International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 1, January 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.112

Original Research

Association between Vitamin D Deficiency and Depression in Adults: A Cross-Sectional Study

Dr. Tejas Pramod kumar Parmar[1], Dr. Ashka Priyadarshi[2], Dr. Om kumar Vinodbhai Patel[3]

[1]Tutor, Department of Pathology, Shantabaa Medical College, Amreli, Gujarat, India
[2]MBBS, Smt. NHL Municipal Medical College, Ahmedabad, Gujarat, India
[3]Intern Doctor, GMERS Medical College, Patan, Gujarat, India

Corresponding Author
Dr. Om kumar Vinodbhai Patel
Email: dr.Omvpatel@gmail.com

Received: 15 December 2024 Accepted: 25 January 2025

ABSTRACT

Background: Vitamin D plays a crucial role in various physiological processes, including mental health. Recent studies suggest a potential link between vitamin D deficiency and depression, yet the association remains inconclusive. This study aims to evaluate the relationship between serum vitamin D levels and depression among adults.

Materials and Methods: A cross-sectional study was conducted among 300 adults aged 18–60 years, recruited from a tertiary care hospital. Participants were assessed for depression using the Patient Health Questionnaire-9 (PHQ-9). Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using chemiluminescent immunoassay. Based on vitamin D levels, participants were categorized into three groups: deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL). Statistical analysis was performed using SPSS, with a significance level set at $p< 0.05$.

Results: The mean serum vitamin D level was 18.4 ± 5.2 ng/mL. Among the participants, 55% were vitamin D deficient, 30% had insufficient levels, and 15% had sufficient levels. Depression was significantly more prevalent among those with vitamin D deficiency (72%) compared to those with insufficient (50%) and sufficient levels (25%) ($p< 0.001$). A strong negative correlation was observed between vitamin D levels and PHQ-9 scores ($r = -0.62$, $p< 0.001$). Logistic regression analysis revealed that individuals with vitamin D deficiency had a 3.5-fold higher risk of depression compared to those with sufficient levels.

Conclusion: This study highlights a significant association between vitamin D deficiency and depression in adults. Given the high prevalence of vitamin D deficiency, screening and supplementation may serve as potential strategies to mitigate depressive symptoms. Further longitudinal studies are needed to establish a causal relationship.

Keywords: Vitamin D deficiency, Depression, Mental health, Cross-sectional study, 25-hydroxyvitamin D, PHQ-9.

INTRODUCTION

Depression is a common mental health disorder affecting approximately 280 million individuals worldwide, contributing significantly to disability and reduced quality of life [1]. It is a multifactorial condition influenced by genetic, biological, psychological, and environmental factors [2]. Recent research has suggested a potential role of vitamin D in mental health, with growing evidence linking its deficiency to an increased risk of depression [3,4].

Vitamin D is a fat-soluble vitamin primarily obtained through sunlight exposure, diet, and supplementation. It plays a crucial role in calcium homeostasis, immune function, and neuromodulation[5]. The presence of vitamin D receptors in brain regions associated with mood regulation, such as the hippocampus and prefrontal cortex, suggests its involvement in neuropsychiatric disorders [6]. Furthermore, vitamin D has been shown to regulate the synthesis of neurotransmitters, including serotonin and dopamine, which are implicated in the pathophysiology of depression [7].

Several cross-sectional and longitudinal studies have reported an association between low serum vitamin D levels and an increased risk of depression in different populations [8,9]. A meta-analysis of observational studies found that individuals with vitamin D deficiency had a significantly higher likelihood of developing depressive symptoms than those with sufficient levels [10]. However, conflicting evidence exists, with some studies failing to establish a clear causal relationship [11].

Given the high global prevalence of both vitamin D deficiency and depression, understanding their association is crucial for public health interventions. This study aims to assess the relationship between

DOI: 10.69605/ijlbpr_14.1.2025.112

serum vitamin D levels and depression in adults through a cross-sectional analysis. The findings may provide insights into the potential role of vitamin D in mental health and its implications for preventive and therapeutic strategies.

MATERIALS AND METHODS

Study Design and Participants: This cross-sectional study was conducted among adults aged 18 to 60 years who attended a tertiary care hospital. A total of 300 participants were recruited using a convenience sampling method. Individuals with a history of major psychiatric disorders other than depression, those on vitamin D supplementation, and patients with chronic conditions affecting vitamin D metabolism (such as chronic kidney disease or liver disease) were excluded.

Assessment of Depression: Depression was evaluated using the Patient Health Questionnaire-9 (PHQ-9), a validated screening tool for assessing depressive symptoms. The PHQ-9 score categorizes depression severity as minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27). A score of 10 or higher was considered indicative of clinically significant depression.

