Original Article

Association between depression and vitamin D3 among the people attending private clinic in Ernakulam, Kerala, India

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Abstract

Background: Depression is a serious global public health issue due to its significant impact on well-being and quality of life. Since vitamin D3 is involved in more than simply bone health, there has been discussion over its potential link to depression. Despite growing evidence that there is a connection between vitamin D3 deficiency and depression, there is a lack of evidence from India. So this study aims to evaluate vitamin D deficiency and depression among patients attending private clinics in Ernakulam, Kerala, India. **Methods:** The cross-sectional study investigated the association between vitamin D3 levels and depression. This study was approved by the institutional ethical committee of SRM School of Public Health, SRMIST, Kattankulathur, and Tamil Nadu. After getting informed consent from the patients the data regarding socio-demographic profile, Vitamin D and depression was acquired from the patients during their next consecutive follow-up. Participants without significant psychiatric problems or chronic illnesses between the ages of 18 and 49 were enrolled. Serum 25 (OH) D levels were tested, and depression was evaluated using the modified Beck Depression Inventory (BDI-II). Descriptive, Chi-square, and logistic regression analyses were done. **Results:** The study was among the 126 participants. Depression was more common in those with low vitamin D3 levels than in those without it (67.2% vs. 32.8%). There is a significant association between depression and demographic variables such as age, gender, and occupation. Under logistic regression, age was found to be a significant predictor, the odds ratios showed that older adults had 12 times the odds of developing depression than younger adults. Males have 2.9 times the odds of developing depression than females. **Conclusion:** This study shows that there is an association between vitamin D insufficiency and increased depression in Ernakulam, Kerala, India. The identification and treatment of depression should take into account vitamin D3 status since treating vitamin D3 insufficiency may have an impact on mental health outcomes. Prospective investigations ought to delve into longitudinal associations and encompass a range of demographics to reinforce causal deductions and overall applicability.

Keywords: Association, deficiency, depression, vitamin D3

Introduction

Depression and vitamin D deficiency are both very prevalent worldwide, there has been a lot of attention paid to this association in recent years.[1] Depression, characterized by persistent feelings of melancholy, hopelessness, and apathy, poses a serious threat to public health and has a substantial negative impact on people's quality of life and overall well-being. According to the World Health Organisation (WHO),[2] depression affects around 4.3% of the world's population worldwide and depression is a common disorder.

Existing literature states that five percent of Indians suffer from depression. Based on data from the National Mental Health Survey of India,[3] which was carried out in three districts of Kerala, the prevalence of depressive disorders is around 2.49%. Research progress has illuminated the function of vitamin D beyond its conventional association with bone health.[4] Research indicates that vitamin D may have positive impacts on a number

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of non-skeletal health outcomes, such as mental well-being. The identification of vitamin D binding proteins (DBPs) and vitamin D receptors (VDRs) in the central nervous system (CNS), especially in areas related to mood regulation, has sparked curiosity in a possible association between vitamin D deficiency and depression.[5] There is dispute about the definition of vitamin D insufficiency and the optimal serum 25 (OH) D concentrations. Latitude, time of day, and climatic conditions all affect the availability of UVB that is useful in generating vitamin D. On the other hand, skin pigmentation, clothes, and sunscreen usage determine how much UVB the skin actually receives and how it reacts to it by generating vitamin D. Vitamin D supplements may raise the amount of circulating 25 (OH) D, but their effects are diminished by noncompliance.[6] According to the incidence and illness burden of vitamin D insufficiency, there were large percentages of severe vitamin D deficiency in neonates in Turkey (51%), Iran (86%), and India (61%). By contrast, vitamin D3 insufficiency was present in at least 90% of these nations.[6] According to the European Journal of Clinical Nutrition, the incidence of severe vitamin D insufficiency is 13.0% in Europe, 7.4% in Canada, and 5.9% in the United States. In India, 490 million people are thought to be vitamin D deficient.[7] These results highlight the complex interactions between vitamin D and brain circuits linked to mood regulation, suggesting that a vitamin D deficiency may increase the risk of depression or worsen its symptoms in some people. There are still a number of unresolved issues despite the increasing amount of studies pointing to a possible link between depression and vitamin D insufficiency.[8] Depression and Vitamin D3 should be interpreted in primary health care settings and family physicians need to be aware of the danger involved in undiagnosed which can hamper timely intervention and proper treatment. Even though studies have shown that vitamin D3 is prevalent in 80–90% of cases, because of the expensive cost of this test, it has not been included in standard blood testing by family medicine physicians. Furthermore, the WHO reports that over 75% of depressed individuals in low and middle income countries do not receive treatment; major barriers to providing appropriate care include the stigma associated with mental illnesses in society, a lack of resources, and a shortage of trained healthcare professionals. Giving appropriate treatment is further hampered by inaccurate evaluation.[9]

