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Original Research Article

# Relationship Between Vitamin D Deficiency and Anxiety, Depression and Sleep Quality Among Young Adults: A Cross-Sectional Study

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**Abstract**

**Introduction:** Vitamin D is an essential fat-soluble hormone that plays a crucial role in maintaining calcium homeostasis, bone metabolism, immune regulation, and several neurobiological functions. In recent years, vitamin D has gained increasing attention due to its potential association with mental health outcomes, including anxiety, depression, and sleep disturbances.

**Aims:** To assess the relationship between vitamin D deficiency and the levels of anxiety, depression, and sleep quality among young adults. To evaluate the association between serum vitamin D status and psychological well-being parameters in young adults.

**Materials & Methods:** This cross-sectional study was conducted in the Department of Psychiatry, JIS Medical College and Hospital, Ludhiana, over a period of one year. A total of 100 patients were included in the study.

**Result:** The distribution of study participants according to vitamin D status showed that among 100 participants, 45 (45%) were vitamin D deficient (<20 ng/mL), 30 (30%) had vitamin D insufficiency (20–29 ng/mL), and 25 (25%) had sufficient vitamin D levels (≥30 ng/mL). The difference in vitamin D status distribution was statistically significant ($p = 0.003$).

**Conclusion:** We concluded that vitamin D deficiency is significantly associated with increased anxiety, depressive symptoms, and poor sleep quality among young adults. In this cross-sectional study of 100 participants, individuals with deficient vitamin D levels demonstrated higher levels of anxiety and depression compared to participants with sufficient vitamin D status.

**Keywords:** Vitamin D deficiency, Anxiety, Depression, Sleep quality, Young adults, GAD-7, PHQ-9, Pittsburgh Sleep Quality Index (PSQI).

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## Introduction

Vitamin D is an essential fat-soluble hormone that plays a crucial role in maintaining calcium homeostasis, bone metabolism, immune regulation, and several neurobiological functions. In recent years, vitamin D has gained increasing attention due to its potential association with mental health outcomes, including anxiety, depression, and sleep disturbances. Vitamin D receptors and vitamin D metabolizing enzymes are widely distributed throughout the brain, particularly in areas involved in mood regulation, such as the hippocampus, hypothalamus, and prefrontal cortex, suggesting a possible role of vitamin D in psychological well-being [1].Vitamin D deficiency has become a global public health concern, affecting individuals across different age groups, including young adults. Despite adequate sunlight availability in many regions, lifestyle changes, indoor activities, limited sun exposure, dietary insufficiency, and environmental factors have contributed to an increased prevalence of vitamin D deficiency among young populations [2]. Young adulthood represents a critical period characterized by academic, occupational, and social stressors, which may increase vulnerability to psychological disorders. Anxiety and depression are among the

most common mental health conditions affecting young adults and are associated with reduced quality of life, impaired academic and professional performance, and increased risk of long-term health consequences [3]. The relationship between vitamin D deficiency and depression has been investigated extensively, with several studies suggesting that lower serum vitamin D levels may be associated with increased depressive symptoms. Vitamin D may influence mood through multiple mechanisms, including modulation of inflammatory pathways, regulation of neurotransmitters such as serotonin and dopamine, and effects on neuroplasticity [4]. Inadequate vitamin D levels have also been linked with increased anxiety symptoms, although the exact biological mechanisms remain under investigation [5]. Sleep quality is another important determinant of physical and psychological health. Poor sleep is common among young adults due to irregular sleep schedules, excessive screen exposure, stress, and lifestyle-related factors. Vitamin D has been proposed to influence sleep regulation through its involvement in melatonin production, circadian rhythm modulation, and inflammatory control. Studies have reported associations between vitamin D deficiency and poor sleep quality, shorter sleep duration, and increased sleep disturbances [6].

## Materials and Methods

**Type of Study:** A Cross-Sectional Study.

**Place of Study:** Department of Psychiatry, JIS Medical College and Hospital, Ludhiana.

**Study Duration:** 1 Year.

**Sample Size:** 100 Patients.

### Inclusion Criteria

- Young adults aged 18–40 years of either gender.
- Participants willing to participate and provide written informed consent.
- Individuals undergoing assessment of serum vitamin D (25-hydroxy vitamin D) levels.
- Participants available for evaluation of anxiety, depression, and sleep quality using standardized tools (GAD-7, PHQ-9, and PSQI).
- Individuals without any acute illness at the time of study.

