The data were collected using a researcher-made questionnaire the validity and reliability of which were approved by a panel of experts consisting of faculty members of Qom University of Medical Sciences, Qom, Iran.

The content validity index and ratio were found to be 0.887 and 0.735, respectively. The sample size was calculated using the following formula (Eq 1.). According to the error level of 0.05 and standard deviation reported in similar articles (30), the values of the $Z_{1-\frac{\alpha}{2}}$ and σ were considered 1.96 and 11.18, respectively. Therefore, by assuming an acceptable error of 1.3, the number of samples was calculated to be 284.

$$n = \frac{(Z_{1-\frac{\alpha}{2}})^2 \sigma^2}{d^2}$$ Eq 1.

The questionnaires were randomly distributed among the citizens in Qom in different urban and administrative areas. Out of 284 questionnaires distributed, 245 ones were answered. This 34-item questionnaire was developed in four sections and covered such information as demographic characteristics (education level, gender, income status, region of residence, marital status, age, and occupational status), KAP toward UV exposure, behavior regarding sun protection, as well as knowledge about the health effects of UVR along with UVI and SPF labels. The study protocol was approved by the Ethics Committee of Qom University of Medical Sciences, Qom, Iran. It should be noted that the participants were assured of the confidentiality of their personal information.

The KAP assessment was performed using Excel 2010 software. There was one correct answer in each question. In the knowledge section, a score of 0 to 14 was assigned to the correct answers to questions 1 to 11. Question 1 had four options (in front of each option, two choices were as "*Yes/No*" for answers); therefore, each participant gained the maximum score of 4 points. The other questions (n=10) had 10 scores, and the attitude section had five valuable questions (FQ1, FQ2, FQ3, FQ5, and FQ7); accordingly, the participants gave the scores ranging from 0 to 5. Eventually, in the practice section, a score ranging from 0 to 14 was given the correct answers to questions 1 to 5. Moreover, questions 2, 4, and 5 had four options (in front of each option, two choices were as "*Yes/No*" for answers); therefore, each participant gained the maximum score of 4 points for each question. In addition, questions 1 and 3 had one score. Regarding scoring, there was a difference between this section and two previous sections (open-ended questions). For scoring question 2, the authors made use of an Australian study (31). One score was given to participants who maintained that they used sunscreen three or more times per week. Considering scoring question 3, one score was given to the participant who claimed to be exposed to sunlight for two and less than two hours between 10:00 a.m.-2:00 p.m. per week (32). As a final step, total KAP scores were calculated according to the following pattern:

- **Total knowledge scoring:** The scores within the ranges of 0-4, 5- 9, and 10-14 are considered poor, average, and good in this regard.
- **Total attitude scoring:** The scores within the ranges of 0-1, 2-3, and 4-5 are considered poor, average, and good in this regard.
- **Total practice scoring:** The scores within the ranges of 0-4, 5-9, and 10-14 are considered poor, average, and good in this regard.

Independent Samples T-test was used to analyze the differences among group means in terms of gender and marital status. Furthermore, analysis of variance (ANOVA) was utilized to analyze the differences among group means in the ordinal and categorical variables (e.g.education level). Responses to questions between genders were compared using the Chi-square test. Finally, the Pearson correlation test was employed to analyze the correlations between quantitative variables. The data were analyzed in SPSS software (version 16.0), and a p-value less than 0.05 was considered statistically significant.