In colder areas with less sun exposure, low levels of vitamin D3 are more frequent; in other nations, like India, the prevalence of low levels of vitamin D3 in society varies from 40% to 99%, with most studies indicating 80%–90%.[10] In a 1:1 match, US veterans who used vitamin D supplements between 2010 and 2018 were paired with untreated control veterans. According to the research, taking supplements of vitamin D3 and D2 was associated with a considerably decreased risk of self-harm and suicide attempts, with a 45% and 48% lower risk, respectively.[11] Since research has previously shown a connection between depression and vitamin D3 receptors in many different brain areas, As a result, in recent years, vitamin D3 has gained attention as a possible risk factor for the development of depression.[12] There are currently few cohort or case-control studies available, and the majority of the information regarding the association between adult depression and vitamin D comes from cross-sectional research.[13] Through the clarification of the processes behind this association and the identification of modifiable risk factors, such as a deficit in vitamin D, treatments aimed at reducing the prevalence of depression and enhancing mental health outcomes worldwide may be created.

Research on the association between vitamin D3 and depression has been scarce in Kerala, India. A previous study conducted in Ernakulam Kerala by Amrutha Institute of Medical Science revealed that 58% (29) of the cases and 26% (13) of the controls had Vitamin D3 deficiency. The difference was statistically significant <0.001.[14] The study found a significantly higher prevalence of Vitamin D deficiency among cases than controls in Ernakulam, Kerala. This suggests a potential association between Vitamin D deficiency and the condition being studied. Ernakulam is a cosmopolitan emerging metro city in Kerala hence; there is a minimal selection bias on various aspects so that the findings might be relevant to broader populations. Given these factors, the current study aims to investigate the association between vitamin D status and depression, with implications for preventative measures and therapeutic treatments.

Objectives

1. To evaluate vitamin D deficiency and depression among patients at the private clinic in Ernakulam, Kerala, India.
2. To find the association between vitamin D deficiency and depression among patients at the private clinic in Ernakulam, Kerala, India.

Methods

Study design

The cross-sectional study was conducted among the patients visiting the clinics, regardless of gender, participated.

Study setting

The current study was carried out from January 1, 2024, to March 31, 2024, in a private clinic in Thrippunithura, Kerala's Ernakulam district. The clinic treats a variety of psychological illnesses.

Participants

Participants in the research ranged in age from 18 to 49 and were able to attend the clinic on their own. They should not have been using vitamin D3 supplements at the time of data collection. The study did not include participants who had experienced a diagnosis of a chronic illness, particularly a congenital disease, where intervention is not possible, or serious psychological problems resulting in severe cognitive impairment or aphasia in communication, within the preceding three months.

Variables

Numerous demographic exposures and predictors, such as age, gender, marital status, employment, and educational status, were examined in this research. The research examined these

demographic factors as possible confounders, as well as the lack of serious psychiatric issues or chronic diseases, which were excluded from the study sample.

The diagnostic criteria for depression were derived from the Beck Depression Inventory, which had 21 statements on depressed symptoms. Individuals were classed as having normal, mild, moderate, or severe depression based on how their scores fell into different groups. Depending on the vitamin D status, the blood 25 (OH) D levels were classified as adequate, deficient, or insufficient using the Endocrine Society's standards.

Data sources/measurement

A semi-structured questionnaire was developed and tested before collecting data. We used the modified BDI—II Scale and clinical indicators such vitamin D3 level to test for depression. The The Beck Depression Inventory (BDI-II) has twenty-one statements pertaining to various mental health issues such as melancholy, pessimism, guilt, self-dislike, self-harm, social disengagement, trouble at work, exhaustion, and anorexia. A score in the range of 0 to 13 represents a typical mood state. The scores for mild mood disturbance fall between 14 and 19. Scores between 20 and 28 indicate moderate depression. Those with scores between 29 and 69 are considered to be suffering from serious depression.[15] Validation and cultural adaptation of BDI II was established from a previous survey study conducted during COVID-19 Pandemic in Kerala and has been published in 2022 in the International Journal of Research and Review.[16] Thus BDI II is culturally adapted and validated for the Kerala Population.

