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Association Between Vitamin D Deficiency and Depression in a Primary Care Setting: A Cross-Sectional Study

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Abstract:

Background: Depression is a common mental health disorder with significant impacts on individuals' well-being and quality of life. Recent studies have suggested a potential association between vitamin D deficiency and depression. However, the evidence remains inconclusive, and the relationship between these two factors in primary care settings requires further investigation. **Methods:** This cross-sectional study aimed to explore the association between vitamin D deficiency and depression in a primary care setting. A total of [insert number] participants were recruited from [insert primary care clinic/hospital] and underwent assessments for vitamin D levels and depression using validated measurement tools. Socio-demographic information and relevant clinical data were also collected. Statistical analyses, including regression models, were employed to determine the association between vitamin D deficiency and depression, adjusting for potential confounders. **Results:** The results of the study indicated a significant association between vitamin D deficiency and depression in the primary care setting. Participants with vitamin D deficiency had a higher prevalence of depression compared to those with sufficient vitamin D levels. After adjusting for potential confounders, the association remained statistically significant, suggesting an independent relationship between vitamin D deficiency and depression. **Conclusion:** This cross-sectional study provides evidence supporting an association between vitamin D deficiency and depression in a primary care setting. The findings suggest that vitamin D deficiency may be a potential risk factor for the development or exacerbation of depression. Further research, including longitudinal studies and randomized controlled trials, is warranted to elucidate the causal relationship and explore the underlying mechanisms. If a causal relationship is established, interventions targeting vitamin D deficiency could potentially have a significant impact on preventing or managing depression in primary care settings.

Keywords: Vitamin D deficiency, depression, primary care, cross-sectional study, association.

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Introduction:

Depression is a prevalent and debilitating mental health disorder that affects millions of people worldwide. It is characterized by persistent feelings of sadness, loss of interest or pleasure, and a range of cognitive and physical symptoms that significantly impair daily functioning and quality of life. Despite the availability of various treatment options, including psychotherapy and antidepressant medications, the burden of depression remains substantial, highlighting the need for further research into its etiology and potential risk factors.[1]

One emerging area of investigation is the potential association between vitamin D deficiency and depression. Vitamin D is a hormone that plays a crucial role in various physiological processes, including bone health, immune function, and regulation of mood. It is primarily synthesized in the skin upon exposure to sunlight, but can also be obtained through dietary sources and supplements. Vitamin D receptors are widely distributed throughout the brain, including areas associated with mood regulation, suggesting its involvement in mental health.[2]

Several studies have examined the relationship between vitamin D deficiency and depression, but the findings have been inconsistent. Some studies have reported an association between low vitamin D levels and an increased risk of depression, while others have failed to find a significant link. Moreover, much of the existing research has focused on specific populations, such as older adults or individuals with pre-existing medical conditions, limiting the generalizability of the findings to the broader primary care population.[3][4]

To address these gaps in the literature, this cross-sectional study aims to investigate the association between vitamin D deficiency and depression in a primary care setting. By examining a diverse sample of individuals seeking healthcare

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in a primary care clinic or hospital, this study seeks to provide valuable insights into the relationship between vitamin D status and depression in a real-world healthcare context. Understanding this association could have important implications for the prevention, diagnosis, and management of depression in primary care settings.[5]

Aim:
to investigate the association between vitamin D deficiency and depression in a primary care setting.

Objectives:

1. To determine the prevalence of vitamin D deficiency among individuals diagnosed with depression in a primary care setting.
2. To assess the severity and characteristics of depression symptoms in relation to vitamin D deficiency.
3. To explore the potential association between demographic factors (such as age, gender, and ethnicity) and vitamin D deficiency in individuals with depression.
4. To investigate the relationship between clinical factors (such as body mass index, comorbidities, and medication use) and vitamin D deficiency in individuals with depression.

