Original Article

# The Impact of Ultraviolet Radiation on the Eyes and the Relevant Protective Measures: Knowledge and Awareness

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## Abstract

UV radiation is a known risk factor for various eye conditions, including cataracts, macular degeneration, and pterygium. These conditions can lead to vision impairment and even blindness if not properly addressed. To evaluate the level of awareness and knowledge of the Saudi population regarding the effects of UV radiation on the eyes. To assess the current protective practices that individuals in Saudi Arabia use to prevent UV radiation damage to their eyes. This is an observational cross-sectional study that was conducted in Saudi Arabia. The sample size was estimated by Raosoft with a confidence level of 95% and a margin of error of 5%. 82.7% of the respondents have heard of UV protection glasses, while 17.3% have not. The survey also asked the participants about their perception of the effects of UV rays on the human body and eyes. Moving on to the survey on the most dangerous time to be exposed to the sun without protection, the majority of respondents (89.0%) identified noon time as the most perilous period. Furthermore, a noteworthy 68.6% of respondents acknowledged that commercial sunglasses hurt the eyes, while 31.4% did not share this belief. Age exhibited a significant association with knowledge score with p-value= 0.015. Furthermore, the gender distribution also revealed interesting insights. Compared to males, a higher number of females (73.3%) demonstrated knowledge, exhibiting significant association with knowledge score with p-value= 0.006. In conclusion, participants seemed to exhibit adequate knowledge. Age and gender were significantly associated with knowledge of UV rays.

**Keywords:** Ultraviolet, Protective measures, Knowledge, Awareness, Eyes, Radiation

## INTRODUCTION

The sun emits Ultraviolet (UV) radiation as part of its electromagnetic spectrum [1], it is described as radiation with a wavelength of between 100 and 400 nanometers (nm) [2]. It is further divided into UV A (315-400 nm), B (280-315 nm), and C (100-280 nm) according to wavelength [2]. The fields of ophthalmology and optometry have become interested in the clear rise in environmental ultraviolet radiation that we have been observing for some time, particularly the range of UVB, 280-315 nm, and UVA, 315-400 nm [3]. Additionally, the amount of UV-B at the Earth's surface has increased due to the ozone layer's depletion during the past few decades [4]. Human health is impacted by UVR. Aside from the skin, UVR has a high potential for damaging the eyes as well [5]. Chronic exposure to UV radiation can cause eye damage such as corneal damage, cataracts, and macular degeneration, all of which can ultimately lead to blindness [1]. Furthermore, regarding the relationship between cataracts and UV radiation, McCarty and Taylor (2002) did a systematic review of the human data supporting a link between UV exposure and cataract development. 15 of the 22 epidemiologic studies showed a substantial link between UV exposure and cortical cataracts [6].

As the two organs most frequently targeted are the skin and eyes [7], the skin is compensated by the stratum corneum thickening and increased pigmentation. The eyes, in contrast, lack these inherent defense mechanisms. The recessed position of the eye in the orbit and the partial closure of the eyelids in reaction to high visible light levels are the two

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primary natural ocular defense strategies and since they are only partially effective, Over time, UVR that is absorbed and integrated may lead to degenerative effects [8].

Effective measures for ocular protection against UVR include simple behavioral modifications, suitable attire, shade use (using hats or umbrellas), and the use of UVR-blocking eyewear, sunglasses, or contact lenses [9].

A previous study conducted by Othman Bahakim, Nasr Addin, *et al*., evaluated Prince Sattam bin Abdulaziz University students' attitudes, practices, and behaviors related to sun exposure and found that Sunglasses were used by 161(40.4%) participants out of 399 [10].

Another study conducted in Australia was conducted on an adolescent population, which showed that more people knew about the effects of sunshine and body protection than they did about the effects of sunlight and eye protection [11].

Numerous studies that assess public understanding and sun exposure protective practices have been published in Saudi Arabia. However, most of them discussed its effects on the skin, while a lack of sufficient studies conducted to assess UV radiation and its connection to eye harm.

