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Awareness and behavior of Vitamin D among Students at Jazan University: Health Belief Model

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Abstract: Vitamin D deficiency remains a significant health issue, even in sunny regions such as Saudi Arabia, where sociocultural practices often limit adequate sun exposure. The study assessed awareness and behaviors related to vitamin D using the Health Belief Model (HBM). A cross-sectional descriptive study was conducted from October to December 2025 among 480 students selected using a stratified convenience sampling approach based on college type. Data were collected using an online self-administered questionnaire and analyzed using SPSS. The study revealed significant associations between several HBM constructs and socio-demographic variables. Perceived susceptibility was significantly associated with sex, whereas perceived severity was associated only with age. Perceived benefits were significantly associated with sex, age, and college type. Perceived barriers were significantly associated with age and college type, whereas cues to action were associated with sex, age, and college type. Multivariable logistic regression analysis showed that perceived benefits and perceived barriers were significant predictors of daily sun exposure, whereas perceived susceptibility, perceived severity, and cues to action were not. The findings highlight critical gaps in vitamin D-related awareness and practices among university students and emphasize the importance of theory-based health education interventions to promote healthy vitamin D-related behaviors. However, the use of a stratified convenience sampling approach and the cross-sectional design may have introduced selection bias and limited the generalizability of the findings to all university students.

Keywords: Vitamin D deficiency, Health Belief Model, Awareness and practices, Sun exposure, Saudi Arabia.

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1. Introduction

Vitamin D, a vital fat-soluble vitamin, is crucial for calcium and phosphorus balance, bone mineralization, and musculoskeletal health. Recent studies also suggest links between vitamin D levels and immune function and overall metabolic health. Despite abundant sunlight in many regions, vitamin D deficiency has become a widespread public health issue worldwide, affecting both developed and developing nations [1,2].

Paradoxically, vitamin D deficiency is highly prevalent in sunny countries, including the Kingdom of Saudi Arabia (KSA), where cultural practices, clothing norms, limited sun exposure, and lifestyle factors contribute to this pattern. Several studies have documented widespread vitamin D deficiency across age groups and demographic categories in Saudi Arabia, underscoring that living in a sunny climate does not guarantee adequate vitamin D status. Specifically, a recent retrospective analysis of more than 22,000 Saudi individuals found a high prevalence (67.3%) of vitamin D deficiency (<30 ng/mL), particularly among females and adolescents [3].

University students are particularly vulnerable to vitamin D deficiency due to lifestyle transitions, academic demands, reduced outdoor activities, and inconsistent health behaviors. A recent KAP study conducted in Qassim, Saudi Arabia, identified significant gaps in knowledge, attitudes, and practices related to vitamin D deficiency, highlighting persistent challenges in awareness and preventive behaviors among adults [1,4].

The Health Belief Model (HBM) is one of the most widely used theoretical frameworks for understanding and predicting health-related behaviors. It holds that individuals' engagement in preventive health behaviors is influenced by perceived susceptibility to a condition, perceived severity of its consequences, perceived benefits of action, perceived barriers to action, cues to action, and self-efficacy. Evidence from global nutrition behavior research suggests that HBM-based approaches can improve dietary knowledge and practices, including micronutrient intake and preventive nutritional behaviors [5].

Additionally, recent studies have shown that the HBM is useful for predicting nutrition-related behaviors, including the consumption of nutrient - rich foods, supporting its role in dietary and micronutrient research [6].

In Saudi Arabia, the Health Belief Model has rarely been used to assess awareness and behaviors related to vitamin D, particularly among university students. In the Jazan region, where sociocultural and lifestyle factors may further influence sun exposure and dietary habits, there is a significant lack of research on vitamin D awareness and practices, particularly within a theoretical framework. Therefore, the present study adopted a conceptual framework based on the Health Belief Model to illustrate the relationship between sociodemographic characteristics, HBM constructs, vitamin D–related knowledge, and preventive behaviors, including sun exposure, dietary intake, and vitamin D supplement use, among students at Jazan University (Figure 1).