Results

The mean age of the participants was 27.5 years (age range:14-57 years), and the majority (51.8%) of the subjects were male. Moreover, 49.8% of the cases were married. It is worth mentioning that no missing data were reported in this study. Additional information on the

Table 1) Demographic characteristics of the participants (N=245)

Variables	N	Percent
Gender		
Male	127	51.8
Female	118	48.2
Marital status		
Single	123	50.2
Married	122	49.8
Region		
1	55	22.4
2	61	24.9
3	65	26.5
4	64	26.1
Education level		
Illiterate	1	0.4
Primary school	7	2.9
High school (7-11 years)	20	8.2
High school (complete 12 years)	52	21.2
Associate's degree	35	14.3
Bachelor of science	110	44.9
Master's degree or higher	20	8.2
Occupational status		
Unemployed	6	2.4
Housewife	28	11.4
Student	12	4.9
Academic	88	35.9
Employee	57	23.3
Laborer	8	3.3
Self-employed	46	18.8
Income status		
Poor†	156	63.7
average§	82	33.5
Good and very good‡	7	2.8

† Less than 10,000,000 Rials per month.
§ Between 10,000,000 and 20,000,000 Rials per month.
‡ More than 20,000,000 Rials per month.

participants is presented in the supplementary material (Table 1).

Table 2 presents the information about general knowledge of (e.g. SPF) UV and UV health effects among participants. Most participants (89.4% true vs. 10.6% false) were aware of sunlight as a major source of UVR. In addition, participants opted for radiology rooms (79.2% true vs. 20.8% false), fluorescent and energy-efficient light bulbs (42% true vs. 58% false), and tanning device (71.4% true vs. 28.6% false). In addition, about 81.6% of the participants provided incorrect answers to the questions related to UVI and its range, whereas 18.4% of them were aware of UVI.

The gender differences were also observed for this question (P=0.02). In the item of "*The SPF sunscreen should be at least 10 in a country like Iran*", 60.4% of the participants selected the "*True*" option. The gender differences were also observed for this question (P=0.001). Furthermore, the questions about health knowledge of UVR were constructed in the "*True/False*'' format. At first, the participants were asked about the effects of UV on DNA to which most of them (66%) chose the "*True*" option regarding UV damage to DNA. In the next question, 61.6% of the participants believed that exposure to UVR can lead to cataracts. They also knew (70.9% male vs. 68.6% female) that according to the WHO, UV is known as "The silent danger".

Regarding the most and effective appropriate methods to inform the public of UVR, participants believed in the efficacy of television (94.3%), radio (69.8%), books (56.7%), banners and signboards in the city (80%), house-to-house training (36.7%), and free education in schools and cultural centers (70.6%). Moreover, the use of hats or caps with a 49.8% approval rate among participants was regarded as a defensive piece of equipment in terms of protecting against the sun. A statistically significant difference was also observed between gender groups in terms of this question (P=0.005). Supplementary data are available in Table 3.

In total, 78% of the participants (85% male vs. 70.3% female) reported that they received no warning messages from the health authorities on UVR. The gender differences were observed in this regard (P=0.006). In the next question, the results showed that 53.9%, 78%, 62%, and 50.6% of the participants used sunscreen to prevent skin darkening (54 [42.5%] males vs. 78 [66.1%] females, P<0001), sunburn (88

[69.3%] males vs. 103 [87.3%] females, P=0001), and skin cancer (62 [48.8%] males vs. 90 [76.3%] females with P<0001), as well as moisturize the skin (54 [42.5%] males vs. 70 [59.3%] females, P=0.009), respectively.

Considering the popular protective equipment, 61.2%, 75.9%, and 73.9% of the participants chose sunglasses (72 [56.7%] male vs. 78

Table 2) Knowledge of Participants about UV (N=245)

