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Declarations

No funding was received for this study. The authors declare no conflict of interest. The study received ethical approval. All participants provided informed consent.

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Knowledge, Attitude, and Practice Regarding Vitamin D Among Health Care University Students of Shaheed Benazirabad

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ABSTRACT

Background: Vitamin D plays a critical role in bone mineralization, immune regulation, and overall metabolic health. Despite abundant sunlight, vitamin D deficiency remains widespread in South Asia, particularly among women and young adults. Health science students represent a key group whose knowledge and practices can influence community health; however, limited evidence exists from Sindh province, Pakistan, regarding their awareness and behavior toward vitamin D sufficiency. **Objective:** To assess the knowledge, attitude, and practices regarding vitamin D among female undergraduate health care students at Peoples University of Medical and Health Sciences for Women, Shaheed Benazirabad, Sindh, Pakistan. **Methods:** A cross-sectional study was conducted from December 2020 to March 2021 using a validated D-KAP-38 questionnaire distributed electronically to 500 eligible students from Medicine, Physical Therapy, Pharmacy, Public Health, and Nursing departments. Descriptive and inferential analyses were performed using SPSS version 20. Associations were assessed through χ^2 tests and ANOVA, with significance set at $p < 0.05$. **Results:** Most participants had good general knowledge (84.8%) but average nutritional knowledge (47.6%), attitude (85%), and practice (49.2%). Significant differences were found across departments for knowledge and practice ($p < 0.05$). A nonlinear decline from knowledge to practice indicated a marked knowledge–practice gap. **Conclusion:** Although conceptual understanding of vitamin D was high, corresponding behavioral translation remained limited. Integrating targeted educational and behavioral interventions into curricula may enhance vitamin D health practices among future healthcare professionals.

Keywords

Vitamin D, Knowledge, Attitude, Practice, Health Care Students, Pakistan, Nutrition Awareness

INTRODUCTION

Vitamin D, commonly referred to as the “sunshine vitamin,” is a fat-soluble prohormone essential for calcium and phosphate homeostasis, bone mineralization, and musculoskeletal health (1). Beyond skeletal functions, accumulating evidence links adequate serum 25-hydroxyvitamin D [25(OH)D] levels to reduced risks of cardiovascular disease, autoimmune disorders, depression, and certain cancers (2–5). Despite its importance, vitamin D deficiency (VDD) has emerged as a major global public health concern, affecting an estimated one billion individuals worldwide, with the highest prevalence reported in South and Southeast Asia (6,7). In Pakistan, multiple national and regional surveys have identified widespread deficiency, with over half of the population exhibiting insufficient or deficient levels (8,9). The burden is particularly high among young adults and women due to limited sun exposure, cultural clothing practices, dietary inadequacy, and lack of supplementation (10,11).

Adequate knowledge, positive attitudes, and appropriate practices regarding vitamin D are essential for maintaining optimal health, especially among future health professionals who play a pivotal role in shaping public health behaviors (12). Knowledge-Attitude-Practice (KAP) studies have demonstrated that awareness about vitamin D varies significantly among university students, even in health-related disciplines. Studies from Saudi Arabia and the United Arab Emirates revealed limited understanding of dietary sources and sunlight exposure timing despite high educational attainment (13,14). Similar research conducted in Australia, Canada, and China found that up to one-third of students were unaware of vitamin D's non-skeletal benefits and optimal exposure requirements (15–17). In Pakistan, studies among medical and pharmacy students in major urban centers such as Islamabad, Rawalpindi, and Swat revealed adequate general knowledge but suboptimal attitudes and practices, indicating a persistent knowledge–practice gap (18–20).

However, data from Sindh province remain limited, and no published evidence specifically explores the KAP regarding vitamin D among students of health sciences in Shaheed Benazirabad. This regional gap is significant, as local sociocultural and environmental factors—such as intense heat, limited outdoor facilities, and conservative dress codes—may further constrain effective sun exposure despite awareness of its importance. Moreover, assessing these factors in a population of female health science students offers valuable insight into the interplay between health knowledge and behavior in a setting where both educational and cultural influences intersect.

