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Research Article

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A Survey Assessment of Sun Exposure Safety Behaviors and Knowledge Among Adults Living in Yemen and the United States

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Abstract

Sun exposure poses significant health risks, including skin cancer and cataracts, particularly in regions with high UV radiation levels. Therefore, this study aims to assess and compare sun exposure safety behaviors and knowledge among adults in Yemen and the United States. An online questionnaire was administered to gather data on participants' sun protection habits, knowledge of sun protection factors, and awareness of the risks associated with sun exposure. The results revealed notable differences between the two regions. While adults in the United States demonstrated higher levels of sun protection behaviors, such as regular use of sunscreen and protective clothing, participants in Yemen exhibited lower levels of sun protection knowledge and practices. Cultural and religious practices in Yemen, which often involve modest clothing that covers much of the skin, were found to influence sun protection behaviors. These findings underscore the need for culturally tailored public health campaigns to enhance sun protection behaviors and knowledge in both regions. By addressing regional differences and cultural contexts, targeted interventions can be developed to reduce sun-related health risks and promote safer sun exposure practices.

Keywords: Public health; Epidemiology

Introduction

Sun exposure is a significant health risk for adults, as it can lead to skin cancer, cataracts, and other health problems. Sun protection behaviors, which include using sunscreen, wearing protective clothing, and seeking shade during peak sun hours, can help reduce the harmful effects of sun exposure. However, the prevalence of sun exposure safety behaviors and knowledge among adults varies. Therefore, innovative and culturally specific strategies must be employed to assure competence and behavior adoption [1-7].

Skin cancer is becoming more common across the world, owing primarily to increased sun exposure. For example, the Sun Exposure and Protection Index (SEPI) questionnaire, created in Linköping and validated in Sweden and Australia, is used to assess sun habits, sun protection behaviors, and readiness to enhance sun protection. Individuals with reduced UV sensitivity exhibited much riskier sun behaviors and sun protection behaviors, as well as a significantly lower likelihood of increasing sun protection. Women tanned more than males, spent more time in the noon sun, used sunscreen more frequently, and were more inclined to seek shelter for sun protection. Individuals with higher UV sensitivity were much more inclined to enhance their sun protection, whereas those with low UV sensitivity preferred to take risks when sunbathing. Finally, self-estimated skin type and gender have a significant impact on solar exposure and sun protection behaviors [6].

Regarding the carcinogenic effects of sun exposure that increase the risk of skin cancer, this is especially relevant for fair-skinned individuals. Despite an increased chance of dying from skin cancer, fair-skinned women appear to have a higher overall survival rate. In addition, studies have found an inverse relationship between sun exposure and hypertension, thromboembolism, and type 2 diabetes. Furthermore, limited sun exposure raises the risk of Cardiovascular Disease (CVD) and non-CVD/non-cancer mortality in women. Furthermore, there is evidence that increasing amounts of vitamin D/sun exposure improves cancer prognosis [2].

Additional factors we must explore are cultural and regional differences when evaluating knowledge and behaviors. In many cultures, there is a norm of seeking a tan as a sign of health and beauty, which can lead to inadequate sun protection behaviors and an increased risk of skin cancer. For example, in some Middle Eastern cultures, there is a perception that having a tan symbolizes high social status. Similarly, in the United States, tanned skin signifies attractiveness and elevated social standing [1-4,6,8].

Furthermore, cultural customs around modesty and traditional clothing may influence sun exposure safety behaviors, including the use of protective clothing. A study among women in Saudi Arabia found that seeking shade and wearing protective clothing were the most practiced sun protection methods (58.1% and 43.1%,

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respectively). However, the study also found that many respondents were not aware of the sun protection factor of sunscreen products and that discomfort felt on the skin was a common reason for avoiding the use of sunscreen. As a result, understanding sun exposure safety behaviors and knowledge among adults in both the Middle East and North America is critical for establishing culturally appropriate and relevant skin cancer prevention initiatives. Therefore, the purpose of this study is to assess sun exposure safety behaviors and knowledge among adults living in Yemen and the United States. Moreover, a comparison of the outcomes between the two regions will be explored [9].