### *Objectives*

This study aims to evaluate the level of awareness and knowledge of the Saudi population regarding the effects of UV radiation on the eyes. In addition, we examine the current protective practices that individuals in Saudi Arabia use to prevent UV radiation damage to their eyes.

## Materials and Methods

### *Study Design*

This is an observational cross-sectional study that was conducted in Saudi Arabia.

### *Study Setting: Participants, Recruitment, and Sampling Procedure*

The study was conducted on the Saudi Arabian population through an online survey. A sample size of 600 was determined with a 95% confidence level.

### *Inclusion and Exclusion Criteria*

This study will include the Saudi Arabian population aged from 15 -70 years old, male and female, and who agreed to participate in the study. Age less than 15 or above 70 years old, and who refused to participate in the study are excluded from this study.

### *Sample Size*

The sample size was estimated by Raosoft with a confidence level of 95% and a margin of error of 5%.

### *Method for Data Collection and Instrument (Data Collection Technique and Tools)*

The data was collected via an online Google Form questionnaire, which was distributed electronically in Arabic language to the targeted population. The questionnaire will include questions regarding the patients' sociodemographics (age, gender, and educational level) as well as questions about knowledge and awareness level of the impact of UV radiation on the eyes and the relevant protective measures among the Saudi Arabian population.

### *Analysis and Entry Method*

A pre-tested questionnaire was used in data collection. The questionnaire included questions about sociodemographic factors and awareness. Data was coded, entered, and analyzed using the Statistical Package for the Social Sciences version 25.

## Results and Discussion

**Table 1** shows that the age distribution indicates that most individuals fall within the 20-30 age bracket, comprising 64.4% of the sample. Meanwhile, those aged 31-40 and 41-50 constitute 12.7% and 5.9% respectively. It's noteworthy that the younger demographic (less than 20) accounts for 11.9%, with older age groups (51-60 and over 60) representing smaller percentages at 3.7% and 1.4% respectively. Gender-wise, the data highlights a significant majority of females, constituting 75.7% of the sample, while males make up 24.3%. Location distribution of the sample is also detailed, with the highest representation from the West at 45.0%, followed by the Middle at 22.3%. The East, North, and South regions contribute 14.6%, 9.1%, and 9.0% respectively. Education levels within the sample are quite diverse, with the majority holding a Bachelor's degree (66.4%) and a significant proportion having completed secondary education (27.3%). Postgraduates and those with primary or middle school education make up smaller percentages, while the uneducated population is minimal at 0.3%. Lastly, the occupational breakdown reveals that the largest group is engaged in indoor jobs (43.7%), followed by the unemployed (45.4%) and those in outdoor jobs (10.9%).

**Table 1.** Sociodemographic characteristics of participants (n=700)

| Parameter | | No. | % |
|---|---|---|---|
| Age | less than 20 | 83 | 11.9 |
| | 20_30 | 451 | 64.4 |
| | 31_40 | 89 | 12.7 |
| | 41_50 | 41 | 5.9 |
| | 51_60 | 26 | 3.7 |
| | more than 60 | 10 | 1.4 |
| Gender | Male | 170 | 24.3 |
| | Female | 530 | 75.7 |

| | | | |
|---|---|---|---|
| Location | East | 102 | 14.6 |
| | Middle | 156 | 22.3 |
| | North | 64 | 9.1 |
| | South | 63 | 9.0 |
| | West | 315 | 45.0 |
| Education Level | Uneducated | 2 | .3 |
| | Primary | 3 | .4 |
| | Middle | 6 | .9 |
| | Secondary | 191 | 27.3 |
| | Bachelor's | 465 | 66.4 |
| | Postgraduate | 33 | 4.7 |
| Occupation | Indoor jobs (not exposed to the sun) | 306 | 43.7 |
| | Outdoor jobs (exposed to the sun) | 76 | 10.9 |
| | Unemployed | 318 | 45.4 |

**Table 2** shows that 95.6% of the respondents have heard of ultraviolet rays, while only 4.4% have not. Furthermore, 82.7% of the respondents have heard of UV protection glasses, while 17.3% have not. The survey also asked the participants about their perception of the effects of UV rays on the human body and eyes. A staggering 93.6% of the respondents believe that UV rays may affect the human body. In comparison, only 6.4% think otherwise. Similarly, 95.9% of the respondents believe that UV rays affect the eyes, while only 4.1% think otherwise **Figure 1**.