Type of questions	Male* n (%)	Female** n (%)	General n (%)
Q2: What time should an intense activity be avoided in an open environment?			
08:00–12:00	7(5.5)	6(5.1)	13(5.3)
10:00–12:00	16(12.6)	10(8.5)	26(10.6)
10:00–14:00	47(37)	54(45.8)	101(41.2)
12:00–14:00	57(44.9)	48(40.7)	105(42.9)
Q3: What is SPF on sunscreen?			
The amount of oil cream	15(11.8)	6(5.1)	21(8.6)
Factor affecting the evolution of bleaching	11(8.7)	9(7.6)	20(8.2)
Sun protection factor	92(72.4)	97(82.2)	189(77.1)
Moisturizing factor	9(7.1)	9(7.1)	15(6.1)
Q4: UVI is between 1-11 and indicates the intensity of the UVR of the sun			
True	30(23.6)	15(12.7)	45(18.4)
False	97(76.4)	103(87.3)	97(76.4)
Q5: The SPF on sunscreen should be at least 10 in a country such as Iran			
True	89(70.1)	59(50)	148(60.4)
False	38(29.9)	59(50)	97(39.6)
Q6: UVR can damage DNA			
True	84(66.1)	79(67)	163(66)
False	43(33.9)	38(33)	81(34)
Q7: Exposure to UVR can lead to cataract			
True	79(62.2)	72(61)	151(61.6)
False	48(37.8)	46(39)	94(38.4)
Q8: UV is known as "The silent danger"			
True	90(70.9)	81(68.6)	171(69.8)
False	37(29.1)	37(31.4)	74(30.2)
Q9: If every person suffers from sunburn for 5 times, h/she is prone to skin cancer			
True	59(46.5)	59(50)	118(48.2)
False	68(53.5)	59(50)	127(51.8)
Q10: Premature aging is one of the acute effects of UVR			
True	93(73.2)	90(76.3)	183(74.7)
False	34(26.8)	28(23.7)	62(25.3)
Q11: Prostate cancer is one of the chronic effects of UVR			
True	69(54.3)	63(53.4)	132(53.9)
False	58(45.7)	55(46.6)	113(46.1)
Q12: Have your relatives been damaged by UVR?			
Yes	8(6.3)	11(9.3)	19(7.8)
No	56(44.1)	38(32.2)	94(38.4)
I do not know	63(49.6)	69(58.5)	132(53.9)

* n=127
** n=118

Table 3) Attitude toward UVR (N=245)

Type of questions*	I quite agree	I agree	I disagree	I quite disagree
	Total, n (%)	Total, n (%)	Total, n (%)	Total, n (%)
FQ1	128(52.2)**	102(41.6)	11(4.5)	4(1.6)
FQ2	144(58.8)**	89(36.3)	9(3.7)	3(1.2)
FQ3	56(22.9)	102(41.6)**	64(26.1)	23(9.4)
FQ4	65(26.5)	122(49.8)**	44(18)	14(5.7)
FQ5	8(3.3)	14(5.7)	98(40)	125(51)**
FQ6	29(11.8)	102(41.6)**	78(31.8)	36(14.7)
FQ7	9(3.7)	39(15.9)	115(46.9)**	82(33.5)
FQ8	17(6.9)	87(35.5)	98(40)**	43(17.6)

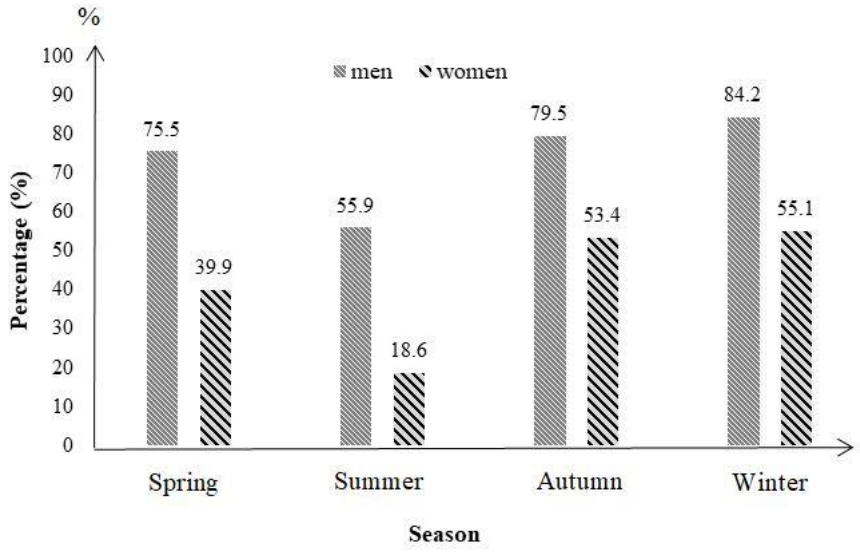

Figure 1) Rate (percentage) of sunscreen use below the permissible limit among the participants

