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Vitamin D Deficiency Knowledge and Associated Factors among Nursing Students at the University of Sulaimani, Iraq: A Cross-Sectional Study

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ABSTRACT

Nursing students need good knowledge regarding Vitamin D to promote health and prevent deficiency. The current study aimed to assess the knowledge of nursing students about Vitamin D deficiency at the University of Sulaimani. A quantitative cross-sectional study was conducted among 118 nursing students, who were selected through simple random sampling. Data were collected using a structured questionnaire that assessed sociodemographic characteristics and knowledge about Vitamin D deficiency. Knowledge scores were classified as high or low. The mean knowledge score was 30.8 out of 52 (59.24%), with 50% having high knowledge and 50% having low knowledge. The overall average correct answer rate was 59.24%. Students performed best on questions about Vitamin D increasing chronic disease risk (76.27%) and improving muscle strength and reducing fall risk (72.88%). They struggled with low Vitamin D increasing the risk of autoimmune disease, infection (36.44%), regulating mood and reducing the risk or severity of depression and anxiety (38.98%), and darker skin risk (40.67%). Self-reported Vitamin D deficiency was significantly associated with knowledge level (P = 0.04). These findings suggest that nursing education should provide both theoretical knowledge and practical behaviors such as appropriate sun exposure, dietary intake, and supplementation.

Index Terms: Knowledge, Vitamin D, Nursing Students, College of Nursing, Sulaimani, Iraq

1. INTRODUCTION

Vitamin D is a fat-soluble vitamin that is necessary for healthy bones, teeth, proper functioning of the immune system, and calcium absorption. It exists in two major forms, the latter of which is synthesized in the skin from cholesterol following exposure to ultraviolet B (UVB) radiation from sunlight. Vitamin D is activated by two hydroxylations: one in the liver to form 25-hydroxyvitamin D [25(OH)D], and another in the kidneys to produce its active form, 1,25-dihydroxyvitamin D (calcitriol). Calcitriol is a hormone that regulates calcium and phosphate levels to maintain bone health and other physiological functions. Adequate levels of Vitamin D are crucial for preventing diseases such as rickets in children and osteomalacia in adults. It exists primarily in two forms: Vitamin D_2 (ergocalciferol) and Vitamin D_3 (cholecalciferol), the latter synthesized in the skin from cholesterol upon

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exposure to solar UVB rays [1]. To become biologically active, Vitamin D undergoes consecutive hydroxylations in the liver to 25(OH)D, and subsequently in the kidneys to 1,25-dihydroxyvitamin D (calcitriol) – a potent hormone regulating calcium and phosphate homeostasis to prevent conditions such as childhood rickets and adult osteomalacia [2].

Despite its vital physiological role, public and professional awareness regarding Vitamin D remains inconsistent. Recent evaluations in Iraq demonstrate variable knowledge levels; whereas Baghdad residents generally possess a fair understanding of its overall importance, notable gaps persist regarding specific dietary sources and safe, optimal seasonal sun exposure [3]. Furthermore, studies among healthcare personnel reveal only a moderate level of awareness [4], underscoring an urgent need for targeted educational strategies and promotional health campaigns to address these knowledge deficiencies across both the public and clinical sectors.

Ultraviolet (UV) radiation has three types: UVA (aging, passes through glass), UVB (sunburn, essential for Vitamin D but blocked by glass), and UVC (absorbed by ozone, never reaches the ground). UVB is effective for Vitamin D synthesis generally between 10:00 AM and 4:00 PM, peaking around midday [5].

Vitamin D deficiency is a significant public health concern in Iraq, including the Kurdistan region. Deficiency has also been linked to increased risk of autoimmune diseases, infections, inflammatory conditions, and certain chronic conditions [6]–[8]. Vitamin D is believed to play a role in mood regulation and mental health, particularly in reducing the risk of depression and anxiety, and may help prevent or reduce the severity of depression and anxiety [9], [10]. Vitamin D's role in regulating cell growth, differentiation, and apoptosis (programmed cell death) may help reduce the risk of cancer development [11]. Likewise, it improves muscle strength, reduces the risk of falls, and enhances physical performance, particularly in older adults [12], [13].