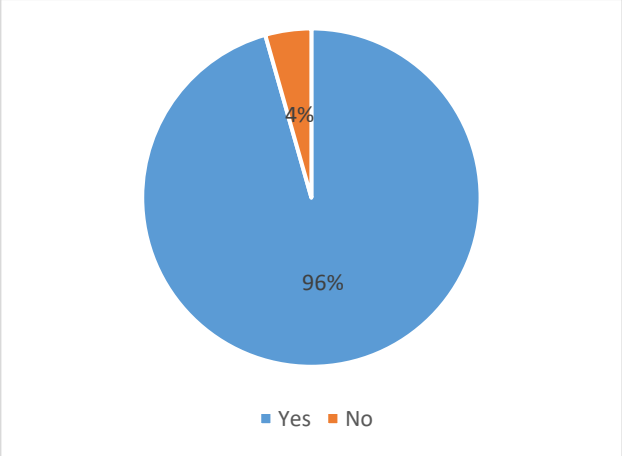


**Figure 1.** Participants heard of UV rays

**Table 2.** Awareness of participants of the impact of Ultraviolet Radiation on the eyes (n=700)

| Parameter | Yes | No |
|---|---|---|
| Have you ever heard of UV protection glasses? | 579<br>82.7% | 121<br>17.3% |
| Do you think that ultraviolet rays may affect the human body? | 655<br>93.6% | 45<br>6.4% |
| Do you think UV rays affect the eyes? | 671<br>95.9% | 29<br>4.1% |

**Table 3** shows that a significant portion of respondents (42.0%) believe that UV protection glasses are effective and should be worn, however, a smaller fraction (5.7%) regards them as a marketing ploy to drive profits. Additionally, a substantial majority (52.3%) expressed a lack of sufficient information. Moving on to the survey on the most dangerous time to be exposed to the sun without protection, the majority of respondents (89.0%) identified noon time as the most perilous period.

**Table 3.** Awareness of participants of the impact of Ultraviolet Radiation on the eyes and the relevant protective measures (n=700)

| Parameter | | No. | % |
|---|---|---|---|
| What do you think of UV protection glasses? | Effective and must be worn | 294 | 42.0 |
| | In my opinion, it is a marketing scam to increase the profit | 40 | 5.7 |
| | I don't have enough information | 366 | 52.3 |
| The time of day is the most dangerous time to be exposed to the sun without protection | Morning time | 47 | 6.7 |
| | noon time | 623 | 89.0 |
| | Afternoon time | 30 | 4.3 |

According to **Table 4**, only 53.3% of the respondents were aware of the fact that there are artificial sources of ultraviolet radiation other than the sun. Another interesting finding from the survey is that many people are not familiar with certain eye conditions that can be caused by exposure to UV rays. For instance, only 60.7% of the respondents knew what a cataract is, and just 24.6% were familiar with pterygium, which is a raised yellow growth on the conjunctiva. Moreover, age-related macular degeneration (AMD) is a condition that affects the retina and can lead to vision loss. Only 33.7% of the respondents knew what AMD is, and even fewer (29.3%) were aware that exposure to UV rays without protection can increase the risk of developing this condition. Interestingly, the survey also found that UV rays are more dangerous for young people than for the elderly, with only 35.1% of the respondents being aware of this fact. The survey found that 76.1% of the respondents were aware of the fact that wearing UV protective glasses prevents harmful UV rays from entering the eyes.