### Exclusion Criteria

- Participants with known psychiatric disorders or currently receiving psychiatric treatment.
- Individuals taking vitamin D supplements or medications affecting vitamin D metabolism.
- Patients with chronic medical illnesses such as chronic kidney disease, liver disease, endocrine disorders, or malignancy.
- Pregnant women and lactating mothers.
- Individuals with substance abuse or alcohol dependence.
- Participants unwilling to provide consent or incomplete data collection.

### Study Variables

- Vitamin D status
- Deficient: <20 ng/mL
- Insufficient: 20–29 ng/mL
- Sufficient: ≥30 ng/Ml
- Anxiety level
- Depression level (PHQ-9 score)
- Sleep quality

**Statistical Analysis:** Data were entered into Excel and subsequently analyzed using SPSS and GraphPad Prism. Continuous variables were summarized as means with standard deviations, while categorical variables were presented as counts and percentages. Comparisons between independent groups were performed using two-sample t-tests, and paired t-tests were applied for correlated (paired) data. Categorical data were compared using chi-square tests, with Fisher's exact test applied when expected cell counts were small. A p-value of $\leq 0.05$ was considered statistically significant.

## Result

**Table 1: Distribution of Study Participants According to Vitamin D Status**

| Vitamin D Status | Frequency | Percentage (%) | P-value |
|---|---|---|---|
| Deficient (<20 ng/mL) | 45 | 45 | 0.0030 |
| Insufficient (20–29 ng/mL) | 30 | 30 | |
| Sufficient (≥30 ng/mL) | 25 | 25 | |
| Total | 100 | 100 | |

**Table 2: Association between Vitamin D Status and Anxiety Level (GAD-7 Score)**

| Vitamin D Status | Minimal Anxiety | Mild Anxiety | Moderate Anxiety | Severe Anxiety | P-value |
|---|---|---|---|---|---|
| Deficient | 8 (17.8%) | 20 (44.4%) | 13 (28.9%) | 4 (8.9%) | 0.023 |
| Insufficient | 12 (40.0%) | 12 (40.0%) | 5 (16.7%) | 1 (3.3%) | |
| Sufficient | 18 (72.0%) | 6 (24.0%) | 1 (4.0%) | 0 (0%) | |

**Table 3: Association between Vitamin D Status and Depression Level (PHQ-9 Score)**

| Vitamin D Status | No Depression | Mild n | Moderate | Moderately Severe/Severe | P-value |
|---|---|---|---|---|---|
| Deficient | 10 (22.2%) | 19 (42.2%) | 12 (26.7%) | 4 (8.9%) | 0.031 |
| Insufficient | 14 (46.7%) | 10 (33.3%) | 5 (16.7%) | 1 (3.3%) | |
| Sufficient | 20 (80.0%) | 4 (16.0%) | 1 (4.0%) | 0 (0%) | |

**Table 4: Association between Vitamin D Status and Sleep Quality (PSQI Score)**

| Vitamin D Status | Good Sleep Quality | Poor Sleep Quality | P-value |
|---|---|---|---|
| Deficient | 15 (33.3%) | 30 (66.7%) | 0.005 |
| Insufficient | 16 (53.3%) | 14 (46.7%) | |
| Sufficient | 19 (76.0%) | 6 (24.0%) | |

**Table 5: Correlation between Vitamin D Level and Anxiety, Depression & Sleep Scores**

| Variables | Correlation coefficient (r) | p-value |
|---|---|---|
| Vitamin D vs GAD-7 Anxiety Score | -0.42 | <0.001 |
| Vitamin D vs PHQ-9 Depression Score | -0.38 | <0.001 |
| Vitamin D vs PSQI Sleep Score | -0.35 | 0.001 |

