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Research Article

Vitamin D Deficiency and Its Relationship with Academic Performance among Medical Students: A Cross-Sectional Study from Nawabshah

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ABSTRACT

Background: Vitamin D deficiency has become a global health concern and is of increasing concern for healthcare providers. The limited knowledge about the importance of vitamin D supplements is one reason why it remains so common. Medical students often prioritize academic and clinical responsibilities during both their early and late years of MBBS, which increases their risk of deficiency due to poor lifestyle choices. **Materials and Methods:** This was a cross-sectional study involving 140 medical students aged 19-30, conducted over six months. A structured questionnaire collected data on demographic details, supplement use, physical activity, body mass index (BMI), and sun exposure, including the percentage of body surface area exposed. **Results**: 43 percent of participants were found to be vitamin D deficient, and 36 percent had levels below the recommended range. Deficiency was strongly associated with minimal daily sun exposure (less than 15 minutes). Additionally, a significant portion of students who reported adequate vitamin D levels also noted improved academic performance; about 80 percent of them reported better grades. **Conclusion**: Vitamin D deficiency is still very widespread among medical students, which is mostly caused by a sedentary lifestyle, unhealthy eating habits, insufficient intake of supplements, and a lack of sun exposure. Early intervention through dietary modification, increased awareness, supplementation, and food fortification strategies is essential to reduce long-term health risks in this population.

Keywords: Vitamin D deficiency, Medical students, Academic performance, Sun exposure, Lifestyle factors

INTRODUCTION

Although vitamin D deficiency is a global epidemic, most people are generally unaware of it [1], and it may be the reason for morbidity, death, and higher health care costs due to the associated chronic disorders [2]. Vitamin D has recently been associated with a lower risk of a number of chronic illnesses and ailments, including depression, diabetes, heart disease, breast cancer, and bone health [1,2]. Globally, vitamin D insufficiency is thought to affect one billion individuals [3]. Essential for maintaining healthy health, vitamin D is found naturally in fish and a few other foods and supplements. It is also created in vertebrates' skin after they are exposed to ultraviolet B light from the sun or artificial sources. When skin absorbs ultraviolet light B (UV-B), 7 7-dehydroxycholesterol is converted to vitamin D3 (cholecalciferol). It is biologically inert and needs to be activated by two hydroxylations in the body. The first one takes place in the liver and produces 25-hydroxyvitamin D [25(OH)D], which is also referred to as calciferol [4]. The production of 1,25-dihydroxyvitamin D [1,25(OH)2D], the physiologically active form of vitamin D3, either by the kidneys or by immune system monocyte-macrophages, is the main outcome of the second process. As a cytokine produced by monocyte-macrophages, calciferol protects the body from microbial invasions [5]. Sunshine vitamin [6] is another name for vitamin D. Around 80–100% of the vitamin D that the body needs can be obtained

through the skin, which has been identified as the primary source of vitamin D exposure [7, 8]. For about 3000 IU of vitamin D3, the arms and legs should be exposed to direct sunshine for 5 to 10 minutes (0.5 minimal erythemal dose of UVB wavelength 290 315 nm) [1]. There has been evidence of widespread prevalence hypovitaminosis in both rural and urban settings in all age categories, including toddlers, schoolchildren, men, women, the elderly, pregnant women, and their newborns [8], with the Middle East and South Asia having the greatest rates of severe deficiency [9]. Despite the Middle East's abundant annual sunshine (15°–36°N), it has one of the highest rates of vitamin D deficiency in the world. Rickets and vitamin D insufficiency are common in the Middle Eastern nations of Bahrain, Cyprus, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen [10,11]. Numerous studies from other Gulf or Arab nations show that vitamin D insufficiency (VDD) is very common, especially in women [12,13]. Environmental and socioeconomic variables contribute to the higher frequency of VDD in women than in men [14]. Adolescent girls in particular are at risk for osteoporosis in later life because of their unhealthy eating habits, lack of physical activity, avoidance of the sun, and low consumption of dairy products [15,16].

A research study conducted in Nawabshah, Pakistan, revealed that a significant number of young women, including medical students, have low vitamin D levels. This can be attributed to cultural beliefs about dressing conservatively, lack of exercise, use of sunscreen, and unhealthy dietary intake of foods rich in vitamin D. The study also investigated academic performance indicators and risk factors associated with vitamin D status. The study emphasizes the need to recognize how vitamin D affects the academic performance of medical students because it may affect their memory, attention, and learning ability. The research recommends specific intervention measures, such as awareness, nutrition education, and vitamin D supplementation intervention programs, to protect the health and educational prospects of future physicians and eventually make the healthcare delivery system in Pakistan.