[66.1%] female), long-sleeved shirt and full coverage (97 [76.4%] male vs. 89 [75.4%] female), and sunscreen (73 [57.5%] male vs. 108 [91.5%] female, P<0001), respectively. However, cap (28.2%) and umbrella (6.5%) were not among the most popular protective equipment. It should be noted that females were more likely to use sunscreen, compared to males (P<0.001).

The mean±SD values of sunscreen use in the spring, summer, autumn, and winter per week were obtained at 3±3.7, 4.8±5.1, 2.6±3.8, and 2.2±3.4, respectively. In addition, Figure 1 presents the rate (percentage) of sunscreen use below the permissible limit (less than 3 times per week) regarding the gender variable. As is evident, the lack of sunscreen use among the male participants in this study was between 55%-84% in all four seasons. In both autumn and winter, this rate was found to be above 50% for females. Furthermore, the mean value of sun exposure at 10:00 a.m.-2:00 p.m. per week was found to be 4.4±4.6. Additionally, 46.5% and 40.9% of the females and males stated that they were exposed to sunlight for 2 and less than 2 hours between 10:00 a.m. and 2:00 p.m. per week. In general, this rate was found to be 43.6%.

Total KAP scores indicated that the proportion of the average situation was more than that in poor and good situations concerning knowledge (80.5%), attitude (45.3%), and practice (59 %). The majority of good situations (22.5%) was observed in the participants' attitude. Furthermore, the poor situation was better than a good one in all three

parameters (Figure 2).

As a final step, the relationship of age with open question data and total KAP scores were analyzed using a non-parametric rank correlation test (Pearson), the results of which have been presented in Table 4. According to the results, age was negatively associated with sunscreen use in four seasons and total practice. However, significant correlations were found between total practice and sunscreen use (Pearson=0.541 to 0.624) along with a significant difference (P<0.001) in four seasons. On the other hand, total knowledge and attitude were negatively correlated with the amount of sun exposure per week between 10:00 a.m. and 2:00 p.m.

Considering sunscreen use, the majority of the associations were observed between autumn and spring (Pearson=0.902), as well as autumn and winter (Pearson=0.873).