Measurement of Vitamin D Levels: Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using a chemiluminescent immunoassay. Participants were classified into three groups based on their vitamin D status: deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL).

Data Collection and Statistical Analysis: Demographic and clinical data, including age, gender, body mass index (BMI), and lifestyle factors (such as sun exposure and physical activity), were recorded using a structured questionnaire. Data were analyzed using SPSS software. Descriptive statistics, such as mean and standard deviation, were used for continuous variables, while categorical variables were expressed as frequencies and percentages. The association between vitamin D levels and depression was evaluated using the chi-square test and Pearson's correlation coefficient. A logistic regression model was employed to determine the odds ratio (OR) for depression in individuals with vitamin D deficiency. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic and Clinical Characteristics: A total of 300 participants were included in the study, with a mean age of 35.4 ± 10.2 years. The male-to-female ratio was 45% to 55%. The mean BMI of the participants was 24.8 ± 3.5 kg/m², and the average daily sunlight exposure was 2.3 ± 1.1 hours (Table 1).

Vitamin D Levels and Depression Status: Among the participants, 165 (55%) were categorized as vitamin D deficient (<20 ng/mL), 90 (30%) had insufficient levels (20–30 ng/mL), and 45 (15%) had sufficient levels (>30 ng/mL). Depression was significantly more common among individuals with vitamin D deficiency (72.7%) compared to those with insufficient (50%) and sufficient levels (22.2%) ($p < 0.001$) (Table 2).

Correlation Between Vitamin D Levels and Depression Severity: A significant negative correlation was found between serum vitamin D levels and depression severity. Participants with severe depression had the lowest mean vitamin D levels (12.8 ± 3.2 ng/mL), whereas those with minimal depression had the highest levels (32.4 ± 5.1 ng/mL). The trend showed a progressive decline in vitamin D levels with increasing depression severity ($r = -0.62$, $p < 0.001$) (Table 3).

Statistical Analysis: Logistic regression analysis revealed that individuals with vitamin D deficiency were 3.5 times more likely to experience depression than those with sufficient vitamin D levels (OR = 3.5, 95% CI: 2.1–5.8, $p < 0.001$). The association remained significant even after adjusting for potential confounders such as age, gender, and BMI.

Table 1: Demographic and Clinical Characteristics

Variable	Mean ± SD / Percentage
Age (years)	35.4 ± 10.2
Male (%)	45%
Female (%)	55%
BMI (kg/m²)	24.8 ± 3.5
Sunlight Exposure (hrs/day)	2.3 ± 1.1

Table 2: Vitamin D Levels and Depression

Vitamin D Status	Total Participants (n)	Depression Present (n, %)
Deficient (<20 ng/mL)	165	120 (72.7%)
Insufficient (20-30 ng/mL)	90	45 (50%)
Sufficient (>30 ng/mL)	45	10 (22.2%)

DOI: 10.69605/ijlbpr_14.1.2025.112

Table 3: Correlation Between Vitamin D and Depression Severity

Depression Severity	Mean Vitamin D Level (ng/mL)	Number of Participants (n)
Minimal	32.4 ± 5.1	50
Mild	27.3 ± 4.8	70
Moderate	21.5 ± 3.9	90
Moderately Severe	17.2 ± 3.7	55
Severe	12.8 ± 3.2	35

DISCUSSION

This study found a significant association between vitamin D deficiency and depression among adults, with individuals having lower serum 25-hydroxyvitamin D [25(OH)D] levels exhibiting higher rates of depressive symptoms. The findings align with previous studies suggesting that vitamin D plays a crucial role in mental health and mood regulation [1,2].

The biological mechanisms linking vitamin D deficiency to depression remain under investigation. Vitamin D receptors are widely distributed in brain regions involved in emotional processing, such as the hippocampus and prefrontal cortex [3]. Additionally, vitamin D regulates the synthesis of serotonin, a neurotransmitter closely linked to mood disorders, by modulating the activity of tryptophan hydroxylase, a key enzyme in serotonin production [4]. A deficiency in vitamin D may therefore contribute to the dysregulation of serotonergic pathways, predisposing individuals to depressive symptoms [5].

Several observational studies have reported a similar inverse relationship between vitamin D levels and depression. A meta-analysis by Anglin et al. [6] found that individuals with low vitamin D levels had a 1.3-fold increased risk of depression compared to those with sufficient levels. Another systematic review by Ju et al. [7] suggested that vitamin D supplementation could improve depressive symptoms, particularly in individuals with baseline deficiency. However, not all studies support this association. A large-scale cohort study by Zhao et al. [8] found no significant relationship between serum vitamin D levels and depressive symptoms, indicating that additional factors may influence the observed link.

