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PUBLIC AWARENESS OF APPROPRIATE SUN EXPOSURE FOR VITAMIN D MAINTENANCE AND SKIN CANCER PREVENTION: A CROSS-SECTIONAL STUDY IN SAUDI ARABIA

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ABSTRACT

Introduction: Vitamin D production requires adequate sunlight. Excessive UV exposure is the leading cause of skin cancers. Establishing an optimal balance between obtaining enough vitamin D and reducing the risk of cancer is a challenging task. This paper aims to examine public knowledge regarding the appropriate amount of sunlight exposure, the symptoms of vitamin D deficiency, and ways to prevent skin cancer in Jeddah, Saudi Arabia. **Methods:** The cross-sectional study was carried out by administering an online survey to 230 individuals during January – May 2024. Demographics, knowledge of the benefits of vitamin D, as well as awareness about the dangers of too much sun exposure, were considered. A cumulative knowledge score was classified into poor (<60%), fair (60-75%), and good (>75%) categories. **Results:** Most respondents were women (67%) and well-educated (67.8% had a bachelor's degree or above). Participants were familiar with the role of sunlight in producing vitamin D (90.4%) and could identify clinical signs of vitamin D deficiency (87.8%). However, many participants had gaps in knowledge, as less than half (46.5%) knew that the elderly should be at high risk of deficiency, and a small share (52.6%) were aware that too much sun exposure increases skin cancer risk. In general, 61.3% showed fair knowledge and 20% showed good knowledge. There was a statistically significant gender disparity, with women having significantly higher knowledge scores than men (p=0.023). **Conclusion:** While there is adequate foundational knowledge regarding vitamin D among a highly educated population, there is substantial ignorance related to skin cancer and risk groups, especially men.

KEYWORDS: Vitamin D, Sun exposure, Skin cancer, Knowledge, Awareness, Saudi Arabia.

1. INTRODUCTION

The relationship between useful ultraviolet (UV) radiation and the negative effects of UV radiation has been an ongoing issue in clinical practice.[1] Sunlight is the greatest source of vitamin D production in the epidermis, which acts as a precursor in the formation of bone minerals, the regulation of the immune system, and the prevention of cardiovascular and autoimmune diseases.[2] Although there are vitamin D supplements available, UVB rays have proven to be the easiest and most effective way to ensure sufficient blood levels of the hormone.[3,4]

On the other hand, excessive sunlight exposure causes malignant tumors on the skin, particularly melanoma.[5,6] As the occurrence of skin cancer increases across the world, stricter regulations on exposure to sun radiation become necessary, conflicting, in turn, with the need to avoid the deficiency of the important vitamin.[7] This problem can be exacerbated due to personal differences based on factors like latitude, skin phototypes, and cultural norms associated with clothing.[8]

While both national policies on preventing skin cancer and measures aimed at ensuring proper intake of vitamin D are currently adopted in most countries, the message they convey to people is often confusing.[9] In Saudi

Arabia, public perception of the appropriate limits of exposure to sunlight is still unclear. The main goal of the research, therefore, was to assess public awareness about the correct adjustment of sun exposure to achieve a good balance of skin protection and vitamin D sufficiency in Jeddah, Saudi Arabia.

2. METHODS

2.1. Study Design and Setting

A cross-sectional survey was carried out among residents of Jeddah, Saudi Arabia, from January to May 2024.

2.2. Study population, Sample Size, and Technique

The target population was the public residents in Jeddah, Saudi Arabia. The inclusion criteria for participation included being an adult resident (age >18) of Jeddah. Healthcare professionals and respondents who had incomplete questionnaire responses were excluded from the study analysis.

The calculated sample size using the G*Power (α=0.05, power =0.95, effect size =0.30, and five degrees of freedom) was 220 participants.[10-12] Non-probability sampling by the convenience sampling technique was used in recruiting participants for the study.

2.3. Data Collection Methods

Information was collected using a pre-coded online questionnaire that was adapted from a previous study[13], and then posted on Google Forms. Respondents were provided with information about the study's aim on the first screen during questionnaire administration. Mandatory electronic informed consent was also sought before participation in the survey. Demographic data such as age, gender, education level, occupation, working place were documented in addition to the knowledge and attitude of respondents on vitamin D production and its deficiency symptoms and dangers of sunbathing (UV exposure).

2.4. Statistical Analysis

Data analysis was done using SPSS v.22. For continuous variables, mean values ± SD were calculated, while categorical variables were represented by frequencies (%). The knowledge score ranged between 0 and 20. Participants' knowledge level was categorized into poor (<60%), fair (60-75%), and good (>75%) scores. The chi-square was used for group comparisons, where $p < 0.05$ was considered statistically significant.

2.5. Ethical Considerations

The study was conducted in accordance with the ethical standards in the 1975 Declaration of Helsinki. Ethical approval was obtained from Ibn Sina National College (ISNC) Institutional Research Review Board (IRRB). Written informed consent was obtained from all participants before participation. Confidentiality and anonymity were maintained by ensuring that no personal identifiers were collected. Data were securely stored and accessible only to the research team.