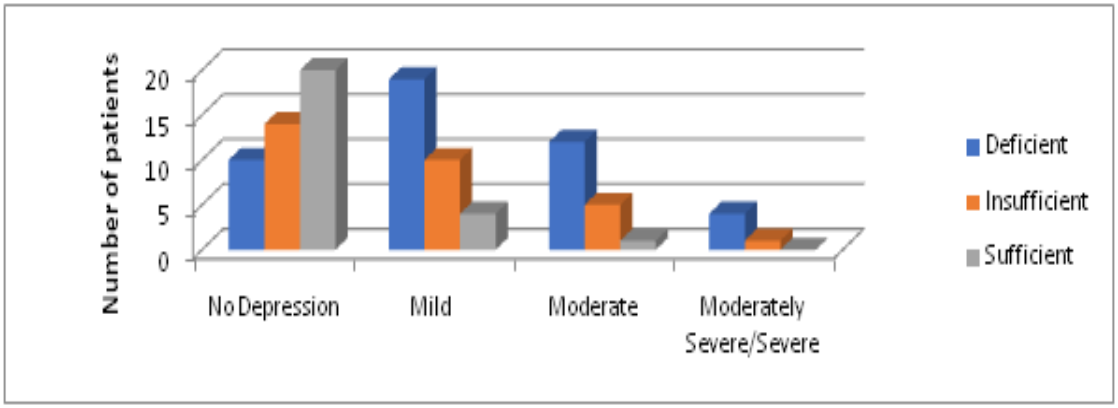


**Figure 1: Association between Vitamin D Status and Depression Level (PHQ-9 Score)**

The present cross-sectional study included a total of 100 young adults to assess the relationship between vitamin D status and anxiety, depression, and sleep quality. The distribution of study participants according to vitamin D status showed that among 100 participants, 45 (45%) were vitamin D deficient (<20 ng/mL), 30 (30%) had vitamin D insufficiency (20–29 ng/mL), and 25 (25%) had sufficient vitamin D levels (≥30 ng/mL). The difference in vitamin D status distribution was statistically significant (p = 0.003). The association between vitamin D status and anxiety level assessed by GAD-7 score revealed that among 45 vitamin D-deficient participants, 8 (17.8%) had minimal anxiety, 20 (44.4%) had mild anxiety, 13 (28.9%) had moderate anxiety, and 4 (8.9%) had severe anxiety.

Among 30 vitamin D-insufficient participants, 12 (40%) had minimal anxiety, 12 (40%) had mild anxiety, 5 (16.7%) had moderate anxiety, and 1 (3.3%) had severe anxiety. Among 25 participants with sufficient vitamin D, 18 (72%) had minimal anxiety, 6 (24%) had mild anxiety, and only 1 (4%) had moderate anxiety, with no severe anxiety cases. The association was statistically significant (p = 0.023). The relationship between vitamin D status and depression level assessed by PHQ-9 score showed that among 45 vitamin D-deficient participants, 10 (22.2%) had no depression, 19 (42.2%) had mild depression, 12 (26.7%) had moderate depression, and 4 (8.9%) had moderately severe/severe depression. Among 30 vitamin D-insufficient participants, 14 (46.7%) had no depression, 10 (33.3%) had mild depression, 5 (16.7%) had moderate depression, and 1 (3.3%) had moderately severe/severe depression. Among 25 vitamin D-sufficient participants, 20 (80%) had no depression, 4 (16%) had mild depression, and 1 (4%) had moderate depression. This association was statistically significant (p = 0.031).

The association between vitamin D status and sleep quality assessed using PSQI score showed that among 45 vitamin D-deficient participants, 15 (33.3%) had good sleep quality and 30 (66.7%) had poor sleep quality. Among 30 participants with insufficient vitamin D, 16 (53.3%) had good sleep quality and 14 (46.7%) had poor sleep quality. Among 25 participants with sufficient vitamin D, 19 (76%) had good sleep quality and only 6 (24%) had poor sleep quality. The difference in sleep quality according to vitamin D status was statistically significant (p = 0.005). Correlation

analysis among 100 participants showed that vitamin D level had a significant negative correlation with anxiety score ($r = -0.42$, $p < 0.001$), depression score ($r = -0.38$, $p < 0.001$), and PSQI sleep score ($r = -0.35$, $p = 0.001$). This indicates that lower vitamin D levels were associated with increased anxiety, depressive symptoms, and poorer sleep quality.