Recent studies highlight its role in supporting muscle function, immune health, and reducing inflammation [14], [15]. It is recommended that individuals maintain adequate Vitamin D levels through a combination of sunlight exposure, diet, and supplementation, especially in populations at higher risk for deficiency, such as older adults and those living in regions with limited sunlight [16]. Vitamin D is thought to play a role in cardiovascular health by influencing blood pressure regulation, reducing inflammation, and affecting the function of endothelial cells [17]. A comprehensive 2024 systematic review and meta-analysis found that Vitamin D deficiency during pregnancy is significantly associated with a higher incidence of low birth weight [18]. Leg and musculoskeletal pain are common in Vitamin D deficiency, which is also positively associated with non-specific bone pain, particularly in women [19]. Studies have suggested an association between hearing loss and inner ear disorders related to Vitamin D deficiency. Therefore, Vitamin D plays an important role in bone health and calcium absorption. This is because the smallest bones in the human body are located inside the middle ear (the auditory ossicles: Malleus, incus, and stapes); a deficiency in this vitamin can lead to bone weakening or structural changes (such as Otosclerosis) or impair inner ear sensory structures and nerves [20].

Nurses have a vital role in raising awareness, educating, and supporting the prevention and treatment of Vitamin D deficiency in communities. In addition, nurses play an important role in advocating for policies that ensure equitable access to Vitamin D supplementation, particularly for vulnerable groups such as the elderly or those in care homes. By integrating these strategies into their practice, nurses help decrease the prevalence of Vitamin D deficiency and improve population health outcomes among populations [21], [22].

Bone health, adequate immune function, and overall well-being are related to adequate Vitamin D levels. While the body can synthesize Vitamin D upon exposure to sunlight, obtaining it from dietary sources such as fatty fish, eggs, milk, mushrooms, and orange juice is crucial, especially in regions with limited sunlight [1], [23].

The amount of Vitamin D produced in the skin depends on several factors, including:

Time of day: Midday sunlight is the most effective for Vitamin D production [16]. Latitude and season: Regions farther from the equator or during winter months may experience reduced UVB exposure. Skin pigmentation: Individuals with darker skin require more sunlight to produce the same amount of Vitamin D as those with lighter skin. Older adults have reduced levels of 7-dehydrocholesterol, leading to decreased Vitamin D synthesis [24].

The current study was conducted to assess nursing students' knowledge at the University of Sulaimani regarding Vitamin D deficiency.

2. MATERIALS AND METHODS

2.1. Study Design

A quantitative, descriptive cross-sectional study design was used to assess nursing students' knowledge regarding Vitamin D deficiency at the College of Nursing, University of Sulaimani, during the period from November 10, 2024, to May 15, 2025.

2.2. Administrative Approvals

Administrative and ethical approvals were obtained from the Community Health Nursing, Scientific and Ethical Committee of the College of Nursing, University of Sulaimani, prior to conducting the study.

2.3. Setting of the Study

The study was conducted at the College of Nursing, University of Sulaimani. The College of Nursing is one of the medical colleges at the University of Sulaimani. It was established in 2000 and began enrolling its first cohort of students in 2001.

2.4. The Sample of the Study

Students who participated were selected from the College of Nursing using simple random sampling. Verbal informed consent was obtained from each participant before collecting the data.

2.5. Inclusion and Exclusion Criteria

Inclusion criteria covered all nursing students of grades 2, 3, and 4; grade 1 students were not included in this study because they had not yet received the nursing curriculum. At the same time, exclusion criteria comprised students who refused to participate.

2.6. Study Instrument

A questionnaire, developed from a literature review, covered demographic information and questions about Vitamin D deficiency. The tool consists of two parts; the first part deals with sociodemographics and some clinical data, such as age, gender, marital status, stages of the study, economic status, cigarette smoking, and the existence of Vitamin D deficiency. The second part deals with the participants' knowledge of these variables; Vitamin D is a fat-soluble vitamin whose production and status are influenced by several variables, including sunlight exposure (time of day, midday sun being most effective), skin pigmentation (darker skin requires longer exposure than lighter skin), latitude (high latitude reduces the body's ability to produce Vitamin D), sunscreen use (regular use reduces synthesis), and window glass (which blocks Vitamin D production). Other variables include dietary intake (fish, eggs, dairy, mushrooms, and fortified foods, especially in low-sunlight areas), supplement use, malabsorption syndromes (requiring higher doses), pregnancy (low birth weight signals deficiency), and sedentary behavior (no link to fibroid risk). These variables together determine whether a person maintains adequate Vitamin D levels or faces deficiency, which can affect the cardiovascular system, musculoskeletal strength, immune function, mood, cancer risk, vision, hearing, and risk of chronic disease.

2.7. Validity

Content validity was established by seven experts who reviewed the questionnaire and provided their opinions regarding its clarity, relevance, and appropriateness. Based on the experts' feedback, necessary modifications were made to improve the clarity and relevance of the questionnaire. The final version of the instrument was considered valid and appropriate for data collection.

2.8. Pilot Study

A pilot study was conducted with 10 nursing students who were excluded from the study sample, during the period of November 20–December 06, 2024.