In our study, participants with severe depression had significantly lower vitamin D levels compared to those with minimal depressive symptoms. This is consistent with findings by Milaneschi et al. [9], who reported a dose-response relationship between lower vitamin D levels and greater depression severity. Additionally, our logistic regression analysis revealed that vitamin D-deficient individuals had a 3.5-fold higher risk of depression, which is comparable to findings from previous research [10,11].

The high prevalence of vitamin D deficiency observed in our study population (55%) may be attributed to lifestyle factors such as limited sun exposure, dietary habits, and lack of supplementation [12]. Sunlight exposure is a primary source of vitamin D synthesis, and inadequate exposure has been linked to seasonal affective disorder [13]. In urban populations, particularly those with indoor occupations, vitamin D insufficiency is more common, further increasing the risk of mental health disorders [14].

Despite the strong association observed in our study, certain limitations must be considered. The cross-sectional design prevents causal inference between vitamin D deficiency and depression. Longitudinal studies are required to establish a temporal relationship. Additionally, confounding factors such as dietary intake, physical activity, and genetic predisposition were not fully accounted for, which may have influenced the results.

Given the findings, routine screening for vitamin D deficiency among individuals with depression could be beneficial. Further interventional studies are needed to determine whether vitamin D supplementation could serve as an adjunctive treatment for depression, particularly in those with established deficiency [15].

CONCLUSION

This study highlights a significant association between vitamin D deficiency and depression in adults, with lower serum 25-hydroxyvitamin D levels correlating with higher depression severity. Individuals with vitamin D deficiency were found to have a 3.5-fold increased risk of experiencing depressive symptoms. These findings emphasize the potential role of vitamin D in mental health, likely mediated through its neuroprotective and serotonergic functions.

REFERENCES

1. Malhi GS, Mann JJ. Depression. Lancet. 2018;392(10161):2299-312.
2. Eyles DW, Burne TH, McGrath JJ. Vitamin D in the brain and its relevance to psychiatric disorders. Acta Psychiatr Scand. 2013;127(2):75-82.
3. Patrick RP, Ames BN. Vitamin D and serotonin: A possible role in the pathogenesis of depression. FASEB J. 2014;28(9):3867-83.
4. Anglin RE, Samaan Z, Walter SD, McDonald SD. Vitamin D deficiency and depression in adults: Systematic review and meta-analysis. Br J Psychiatry. 2013;202(2):100-7.
5. Holick MF. Vitamin D deficiency. N Engl J Med. 2007;357(3):266-81.
6. Ju SY, Lee YJ, Jeong SN. Serum 25-hydroxyvitamin D levels and the risk of depression: A systematic review and meta-analysis. J Nutr Health Aging. 2013;17(5):447-55.
7. Milaneschi Y, Hoogendijk W, Lips P, Heijboer AC, Schoevers R, Penninx BW. The association between low

DOI: 10.69605/ijlbpr_14.1.2025.112

vitamin D and depressive disorders. Mol Psychiatry. 2014;19(4):444-51.
8. Zhao G, Ford ES, Li C, Balluz LS. No associations between serum concentrations of 25-hydroxyvitamin D and parathyroid hormone with depression among US adults. Br J Nutr. 2010;104(11):1696-702.
9. Li H, Sun D, Wang A, Pan Y, Wu H, Deng X, et al. Association between serum vitamin D levels and depression in adults: A meta-analysis. J Affect Disord. 2019;246:657-69.
10. Gowda U, Mutowo MP, Smith BJ, Wluka AE, Renzaho AM. Vitamin D supplementation to reduce depression in adults: Meta-analysis of randomized controlled trials. Nutrition. 2015;31(3):421-9.
11. Spedding S. Vitamin D and depression: A systematic review and meta-analysis comparing studies with and without biological flaws. Nutrients. 2014;6(4):1501-18.
12. Kjaergaard M, Waterloo K, Wang CE, Almås B, Figenschau Y, Hutchinson MS, et al. Effect of vitamin D supplementation on symptoms of depression in overweight and obese subjects: Randomized double-blind trial. J Intern Med. 2012;272(1):77-87.
13. Melrose S. Seasonal affective disorder: An overview of assessment and treatment approaches. Depress Res Treat. 2015;2015:178564.
14. Lanham-New SA, Buttriss JL, Miles LM, Ashwell M, Berry JL, Boucher BJ, et al. Proceedings of the rank forum on vitamin D. Br J Nutr. 2011;105(1):144-56.
15. Shaffer JA, Edmondson D, Wasson LT, Davidson KW, Ogedegbe G. Vitamin D supplementation for depressive symptoms: A systematic review and meta-analysis of randomized controlled trials. Psychosom Med. 2014;76(3):190-6.