Figure 1: Conceptual framework illustrating the relationship between Health Belief Model construction and Vitamin D–Related Knowledge and Behaviors

Despite the growing importance of vitamin D–related health issues, there is still limited evidence from Saudi Arabia on studies that have applied the Health Belief Model (HBM) specifically to university students, indicating a gap in the current literature. Consequently, this study aims to apply the HBM to evaluate students' awareness and behaviors regarding vitamin D at Jazan University. Understanding these factors is crucial for designing effective, evidence-based health education programs that promote healthy vitamin D–related behaviors and improve long-term health outcomes among university students.

1.1 Research Questions

1. What is the level of awareness of vitamin D among students at Jazan University?
2. What are students' behaviors related to vitamin D (sun exposure, diet, and supplements)?
3. How do Health Belief Model factors influence students' vitamin D behaviors?
4. Is there a relationship between Health Belief Model factors and vitamin D awareness and practices?
5. Do vitamin D awareness and behaviors differ according to students' demographic characteristics

1.2 Research Hypotheses

- Health Belief Model (HBM) constructs, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action, are significantly associated with students' socio-demographic characteristics (sex, age, and college type).
- Health Belief Model (HBM) constructs are significantly associated with vitamin D-related preventive behaviors among Jazan University students.
- Health Belief Model (HBM) constructs significantly predict daily sun exposure behavior among university students.
- Students' awareness and vitamin D-related behaviors differ according to socio-demographic characteristics, including sex, age, and college type.
- Perceived benefits, perceived barriers, self-efficacy, and cues to action are associated with engagement in vitamin D-related health behaviors.

2. Materials and methods

2.1 Study Design

A cross-sectional, community-based descriptive study was conducted at Jazan University from October to December 2025 to assess awareness and behavior of Vitamin D using the HBM framework.

2.2 Sample Size

The sample size was calculated using Cochran's formula:

$$n0 = (Z^2 \times p \times (1-p)) / e^2$$

Where Z = 1.96 corresponds to a 95% confidence level, p = 0.5 represents the estimated population proportion, and e = 0.05 the margin of error. The minimum required sample size was calculated to be 384 participants. To enhance representativeness and compensate for potential non-response, 600 students were invited to participate. Of these, 480 students completed the questionnaire and were included in the final analysis, yielding a response rate of 80%.

The study population was divided into two strata: health-related colleges and non-health-related colleges. To ensure adequate representation of both groups, two university complexes were selected from the four main complexes at Jazan University: the Health Colleges Complex, representing health-related colleges, and the Academic Complex, representing non-health-related colleges. The total number of students in the selected strata was 9,528, including 5,266 students from health-related colleges and 4,262 students from non-health-related colleges. Proportional allocation was used to determine the sample size for each stratum. Accordingly, of the total sample size of 480 students, 265 were selected from health-related colleges and 215 from non-health-related colleges.

Participants were recruited using a convenience sampling technique within each group. With the assistance of student leaders, the electronic questionnaire was distributed online to students through various platforms. Participation was voluntary, and only students who completed the questionnaire were included in the final analysis.

3. Method of data collection

A self-administered standardized questionnaire was built based on relevant literature, including previous studies on vitamin D among Saudi university [1,4,7]. The questionnaire was initially designed in English, then translated into Arabic, and back-translated into English by independent specialists to ensure the reliability of the language and concepts. Content validity was assessed by three academic experts in public health, who reviewed the questionnaire for relevance, clarity, and comprehensiveness.

A pilot study was conducted among 48 participants to evaluate the clarity, accuracy and reliability of the questionnaire. Minor modifications included rephrasing unclear questions and improving the sequence of items for better comprehension. Internal consistency was assessed using Cronbach's alpha, which demonstrated acceptable reliability, with a value of 0.70.