Materials and Methods

Study design

This cross-sectional study was designed to assess and compare sun exposure safety behaviors and knowledge among adults living in Yemen and the United States. The study employed an online questionnaire to collect data from participants in both regions.

Participants

Participants were adults aged 18 and older living in Yemen and the United States. Recruitment was conducted through various channels, including social media platforms, community outreach programs, and healthcare providers. The survey was available in both Arabic and English to ensure accessibility and inclusivity. Informed consent was obtained from all participants before they completed the questionnaire.

Data collection

Data were collected using an online questionnaire administered *via* Qualtrics and mini lectures at the university. The questionnaire was adapted from validated instruments and included both multiple-choice and Likert-scale questions (see Appendix I). Specifically, the questionnaire covered the following areas:

- Demographics: Age, gender, country of residence.
- Sun Protection Behaviors: Frequency of using sunscreen, wearing protective clothing, seeking shade during peak sun hours, avoiding tanning beds, performing regular skin self-exams.
- Knowledge and Awareness: Awareness of the risks associated with sun exposure, knowledge of the effectiveness of various sun protection measures, discussions about sun protection with healthcare professionals.

Data analyses

Data analyses were conducted using SPSS version 26. Descriptive statistics were used to summarize the sample characteristics and main variables of interest. This included measures of central tendency (mean, median, mode) and dispersion (standard deviation, range, interquartile range) for continuous variables, as well as frequency counts and percentages for categorical variables. Comparative analyses were performed to identify differences in sun protection behaviors and knowledge between participants in Yemen and the United States. Chi-square tests were used for categorical variables, and t-tests were used for continuous variables. Statistical significance was set at $p < 0.05$.

Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) at East Carolina University. Participation in the study was voluntary, and confidentiality of responses was maintained. As indicated in the IRB, no personally identifiable information was collected, and participants could withdraw from the study at any time without penalty.

Results

Participant demographics

As indicated in Table 1, the study included a total of 219 participants, with 111 (51%) residing in Yemen and 108 (49%) residing in the United States. The age distribution of participants was as follows: (a) 76% were aged 18-24 years, (b) 22% were aged 25-34 years, and (c) 2% were aged 45-54 years. Additionally, the gender distribution showed that 73% of participants were female and 27% were male.

	Yemen (n=111)	**USA (n=108)**	Total (n=219)
Age			
18-24 years	83 (74.8%)	82 (75.9%)	165 (75.3%)
25-34 years	25 (22.5%)	22 (20.4%)	47 (21.5%)
45-54 years	3 (2.7%)	3 (2.8%)	6 (2.7%)
Unknown/Not Answered	0 (0.0%)	1 (0.9%)	1 (0.5%)
Gender			
Male	30 (27.0%)	29 (26.9%)	59 (27.0%)
Female	81 (73.0%)	79 (73.1%)	160 (73.0%)

Table 1: Demographic characteristics of participants.

Sun protection behaviors

Participants reported on various sun protection behaviors, including wearing protective clothing, applying sunscreen, avoiding tanning beds, and performing regular skin self-exams. Specifically, participants reported on various sun protection behaviors, including wearing protective clothing, applying sunscreen, avoiding tanning beds, and performing regular skin self-exams (Table 2). Specifically, 32.4% of participants from Yemen reported wearing protective clothing compared to 30.6% from the USA. Sunscreen application was reported by 54.1% of participants from Yemen and 65.7% from the USA. The behavior of avoiding tanning beds was noted by 5.4% of participants from Yemen and 1.9% from the USA. Regular skin self-exams were performed by 8.1% of participants from Yemen and 13.9% from the USA. Also noted in Figure 1 are comparisons of the sun protection behaviors (wearing protective clothing, applying sunscreen, avoiding tanning beds, performing regular skin self-exams) between participants from Yemen and the USA. The results show that a higher percentage of participants in the USA apply sunscreen and perform regular skin self-exams, while a slightly higher percentage of participants in Yemen avoid tanning beds.