3. RESULTS

3.1. Sociodemographic characteristics of the participants

A total of 230 participants were involved in the current study, among whom most were women (67%). As far as age is concerned, the majority of subjects fell into the younger group (36.6% were aged 18-25; 33.5% were aged 26-40). In terms of education level, the highest number of participants had received a bachelor's degree (61.3%), while 6.5% had completed postgraduate studies. Most of the participants were employed (40.4%), and some were students (30.4%). Finally, 79.6% were exposed to the indoor primary work environment (Table 1).

Table 1: Sociodemographic Characteristics of the Study Participants (N = 230).

Variable	Response	Frequency (n)	Percentage (%)
Primary Source of Vitamin D	Fruits	9	3.9%
	Vegetables	6	2.6%
	Sunlight	208	90.4%
	Dairy products	7	3.0%
Symptoms of Vitamin D Deficiency	Fatigue	13	5.7%
	Muscle weakness	7	3.0%
	Joint pain	8	3.5%
	All of the above	202	87.8%
Primary At-Risk Groups	Newborns (<2 years)	41	17.8%
	Children (2–12 years)	24	10.4%
	Adolescents (13–19 years)	31	13.5%
	Postmenopausal women	27	11.7%
	Elderly men and women	107	46.5%
Prior Vitamin D Serum Check	No	74	32.2%
	Yes	150	65.2%
	Not sure	6	2.6%

3.2. Knowledge of Vitamin D Synthesis and Deficiency

Most subjects (90.4%) indicated sunlight as the main source of vitamin D. Also, they proved to have a fairly good understanding of symptoms of deficiency (87.8% recognized fatigue, muscle weakness, and joint pain as vitamin D deficiency indicators). As regards proactive health monitoring, it should be noted that 65.2% of participants mentioned their clinical screening for serum vitamin D levels previously. However, one should pay attention to the lack of information about certain vulnerable groups (only 46.5% pointed out the risk group) (Table 2).

Table 2: Participant Knowledge Regarding Vitamin D Sources, Deficiency Symptoms, and At-Risk Groups.

Variable	Response	Frequency (n)	Percentage (%)
Primary Source of Vitamin D	Fruits	9	3.9%
	Vegetables	6	2.6%
	Sunlight	208	90.4%
	Dairy products	7	3.0%
Symptoms of Vitamin D Deficiency	Fatigue	13	5.7%
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Prior Vitamin D Serum Check	No	74	32.2%
	Yes	150	65.2%
	Not sure	6	2.6%

3.3. Attitudes Toward Sun Exposure and Carcinogenic Risk

As to the time period during which one can achieve adequate vitamin D production, 74.3% indicated an interval from sunrise to 10:00 a.m. Moreover, 50.4% were convinced that 5 to 15 minutes of sun exposure per week would be sufficient (Table 3). There was quite high variation in participants' answers on potential risks associated with ultraviolet radiation. When discussing the possible effects of 30 minutes of daily sun exposure, 17.4% indicated cancer, 43.0% chose heat stroke, 25.2% picked dehydration. Although the necessity of using sunscreen "always" was shared by 62.2% of participants, only 52.6% associated it with skin cancer (Table 3).

Table 3: Participant Knowledge and Attitudes Regarding Sun Exposure Practices and Associated Hazards.

Variable	Response	Frequency (n)	Percentage (%)
Perceived Health Effects of Regular Sunlight Exposure	There is no relationship	12	5.2%
	Very harmful	30	13.0%
	Fairly harmful	55	23.9%
	Fairly good	69	30.0%
	Very good	64	27.8%
Potential Harmful Effects of 30-min Daily Sun Exposure	Heat stroke	99	43.0%
	Dehydration	58	25.2%
	Cancer	40	17.4%
	Skin burn	33	14.3%
Best Time for Vitamin D Synthesis via Sun Exposure	Sunrise to 10:00 AM	171	74.3%
	10:00 AM to 3:00 PM	20	8.7%
	3:00 PM to sunset	26	11.3%
	Not sure	13	5.7%
Minimum Weekly Sun Exposure Duration for Adequacy	5–15 minutes	116	50.4%
	15–30 minutes	56	24.3%
	30 minutes–1 hour	36	15.7%
	1–3 hours	16	7.0%
	More than 3 hours	6	2.6%
Required Frequency of Sunscreen Use to Avoid Hazards	Always	143	62.2%
	Sometimes	49	21.3%
	No need to use	11	4.8%

	Not sure	27	11.7%
Awareness of Skin Cancer Risk Due to Sun Exposure	No	54	23.5%
	Yes	121	52.6%
	Not sure	55	23.9%

3.4. Comparative Knowledge Analysis

Thus, as a result of the analysis, 61.3% of participants had "fair" knowledge, 20% – "good", 18.7% - "poor". Chi-square analysis revealed only one statistically significant factor: women possessed higher knowledge level compared to men (p=0.023). Age (p=0.101), occupation (p=0.146), work environment (p=0.878), and education level (p=0.344) were not related to the knowledge levels statistically significantly (Table 4).