2.9. Reliability

The reliability of the knowledge regarding Vitamin D deficiency was determined through the use of the internal consistency (split-half) approach and the Cronbach Alpha = 0.85.

2.10. Methods of Data Collection

The study selected all nursing students in the College of Nursing at the University of Sulaimani, but only 118 students agreed to participate in the current study. Data were collected through a face-to-face direct interview. The collection period started from December 16, 2024, to January 15, 2025. The questionnaire, covering demographic data and knowledge about Vitamin D deficiency among nursing students, took approximately 10 min for each participant. The study included 118 students due to non-participation and dropouts of several students.

2.11. Rating and Scoring

The knowledge items were rated and scored using a three-point scale consisting of correct, incorrect, and I do not know responses. For positively worded questions, responses were scored as follows: correct = 2, I do not know = 1, and incorrect = 0. For negatively worded questions, the

scoring was reversed: correct = 0, I do not know = 1, and incorrect = 2. In the current study, items 1, 3, 8, 14, 17, 18, 19, 20, and 26 were negatively worded, whereas the remaining items (2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 16, 21, 22, 23, 24, and 25) were positively worded.

The knowledge section consisted of 26 items, each scored from 0 to 2, giving a total possible score ranging from 0 to 52. The total score obtained by each participant was converted into a percentage of the maximum possible score using the following formula:

$$\text{Knowledge Percentage} = (\text{Total Score} / 52) \times 100$$

The overall mean knowledge score was 30.8 out of 52, corresponding to 59.24% of the maximum possible score. Participants were classified into two knowledge levels using a median split based on their percentage scores: Those scoring at or above the median (≥59%, equivalent to ≥31 points) were classified as having high knowledge, whereas those scoring below the median (<59%, equivalent to <31 points) were classified as having low knowledge. This resulted in two equal groups of 59 participants (50%) each.

2.12. Statistical Analysis

The data were organized and coded into computer files using the Statistical Package for Social Science (SPSS), version 26. The data were analyzed through the computation of frequencies and percentages, inferential data analysis, and the Chi-square test. *P*-values were considered to be significant ($P < 0.05$) or non-significant ($P > 0.05$).

The data were organized, coded, and analyzed using SPSS version 26. Descriptive statistics were computed for all variables, including frequencies and percentages for categorical variables, and mean ± standard deviation for continuous variables. Bivariate analysis was performed to assess the association between independent variables and the outcome using the Chi-square test. $P < 0.05$ was considered statistically significant, $P < 0.01$ was considered highly significant, and $P > 0.05$ was considered non-significant.

3. RESULTS OF THE STUDY

Table 1 demonstrated that the age of 91.5% of the students was between 18 and 22 years old, 67.8% of them were female, 87.3% of them were single, and 90.7% of them were non-smokers. They were evenly distributed across the second, third, and fourth stages (33.1%, 32.2%, and 34.7%). 56.8% of them had sufficient economic status, and 39.8% had barely sufficient. Regarding Vitamin D, 40.7% reported having a deficiency, but only 28.8% took supplements.

Table 2 shows the knowledge levels of 118 nursing students regarding Vitamin D deficiency. The mean knowledge score was 30.8 out of 52 (59.24%), indicating a moderate level of knowledge. Based on a median split at 59% (31 points), participants were divided equally into high knowledge ($n = 59$, 50%) and low knowledge ($n = 59$, 50%) groups. These results reveal that while half of the students had adequate knowledge, the remaining half demonstrated poor

TABLE 1: Sociodemographic and some clinical characteristics of the participants

Characteristic	Frequency	%
Age (years)		
18–22	108	91.5
23–24	10	8.5
Mean±SD 20.5±2.1		
Gender		
Female	80	67.8
Male	38	32.2
Stage of study		
Stage 2	39	33.1
Stage 3	38	32.2
Stage 4	41	34.7
Economic status		
Sufficient	67	56.8
Barely sufficient	47	39.8
Insufficient	4	3.4
Marital status		
Single	103	87.3
Married	15	12.7
Cigarette smoking		
No	107	90.7
Yes	11	9.3
Self-reported Vitamin D deficiency		
No	36	30.5
Yes	48	40.7
I don't know	34	28.8
Vitamin D supplementation		
No	84	71.2
Yes	34	28.8
Total	118	

TABLE 2: Distribution of knowledge levels among participants

Distribution of level of knowledge among participants		
Knowledge levels	***n* (%)**	**Cutoff (%)**
Mean knowledge score	30.8 out of 52 (59.24)	—
High knowledge	59.0 (50)	≥59 (≥31 points)
Low knowledge	59.0 (50)	<59 (<31 points)
Total	118 (100)	—

knowledge, suggesting a need for improved educational strategies on Vitamin D deficiency.