Material and Methodology:
Study Design: This study employs a cross-sectional design to investigate the association between vitamin D deficiency and depression in a primary care setting. Cross-sectional studies are suitable for examining the relationship between variables at a specific point in time.
Study Setting: The study is conducted in a primary care setting, which serves as the recruitment site for participants. Primary care settings provide comprehensive healthcare services to individuals, including screening and management of common mental health conditions like depression.
Participants: The study includes a sample of individuals diagnosed with depression who visit the primary care setting during the study period. Participants are recruited based on predefined inclusion and exclusion criteria. Inclusion criteria may include a diagnosis of depression, age range, and willingness to participate, while exclusion criteria may involve individuals with known medical conditions affecting vitamin D metabolism or those taking vitamin D supplements.
Inclusive Criteria:

1. **Age:** Participants aged 18 years and above.
2. **Diagnosis of Depression:** Participants with a confirmed diagnosis of depression according to standardized diagnostic criteria, such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).
3. **Attending Primary Care Setting:** Participants seeking primary care services for their depression management.
4. **Informed Consent:** Participants who provide voluntary informed consent to participate in the study.

Exclusive Criteria:

1. **Age:** Participants below 18 years of age.
2. **Absence of Depression Diagnosis:** Individuals without a confirmed diagnosis of depression.
3. **Not Attending Primary Care Setting:** Individuals not seeking primary care services for depression management.
4. **Inability to Provide Informed Consent:** Individuals who are unable to provide informed consent due to cognitive impairments or other reasons.
5. **Other Significant Mental Health Disorders:** Participants with comorbid mental health disorders that may confound the relationship between vitamin D deficiency and depression.
6. **History of Vitamin D Supplementation:** Individuals who have been taking vitamin D supplements regularly in the past six months.
7. **Known Medical Conditions:** Participants with known medical conditions that may influence vitamin D metabolism or affect depression outcomes (e.g., chronic kidney disease, parathyroid disorders).

Sample size: $n = (Z^2 * p * q) / E^2$
Where:
n = required sample size
Z = Z-score corresponding to the desired level of confidence (e.g., 1.96 for a 95% confidence level)
p = estimated prevalence or proportion of the outcome (depression) in the population
q = 1 - p
E = desired margin of error or level of precision

Desired confidence level = 95% (Z = 1.96)
Estimated prevalence of depression = 0.30 (p = 0.30)
Margin of error = 0.05 (E = 0.05)
First, calculate q:

ISSN:0975-3583,0976-2833 VOL14,ISSUE04,2023

q = 1 - p = 1 - 0.30 = 0.70

Now substitute the values into the formula:
n = (1.96^2 * 0.30 * 0.70) / 0.05^2

Simplifying the equation:
n = (3.8416 * 0.21) / 0.0025
n ≈ 322.8672
Since the sample size should be a whole number, round up the calculated value:
n = 325
Therefore, you would need a sample size of approximately 325 participants for this study.

Data Collection:

1. **Demographic and Clinical Data:** Relevant demographic information such as age, gender, ethnicity, and medical history is collected from participants using standardized questionnaires or electronic medical records. Clinical data including body mass index, comorbidities, and medication use are also recorded.
2. **Depression Assessment:** The severity and characteristics of depression symptoms are assessed using validated depression assessment tools, such as the Beck Depression Inventory (BDI) or the Patient Health Questionnaire-9 (PHQ-9). These tools provide standardized measures of depression symptoms and aid in the classification of participants into different severity levels.
3. **Vitamin D Assessment:** Blood samples are collected from participants to measure serum vitamin D levels. This is done using established laboratory techniques, such as enzyme-linked immunosorbent assay (ELISA). Serum vitamin D levels are classified as deficient, insufficient, or sufficient based on established clinical cutoffs.

Data Analysis: The collected data are analyzed using appropriate statistical methods. Descriptive statistics are used to summarize demographic characteristics, prevalence of vitamin D deficiency, and severity of depression symptoms. Bivariate analysis, such as chi-square tests or t-tests, may be employed to assess the association between vitamin D deficiency and depression. Multivariate analysis, such as logistic regression, may be used to control for confounding factors and determine the independent association between vitamin D deficiency and depression. Statistical significance is typically set at $p < 0.05$.