After an overnight fast, 2 milliliters of peripheral venous blood were drawn from each subject in the morning. After that, the samples were sent to the authorized laboratory for centrifugation and serum separation, Doctors Diagnostic Centre (DDC), Ernakulam. Electrochemiluminescence techniques were used to measure the serum concentrations of 25 (OH) D. Serum 25-OH Vitamin D3 values below 20 ng/ml (50 nmol/L), 21–29 ng/ml (52.5–72.5 nmol/L), and 30-100 ng/ml (75–250 nmol/L), respectively, point to a deficiency, insufficiency, or sufficiency in Vitamin D3 status, according to Endocrine Society standards. Despite the fact that the majority of individuals on the planet are determined to be deficient in Vitamin D3, despite this widespread acceptance, significant attempts are being undertaken to understand the criteria underpinning this categorization.[17]

Bias

To mitigate possible bias and ensure participant representation, the research used stringent inclusion and exclusion criteria. Standardized data collecting techniques and ethical permission were acquired in order to lessen measurement and ethical biases. Among the statistical methods employed to account for confounders was logistic regression. However, it was recognized that selection bias and residual confounding are two of the fundamental limitations of observational research.

Sample size calculation

A previous study conducted in Ernakulam Kerala revealed that 58% (29) of the cases and 26% (13) of the controls had Vitamin D3 deficiency. With the 58% of prevalence, 95% confidence interval (CI), a margin of error of 9, and 116 were calculated as the ideal sample size. Finally, n =126 was obtained as the sample.

Sampling strategy: Every patient who visited the clinics throughout the research period was asked to participate. Participants were chosen by simple random sampling. By signing the permission form, they indicated that they were okay with joining. Out of the 180 patients who were contacted, 126 were enrolled in the study, as shown in Figure 1, and 54 participants had a 70% response rate and were dropped from the study.

Data analysis

The Excel was used for cleaning. Univariate analysis has been performed first; including frequency distribution, central tendency, and dispersion for age, gender, BMI, time spent outside, exercise, socioeconomic status, and co-morbidity. Chi-squared test has been used to find out how two variables are related to each other. Logistic regression analysis was used to assess the independent effect of vitamin D levels on depression while taking possible variables into consideration. In the logistic regression analysis, the research tried to take confounding factors into account, even if the impact modifiers were not indicated explicitly. The analysis of the final data was done using SPSS 17 Version.

Ethical considerations

This study was approved by the institutional ethical committee of SRM School of Public Health, SRMIST, Kattankulathur, and Tamil Nadu. After getting informed consent from the patients the data regarding socio-demographic profile, Vitamin D and Depression was acquired from the patients during their next consecutive follow-up.

Results

Table 1 summarizes the demographic characteristics of the respondents. According to the study findings, the average age

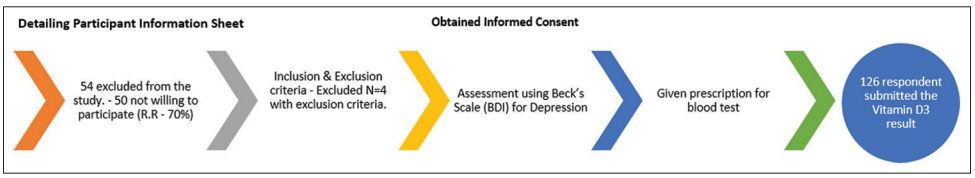

Figure 1: Selection of Study Participants

of the research participants was determined to be 29.5 years old. Around 47% of respondents were married, and 57.9% of respondents were female. The majority of the study subject which is 84.1% of respondents in our research had a degree. About 37% of the participants work outside in environments with more solar exposure.

Table 2 summarizes the association between depression and demographic profiles. Many significant associations were found when depressed and non-depressed people were compared across a range of factors. First, compared to non-depressed people, who had a mean age of 28 years with a standard deviation of 7 years, depressed people had a substantially higher mean age of 34 years with a standard deviation of 9 years ($P < 0.001$). In addition, there was a noticeable difference in the age distribution: most depressed people (78.3%) were in the 40–60 age range, while most non-depressed people (73.8%) were in the 18–39 age range.

Table 3 summarizes the statistical analysis between Vitamin D and depression. Vitamin D deficiency was found in 67.2% of the depressed group but only in 32.8% of the non-depressed group ($P < 0.001$). In contrast, a far greater percentage (73.5%) of the non-depressed group than the depressed group (26.5%) had adequate levels of Vitamin D.

Table 4 summarizes the logistic regression for selected risk factors and depression after controlling for confounding factors. The odds ratios indicated that older adults had 12 times the odds of developing depression than younger adults. Males have 2.9 times the odds of developing depression than females. In addition to this, the younger age, and sufficient Vitamin D found to be a protective factor against developing depression (inverse relation). Therefore, based on this analysis, the main risk factors of depression remain older age, male, and Vitamin D deficiency.