Table 3 indicates that only Vitamin D deficiency was significantly associated with knowledge level ($\chi^2 = 6.20$, df = 2, $P = 0.042$). Other factors – including gender ($\chi^2 = 0.03$, df = 1, $P = 0.841$), study stage ($\chi^2 = 0.05$, df = 2, $P = 0.972$), economic status ($\chi^2 = 1.66$, df = 2, $P = 0.432$), marital status ($\chi^2 = 0.30$, df = 1, $P = 0.581$), smoking ($\chi^2 = 3.01$, df = 1, $P = 0.083$), and taking Vitamin D supplements ($\chi^2 = 1.07$, df = 1, $P = 0.301$) – showed no significant relationship with knowledge level ($P > 0.05$).

TABLE 3: Relationship between knowledge and demographic variables

Variable	Chi-square	*P*-value	Degrees of freedom	Interpretation
Gender	0.03	0.841	1	Not significant
Stage	0.05	0.972	2	Not significant
Economic Status	1.66	0.432	2	Not significant
Marital Status	0.30	0.581	1	Not significant
Cigarette smoking	3.01	0.083	1	Not significant
Self-reported Vitamin D deficiency	6.20	0.042	2	Significant
Taking a Vitamin D supplement	1.07	0.301	1	Not significant

Table 4 shows that the highest proportion of correct responses was observed for the statement that Vitamin D deficiency can increase the risk of chronic diseases (76.27%). This was followed by the statement that musculoskeletal pain is common in Vitamin D deficiency, particularly in children (72.03%), vision problems are potential symptoms of Vitamin D deficiency (72.03%), and fatigue is a common symptom of Vitamin D deficiency (71.18%).

In contrast, students demonstrated the lowest levels of knowledge regarding the association between low Vitamin D levels and increased risks of autoimmune diseases, infections, and inflammation (36.44%), followed by the role of Vitamin D in regulating mood and reducing the risk or severity of depression and anxiety (38.98%), and the statement regarding UVA radiation and Vitamin D production (38.13%). In addition, only 40.67% of students correctly responded to the statement that individuals with darker skin require longer sun exposure than those with lighter skin to produce equivalent amounts of Vitamin D.

TABLE 4: Correct response rates for knowledge questions

Questions	Correct response percentage
1. Vitamin D is a water-soluble vitamin.	57.62
2. Vision problems are potential symptoms of Vitamin D deficiency.	72.03
3. The primary natural source of Vitamin D is the synthesis in the lower layers of the intestine.	67.79
4. The cardiovascular system is supported by adequate levels of Vitamin D.	54.23
5. Hearing loss and inner ear disorders related to deficiency of Vitamin D	67.79
6. Fatigue is a common symptom of Vitamin D deficiency.	71.18
7. Vitamin D may help regulate mood and reduce the risk or severity of depression and anxiety.	38.98
8. Musculoskeletal pain is common in Vitamin D deficiency, especially in children.	72.03
9. Vitamin D screening is recommended for everyone, regardless of risk factors and disease.	61.86
10. Low Vitamin D increases risk of autoimmune disease, infection, and inflammation.	36.44
11. Vitamin D improves muscle strength, reduces fall risk, and enhances physical performance, particularly in older adults	72.88
12. Vitamin D production in the skin depends on factors like time of day, with midday sun being most effective.	68.64
13. Low birth weight signals pregnancy-related Vitamin D deficiency.	54.23
14. Leafy green vegetables are rich sources of Vitamin D.	51.69
15. Sunlight, diet, and supplements together help maintain Vitamin D levels, particularly for those at higher risk of deficiency.	61.86
16. Vitamin D helps lower cancer risk through its role in cell growth and programmed cell death.	44.06
17. In cases of Vitamin D deficiency, dietary sources are typically more effective at correcting the deficiency than sunlight.	66.96
18. Living at a high latitude increases the body's ability to produce Vitamin D from sunlight.	55.55
19. No link exists between sedentary behavior and lower serum Vitamin D levels in women with uterine fibroids.	64.40
20. Sunlight penetrating through window glass can strongly help the human body produce Vitamin D.	63.55
21. Darker skin needs longer sun exposure than lighter skin for equivalent Vitamin D production.	40.67
22. Regular use of sunscreen can reduce Vitamin D synthesis from sunlight.	60.16
23. Vitamin D deficiency can increase the risk of chronic disease.	76.27
24. In patients with malabsorption syndromes, a higher dose of Vitamin D is necessary.	61.86
25. In low-sunlight areas, Vitamin D from foods such as fish, eggs, dairy, mushrooms, and fortified juice is essential.	59.32
26. Ultraviolet A produces Vitamin D only when the sun is highest in the sky.	38.13
Total	59.24

The overall correct response rate was 59.24%, indicating a considerable gap in students' knowledge regarding Vitamin D deficiency. These findings highlight the need to strengthen Vitamin D-related education within nursing curricula, particularly in areas related to risk factors, clinical manifestations, sunlight exposure, and the health consequences of Vitamin D deficiency.