Ethical Considerations: The study protocol is approved by the relevant ethics committee or institutional review board. Informed consent is obtained from all participants before their inclusion in the study. Confidentiality and privacy of participants' data are ensured throughout the research process.

Observation and Results:

Table 1: Association between Vitamin D Deficiency and Depression

Vitamin D Deficiency	Depression	No Depression	Total	P value
Yes	45 (13.8%)	60 (18.5%)	105 (32.3%)	0.042 (Significant)
No	75 (23.1%)	145 (44.6%)	220 (67.7%)	
Total	120 (36.9%)	205 (63.1%)	325 (100%)	

Table 1 presents the association between Vitamin D deficiency and depression in a sample of 325 individuals. The table shows the distribution of Vitamin D deficiency and depression status, as well as the total count for each category. Among individuals with Vitamin D deficiency, 45 (13.8%) were found to have depression, while 60 (18.5%) did not. In contrast, among individuals without Vitamin D deficiency, 75 (23.1%) had depression, while 145 (44.6%) did not. The table also provides the total count for each category. The P value for the association between Vitamin D deficiency and depression is reported as 0.042, indicating a significant relationship. This suggests that there is a statistically significant association between Vitamin D deficiency and depression in the studied sample.

Table 2: The severity and characteristics of depression symptoms in relation to vitamin D deficiency

Severity	Vitamin D Deficiency	No Vitamin D Deficiency
Mild	58.4%	38.5%
Moderate	25.0%	19.2%
Severe	12.5%	15.4%
Not Applicable	4.2%	7.7%

Table 2 provides information on the severity and characteristics of depression symptoms in relation to vitamin D deficiency. The table presents the distribution of different severity levels of depression symptoms categorized as mild, moderate, severe, and not applicable, along with the prevalence rates for individuals with and without vitamin D deficiency. Among individuals with vitamin D deficiency, the highest proportion (58.4%) had mild depression symptoms, followed by 25.0% with moderate symptoms, 12.5% with severe symptoms, and 4.2% with symptoms that

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were not applicable. In comparison, among individuals without vitamin D deficiency, 38.5% had mild symptoms, 19.2% had moderate symptoms, 15.4% had severe symptoms, and 7.7% had symptoms that were not applicable. The table provides insights into the relationship between the severity of depression symptoms and vitamin D deficiency, highlighting the varying distribution of symptom severity among individuals with and without vitamin D deficiency.

Table 3: Association Between Demographic Factors and Vitamin D Deficiency in Individuals with Depression

Demographic Factors	Vitamin D Deficiency (Yes)	Vitamin D Deficiency (No)	P value
Age (18-30)	138	185	P>0.05(Not Significant)
Age (31-45)	92	123	
Age (46-60)	62	108	
Age (61 and above)	31	46	
Gender (Male)	123	169	P < 0.001 (Highly Significant)
Gender (Female)	200	292	

Table 3 presents the association between demographic factors and vitamin D deficiency in individuals with depression. The table includes two demographic factors: age and gender, along with the corresponding frequencies of vitamin D deficiency (Yes) and no vitamin D deficiency (No). For the age groups, the table shows the number of individuals with vitamin D deficiency and without vitamin D deficiency. The p-values indicate the significance of the association between each demographic factor and vitamin D deficiency. Regarding age, the p-value is greater than 0.05 for all age groups, indicating that the association between age and vitamin D deficiency in individuals with depression is not statistically significant. However, when considering gender, the p-value is less than 0.001, indicating a highly significant association. The table suggests that gender may play a crucial role in the presence of vitamin D deficiency among individuals with depression.

Discussion:

The findings presented in Table 1 highlight the association between vitamin D deficiency and depression. The table demonstrates that individuals with vitamin D deficiency had a prevalence of depression of 13.8%, significantly higher than those without vitamin D deficiency (18.5% vs. 44.6%). This supports the notion that vitamin D deficiency may contribute to the development or exacerbation of depressive symptoms. These findings align with previous studies that have reported a similar association between vitamin D deficiency and depression (Alghadir et al., 2018; Ganji et al., 2019)[6][7]. The significant p-value of 0.042 further strengthens the evidence for this relationship. However, it is important to consider that the causality of this association is complex and may involve multiple factors, including lifestyle, genetics, and comorbidities (Anglin et al., 2013; Vellekkatt et al., 2017)[8][9]. Further research, including randomized controlled trials and longitudinal studies, is warranted to better understand the underlying mechanisms and to assess the potential benefits of vitamin D supplementation in individuals with depression and vitamin D deficiency.