**Table 4.** Knowledge of participants of the impact of Ultraviolet Radiation on the eyes (n=700)

| Parameter | Yes | No |
|---|---|---|
| Did you know that there are artificial sources of ultraviolet radiation other than the sun? | 373<br>53.3% | 327<br>46.7% |
| Do you know what a cataract is? | 425<br>60.7% | 275<br>39.3% |
| Did you know that exposure to the sun's harmful rays (UV rays) without protection can lead to cataracts or cataracts? | 348<br>49.7% | 352<br>50.3% |
| Do you know what a pterygium (a raised yellow growth on the conjunctiva) is? | 172<br>24.6% | 528<br>75.4% |

| | | |
|---|---|---|
| Did you know that exposure to harmful sun rays (ultraviolet rays) without protection may lead to the development of keloids (pterygium or eye patch)? | 167<br>23.9% | 533<br>76.1% |
| Do you know what age-related macular degeneration (retinal damage) is? | 236<br>33.7% | 464<br>66.3% |
| Did you know that exposure to the sun's harmful rays (UV rays) without protection may lead to age-related macular degeneration (retinal damage)? | 205<br>29.3% | 495<br>70.7% |
| Did you know that UV rays are more dangerous for young people than for the elderly? | 246<br>35.1% | 454<br>64.9% |
| Did you know that wearing UV protective glasses prevents harmful UV rays from entering the eyes? | 533<br>76.1% | 167<br>23.9% |

**Table 5** presents the percentage of respondents who believe UV protection is necessary in different seasons. The highest percentage, 92.4%, indicated that UV protection is necessary in the summer, followed by 32.0% in winter, 29.6% in autumn, and 28.0% in spring. Moving on, when asked about the importance of wearing UV protective glasses in winter, 65.9% of respondents agreed that it is important, while 34.1% disagreed. Furthermore, a noteworthy 68.6% of respondents acknowledged that commercial sunglasses hurt the eyes, while 31.4% did not share this belief. In terms of behavior when exposed to ultraviolet rays, 50.0% of respondents reported ensuring the use of high-quality glasses with fully tested UV protection purchased from specialized eyewear stores. Conversely, 34.9% of respondents admitted to not wearing any glasses or contact lenses that protect from ultraviolet rays. The table also addresses the use of protective measures against industrial sources of ultraviolet rays, such as electronic devices. Here, 40.6% of respondents claimed to use goggles or a protective screen, while 59.4% did not take such precautions. Lastly, the table provides insights into the reasons for not using quality sunglasses with UV protection. The most prevalent reasons included high prices for high-quality sunglasses (25.2%), dislike for the appearance or weight of sunglasses (26.2%), and lack of awareness about UV protection glasses (32.2%).

**Table 5.** Knowledge of participants of the impact of Ultraviolet Radiation on the eyes and the relevant protective measures (n=700)

| Parameter | | No. | % |
|---|---|---|---|
| In which season is UV protection necessary? (You can choose more than one answer) | summer | 647 | 92.4 |
| | the spring | 196 | 28.0 |
| | winter | 224 | 32.0 |
| | autumn | 207 | 29.6 |
| Do you think wearing UV protective glasses in winter is important? | Yes | 461 | 65.9 |
| | no | 239 | 34.1 |
| Did you know that commercial sunglasses hurt the eyes? | Yes | 480 | 68.6 |
| | no | 220 | 31.4 |
| When you go outside and are exposed to ultraviolet rays from the sun, you: | Make sure to wear high-quality glasses with fully tested UV protection purchased from specialized eyewear stores | 350 | 50.0 |
| | Wear a contact lens that has UV protection | 16 | 2.3 |
| | Wearing cheap, aesthetic sunglasses purchased from accessory stores that do not specialize in eyeglasses without checking whether they have UV protection | 90 | 12.9 |
| | Do not wear any glasses or contact lenses that protect from ultraviolet rays | 244 | 34.9 |
| Do you make sure to use goggles or a protective screen to protect the eyes when exposed to industrial sources of ultraviolet rays emanating from electronic devices such as mobile phones, laptops, etc? | Yes | 284 | 40.6 |
| | no | 416 | 59.4 |
| Answer if you are someone who does not wear any quality sunglasses with UV protection; What is the main reason for not using them? | Wear glasses, it is difficult to switch | 5 | 1.2 |
| | I wear glasses because I have severe near-sightedness | 1 | 0.2 |
| | High prices for high-quality sunglasses | 105 | 25.2 |
| | Sunglasses affect my color vision | 35 | 8.4 |
| | I don't believe in the effectiveness of sunglasses to protect against UV rays | 27 | 6.5 |
| | I do not like to wear sunglasses because of their appearance or their weight on the nose and face | 109 | 26.2 |
| | You've never heard of UV protection glasses | 134 | 32.2 |