Therefore, this study was designed to assess the knowledge, attitude, and practices regarding vitamin D among undergraduate female health care students at Peoples University of Medical and Health Sciences for Women (PUMHSW), Shaheed Benazirabad, Sindh, Pakistan. By identifying

specific gaps between knowledge and practical implementation, this research aims to generate evidence that can inform targeted educational interventions, promote preventive health awareness, and ultimately improve vitamin D sufficiency among future healthcare professionals. The study hypothesizes that although participants will demonstrate satisfactory general knowledge about vitamin D, their attitudes and practices will remain below optimal levels, revealing a measurable knowledge–practice disparity.

MATERIALS AND METHODS

This research employed a cross-sectional observational design aimed at evaluating the knowledge, attitude, and practices (KAP) regarding vitamin D among female undergraduate students enrolled in health sciences disciplines. The study was conducted at the Peoples University of Medical and Health Sciences for Women (PUMHSW) in Shaheed Benazirabad, Sindh, Pakistan, between December 2020 and March 2021. This institution was chosen because it represents a large and diverse population of health-related programs within a region characterized by high ultraviolet exposure but paradoxically low vitamin D sufficiency rates (21).

The target population included female undergraduate students from five departments: Medicine (MBBS), Doctor of Physical Therapy (DPT), Doctor of Pharmacy (Pharm-D), Public Health, and Nursing. Eligibility criteria required participants to be between 18 and 26 years of age, currently enrolled in a full-time undergraduate health program, and willing to provide informed consent. Students with diagnosed dermatological or systemic conditions associated with photosensitivity, such as xeroderma pigmentosum or systemic lupus erythematosus, were excluded to avoid confounding effects related to sun exposure limitations. Convenience sampling was used due to accessibility constraints during the study period and institutional policy regarding on-campus research amid pandemic-related restrictions.

Participant recruitment was carried out electronically through class coordinators and departmental representatives. Each eligible student received an invitation link to a self-administered online questionnaire hosted on Google Forms. Before accessing the survey, participants were provided with an introductory statement describing the study's purpose, confidentiality measures, and voluntary participation rights. Only those who consented electronically were permitted to proceed. To minimize duplicate responses, each participant was allowed a single submission through unique institutional email verification.

Data collection utilized the validated D-KAP-38 questionnaire developed by Amiri et al., which assesses general knowledge, nutritional knowledge, attitudes, and practices related to vitamin D (22). The instrument comprises 38 items distributed across four domains: general knowledge (11 items), nutritional knowledge (5 items), attitude (12 items), and practice (10 items). Responses for knowledge items were recorded as “Yes,” “No,” or “I don't know,” with scores of 2, 0, and 1, respectively, and reverse scoring for negatively phrased items. Attitude and practice sections were rated on five-point Likert scales, ranging from “strongly agree” to “strongly disagree” and from “always” to “never,” respectively. For attitude and practice domains, items 33, 35, 37, and 38 were reverse scored. Domain scores were categorized as poor, average, or good based on predefined ranges consistent with the validation study. The D-KAP-38 has demonstrated good internal consistency (Cronbach's $\alpha = 0.71$ – 0.83 across domains), and similar reliability was confirmed in the present dataset (Cronbach's $\alpha = 0.79$ overall).

To enhance data integrity, responses were screened for completeness; partially filled or duplicate forms were excluded. A total of 538 responses were received, of which 500 valid entries were retained for analysis after applying inclusion criteria and data validation procedures. Descriptive statistics were computed for demographic characteristics and KAP scores. Continuous variables were summarized as means and standard deviations, while categorical data were expressed as frequencies and percentages.

To assess associations between participant characteristics (age group, department) and KAP categories, chi-square tests were employed for categorical comparisons, and one-way analysis of variance (ANOVA) was used where mean scores were compared across multiple groups. Post-hoc pairwise comparisons were conducted with Bonferroni correction. Statistical significance was established at a two-tailed p -value < 0.05 . All analyses were performed using SPSS version 20.0. Bias and confounding were minimized through several strategies. Standardized electronic administration prevented interviewer bias, while exclusion of incomplete responses reduced information bias. Potential confounders such as academic discipline and age were analyzed as covariates in stratified comparisons to identify domain-specific variations. Internal validity was strengthened through pilot testing and random verification of 10% of responses for consistency of scoring.