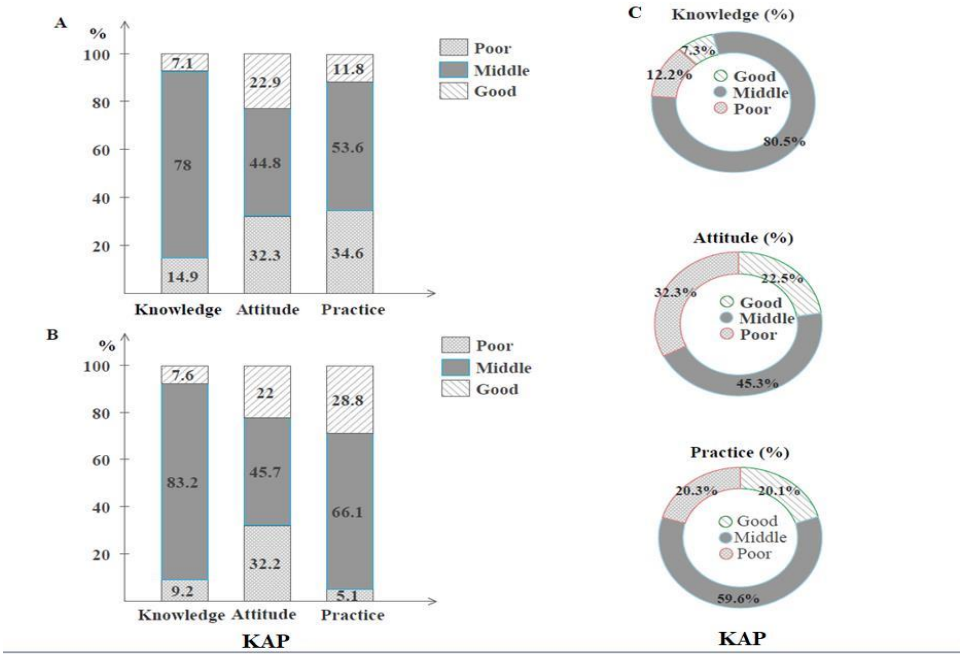

Figure 2) Total KAP scores (A, males; B, females; C, general) regarding UVR among participants

Table 4) Pearson correlation of age with open-ended question data and total KAP scores (N=245)

	Age	Spring [a]	Summer [a]	Autumn [a]	Winter [a]	Q3 [b]	Total K	Total A	Total P
Age	1								
Spring	– 0.100	1							
Summer	– 0.129*	0.813***	1						
Autumn	– 0.075	0.902***	0.746***	1					
Winter	– 0.022	0.861***	0.703***	0.873***	1				
Q3	0.007	0.166**	0.170**	0.164*	0.184**	1			
Total k	0.051	0.066	0.066	0.043	0.048	– 0.019	1		
Total a	0.100	0.100	0.035	0.065	0.124	– 0.025	0.124	1	
Total p	– 0.051	0.624***	0.609***	0.570***	0.541***	0.002	0.085	0.105	1

[a] Options of question 2 of practice section.
[b] Question 3 of practice section.
* P<0.05.
** p<0.01.

Discussion

To the best of the authors' knowledge, except for cross-sectional studies, no integrated training has been implemented on UV in Iran so far. The majority of the citizens belong to a general class who do not usually have access to scientific resources. On the other hand, due to living conditions, most people are not aware of the damaging effects of UVR. However, several valuable studies have been performed in Iran in this regard. Mention can be made of one which presents the requirements, instructions, and guidelines for environmental and occupational health center (25), which has been prepared as a complete information package on UV. However, this information is limited to the university level and is not considered at the level of a national program. In the current study, the observed total KAP scores of females were higher than those of males (except for one case in which the level of attitude was good in 22% of the females vs. 22.9% of the males). Moreover, there were significant differences between females and males in terms of total practice scores (8.1±2.2 in females vs. 5.9±2.8 in males).

Regarding the education level (except for total practice scores of people with primary school education), people with higher education had better behavior. Though there were no significant associations between income status and total KAP, it was found that participants from the middle class gained higher scores. In a community-based survey in Shanghai, China, it was observed that women and people with higher education were more likely to implement sun-protective practices (33). Pinault and Fioletov (2017) showed that women were more likely to use sunscreen, seek shade, or wear a hat (34). This protection equipment is the best method to prevent sunburn which subsequently turns into a major risk factor for melanoma (35).

In the knowledge section, the majority of the participants (77.1%) were aware that SPF stood for Sun Protection Factor; however, 60.4% of the cases provided incorrect answers to the item of "the minimum SPF in Iran". Therefore, the answers to these two questions indicated that the study population did not have adequate information about the authorized SPF despite knowing its meaning. In some cases, participants reported using sunscreen with low SPF, which had little effectiveness. In a study conducted in the USA, it was concluded that sunscreen with SPF 100+ was more effective in protecting against erythema and sunburn from UVR (36). The findings of this study indicate that when people are asked specialized questions, the rate of the wrong answers is increased, compared to less specialized inquiries. For instance, 61.1% of the participants knew that exposure to UVR could lead to cataracts; however, only 25.3% of them could recognize that premature aging is one of the chronic effects of UVR. On the other hand, although there is knowledge about skin cancer as the most important effect of UV, Iran is regarded as one of the countries at high risk of skin cancer (37). Due to the paramount importance of skin cancer and the increasing rate of this cancer in Iran as shown by statistics (38), it can be claimed that UVR has a direct relationship with different types of skin cancer.