4. DISCUSSION

The current study was conducted to assess knowledge regarding Vitamin D deficiency among 118 nursing students at the College of Nursing, University of Sulaimani. The purpose of the study was to assess nursing students' knowledge regarding Vitamin D deficiency and to identify potential gaps in their knowledge.

Concerning the sociodemographic characteristics, the present study demonstrated that the majority of participants (91.5%) were between 18 and 22 years of age. More than half of the participants were female and reported having sufficient economic status. The majority were single, and most participants were non-smokers (90.7%). Regarding Vitamin D deficiency, 40.7% of the participants reported having Vitamin D deficiency, whereas 30.5% reported no deficiency and 28.8% did not know whether they had Vitamin D deficiency. In contrast to the original statement, only 28.8% of the participants reported taking Vitamin D supplements, whereas 71.2% did not.

The mean knowledge score was 30.8 out of 52 (59.24%), with 50.0% of the students classified as having a high level of knowledge and 50.0% classified as having a low level of knowledge. The overall correct response rate across the 26 knowledge questions was 59.24%, suggesting an overall moderate level of knowledge, with notable gaps in specific areas of Vitamin D deficiency.

4.1. Knowledge Levels Compared to Other Studies

The knowledge level observed in the current study is that half of the participants have low and half have high levels of knowledge regarding Vitamin D deficiency. This equal distribution of participants between high and low knowledge groups (50% each) is due to several reasons, such as the use of a median split, which divides the sample at the midpoint rather than representing a natural dichotomy in knowledge levels. However, the variation in knowledge scores can be explained by personal factors – particularly prior personal experience with Vitamin D deficiency, which was the only variable significantly associated with knowledge in this study ($P = 0.042$). This is supported by the fact that nearly half of the participants reported having Vitamin D deficiency and 34% took supplements. Additional factors include exposure to the topic through the nursing curriculum, daily social media discussion of Vitamin D as a modern health issue, individual interest in the topic, self-directed learning habits, and clinical exposure. This is comparable to findings from other regional studies. The study conducted by Kamal, [25] which was conducted at Sulaimani Polytechnic University – in the same city as the present study– detected that less than a quarter of their participants had good knowledge about Vitamin D, whereas most had moderate to poor knowledge. Our students performed better than this local comparison group. However, the knowledge level in the current study is lower than that reported by Mohamed, [26] which assessed medical students at Al-Qadisiyah University in Iraq and reported that nearly most of their population had high knowledge, and they were much higher than the current finding. The study conducted by Sampat *et al.* [27] in Oman found that more than three-quarters of their students had moderate general knowledge about Vitamin D, but poor nutritional knowledge (45.1%), with only 20.6% having good overall knowledge. The present research shows that students' performance falls short of general Vitamin D concepts but struggle with more detailed nutritional and clinical knowledge.

4.2. Factors Associated with Knowledge

In the current study, a history of Vitamin D deficiency was the only factor significantly associated with knowledge level ($P = 0.04$). This is based on self-reported deficiency, rather than laboratory-confirmed Vitamin D status.

Whereas, a study done by Kamal, [25] who reported that knowledge was significantly associated with being a student compared to employees, but not with gender or age. The study done by Sharif *et al.* [28] in Sulaimani assessed healthcare professionals' knowledge in Sulaimani hospitals and similarly detected that knowledge was significantly associated with education level and professional position, not with demographic factors. Another study conducted in Pakistan among health science university students in 2025 [29] demonstrated that nearly three-quarters of their participants had good knowledge, with a significant association between knowledge and gender, study year, and economic status, which contrasts with the present findings where these factors showed no association. This difference may be due to variations in study populations and educational systems.

4.3. Specific Knowledge Gaps

The present study identified several specific gaps in students' knowledge regarding Vitamin D deficiency. Students performed best on questions concerning the association between Vitamin D deficiency and chronic disease risk (76.27%), the potential symptoms of Vitamin D deficiency, including vision problems (72.03%), fatigue as a common symptom of Vitamin D deficiency (71.18%), and the role of Vitamin D in improving muscle strength and reducing the risk of falls (72.88%). These findings indicate that students had relatively better knowledge of the general health consequences and clinical manifestations of Vitamin D deficiency.