METHODOLOGY

The research adopted a cross-sectional analytical research design to examine the association between vitamin D deficiency and academic performance among undergraduate medical students. It evaluated the prevalence of hypovitaminosis D, its relation with academic markers, and which lifestyle habits affected vitamin D levels and academic performance, which gives an understanding of the student well-being in medical education.

Study Duration

The study was carried out at the Peoples University of Medical and Health Sciences in Nawabshah, Pakistan, between March, 2025-December, 2025. The organized academic atmosphere and the heterogeneous nature of the students of the university provided the ability to conduct a controlled study about the correlation between health status and academic performance.

Sampling technique

The research was conducted among undergraduate medical students of the female gender aged between 19-30 years of PUMHSW, where convenience sampling was used. The ultimate sample was composed of 140 students, which was sufficient enough to carry out cross-sectional studies. The students in every academic year were included in the study to enable subgroup comparisons and to consider the differences in academic workload and sun exposure habits.

Ethical Review

The research was conducted in accordance with ethical standards and was ethically approved by the Ethical Review Committee of PUMHSW, and informed consent was obtained from the participants. The privacy of the data was ensured by using password-protected files and limited access to the research team. Students who were deficient in vitamin D were sent to be further managed and advised on supplementation.

RESULTS

The 140 medical students aged 19-30 were participated in this study (Tab 1) . Most of them are in their first year, and 65% of them live in cities. While a sizable percentage are overweight or obese, the majority have a normal BMI. Students' daily sun exposure for vitamin D synthesis varies; 40.7% spend 15 to 30 minutes in the sun, while 34.3% spend less than 15 minutes. The majority do not take vitamin D supplements, while only 22.9% do. The majority of students hardly ever apply sunscreen, 12.9% do so frequently, while 60.7% never do.

Table 1. General Characteristics of Study Participants (N = 140)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	19–21	56	40.0
	22–24	62	44.3
	25–30	22	15.7
Year of Study	1st Year	28	20.0
	2nd Year	30	21.4

	3rd Year	27	19.3
	4th Year	25	17.9
	Final Year	30	21.4
Residence	Urban	91	65.0
	Rural	49	35.0
BMI (Body Mass Index)	Underweight (<18.5)	18	12.9
	Normal (18.5–24.9)	85	60.7
	Overweight (25–29.9)	30	21.4
	Obese (≥30)	7	5.0
Sun Exposure (per day)	<15 minutes	48	34.3
	15–30 minutes	57	40.7
	>30 minutes	35	25.0
Vitamin D Supplement Use	Yes	32	22.9
	No	108	77.1
Sunscreen Usage	Regularly	18	12.9
	Occasionally	37	26.4
	Never	85	60.7

According to Figure 1, 43% of medical students suffer from a vitamin D deficiency, and 36% of students are vitamin D insufficient, both of which fall below the ideal range for preserving good health. Just 21% of students had adequate amounts of vitamin D, underscoring the need for greater education and initiatives to promote health.

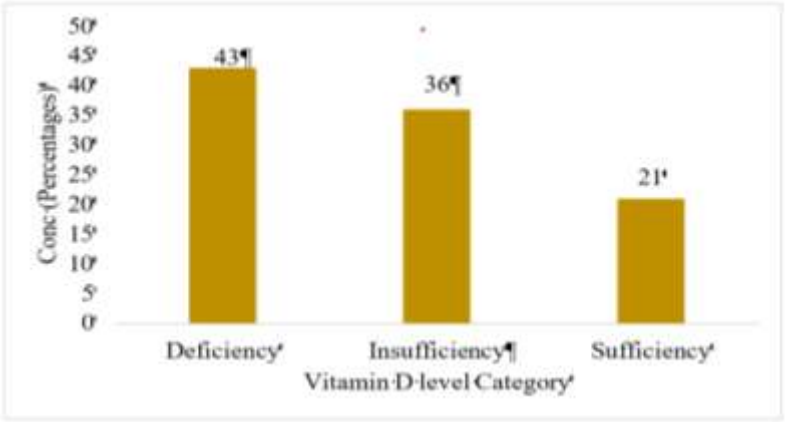

Figure 1. Distribution of Vitamin D Levels (Deficiency, Insufficiency, and Sufficiency)

According to table 2.0, vitamin D deficiency is common across a range of demographic and lifestyle parameters, with rates that are constant across age groups, place of residence, BMI, sunscreen application behaviors, sun exposure, and supplement use. While the 25–30 age group had a somewhat lower percentage of deficiency (41%), the 19–21 and 22–24 year olds displayed comparable percentages of deficiency (43%). There was no discernible difference in vitamin D deficiency by academic year; it was consistently high throughout all years. The greatest insufficiency was found in students who were exposed for less than 15 minutes each day (44%). The usage of vitamin D supplements was linked to a somewhat greater rate of insufficiency (44%).