Behavior	**Yemen (n=111)**	**USA (n=108)**	**Total (n=219)**
Wear protective clothing	36 (32.4%)	33 (30.6%)	69 (31.5%)
Apply sunscreen	60 (54.1%)	71 (65.7%)	131 (59.8%)
Avoid tanning beds	6 (5.4%)	2 (1.9%)	8 (3.7%)

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Perform regular skin self-exams	9 (8.1%)	15 (13.9%)	24 (11.0%)

Table 2: Sun protection behaviors. **Note:** Respondents could select multiple behavior options. Therefore, outcomes represent the number of selections rather than the number of participants.

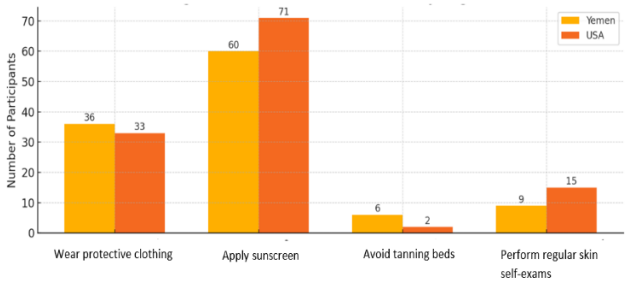

Figure 1: Sun protection behaviors by region.

Knowledge and awareness

Participants' knowledge and awareness of the risks associated with sun exposure and the effectiveness of various sun protection measures were assessed as well. Participants' knowledge and awareness of the risks associated with sun exposure and the effectiveness of various sun protection measures were assessed as well (Table 3). Specifically, 81.1% of participants from Yemen believed that covering the skin helps reduce sun exposure risk, compared to 89.8% of participants from the USA. Awareness that using tanning pads can lead to skin cancer was reported by 45.9% of participants from Yemen and 58.3% from the USA. Discussions about sun protection with healthcare professionals were reported by 18.9% of participants from Yemen, compared to 36.1% of participants from the USA. Figure 2 shows the participants' knowledge and awareness regarding sun protection measures, including the belief that covering reduces sun exposure risk, awareness that tanning pads can lead to skin cancer, and whether they have discussed sun protection with a healthcare professional. The results indicated that participants in the USA generally have higher awareness and knowledge regarding sun exposure risks and protection measures compared to participants in Yemen. A significantly higher proportion of participants in the USA reported discussing sun protection with healthcare professionals, suggesting that healthcare providers in the USA might play a more active role in educating patients about sun safety.

	Yemen (n=111)	**USA (n=108)**	**Total (n=219)**
Do you think that covering helps to reduce sun exposure that may lead to skin cancer?			
Yes	90 (81.1%)	97 (89.8%)	187 (85.4%)
No	21 (18.9%)	11 (10.2%)	32 (14.6%)
Did you know that using tanning pads can lead to skin cancer?			
Yes	51 (45.9%)	63 (58.3%)	114 (52.1%)
No	60 (54.1%)	45 (41.7%)	105 (47.9%)
Have you ever discussed sun protection with a healthcare professional?			
Yes	21 (18.9%)	39 (36.1%)	60 (27.4%)
No	90 (81.1%)	69 (63.9%)	159 (72.6%)

Table 3: Knowledge and awareness.

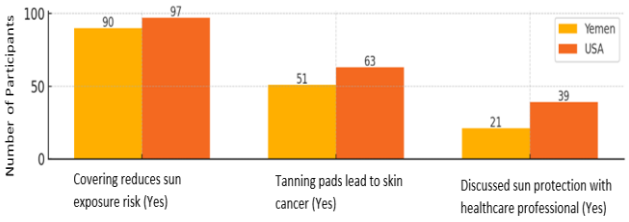

Figure 2: Knowledge and awareness of sun exposure risks

Comparative analyses

Comparative analyses were conducted to identify significant differences between participants in Yemen and the United States. Chi-square tests were used for categorical variables, and t-tests were used for continuous variables. As indicated in Table 4, the application of sunscreen showed a near-significant difference between participants from Yemen and the USA (Chi-square value = 3.671, p = 0.055). Although the p-value is slightly above the conventional threshold of 0.05, the data suggests that participants in the USA are more likely to apply sunscreen compared to those in Yemen. Additionally, there was a significant difference in the knowledge that tanning pads can lead to skin cancer between the two regions (Chi-square value = 3.871, p = 0.049). A higher percentage of participants from the USA were aware of this risk compared to participants from Yemen, indicating better awareness about the dangers of tanning pads in the USA. A highly significant difference was observed in discussions about sun protection with healthcare professionals (Chi-square value = 7.984, p = 0.005). Participants in the USA were much more likely to have had these discussions compared to participants in Yemen.