However, students demonstrated lower levels of knowledge regarding the association between low Vitamin D levels and increased risks of autoimmune diseases, infections, and inflammation, with only 36.44% answering correctly. Similarly, 38.98% correctly identified the potential role of Vitamin D in regulating mood and reducing the risk or severity of depression and anxiety. Knowledge regarding the increased Vitamin D requirements of individuals with darker skin was also limited, with only 40.67% answering correctly. Furthermore, only 38.13% correctly responded to the question concerning UV radiation and Vitamin D production. These findings suggest that students had greater difficulty with more specific physiological, clinical, and sunlight-related aspects of Vitamin D than with general health effects.

These findings can be compared with the study conducted by Albogmi *et al.* [30] among medical students in Jeddah, Saudi Arabia, which reported a satisfactory level of knowledge regarding Vitamin D and calcium. The differences between the two studies may be related to differences in the study populations, educational curricula, exposure to Vitamin D-related information, and the knowledge assessment tools used.

A study conducted by Saeed *et al.* [31] among female prisoners in Sulaimani reported that none of the participants had Vitamin D levels within the normal range and suggested that limited sunlight exposure was associated with lower Vitamin D levels. Although this study focused on Vitamin D status rather than knowledge, its findings emphasize the importance of sunlight exposure as a potentially relevant factor in Vitamin D deficiency, which was also an area of limited knowledge among students in the present study.

Similarly, Ara *et al.* [29], among health science students in Pakistan, identified a measurable gap between knowledge and practice regarding Vitamin D. The present study also suggests a possible knowledge–practice gap, as only 28.8% of participants reported taking Vitamin D supplements, despite 40.7% reporting a history of Vitamin D deficiency. This finding is important because having knowledge about Vitamin D deficiency does not necessarily translate into preventive or health-promoting practices. Therefore, nursing education should not only improve theoretical knowledge but also emphasize appropriate sun exposure, dietary sources of Vitamin D, recognition of risk factors, and appropriate use of supplementation when indicated.

4.4. Importance of Risk Factor Knowledge

In the current study, more than half of the students answered correctly and particularly showed adequate understanding that Vitamin D production in the skin depends on factors such as time of day, with midday sun being most effective. This finding comes along with a study done by Sampat *et al.* [27], which found that only more than half of Omani students avoided the sun for more than 15 min, and also more than half of them agreed on the benefits of adequate Vitamin D levels on bone health, but nutritional knowledge remained poor. Similarly, in the present study, the students understood the general benefits of Vitamin D but lacked deeper knowledge about specific risk factors and clinical management.

4.5. Clinical Implications

Regarding the clinical guideline questions, such as whether Vitamin D screening is recommended for everyone, regardless of risk factors and disease, more than half of them responded correctly, because nursing students will soon be healthcare providers responsible for patient education and clinical decision-making. The study by Sharif *et al.* [28] emphasized that healthcare professionals need adequate knowledge to recognize Vitamin D deficiency comorbidity and manage patients effectively. The results of the present findings suggested that targeted educational interventions are needed because the current curricula may not sufficiently cover these clinical aspects.

5. CONCLUSION

This study indicates that nursing students at the University of Sulaimani had an overall moderate level of knowledge regarding Vitamin D deficiency, with 50.0% demonstrating a high level of knowledge and 50.0% demonstrating a low level of knowledge. The overall correct response rate of 59.24% highlights important gaps in knowledge, particularly

regarding the association of Vitamin D deficiency with autoimmune diseases, infections, and inflammation, its potential role in mood regulation and mental health, the influence of skin pigmentation on Vitamin D synthesis, and sunlight-related factors.

Furthermore, 40.7% of participants self-reported having Vitamin D deficiency, whereas only 28.8% reported taking Vitamin D supplements. These findings suggest that nursing education should strengthen both theoretical knowledge and practical health-promoting behaviors related to Vitamin D, including appropriate sun exposure, adequate dietary intake, recognition of risk factors, and appropriate supplementation when indicated. Assessing nursing students' knowledge can help identify specific educational gaps and support the development of targeted educational and health-promotion interventions to improve their preparedness to educate patients and communities about Vitamin D deficiency.

5.1. Study Limitation

This study has three main limitations. First, Vitamin D deficiency and supplementation were self-reported without clinical verification. Second, Vitamin D status was not confirmed by serum 25(OH)D testing. Third, the study was conducted at a single institution, limiting generalizability. Hence, the study recommended that future research should include clinical verification of Vitamin D status through serum 25(OH)D testing rather than self-reported deficiency, recruit participants from multiple institutions to improve generalizability, use longitudinal designs to assess knowledge changes over time, and develop educational interventions to address the specific knowledge gaps identified in this study.