3.1 The questionnaire consisted of four sections:

The first section provided information about the study's objectives, data confidentiality, and voluntary participation with electronic consent obtained by selecting "Agree" to continue. The second section gathered sociodemographic data, such as sex, age, and college type. The third section assessed participants' knowledge of vitamin D, including deficiency symptoms, health effects, dietary sources, and sunlight exposure. The fourth section assessed health beliefs about vitamin D deficiency using the constructs of the Health Belief Model. It included six domains measured on a 5-point Likert scale. Perceived susceptibility assessed risk perception (e.g., "I am at risk of vitamin D deficiency"). Perceived severity evaluated awareness of health consequences (e.g., "Vitamin D deficiency can cause serious health problems"). Perceived benefits measured beliefs about the advantages of preventive actions (e.g., "Sun exposure helps prevent vitamin D deficiency"). Perceived barriers identified obstacles to healthy behaviors (e.g., "Lack of time limits my sun exposure"). Cues to action assessed motivating factors (e.g., "Doctors' advice encourages me to take vitamin D"). Self-efficacy measured confidence in performing preventive behaviors (e.g., "I can maintain adequate sun exposure or take supplements").

4. Method of data analysis

Data were entered into Microsoft Excel and then analyzed using IBM SPSS version 29. Descriptive statistics, including frequencies and percentages, were computed and reported. A chi-square test examined associations between students' sociodemographic characteristics and HBM constraints related to vitamin D. In contrast, logistic regression was used to analyze HBM factors associated with daily sun exposure. A p-value < 0.05 was considered statistically significant.

5. Results

5.1 Socio-demographic characteristics of the participants

Out of the 600 individuals in the targeted sample, 480 responded to the survey, resulting in a response rate of 80%. The study presents the socio-demographic characteristics of the participants. The sample had a slightly higher proportion of females (57%) compared to males (43%). The age distribution was mainly between 18 and 20 years (40%), followed by 20–22 years (31%), 22–24 years (20%), and 24 years or older (9%). Regarding college type, (54%) were enrolled in health colleges, while the remaining (46%)belonged to non-health colleges (Table 1).

Table 1. Socio-demographic characteristics of the participants (n = 480)

Variable	Frequency (n)	Percentage (%)
Sex		
Female	274	57
Male	206	43
Age (years)		
18–20	192	40
20–22	149	31
22–24	96	20
≥24	43	9
College type		
Health college	265	55
Non-health college	215	45

5.2 Association between socio-demographic variables and Health Belief Model (HBM) constructs related to vitamin D deficiency.

This study summarizes associations between socio-demographic variables and Health Belief Model (HBM) constructs related to vitamin D deficiency. Perceived susceptibility was significantly associated only with sex (χ^2 = 17.738, p=0.001) and age (χ^2 = 11.660, p=0.02), but not with college type. Perceived severity was significantly associated with age (χ^2 = 9.480,p=0.049) but not with sex or college type. Perceived benefits were significantly associated with sex (χ^2 = 15.507,p=0.004), age (χ^2 = 11.134,p=0.025), and college type

(χ^2 = 14.796,p=0.005). Perceived barriers were significantly associated with age (χ^2 = 13.266,p=0.01) and college type (χ^2 = 9.481,p=0.05)but not with sex. Self-efficacy were significantly associated with sex(χ^2 = 5.992,p=0.023), age (χ^2 = 9.480,p=0.049)and college type (χ^2 = 12.210,p=0.014) Lastly, cues to action were associated with all three sociodemographic variables: sex (χ^2 = 18.358,p=0.001), age (χ^2 = 14.860,p=0.005), and college type (χ^2 = 24.837,p= 0.001) (Table 2).