Table 4: Association Between Sociodemographic Characteristics and Comprehensive Knowledge Scores.

Variable	Category	Poor Knowledge (%)	Fair Knowledge (%)	Good Knowledge (%)	p-value
Overall Total		**43 (18.7%)**	**141 (61.3%)**	**46 (20.0%)**	
Age Groups	18–25	10 (23.8%)	52 (37.4%)	21 (47.7%)	0.101
	26–40	18 (42.9%)	43 (30.9%)	14 (31.8%)	
	41–60	13 (31.0%)	44 (31.7%)	9 (20.5%)	
	>61	1 (2.4%)	0 (0.0%)	0 (0.0%)	
Gender	Male	21 (48.8%)	45 (31.9%)	10 (21.7%)	**0.023***
	Female	22 (51.2%)	96 (68.1%)	36 (78.3%)	
Occupation	Student	7 (16.3%)	43 (30.5%)	20 (43.5%)	0.146
	Employed	22 (51.2%)	54 (38.3%)	17 (37.0%)	
	Unemployed	9 (20.9%)	33 (23.4%)	7 (15.2%)	
	Others	5 (11.6%)	11 (7.8%)	2 (4.3%)	
Work Environment	Indoor	33 (76.7%)	113 (80.1%)	37 (80.4%)	0.878
	Outdoor	10 (23.3%)	28 (19.9%)	9 (19.6%)	
Education Level	No schooling completed	4 (9.3%)	6 (4.3%)	2 (4.3%)	0.344
	High school graduate	9 (20.9%)	35 (24.8%)	18 (39.1%)	
	Bachelor's degree	28 (65.1%)	89 (63.1%)	24 (52.2%)	
	Postgraduate	2 (4.7%)	11 (7.8%)		

* Indicates statistical significance ($p < 0.05$) utilizing the Chi-square test.

4. DISCUSSION

A key observation made by this cross-sectional study concerns the division in public health literacy in relation to ultraviolet radiation. While knowledge of the primary sources of vitamin D, as well as deficiency symptoms, is relatively good within this group of highly educated people from Saudi Arabia, there are significant deficiencies in terms of understanding safety exposure to ultraviolet radiation and related cancer risk.[14,15]

It appears that 90.4% of people recognized sunlight as the source of vitamin D. However, although 79.5% work indoors, thus placing themselves at high risk for developing hypovitaminosis D, less than 50% recognized elderly people as those who have a higher likelihood of developing it.[16] More worryingly, even when taking into consideration skin cancer as one of the most common types of malignancies globally, only 52.6% of people were aware that it has a direct correlation with ultraviolet exposure, while 17.4% were not able to identify cancer among the main dangers of 30 minutes of daily exposure.[17]

Interestingly enough, contrary to the findings reported by other researchers, education level, age, and job type did not correlate significantly with knowledge gaps in terms of health literacy. The reason for it may be the highly-educated character of this cohort; for instance, 67.8% of participants had at least a tertiary degree.[18,19] However, a significant difference in knowledge between men and women was found; females demonstrated significantly more comprehensive awareness ($p = 0.023$). Such results can be explained by the tendency of women to show higher awareness about preventive health care measures.[20,21]

The key limitation of this study concerns the design, as it is characterized by convenience sampling performed in one of the cities of Saudi Arabia, making it impossible to extrapolate the results to the national population. Second, the sample was characterized by high educational and young age levels, as well as a preponderance of females, meaning that knowledge gaps may exist in rural and less formally educated populations. Third, the data collection through online self-reports carries with it potential biases.

Despite the described limitations, a key implication of this research is that generalized recommendations about sun exposure are dangerous for the public due to the absence of quantitative parameters. Public health campaigns should shift from generalized

recommendations to gender-based and quantified recommendations, emphasizing the importance of photoprotection to prevent malignant transformation.

5. CONCLUSION

The investigated population demonstrates a fair, though superficial, understanding of vitamin D physiology. Significant deficits persist in the public's ability to safely navigate the dichotomy between securing sufficient UV exposure for health and avoiding the severe risks of cutaneous malignancy. Future public health strategies must specifically target male demographics and lower-educated populations, providing nuanced, balanced guidelines that promote vitamin D adequacy without compromising dermatological oncology protocols.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Disclaimer (Artificial Intelligence)

During the preparation of this manuscript, the authors used a generative artificial intelligence (AI) tool, OpenAI's ChatGPT (July 19, 2025 version), to assist in revising and proofreading the text. All AI-generated content was carefully reviewed, edited, and verified by the authors to ensure accuracy, completeness, and compliance with the study objectives. The authors assume full responsibility for the content and conclusions presented in this publication.

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