REFERENCES

[1] M. Rodríguez-Rivero and M. Á. Medina, "Vitamin D as a systemic regulatory axis: from homeostasis to multiorgan disease," Biomedicines, vol. 13, no. 11, p. 2733, 2025. DOI: 10.3390/biomedicines13112733.

[2] R. Bouillon, G. Carmeliet, L. Verlinden, E. van Etten, A. Verstuyf, H. F. Luderer, L. Lieben, C. Mathieu, and M. Demay, "Vitamin D and human health: Lessons from vitamin D receptor null mice and tissue-specific knockout models". *Physiological Reviews*, vol. 95, no. 1, pp. 1-25, 2015.

[3] H. F. Ghazi, T. M. J. Taher and T. N. Hasan. "Knowledge about vitamin D among general population in Baghdad City". *Rwanda Journal Medical Health Science*, vol. 7, no. 1, pp. 89-100, 2024.

[4] S. Q. Saeed and S. A. Shabu. "Knowledge and practices towards vitamin D sources and insufficiency among healthcare workers in Erbil, Iraq, 2025". *Zanco Journal of Medical Sciences*, vol. 30, no. 2, pp. 333-344, 2026.

[5] M. A. Kallioğlu, A. Sharma, A. Kallioğlu, S. Kumar, R. Khargotra and T. Singh. "UV index-based model for predicting synthesis of (pre-)vitamin D3 in the Mediterranean basin". *Scientific Reports*, vol. 14, no. 1, p. 3541, 2024.

[6] W. B. Grant, H. Lahore, S. L. McDonnell, C. A. Baggerly, C. B. French, J. L. Aliano and H. P. Bhattoa. "Evidence that vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths". *Nutrients*, vol. 12, no. 4, p. 988, 2020.

[7] B. Altieri, E. Cavalier, H. P. Bhattoa, F. R. Pérez-López, M. T. López-Baena, G. R. Pérez-Roncero, P. Chedraui, C. Annweiler, S. Della Casa, S. Zelzer, M. Herrmann, A. Faggiano, A. Colao and M. F. Holick. "Vitamin D testing: Advantages and limits of the current assays". *European Journal of Clinical Nutrition*, vol. 74, pp. 231-247, 2020.

[8] C. Huang. "Vitamin D supplementation and mortality among critically ill adults: A systematic review and meta-analysis". *Frontiers in Nutrition*, vol. 13, p. 1796272, 2026.

[9] M. Kjærgaard, K. Waterloo, C. E. A. Wang, Y. Figenschau, M. S. Hutchinson, J. Svartberg and R. Jorde. "Effect of vitamin D supplement on depression scores in people with low levels of serum 25-hydroxyvitamin D: Nested case-control study and randomised clinical trial". *British Journal of Psychiatry*, vol. 201, no. 5, pp. 360-368, 2012.

[10] F. Xie, T. Huang, D. Lou, R. Fu, C. Ni, J. Hong and L. Ruan. "Effect of vitamin D supplementation on the incidence and prognosis of depression: An updated meta-analysis based on randomized controlled trials". *Frontiers Public Health*, vol. 10, p. 903547, 2022.

[11] P. D. Chandler, W. Y. Chen, O. N. Ajala, A. Hazra, N. Cook, V. Bubes, I. M. Lee, E. L. Giovannucci, W. Willett, J. E. Buring, J. E. Manson and VITAL Research Group. "Effect of vitamin D3 supplements on development of advanced cancer: A secondary analysis of the VITAL randomized clinical trial". *JAMA Netw Open*, vol. 3, no. 11, p. e2025850, 2020.

[12] B. Dawson-Hughes. "Impact of vitamin D and calcium on falls and fractures in older adults". *Endocrine Practice*, vol. 31, no. 11, pp. 1495-1500, 2025.

[13] R. Bouillon, D. Manousaki, C. Rosen, K. Trajanoska, F. Rivadeneira and J. B. Richards. "The health effects of vitamin D supplementation: Evidence from human studies". *Nature Reviews Endocrinology*, vol. 18, no. 2, pp. 96-110, 2022.

[14] G. Daryabor, N. Gholijani and F. Rezaei Kahmini. "A review of the critical role of vitamin D axis on the immune system". *Experimental and Molecular Pathology,* vol. 132-133, p. 104866, 2023.

[15] E. Hysa, E. Gotelli, R. Campitiello, S. Paolino, C. Pizzorni, A. Casabella, A. Sulli, V. Smith and M. Cutolo. "Vitamin D and muscle status in inflammatory and autoimmune rheumatic diseases: An update". *Nutrients*, vol. 16, no. 14, p. 2329, 2024.

[16] J. R. Raymond-Lezman and S. I. Riskin. "Benefits and risks of sun exposure to maintain adequate vitamin D levels". *Cureus*, vol. 15, no. 5, p. e38578, 2023.