Variable	**Chi-Square Value**	**P-value**
Wear protective clothing	0.229	0.632
Apply sunscreen	3.671	0.055
Avoid tanning beds	2.038	0.153
Perform regular skin self-exams	2.038	0.153
Covering reduces sun exposure risk	3.012	0.083
Tanning pads lead to skin cancer	3.871	0.049*
Discussed sun protection with healthcare professional	7.984	0.005**

Table 4: Comparative analysis of sun protection behaviors and knowledge. **Note:** * denotes $p < 0.05$ and ** denotes $p < 0.01$.

Discussion

The findings of this study provide valuable insights into the sun exposure safety behaviors and knowledge among adults in Yemen and the United States. Significant differences were observed between the two regions, highlighting the influence of cultural, environmental, and educational factors on sun protection practices and awareness. Specially, a primary finding of this study is the disparity in the application of sunscreen between participants from Yemen and the United States. Participants in the United States were more likely to apply sunscreen (65.7%) compared to those in Yemen (54.1%). This difference may be attributed to higher public health awareness and more extensive sun safety campaigns in the United States.

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Additionally, the availability and accessibility of sunscreen products might be more prominent in the United States [10].

Another notable finding is the difference in discussions about sun protection with healthcare professionals. A significantly higher proportion of participants in the United States (36.1%) reported having discussed sun protection with a healthcare professional compared to participants in Yemen (18.9%). This suggests that healthcare providers in the United States may play a more active role in educating patients about sun safety. It also indicates a potential gap in healthcare education in Yemen, where such discussions might be less common or prioritized [11].

Cultural influences

As indicated by the findings of this study, cultural practices in Yemen, such as wearing modest clothing that covers much of the skin, naturally reduce sun exposure. This practice might contribute to a lower perceived need for additional sun protection measures like sunscreen application. However, this also highlights a critical area for public health intervention-educating the population on the importance of protecting exposed areas and understanding the risks of UV radiation even with minimal direct sun exposure. In contrast, in the United States, cultural norms that associate tanned skin with beauty and health can lead to risky behaviors such as intentional tanning. Despite higher overall awareness among participants, this cultural norm may undermine sun protection efforts and contribute to the ongoing need for effective public health messaging that balances aesthetics with health risks [12].

Knowledge and awareness

The study revealed that a significant proportion of participants from both regions were aware that covering the skin reduces sun exposure risk and that using tanning pads can lead to skin cancer. However, the overall levels of knowledge were higher among participants from the United States. This could be due to more robust educational campaigns and greater access to information through various media channels in the United States. Research has shown that effective sun safety campaigns and widespread media coverage significantly enhance public awareness and knowledge about sun protection measures [13].

Public health implications

The results of this study emphasize the need for culturally tailored public health interventions to improve sun protection behaviors and knowledge in both regions. In Yemen, public health campaigns should focus on increasing awareness about the importance of sunscreen use and other protective measures for exposed skin areas. Efforts should also be made to incorporate sun safety education into routine healthcare visits. In the United States, ongoing education is needed to counteract cultural norms that promote tanning as desirable. Public health messages should continue to highlight the risks of UV exposure and the benefits of comprehensive sun protection strategies, including the use of sunscreen, protective clothing, and regular skin checks.