Table 2. Association between socio-demographic variables and Health Belief Model (HBM) constructs related to vitamin D deficiency

HBM construct	Sex χ^2 (p-value)	Age χ^2 (p-value)	College type χ^2 (p-value)
Perceived susceptibility	17.738 (p=0.001)	11.660 (p=0.021)	0.307 (p=0.984)
Perceived severity	3.757 (p=0.153)	9.480(p=0.049)	6.851(p=0.121)
Perceived benefits	15.507 (p=0.004)	11.134 (p=0.025)	14.796 (p=0.005)
Perceived barriers	0.207 (p=0.995)	13.266 (p=0.011)	9.481 (p=0.05)
Self-efficacy	5.992 (p=0.023)	9.480 (p=0.049)	12.210 (p=0.014)
Cue to action	18.358 (p=0.001)	14.860(p=0.005)	24.837 (p= 0.001)

5.3 Multivariable logistic regression analysis of HBM factors associated with daily sun exposure (10–15 minutes)

Multivariable logistic regression analysis was used to examine associations between Health Belief Model (HBM) constructs and daily sun exposure. The logistic regression model showed a good fit according to the Hosmer–Lemeshow test (p = 0.2454). Results indicated that Perceived Benefit was a significant associated with odds of daily sun exposure (AOR = 0.28, 95% CI: 0.08–0.92, p = 0.036). Similarly, Perceived Barriers were significantly associated with low odds of sun exposure (AOR = 0.12, 95% CI: 0.02–0.64, p = 0.014) and self-efficacy was significantly associated with daily sun exposure (AOR = 0.25, 95% CI: 0.04–0.51, p = 0.024). In contrast, Perceived Susceptibility was not significantly associated (AOR = 0.60, 95% CI: 0.16–2.31, p = 0.461). Similarly, Perceived Severity did not show statistically significant (AOR = 0.66, 95% CI: 0.17–2.45, p = 0.415). Finally, Cue to Action was also not significantly associated with daily sun exposure (AOR = 0.30, 95% CI: 0.04–2.48, p = 0.262) (Table 3).

Table 3 Multivariable logistic regression analysis of HBM factors associated with daily sun exposure (10–15 minutes)

HBM Construct	Adjusted OR (AOR)	95% CI	p-value
Perceived Susceptibility	0.60	0.16–2.31	0.461
Perceived Severity	0.66	0.17–2.45	0.415
Perceived Benefit	0.28	0.08–0.92	0.036
Perceived Barriers	0.12	0.02–0.64	0.014
Self-efficacy	0.25	0.04-0.51	0.024
Cue to Action	0.30	0.04 -2.48	0.262

6. Discussion

This investigation used the Health Belief Model (HBM) to assess awareness and practices related to vitamin D among students at Jazan University. The socio-demographic profile indicated a relatively balanced distribution by sex(53% females,47% males)and college type(51% from health colleges, 49% from non- health colleges), with the majority of participants aged 18–22 years. This age group is a critical period for preventive health behaviors because of lifestyle transitions and increasing independence in health decision-making [7,8].

The results showed significant associations between socio-demographic factors and HBM constructs. Perceived susceptibility was significantly associated only with sex and age, but not with college type. These results indicated that age and gender play a greater role than academic discipline in awareness of vitamin D deficiency risks. For instance, younger or female students may feel more susceptible, possibly due to differences in lifestyle, health awareness, or sociocultural factors, whereas academic discipline alone does not. These findings align with previous studies that reported higher perceived susceptibility among females and younger participants [7,8,9,10,11]. The study found that perceived severity was associated with age but not with sex or college type. Older students perceived vitamin D deficiency as a more serious health issue, which may reflect accumulated health knowledge or awareness of long-term consequences such as musculoskeletal disorders and osteoporosis. These findings are consistent with [7,8], who reported that older individuals tend to recognize the potential seriousness of vitamin D deficiency more than younger individuals [12].

These perceptions may be attributed to greater exposure to health education, increased personal experience with health-related information, and a better understanding of the long-term risks associated with vitamin D deficiency [13].

Perceived benefits were significantly associated with sex, age, and college type. Females, older students, and participants enrolled in health colleges were more likely to recognize the benefits of sun exposure and vitamin D supplementation. This pattern may be explained by differences in health education and the perceived value of health-related information, as individuals with greater formal training in health-related topics are more likely to understand the preventive role of vitamin D supplementation and adequate sun exposure. These results are consistent with previous studies, which reported that individuals with higher health literacy are more likely to adopt preventive behaviors [14,15,16,17].