[17] F. De La Guía-Galipienso, M. Martínez-Ferran, N. Vallecillo, C. J. Lavie, F. Sanchis-Gomar and H. Pareja-Galeano. "Vitamin D and cardiovascular health". *Clinical Nutrition*, vol. 40, no. 5, pp. 2946-2957, 2021.

[18] Z. You, H. Mei, Y. Zhang, D. Song, Y. Zhang and C. Liu. "The effect of vitamin D deficiency during pregnancy on adverse birth outcomes in neonates: A systematic review and meta-analysis". *Frontiers Pediatrics*, vol. 12, p. 1399615, 2024.

[19] B. Heidari, J. S. Shirvani, A. Firouzjahi, P. Heidari and K. O. Hajian-Tilaki. "Association between nonspecific skeletal pain and vitamin D deficiency". *International Journal of Rheumatic Disease*, vol. 13, no. 4, pp. 340-346, 2010.

[20] Y. J. Lee, J. H. Jung and J. W. Chung. "The relationship between lower vitamin D levels and hearing loss in older adults". *Journal Audiology Otology*, vol. 28, no. 4, pp. 252-259, 2024.

[21] B. Nandana, G. Salibi and N. Tzenios. "The prevalence of vitamin D deficiency among different population groups and its impact on health outcomes". *Special Journal Medical Academy Other Life Sciences*, vol. 2, no. 7, 2024.

[22] G. Paxton and D. Dalton. "Addressing vitamin D deficiency in vulnerable populations: A guide for nursing practice". *Nursing Standard*, vol. 37, no. 5, pp. 26-31, 2022.

[23] S. Paul, R. Kaushik, P. Chawla, S. Upadhyay, D. Rawat and A. Akhtar. "Vitamin-D as a multifunctional molecule for overall well-being: An integrative review". *Clinical Nutrition ESPEN*, vol. 62, pp. 10-21, 2024.

[24] A. Giustina, R. Bouillon, B. Dawson-Hughes, P. R. Ebeling, J. Lazaretti-Castro, M. Lips, C. Marcocci and J. P. Bilezikian. "Vitamin D in the older population: A consensus statement". *Endocrine*, vol. 79, no. 1, pp. 31-44, 2023.

[25] N. M. Kamal. "Assessment of knowledge, attitudes, and practices regarding vitamin D among students and employees at Sulaimani Polytechnic University, Iraq: A cross-sectional study". *Advances in Public Health*, vol. 2026, no. 1, p. 7437256, 2026.

[26] R. Mohamed and H. Raji Jallab."Knowledge, attitude and practice regarding obesity and its related complications in medical student of the college of medicine of Al-Qadisiyah University". *Al-Qadisiyah Medical Journal*, vol. 21, no. 1, p. 9, 2026.

[27] N. A. Sampat, M. AlRizeiqi, M. M. Essa, L. Al-Subhi, S. Al-Adawi and M. W. Qoronfleh. "Assessing general knowledge and nutritional knowledge on the role of vitamin D, attitudes, and behavior toward sun exposure among tertiary students in Oman". *Advances in Public Health*, vol. 2024, no. 1, p. 9544155, 2024.

[28] B. O. Sharif, S. M. Abdullah, S. A. Star, H. A. Ibrahim, H. M. Muhammad, Z. R. Ali and H. M. Hamasalih. "Assessment of health-care professional's knowledge regarding the comorbidities of vitamin D deficiency and its relationship with uterine fibroids". *UHD Journal Science Technology*, vol. 8, no. 1, pp. 31-41, 2024.

[29] G. Ara, S. Anis, S. Yameen, S. Dua, and T. Sultana. "Knowledge, attitude, and practice regarding vitamin D among health care university students of Shaheed Benazirabad". *Journal Health Wellness Community Research*, vol. 3, p. e851, 2025.

[30] A. M. Albogmi, L. S. Aljehani, L. A. Alharbi, H. A. Kashkari, F. A. Fatta, J. T. Bagasi, A. M. Almutiri and H. H. Mosli. "Evaluation of medical students' understanding and implementation of vitamin D and calcium at a tertiary healthcare facility in Jeddah, Saudi Arabia: A cross-sectional study". *International Journal of Medicine in Developing Countries*, vol. 8, no. 7, pp. 1546-1556, 2024.

[31] M. H. Saeed, C. S. Kakabra, L. L. Ahmad and S. A. Qadir. "Assessment the level of vitamin D among female prisoners in directorate of women and children reformatory in Sulaimani City". *Mosul Journal of Nursing*, vol. 10, no. 2, pp. 393-398, 2022.