## Discussion

The present cross-sectional study was conducted among 100 young adults to assess the relationship between vitamin D status and anxiety, depression, and sleep quality. The findings demonstrated that vitamin D deficiency was significantly associated with increased anxiety symptoms, depressive symptoms, and poor sleep quality among the study participants. In the present study, among 100 participants, 45 (45%) were vitamin D deficient (<20 ng/mL), 30 (30%) had vitamin D insufficiency (20–29 ng/mL), and 25 (25%) had sufficient vitamin D levels (≥30 ng/mL). The difference in vitamin D status distribution was statistically significant ($p = 0.003$). Similar observations were reported by Anglin et al. [4], who found that vitamin D deficiency was common and was associated with increased risk of depressive symptoms. The high proportion of vitamin D deficiency in the present study suggests that inadequate vitamin D status is prevalent among young adults. The association between vitamin D status and anxiety assessed using the GAD-7 scale showed that among 45 vitamin D-deficient participants, 20 (44.4%) had mild anxiety, 13 (28.9%) had moderate anxiety, and 4 (8.9%) had severe anxiety. In comparison, among 25 participants with sufficient vitamin D levels, 18 (72%) had minimal anxiety, 6 (24%) had mild anxiety, and only 1 (4%) had moderate anxiety, with no severe anxiety cases. The association was statistically significant ($p = 0.023$). Similar findings were reported by Kerr et al. [7], who observed that individuals with lower vitamin D levels had increased anxiety symptoms, suggesting a possible role of vitamin D in regulation of mood and emotional health. Regarding depression assessed using the PHQ-9 scale, the present study found that among 45 vitamin D-deficient participants, 19 (42.2%) had mild depression, 12 (26.7%) had moderate depression, and 4 (8.9%) had moderately severe/severe depression. Among 25 vitamin D-sufficient participants, 20 (80%) had no depression, while only 4 (16%) had mild depression and 1 (4%) had moderate depression. This association was statistically significant ($p = 0.031$). These findings are consistent with the study by Lerner et al. [8], who reported an inverse association between serum vitamin D concentration and depressive symptoms. The presence of vitamin D receptors in the brain and its role in neuroinflammation and neurotransmitter regulation may explain this relationship. The present study also demonstrated a significant association between vitamin D status and sleep quality assessed by PSQI score. Among 45 vitamin D-deficient participants, 30 (66.7%) had poor sleep quality, whereas among 25 participants with sufficient vitamin D levels, only 6 (24%) had poor sleep quality. The difference was statistically significant ($p = 0.005$). Similar findings were reported by Gao et al. [9], who found that vitamin D deficiency was associated with increased risk of sleep disturbances and poor sleep quality. Vitamin D may influence sleep through effects on melatonin secretion, inflammatory mediators, and circadian rhythm regulation. Correlation analysis among all 100 participants showed that vitamin D level had a significant negative correlation with anxiety score ($r = -0.42$, $p < 0.001$), depression score ($r = -0.38$, $p < 0.001$), and PSQI sleep score ($r = -0.35$, $p = 0.001$). This indicates that lower vitamin D levels were associated with greater anxiety, depressive symptoms, and impaired sleep quality. Similar results were reported by Hosseini et al. [10], who demonstrated that vitamin D deficiency was associated with psychological distress and sleep-related problems. Present study involving 100 young adults indicate that vitamin D deficiency is significantly associated with adverse mental health outcomes and poor sleep quality. Screening for vitamin D deficiency and maintaining adequate vitamin D levels may be beneficial as a supportive approach for improving psychological well-being and sleep quality. However, as this was a cross-sectional study, further longitudinal studies are required to establish a causal relationship. Arabshahi V et al [11] showed that a study investigated the relationship between dietary vitamin D intake and the risk of mental health disorders, including depression, anxiety, and sleep problems, among physically active Iranian adults. The findings showed that vitamin D intake was not significantly associated with depression risk; however, higher vitamin D consumption was linked with a lower risk of anxiety and sleep disorders. Participants with the highest vitamin D intake had 49% lower risk of anxiety and 46% lower risk of sleep disorders compared to those with the lowest intake. The study concluded that adequate dietary vitamin D may have a protective role against anxiety and sleep disturbances, while further prospective studies are needed to confirm these findings.

## Conclusion

We concluded that vitamin D deficiency is significantly associated with increased anxiety, depressive symptoms, and poor sleep quality among young adults. In this cross-sectional study of 100 participants, individuals with deficient vitamin D levels demonstrated higher levels of

anxiety and depression compared to participants with sufficient vitamin D status. Poor sleep quality was also more commonly observed among vitamin D-deficient individuals, indicating a possible relationship between vitamin D status and sleep disturbances. The significant negative correlations between vitamin D levels and anxiety, depression, and sleep scores suggest that reduced vitamin D levels may contribute to adverse psychological and sleep-related outcomes. These findings emphasize the importance of maintaining adequate vitamin D levels for overall mental health and sleep well-being in young adults. Screening for vitamin D deficiency along with lifestyle modification, adequate sunlight exposure, and appropriate supplementation may help improve psychological health outcomes. Further prospective studies are required to confirm the causal relationship between vitamin D deficiency and mental health conditions.

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