Table 2. Vitamin D Deficiency, Insufficiency, and Sufficiency across Demographic and Lifestyle Factors among Medical Students

Characteristic	Category	Vitamin D ficiency (n=60)	Vitamin D fficiency (n=50)	Vitamin D fficiency (n=30)
Age (years)	19–21	24 (43%)	20 (36%)	12 (21%)
	22–24	27 (43%)	22 (35%)	13 (21%)
	25–30	9 (41%)	8 (36%)	5 (23%)
Year of Study	1st Year	12 (43%)	10 (36%)	6 (21%)
	2nd Year	13 (43%)	11 (37%)	6 (20%)
	3rd Year	12 (44%)	10 (37%)	5 (19%)
	4th Year	11 (44%)	9 (36%)	5 (20%)

	Final Year	13 (43%)	11 (37%)	6 (20%)
Residence	Urban	39 (43%)	33 (36%)	19 (21%)
	Rural	21 (43%)	17 (35%)	11 (22%)
BMI (Body Mass Index)	Underweight (<18.5)	8 (44%)	6 (33%)	4 (23%)
	Normal (18.5–24.9)	37 (44%)	31 (36%)	17 (20%)
	Overweight (25–29.9)	13 (43%)	11 (37%)	6 (20%)
	Obese (≥30)	3 (43%)	3 (43%)	1 (14%)
Sun Exposure (per day)	<15 minutes	21 (44%)	17 (35%)	10 (21%)
	15–30 minutes	25 (44%)	21 (37%)	11 (19%)
	>30 minutes	15 (43%)	12 (34%)	8 (23%)
Vitamin D Supplement Use	Yes	14 (44%)	12 (38%)	6 (19%)
	No	46 (43%)	39 (36%)	23 (21%)
Sunscreen Usage	Regularly	8 (44%)	6 (33%)	4 (23%)
	Occasionally	16 (43%)	13 (35%)	8 (22%)
	Never	37 (44%)	31 (36%)	17 (20%)

A total of 140 medical students in five academic years of study participated; details are shown in Figure 2.0.

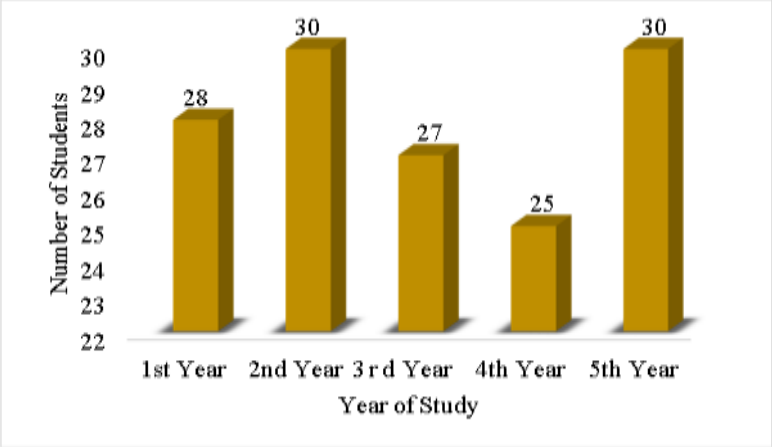

Figure 2. Distribution of Medical Students by Year (n=140)

The analysis of the study on vitamin D deficiency, insufficiency, and sufficiency among students indicates a trend of the same (Table 3.0). The deficiency was 42.9 percent, insufficiency was 35.7 percent, and adequacy was 21.4 percent during the first year. Twenty percent were sufficient, 36.7% were insufficient, and 43.3% were defective in the second year. The deficit percentage was lowest in the fourth year and highest in the third (44.4%).

Table 3. Vitamin D Status across different years of study in medical students

Year of Study	Deficiency (n=60)	Deficiency (%)	Insufficiency (n=50)	Insufficiency (%)	Sufficiency (n=30)	Sufficiency (%)
1st Year	12	42.9%	10	35.7%	6	21.4%
2nd Year	13	43.3%	11	36.7%	6	20.0%
3rd Year	12	44.4%	10	37.0%	5	18.5%
4th Year	11	44.0%	11	36.0%	5	20.0%
Final Year	12	43.3%	8	36.7%	9	20.0%

Table 4.0 shows that the study reveals students with vitamin D deficiency score below 60%, while those with sufficient levels score between 60-79%. However, a significant percentage achieve 80% or above, indicating a correlation between improved academic grades and increased vitamin D status.