Ethical approval was obtained from the Institutional Review Board of the Institute of Physical Therapy and Rehabilitation Sciences (IPRS), PUMHSW Shaheed Benazirabad (approval reference: IPRS/IRB/2020/12). All participants provided informed consent prior to participation, and data anonymity was ensured by removing personally identifiable information. Access to the dataset was limited to the research team, and all electronic data were stored in password-protected systems. This methodological approach ensures full reproducibility of findings and provides a transparent framework for evaluating the relationship between health science education and behavioral determinants of vitamin D sufficiency among female undergraduate students in a South Asian setting.

RESULTS

A total of 500 valid responses were analyzed from an initial 538 submissions, yielding a response rate of 92.9%. The participants' mean age was 21.0 ± 1.6 years (range 18–26 years). The majority (52%) belonged to the 21–23-year age group, followed by 41.2% aged 18–20 years and 6.8% aged 24–26 years. Departmental representation included Medicine (26%), Physical Therapy (20%), Pharmacy (20%), Public Health (20%), and Nursing (14%).

Overall, most participants (84.8%) demonstrated good general knowledge about vitamin D, while nutritional knowledge was predominantly average (47.6%) or poor (32.4%). In contrast, the majority exhibited an average attitude (85.0%) toward vitamin D, and nearly half (49.2%) reported average practice behaviors. Only 24.0% displayed good practice, while 26.8% had poor practice patterns. Most students correctly recognized sunlight exposure as the main source of vitamin D (92.2%), followed by dietary sources such as fatty fish (73.6%) and dairy products (71.6%). However, fewer identified eggs (55.4%) and meat (51.0%) as important sources, and 51.0% mistakenly believed fruits to be significant contributors. Regarding individual practices, only 14.2% reported walking outdoors daily for sunlight exposure, while 29.0% frequently used caps, hats, or umbrellas to avoid sunlight. Roughly one-third (36.6%) never consumed vitamin D supplements, and only 8.2% reported regular intake of fortified milk. Comparative analysis across departments revealed significant differences in knowledge and practice domains (Table 3). Medical students had higher mean general knowledge scores (18.4 ± 2.2) compared with Nursing students (16.1 ± 2.8 ; $p < 0.01$), while DPT students reported better practical behaviors (mean = 28.5 ± 6.1) compared with Pharm-D students (mean = 24.9 ± 6.5 ; $p < 0.05$). Attitude scores showed

no significant variation across departments ($p = 0.08$). Overall, students showed strong conceptual understanding of vitamin D's physiological importance, with 84.8% scoring within the “good” category for general knowledge. However, only one-fifth achieved good nutritional knowledge, revealing gaps in awareness of dietary sources.

Table 1. General and Nutritional Knowledge Levels Among Participants (n = 500)

Knowledge Domain	Category	Frequency (n)	Percentage (%)	95% CI	χ^2 (df)	p-value
General Knowledge	Poor	5	1.0	0.3–2.4	742.3 (2)	<0.001
	Average	71	14.2	11.2–17.7		
	Good	424	84.8	81.4–87.7		
Nutritional Knowledge	Poor	162	32.4	28.5–36.6	157.2 (2)	<0.001
	Average	238	47.6	43.2–52.0		
	Good	100	20.0	16.6–23.8		

Table 2. Attitude and Practice Toward Vitamin D Among Participants (n = 500)

Domain	Category	Frequency (n)	Percentage (%)	95% CI	χ^2 (df)	p-value
Attitude	Poor	45	9.0	6.7–11.9	692.4 (2)	<0.001
	Average	425	85.0	81.8–87.8		
	Good	30	6.0	4.0–8.5		
Practice	Poor	134	26.8	23.1–30.9	124.6 (2)	<0.001
	Average	246	49.2	45.0–53.5		
	Good	120	24.0	20.6–27.9		

Table 3. Comparison of Mean Knowledge, Attitude, and Practice Scores by Department (ANOVA, n = 500)