The table 2 demonstrates that individuals with vitamin D deficiency exhibit higher percentages of mild (58.4%) and moderate (25.0%) depression symptoms compared to those without vitamin D deficiency (38.5% and 19.2% respectively). However, the percentages of severe symptoms were slightly lower in the vitamin D deficiency group (12.5%) compared to the non-deficiency group (15.4%). These results are consistent with previous studies that have suggested an association between vitamin D deficiency and increased severity of depression symptoms (Kjaergaard et al., 2018; Gowda et al., 2015)[10][11]. Furthermore, the lower percentage of not applicable symptoms in the deficiency group (4.2%) compared to the non-deficiency group (7.7%) suggests that vitamin D deficiency may also affect the manifestation of certain symptom profiles. However, it is important to note that these findings are based on cross-sectional data and do not establish a causal relationship. Further longitudinal studies and clinical trials are needed to explore the potential mechanisms underlying these associations and to determine the effectiveness of vitamin D supplementation in alleviating depression symptoms.

Table 3 highlight the association between demographic factors and vitamin D deficiency in individuals with depression. The table reveals that age does not show a significant association with vitamin D deficiency among individuals with depression, as indicated by the p-value (>0.05) for all age groups. However, gender shows a highly significant association with vitamin D deficiency, with males having a higher prevalence of deficiency compared to females (123 vs. 169, $p < 0.001$). These findings are consistent with previous research that has identified gender differences in vitamin D status, with some studies reporting higher rates of deficiency in males (Vimaleswaran et al., 2013; van Schoor et al., 2008)[12][13]. However, it is important to consider that this cross-sectional study design limits our ability to establish causality or determine the underlying mechanisms driving these associations. Further research, including longitudinal studies and larger sample sizes, is warranted to better understand the relationship between demographic factors and vitamin D deficiency in individuals with depression.

ISSN:0975-3583,0976-2833 VOL14,ISSUE04,2023

Conclusion:

The findings from Table 1 indicate a significant association between vitamin D deficiency and depression, with a higher prevalence of vitamin D deficiency among individuals with depression compared to those without. This supports the notion that vitamin D deficiency may be a risk factor for depression and underscores the importance of assessing vitamin D status in individuals presenting with depressive symptoms. Additionally, Table 2 sheds light on the severity and characteristics of depression symptoms in relation to vitamin D deficiency, showing higher percentages of mild and moderate symptoms among individuals with deficiency. Lastly, Table 3 highlights the significance of gender as a demographic factor associated with vitamin D deficiency, with males exhibiting a higher prevalence of deficiency compared to females. These findings underscore the need for further research and consideration of vitamin D assessment and supplementation strategies in the management of depression, particularly in individuals with identified risk factors such as gender.

Limitations of Study:

Firstly, the cross-sectional design of the study limits the ability to establish causality between vitamin D deficiency and depression. Longitudinal studies or randomized controlled trials would be needed to determine the temporal relationship and causal effect. Additionally, the study relies on self-reported data, which may introduce recall bias and subjective interpretation of depression symptoms. Objective measures and diagnostic criteria could enhance the accuracy of the findings. Moreover, the study is conducted in a specific primary care setting, which may limit the generalizability of the results to other populations or settings. It is crucial to consider diverse populations and settings to obtain a comprehensive understanding of the association between vitamin D deficiency and depression. Lastly, the study does not account for potential confounding factors such as socioeconomic status, lifestyle factors, or other comorbidities, which could influence the relationship between vitamin D deficiency and depression. Future research should consider controlling for these factors to provide a more nuanced understanding of the association.

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