Table 4. Distribution of Academic Grades According to Vitamin D Status among Medical Students

Vitamin D Status	Academic Grade	Frequency (n)	Percentage (%)
Deficient (<20 ng/mL)	<60% (Improve)	26	43.3%
	60–69% (Pass)	22	36.7%
	70–79% (Good)	9	15.0%
	≥80% (Excellent)	3	5.0%
Insufficient (20–30 ng/mL)	<60% (Improve)	8	16.0%
	60–69% (Pass)	18	36.0%
	70–79% (Good)	17	34.0%
	≥80% (Excellent)	7	14.0%
Sufficient (>30 ng/mL)	<60% (Improve)	2	6.7%
	60–69% (Pass)	5	16.7%
	70–79% (Good)	13	43.3%
	≥80% (Excellent)	10	33.3%

DISCUSSION

The study examined the correlation between Vitamin D deficiency and academic performance among medical students in Nawabshah, using demographic and lifestyle data to interpret the findings. The study involved 19-24-year-olds, 65% of whom lived in urban areas, which are known to have higher rates of vitamin D deficiency due to lifestyle and environmental factors. Nadeem et al.'s 2023 study on medical students in Karachi revealed that indoor academic lifestyles and urban living significantly predict low vitamin D levels [17].

The study found that 26.4%) of participants were overweight or obese, due to the storage of fat-soluble Vitamin D in adipose tissue. Obesity significantly reduces vitamin D levels due to sequestration, requiring higher doses or exposure to maintain adequate levels, according to a study by Wortsman et al. (2000) [18]. 34.3% of students in Nawabshah reported less than 15 minutes of sun exposure daily, indicating behavioral and academic factors may limit outdoor time. Nadeem et al. (2018) discovered that Karachi medical students' prolonged indoor academic hours significantly hindered their vitamin D synthesis through sunlight [19]. Although the deficiency of vitamin D is widespread, only 22.9% of medical students in South Asia stated that they take vitamin D supplements, which indicates that future health care professionals lack in preventive health behavior. H. Riaz et al (2016) study revealed that vitamin D deficiency is prevalent among healthy Pakistani adults due to inadequate supplementation and limited sun exposure, even in urban areas [20].

Vitamin D deficiency prevalence among medical students is consistent across all academic years, attributed to consistent academic workload and indoor learning environments, despite minimal variation across years. A study by Nadeem et al. (2018) Over 70% of Pakistani medical students are deficient in vitamin D due to limited sun exposure and demanding academic routines that keep them indoors most of the day [19].

The low vitamin D levels among medical students, ranging from 18.5% to 21.4%, indicate a gap between knowledge and practice, despite health literacy expectations, and a high prevalence in urban adults. Riaz et al (2016) found a high prevalence of vitamin D deficiency in health-conscious urban adults due to inadequate sunlight exposure and low supplementation rates [20].

The study revealed that final-year students have increased clinical exposure and health knowledge, but still have a deficiency rate (43.3%), similar to the juniors. Gimono et al. (2023) found that academic knowledge alone doesn't lead to preventive behaviors, especially regarding lifestyle-related nutrient deficiencies [21].

The study shows a significant correlation between vitamin D status and academic performance among medical students. Deficient students scored below 60%, while those with sufficient vitamin D had better academic performance, suggesting vitamin D may enhance cognitive function.

These results align with findings by Annweiler et al. (2015), who reported that vitamin D is crucial for brain function, promoting neuroprotection and regulating neurotrophic factors, which are vital for learning and memory consolidation [22]. Additionally, a study by Dalibalta et al. (2025) The study indicates that university students with higher serum vitamin D levels exhibit better cognitive performance and attention span, indicating a correlation between vitamin D status and academic success [23].

CONCLUSION

In conclusion, even with knowledge of the factors that contribute to vitamin D deficiency, prevention is still difficult. According to this study, deficiencies are quite common among young MBBS students of all ages, and they are caused by a number of factors that are made worse by a sedentary lifestyle and body-covering habits, such as vegetarian diets, poor nutrition, insufficient supplementation, little exercise, and little sun exposure. Prompt action should be taken through

improved food fortification, treatment for this deficiency, and dietary and lifestyle changes to prevent the negative effects of hypovitaminosis D on these young, healthy people in the future.

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