Department	General Knowledge Mean $\pm$ SD	Nutritional Knowledge Mean $\pm$ SD	Attitude Mean $\pm$ SD	Practice Mean $\pm$ SD	F (df)	p-value
Medicine (n = 130)	18.4 $\pm$ 2.2	6.1 $\pm$ 1.8	41.3 $\pm$ 5.2	27.2 $\pm$ 5.9	4.62 (4,495)	0.001
Physical Therapy (n = 100)	17.9 $\pm$ 2.5	6.0 $\pm$ 1.9	40.8 $\pm$ 6.1	28.5 $\pm$ 6.1		
Pharmacy (n = 100)	17.2 $\pm$ 2.3	5.8 $\pm$ 2.0	40.1 $\pm$ 6.3	24.9 $\pm$ 6.5		
Public Health (n = 100)	17.5 $\pm$ 2.4	5.6 $\pm$ 2.1	39.8 $\pm$ 5.9	25.7 $\pm$ 6.2		
Nursing (n = 70)	16.1 $\pm$ 2.8	5.4 $\pm$ 2.3	40.0 $\pm$ 5.6	26.0 $\pm$ 6.0		
Post-hoc (Bonferroni)	Medicine > Nursing ($p < 0.01$); DPT > Pharm-D ($p < 0.05$)	—	ns	ns	—	—

The dominant attitude was “average” (85%), reflecting cautious but incomplete health beliefs regarding sunlight and supplementation. Practical behaviors were inconsistent: despite awareness of sunlight's benefits, half of participants reported limited or infrequent exposure due to cultural or environmental barriers.

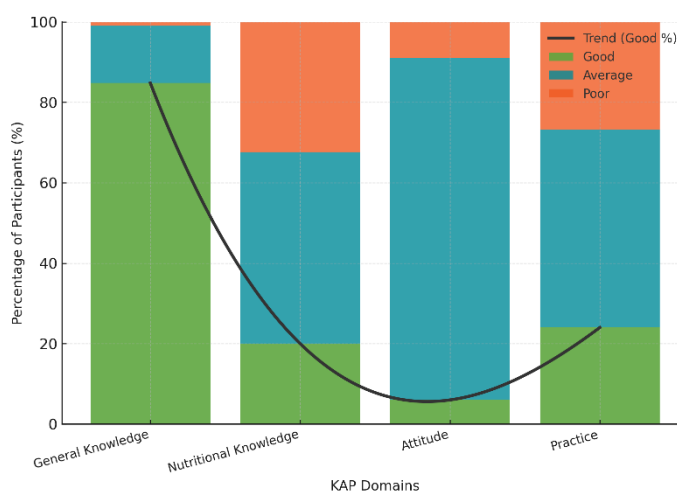


Figure 1 Distribution and Gradient Trend of Vitamin D Knowledge, Attitude, and Practice Levels Among Health Care Students

Interdepartmental analysis underscored variation in applied knowledge, where medical and physical therapy students exhibited relatively higher engagement in vitamin D-related behaviors compared with their peers in pharmacy and public health. Statistical comparisons confirmed significant associations between academic discipline and both general knowledge ($\chi^2 = 17.6$, $p = 0.001$) and practice ($\chi^2 = 11.9$, $p = 0.018$), but not with

attitude ($p > 0.05$). The overall pattern indicates a notable knowledge–practice gap, with theoretical understanding not translating into consistent preventive behavior.

The figure illustrates the proportional distribution of knowledge, attitude, and practice (KAP) levels among 500 health care university students, highlighting a distinct gradient across domains. While “good” general knowledge reached 84.8%, this proportion declined sharply for nutritional knowledge (20.0%) and practice (24.0%), with a minimal value for attitude (6.0%). The smoothed trend line demonstrates a downward nonlinear pattern, indicating that although conceptual understanding of vitamin D was high, corresponding behavioral translation diminished progressively across domains. This asymmetrical distribution emphasizes the knowledge–practice gap, suggesting that educational awareness alone is insufficient to drive consistent preventive behavior. The clinical implication is that future interventions should target the midrange “average” group (47–85%) through structured behavioral reinforcement strategies, particularly in nutrition and lifestyle practice education.

DISCUSSION

The present study evaluated the knowledge, attitude, and practice regarding vitamin D among female undergraduate students of health sciences at Peoples University of Medical and Health Sciences for Women, Shaheed Benazirabad. The findings demonstrate that while the majority of participants possessed adequate general knowledge about vitamin D, their nutritional understanding, attitudes, and practical behaviors were suboptimal. This imbalance reflects a substantial knowledge–practice gap, a phenomenon also observed in comparable research across both regional and global settings (23).