Analyzing the data in **Table 6**, it became evident that age plays a significant role in the participants' knowledge levels. For instance, individuals between the ages of 20-30 exhibited the highest knowledge score. On the other hand, those aged 51-60 and over 60 demonstrated relatively lower levels of awareness (3.1%) and (1.1%), respectively. Age exhibited a significant association with knowledge score with p-value= 0.015. Furthermore, the gender distribution also revealed interesting insights. Compared to males, a higher number of females (73.3%) demonstrated knowledge, exhibiting significant association with knowledge score with p-value= 0.006. Moreover, the data also delves into the influence of location on knowledge levels. The participants from the West exhibited the highest knowledge score, with (42.7%), while (2.3%) reported a lack of knowledge. Conversely, individuals from the East, Middle, North, and South regions displayed relatively lower levels of knowledge. Additionally,

individuals with bachelor's degrees exhibited the highest knowledge score (64%), and those with uneducated (0.3%), primary (0.4%), and middle education (0.7%) levels demonstrated relatively lower levels of awareness. The P-values associated with location and education level further highlight that there is no statistical significance with knowledge score. As the P-values were 0.692, and 0.547, respectively.

**Table 6.** Association between sociodemographic characteristics of participants and knowledge of the impact of Ultraviolet Radiation on the eyes and the relevant protective measures (n=700)

| Parameter | | Knowledge score | | Total (N=700) | P value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Age | less than 20 | 80 | 3 | 83 | 0.015 |
| | | 11.4% | 0.4% | 11.9% | |
| | 20_30 | 434 | 17 | 451 | |
| | | 62.0% | 2.4% | 64.4% | |
| | 31_40 | 85 | 4 | 89 | |
| | | 12.1% | 0.6% | 12.7% | |
| | 41_50 | 40 | 1 | 41 | |
| | | 5.7% | 0.1% | 5.9% | |
| | 51_60 | 22 | 4 | 26 | |
| | | 3.1% | 0.6% | 3.7% | |
| | more than 60 | 8 | 2 | 10 | |
| | | 1.1% | 0.3% | 1.4% | |
| Gender | Male | 156 | 14 | 170 | 0.006 |
| | | 22.3% | 2.0% | 24.3% | |
| | Female | 513 | 17 | 530 | |
| | | 73.3% | 2.4% | 75.7% | |
| Location | East | 99 | 3 | 102 | 0.692 |
| | | 14.1% | 0.4% | 14.6% | |
| | Middle | 148 | 8 | 156 | |
| | | 21.1% | 1.1% | 22.3% | |
| | North | 61 | 3 | 64 | |
| | | 8.7% | 0.4% | 9.1% | |
| | South | 62 | 1 | 63 | |
| | | 8.9% | 0.1% | 9.0% | |
| | West | 299 | 16 | 315 | |
| | | 42.7% | 2.3% | 45.0% | |
| Education Level | Uneducated | 2 | 0 | 2 | 0.547 |
| | | 0.3% | 0.0% | 0.3% | |
| | Primary | 3 | 0 | 3 | |
| | | 0.4% | 0.0% | 0.4% | |
| | Middle | 5 | 1 | 6 | |
| | | 0.7% | 0.1% | 0.9% | |
| | Secondary | 180 | 11 | 191 | |
| | | 25.7% | 1.6% | 27.3% | |
| | Bachelor's | 448 | 17 | 465 | |
| | | 64.0% | 2.4% | 66.4% | |
| | Postgraduate | 31 | 2 | 33 | |
| | | 4.4% | 0.3% | 4.7% | |

It is important to discuss the knowledge and awareness of the impact of ultraviolet (UV) radiation on the eyes and the relevant protective measures among the Saudi Arabian population. UV radiation is a known risk factor for various eye conditions, including cataracts, macular degeneration, and pterygium. These conditions can lead to vision impairment and even blindness if not properly addressed. Therefore, it is crucial for individuals to understand the potential harm that UV radiation can cause to their eyes and to take appropriate measures to protect themselves [6]. In Saudi Arabia, where the climate is predominantly sunny and hot, individuals are exposed to high levels of UV radiation daily. This makes it even more important for the population to be educated about the potential risks and to take proactive steps to protect their eyes. However, there may be a lack of awareness and knowledge about the impact of UV radiation on the eyes, as well as the appropriate protective measures that should be taken [9].