Since people in Iran have a very good tendency toward television, it was selected as an efficient method to educate them about UVR. At the time of the study, the use of virtual networking was not as frequent as the present time. Perhaps if this choice was included in the questionnaire, it could have easily acquired the highest percentage. In a study conducted by Gao et al. (2014), "television" was placed in the third rank, and according to the participants' beliefs, "the Internet" was the greatest source of information on UV (38). Other studies have reported that

more subjects would like to receive training related to sun protection through the media (39, 40). In this study, 93.8% of the participants believed that knowledge of parents about UV had a strong impact on their children. According to a study conducted by Gefeller et al. (2014) in this regard, it was found that parental attitudes affected sun protection; however, parents' attitude was independent of their knowledge (41).

Based on the results, women were more likely to use sunscreen, compared to men ($P<0.001$). Furthermore, the majority of the participants did not believe that sunscreen use was only for women. In contrast, the frequency of sunscreen use below the permissible limit (less than 3 times per week) was found to be between 55% and 84% in all four seasons in males, and it was above 50% for women in two seasons.

In the same vein, the sunscreen use deficiency rates were found to be 27% or fewer than 2 days per week in Australia (42), 75% or fewer than 3 days per week in the USA (43), 92% rarely or never in France (44), 99% rarely or never in Turkey (45), and 76% rarely or never in Japan (46). Since participants are more likely to use sunscreen in the summer than other seasons, it can be claimed that people feel the need for its use only during the summer.

A shocking statistic in this study pertained to warning messages on UVR or sun protection. In other words, the citizens were not provided with any training packages regarding UVR or sun protection in Qom, Iran. Some studies reported that the rate of advertising by mass media about sun protection was often too low, or that health authorities fell short of providing further training through the media (39, 47). In the practice section of the questionnaire, dealing with the question "What are your reasons for sunscreen use?" the results indicated that most people (78%) used sunscreen to avoid sunburn. The option of "*To prevent skin cancer*" with a 62% response rate was the only option bearing on this item, which showed a statistically significant difference between gender groups.

In some studies, applying "*sun protection*" has been used instead of "*sunscreen use*". Healthcare professionals can also increase the rate of sunscreen use with public awareness and through health platforms (48). Gao et al. (2014) observed that 90% of the subjects used sunscreen since they believed that it could prevent sunburn (38, 43). In some of these studies, the participants had other purposes, such as promoting tanning (49). In the current study, the use of long-sleeved shirts (75.9%), as well as a full coverage, and sunscreen (73.9%) were the most popular protective equipment among participants; nonetheless, the caps and umbrellas were not among the favorite. Although the use of sunscreen had been chosen as a popular protective method, discussions about sunscreen use were not very satisfactory. The use of long-sleeved shirts was selected as the best method of sun protection in the study conducted by Nahar et al. (2013)(50). In general, it could be concluded that the available literature in this regard highlights the public's preference for wearing long clothing (51).

Conclusion

The findings of this study revealed that although total KAP scores were in the average range, some items indicated a lack of knowledge and practice, such as sunscreen use or failure to provide health warnings about UVR. In most cases, the observed total KAP scores of women were higher than those of men. Therefore, it is initially suggested that UV-related health policies be implemented by health authorities, as well as the public, and providers of related health products. Secondly, more pilot studies are suggested to be conducted in order to gain better solutions and recommendations about encouraging people to use sun protection

equipment in Qom. Since citizens in Qom are exposed to direct sunlight, it is strongly recommended that a comprehensive program be designed and implemented by the officials to reach the ideal range in KAP regarding UVR.

Footnotes

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Conflict of Interest

The authors declare that there is no conflict of interest.

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