Limitations

This study has several limitations that should be acknowledged. First, the use of an online survey may introduce selection bias, as it primarily includes participants who have access to the internet and are comfortable with online platforms. This may exclude certain demographics, particularly older adults or individuals from lower socioeconomic backgrounds who may have limited internet access. Second, the data collected are self-reported, which can lead to reporting bias. Participants may overestimate their sun protection behaviors or knowledge due to social desirability bias, or they may misremember past behaviors. This can affect the accuracy of the data and the conclusions drawn from it. Third, the cross-sectional design of the study limits the ability to establish causality. While we can identify associations between variables, we cannot determine cause-and-effect relationships. Longitudinal studies would be necessary to understand the causal links between sun exposure behaviors and knowledge and their impact on health outcomes. Fourth, cultural differences in understanding and interpreting survey questions may affect the responses. Despite translating the survey into Arabic, subtle nuances in language and cultural contexts may lead to different interpretations of the questions by participants from Yemen compared to those from the United States. Finally, the study may not be representative of the entire adult populations of Yemen and the United States. The recruitment methods, while varied, may have missed certain groups, and the sample size, although sufficient for preliminary analysis, may not capture the full diversity of the populations studied.

Strengths

Despite these limitations, the study also has several strengths. One major strength is the cross-regional comparison between adults in Yemen and the United States. This allows for the identification of cultural and regional differences in sun exposure behaviors and knowledge, which is crucial for developing tailored public health interventions.

The use of a bilingual survey (Arabic and English) enhances the inclusivity and accessibility of the study, allowing for a broader range of participants from diverse linguistic backgrounds. This approach helps ensure that the findings are more representative of the target populations. Additionally, the study addresses a significant public health issue by focusing on sun exposure behaviors and knowledge, which are critical for the prevention of skin cancer and other sun-related health problems. By highlighting the differences and similarities between two distinct regions, the study provides valuable insights for public health practitioners aiming to design culturally appropriate sun protection programs. The comprehensive nature of the questionnaire, covering various aspects of sun protection behaviors and knowledge, provides a detailed understanding of the participants' practices and awareness. This thorough approach ensures that multiple facets of sun exposure safety are examined. Finally, the use of rigorous statistical analysis methods strengthens the reliability of the findings. By employing both descriptive and comparative analyses, the study offers a robust examination of the data, ensuring that the conclusions drawn are well-supported by the evidence.

Conclusion

The results of this study highlight the critical role of healthcare professionals in promoting sun safety behaviors. Encouraging discussions about sun protection during routine healthcare visits can significantly enhance awareness and adoption of protective measures. Additionally, public health campaigns must be culturally sensitive and region-specific to effectively address the unique needs of different populations. By addressing the specific cultural and educational contexts of different regions, public health efforts can be more effective using targeted strategies to promote behavior change.

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Appendix I: Survey Instrument/Questionnaire Items

1. **How do you protect yourself from sun exposure? Select all that apply.**
- Wear protective clothing.
- Apply sunscreen.
- Avoid tanning beds.
- Perform regular skin self-exams.

2. **Can covering up help reduce sun exposure that may contribute to skin cancer risk?**
- Yes
- No

3. **Did you know that using tanning pads can lead to skin cancer?**
- Yes
- No

4. **Have you ever discussed sun protection with a healthcare professional?**
- Yes
- No

5. **Which of the following sun safety behaviors are actions taken to minimize the harmful effects of UV radiation from the sun? Select all that apply.**
- Seeking shade during peak sun hours (10 a.m. to 4 p.m.)
- Wearing protective clothing, such as long-sleeved shirts, long pants, wide-brimmed hats, and sunglasses with UV protection.
- Applying broad-spectrum, water-resistant sunscreen with SPF 30 or higher.

6. **Do you check your skin regularly for any changes, such as new or changing moles, spots, or other marks, and report any concerning changes to your healthcare provider?**
- Yes
- No

7. **What country do you live in?**
- Yemen (Middle East)
- USA (North America)

8. **How old are you:**
- 18-24 Years
- 25-34 Years
- 45-54 Years
- 55-64 Years
- 65 Years or older

9. **What is your sex assigned at birth?**
- Male
- Female
- Prefer not to answer

10. **Which of the following best describes your religious affiliation?**
- Christian
- Jewish
- Muslim
- Hindu
- Other religion
- No religious affiliation

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