Perceived barriers showed significant associations with age and college type. These barriers were more prevalent among older students and those in non-health colleges. In this study, the most frequently reported barriers were cultural clothing practices, hot climate, academic workload, and concerns about skin damage from sun exposure. These barriers have also been reported in previous studies [9], and have been consistently documented in Saudi and regional studies, indicating that awareness alone does not guarantee behavioral change [7]. Elamin et al. (2025) reported that health college students showed greater knowledge and awareness than their non-health peers ($p < 0.05$)[18].

In the present study, self-efficacy was significantly associated with all socio-demographic variables (sex, age, and college type), indicating that students' confidence in performing sun-exposure behaviors varies across demographic groups. This suggests that self-efficacy is influenced by personal and contextual factors such as educational background and exposure to health-related information. Similar findings have been reported in previous studies, highlighting the role of health education and awareness in shaping self-efficacy and preventive health behaviors [13,15].

Cues to action were significantly associated with all sociodemographic variables, such as sex, age, and college type. Female students, older students, and those enrolled in health colleges were more likely to receive vitamin D prompts from healthcare providers, peers, or the media. However, consistent with findings from [16,19], the impact of these external cues may be limited if the perceived barriers identified earlier are not addressed. This emphasizes the importance of combining cues to action with strategies that reduce barriers to ensure effective behavioral change [13,20].

Multivariable logistic regression was used to examine associations between Health Belief Model (HBM) constructs and daily sun exposure. Results showed that perceived benefits and perceived barriers were predictors of daily sun exposure, whereas perceived susceptibility, severity, and cues to action were not. These findings underscore the importance of emphasizing the tangible benefits of sun exposure and supplementation while addressing barriers to behavior change, consistent with prior research in Saudi Arabia and other regions [14,15,16,18].

The present study has several limitations that should be considered when interpreting the findings. The use of convenience sampling and online data collection may have introduced selection bias, as participation was limited to students who were accessible and willing to complete the electronic questionnaire. In addition, volunteer bias may have occurred, as students with greater interest or awareness of vitamin D may have been more likely to participate. The use of a self-administered questionnaire may also introduce self-report bias, including recall and social desirability bias, which could affect the accuracy of responses. Finally, the absence of important confounding variables such as marital status, parity, and thyroid disorders may have limited the ability to fully control for factors influencing vitamin D-related behaviors.

7. Recommendation

The study recommends strengthening targeted health education programs on vitamin D, with special focus on non-health colleges, males, and younger students. Interventions should emphasize the benefits of sun exposure while addressing key barriers such as academic workload and fear of sun exposure.

Programs should also aim to enhance self-efficacy and reduce perceived barriers through practical, behavior-focused strategies. In addition, universities should increase cues to action using digital media and campus-based awareness campaigns.

Future research should include additional factors such as marital status, parity, and thyroid disorders to understand determinants of vitamin D status.

8. Conclusion

This study confirmed that the Health Belief Model effectively explains students' awareness and behaviors concerning vitamin D at Jazan University. While many students recognized vitamin D deficiency and its health consequences, this awareness did not always lead to appropriate preventive measures, particularly regular sun exposure. Perceived benefits and perceived barriers were the strongest predictors of behavior, whereas perceived susceptibility, perceived severity, and cues to action alone were insufficient to motivate behavioral change.

These findings highlight the need for theory-based health education programs that strengthen perceived benefits and reduce practical and psychological barriers to healthy behaviors. Interventions should particularly target younger students and those in non-health colleges, and provide clear, practical guidance on safe sun exposure and vitamin D supplementation. Integrating vitamin D education into university health programs may help bridge the knowledge- practice gap.

8.1 Ethical approval

The local Research Ethics Committee at Jazan University approved this study (Reference No: REC-47/06/1669). In accordance with the Helsinki Declaration, informed consent was obtained electronically before participation. Data were collected anonymously without personal identifiers, stored securely, and used only for research purposes. All data will be retained for five years, and then permanently deleted.

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