Our study showed that 95.9% of participants think that UV rays affect the eyes. While only 42% said that they think of UV protection glasses as effective and must be worn, 89% said that noon time is the most dangerous time to be exposed to the sun without protection. Also, 23.9% knew that exposure to harmful sun rays (ultraviolet rays) without protection may lead to the development of keloids (pterygium or eye patch). Moreover, 49.7% knew that exposure to the sun's harmful rays (UV rays) without protection can lead to cataracts. Similarly, a study in Saudi Arabia revealed that approximately 80.6% of the participants concurred that sunlight might potentially impact the health of the eye. Additionally, a significant majority of 78.2% believed that sunshine could provide a potential risk to the eye. Approximately 27.3% of the participants believed that pterygium is associated with sunlight. Merely 13.8% of individuals held the belief that cataract is associated with sunlight, whereas 26% believed that eye cancer is linked to sunlight. Furthermore, only 19.6% thought that conjunctivitis is related to sunlight [12]. A study conducted by Lee Graham revealed that 92% of participants acknowledged the impact of sunshine on the eye, while 93% expressed the belief that it is detrimental. Also, the study revealed that 21% of the participants believed that there was a connection between sunshine and pterygium, while 35% associated sunlight with cataracts. Additionally, 23% of the individuals linked sunlight to eye cancer, and 18% connected it to conjunctivitis [13].

Additionally, our study showed that age and gender exhibited significant association with knowledge score, as age group 20-30 exhibited higher knowledge than other age groups, and females tend to have higher knowledge than males. Further study indicates that females possess a greater understanding of the detrimental effects of UV radiation and the measures to guard against it [14]. This phenomenon might be attributed to the inclination of women towards self-care and body image, which is actively encouraged by society and the media [15].

One way to improve knowledge and awareness about UV radiation and its impact on the eyes is through public health

campaigns and educational initiatives. These initiatives can provide information about the harmful effects of UV radiation on the eyes, the specific eye conditions that can result from prolonged exposure and the importance of taking preventive measures. Additionally, these campaigns can also educate the population about the various protective measures that can be taken, such as wearing sunglasses that block 100% of UV rays, using wide-brimmed hats, and seeking shade during peak UV hours [12]. Furthermore, healthcare professionals play a crucial role in educating the population about the impact of UV radiation on the eyes and the relevant protective measures. Optometrists and ophthalmologists can provide valuable information to their patients about the importance of protecting their eyes from UV radiation and can recommend specific measures based on individual needs and lifestyle factors. Additionally, these professionals can also advocate for the inclusion of UV protection as part of routine eye care and can guide on selecting appropriate UV-protective eyewear [7].

The study presents valuable insights into the understanding and awareness of the Saudi Arabian population regarding the impact of ultraviolet radiation on the eyes and the relevant protective measures. However, it is important to acknowledge the limitations of the study. Firstly, the sample size of the study may not be representative of the entire Saudi Arabian population, leading to potential biases in the findings. Additionally, the study may have relied on self-reported data, which could introduce response bias. Furthermore, the study may not have accounted for potential confounding variables that could influence the knowledge and awareness of the population regarding ultraviolet radiation and protective measures.

## Conclusion

In conclusion, participants seemed to exhibit adequate knowledge. Age and gender were significantly associated with knowledge of UV rays. By educating individuals about the potential risks and the steps that can be taken to protect their eyes, we can help reduce the incidence of UV-related eye conditions and improve overall eye health in the population. Public health campaigns, educational initiatives, and the involvement of healthcare professionals are all important strategies for achieving this goal. Ultimately, by increasing knowledge and awareness, we can empower individuals to take proactive steps to protect their eyes from the harmful effects of UV radiation.

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Written consent was obtained from all individual participants included in the study.

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