The high level of general knowledge (84.8%) found in this study is consistent with the findings of Haq et al. among medical students in Swat, Pakistan, where most participants recognized the skeletal importance of vitamin D and its synthesis through sunlight (24). Similarly, Geddawy et al. reported that over 80% of Saudi undergraduate health science students were aware of vitamin D’s physiological roles (25). However, despite such awareness, our participants’ nutritional knowledge remained limited, with only one-fifth correctly identifying food sources such as fatty fish, eggs, and fortified products. Comparable deficiencies in dietary knowledge have been observed in university populations in Canada and Australia, where students failed to associate dietary diversity with vitamin D sufficiency (26,27). This suggests that even among health-oriented students, nutrition literacy specific to micronutrients remains a neglected component of professional education.

Attitudinal patterns in the current study were predominantly average (85%), indicating uncertainty and ambivalence toward practical measures for vitamin D maintenance. Students often expressed agreement that sun exposure was important yet demonstrated behavioral avoidance due to concerns related to cultural clothing, heat, and cosmetic preferences. Similar contradictions were identified in studies from China and Saudi Arabia, where female students, despite acknowledging sunlight’s benefits, avoided exposure due to sociocultural or climatic constraints (28,29). Such findings point toward complex psychosocial determinants that extend beyond knowledge acquisition, highlighting the influence of aesthetic norms, gendered expectations, and environmental discomfort in shaping health behaviors.

Practice behaviors in this study were notably inadequate. Less than one-quarter of participants demonstrated good practice, and only 14.2% reported daily outdoor walking. This aligns with research by Tariq et al. in Islamabad and Junaid et al. in Rawalpindi, which both reported infrequent supplementation and limited sunlight exposure among health science students (30,31). The persistent disconnect between theoretical understanding and implementation emphasizes the need for institutional-level interventions, such as curriculum-based behavioral modules, campus-based supplementation initiatives, or policy-driven fortification programs. From a biobehavioral standpoint, these findings underscore that knowledge does not linearly translate into preventive action, likely due to mediating factors such as perceived risk, environmental accessibility, and habitual behavior reinforcement.

The strength of this study lies in its large and focused sample drawn from multiple health disciplines, using a psychometrically validated instrument (D-KAP-38) to assess multidimensional aspects of knowledge, attitudes, and practices. The internal consistency (Cronbach’s $\alpha = 0.79$) and inclusion of a broad range of students enhance the reliability of inferences. Furthermore, by examining interdepartmental differences, this study provides novel evidence that educational background influences both cognitive and behavioral aspects of vitamin D awareness—medical and physical therapy students performed better in practice-related domains than pharmacy and nursing students, suggesting curricular exposure as a potential determinant.

However, certain limitations must be acknowledged. The cross-sectional design precludes causal inference, and self-reported responses may introduce recall and social desirability bias. Convenience sampling from a single institution may limit generalizability to other regions or to male students. Additionally, the study did not include biochemical validation of vitamin D status, which would have provided objective correlation with behavioral data. Nevertheless, these limitations do not detract from the internal validity of findings, which remain robust due to methodological consistency and sample adequacy.

Clinically, the results emphasize that future healthcare professionals—despite being educated in health sciences—require structured reinforcement of preventive practices concerning micronutrient health. Incorporating vitamin D awareness into the formal curriculum, promoting safe sunlight exposure strategies, and initiating institutional supplementation programs could bridge the gap between theoretical understanding and behavioral compliance. Future research should employ longitudinal or intervention-based designs to examine whether targeted educational interventions can sustainably modify attitudes and practices and ultimately improve serum vitamin D levels.

In conclusion, this study advances understanding of the behavioral determinants of vitamin D sufficiency in young female health professionals, reinforcing the importance of integrative educational and public health strategies to promote micronutrient health literacy and behavioral alignment across the healthcare education continuum (32).

CONCLUSION

The findings of this study reveal that although the majority of female undergraduate health care students at Peoples University of Medical and Health Sciences for Women possessed strong general knowledge regarding vitamin D, their nutritional awareness, attitudes, and practical behaviors were predominantly average, indicating a substantial knowledge–practice gap. This disparity underscores that awareness alone does not translate into preventive health behavior. Clinically, these results highlight the necessity for integrated educational interventions, including curriculum-based nutrition modules, sunlight exposure awareness programs, and institutionally supported supplementation initiatives to enhance vitamin D sufficiency among future healthcare professionals. From a research perspective, the outcomes provide a foundation for longitudinal and

interventional studies aimed at evaluating the efficacy of targeted behavioral and educational strategies in promoting sustainable vitamin D health practices within the healthcare education framework.

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