Discussion

It is crucial to take into account the larger implications of vitamin D deficiency and depression in the context of our research, which was carried out in Kerala, India. Indians residing in metropolitan regions, where vitamin D and calcium are not regularly added to food, are in danger due to their skin tone and indoor lifestyle. While fatty fish like sardines are inexpensive and often eaten in coastal places like Kerala, research demonstrating a high incidence of vitamin D insufficiency in India frequently concentrates on rural or interior areas north of the Tropic of Cancer.[18]

As research suggests a potential association between vitamin D deficiency and a range of diseases, including osteoporosis, diabetes, depression, cancer, and autism, Vitamin D3 is crucial for overall health.[19] The findings align with the broader national trend of vitamin D deficiency in India. For example, a study published in the Indian Journal of Endocrinology and Metabolism found that over 70% of urban and 60% of rural Indians were deficient in vitamin D.[20,21] The key similarity with the current study is there is a higher rate of vitamin D deficiency in the depressed group is consistent. The above-mentioned study focused on both urban and rural areas, but it might also

Table 1: Demographic Characteristics of the respondents (*n*=126)

Characteristics	Character	Frequency	Percentage
Sex	Female	73	57.9
	Male	53	42.1
Marital Status	Married	59	46.8
	Single	67	53.2
Religion	Christian	37	29.4
	Hindu	82	65.1
	Muslim	7	5.6
Education	Graduate	106	84.1
	Non-Graduate	20	15.9
Occupation	Indoor Job	79	62.7
	Outdoor Job	47	37.3
Residence	Rural	26	20.6
	Urban	100	79.4
Age Classification	17 to 30 Years	80	64
	31 to 45 Years	46	36

Table 2: Association between Depression and Demographic Profiles (*n*=126)

Variables	Depressed (*n*=57)	Non depressed (*n*=69)	*P*
AGE (YEARS)			
18-39, *n* (%)	21 (26.3%)	59 (73.8%)	<0.001
40-60 *n* (%)	36 (78.3%)	10 (21.7%)	
GENDER			
Female	22 (30.1%)	51 (69.1%)	<0.001
Male	35 (66%)	18 (34%)	
TYPE OF JOB			
Indoor Job	28 (59.6%)	19 (40.4%)	<0.001
Outdoor Job	29 (36.7%)	50 (63.3%)	
EDUCATION			
Non-Graduate	49 (46.2%)	57 (53.8%)	0.397
Graduate	8 (40%)	12 (60%)	

Table 3: Vitamin D3 and Depression (*n*=126)

Characteristics	Depressed (*n*=57)	Non-Depressed (*n*=69)	*P*
VITAMIN D			
Deficient	39 (67.2%)	19 (32.8%)	<0.001
Sufficient	18 (26.5%)	50 (73.5%)	

Table 4: Logistic regression model on association of selected risk factors vs. Depression after controlling for confounding factors

Variables	β	AOR	*P*	95% CI
Age	2.487	12.043	<0.001	3.189–45.472
Gender	1.07	2.916	<0.001	1.079–7.879
Educational status	-0.632	0.532	0.357	0.139–2.034
Marital Status	-0.598	0.549	0.366	0.149–2.018
Occupational status	-0.438	0.645	0.413	0.226–1.842
Vitamin D	-1.704	0.182	<0.001	0.072–0.461
Constant	1.034	<0.001	2.812	

obscure regional variations in Vitamin D status and related health outcomes.[20,21] In contrast, the current study focused on a particular group of the depressed and non-depressed. India's geographic location, with its predominantly tropical climate and cultural practices that often limit sun exposure, contributes to widespread vitamin D deficiency. However, it's important to note that specific prevalence may vary across different regions and demographics within India.

The findings of this study contribute to the growing body of research that looks at the association between depression and vitamin D levels in residents of Kerala, India. Consistent with previous research, this study discovered a strong association between depression and vitamin D deficiency, indicating that those with lower vitamin D levels are more likely to have depressed symptoms. This confirms the findings of several studies conducted on various populations, which have consistently shown a connection between low vitamin D levels and an increased risk of depression.[15,22] Additionally, the discussion of the recommended dietary intake of vitamin D, as defined by Canadian standards, provides important context for understanding the implications of vitamin D deficiency and the potential need for supplementation.[23] Our findings on the association between depression and vitamin D levels in Kerala, India, suggest that addressing vitamin D insufficiency with supplements or increasing sun exposure may affect mental health outcomes. There remained a strong association between vitamin D levels and depression even after controlling for age, gender, marital status, level of education, and occupation. Similar results from other studies have supported the hypothesis that vitamin D may have a role in the pathophysiology of depression.[24,25]

Furthermore, the logistic regression analysis showed that age and gender were significant predictors of depression, with males and older individuals having higher odds of having depression. These findings are consistent with other studies that have consistently shown that depression rates differ by gender and that depression is more prevalent in older adults.[26,27] The inclusion of these factors in the analysis enhances the comprehensiveness of the research and provides a better understanding of the demographic features of the study group that are associated with depression. The demographics of the study participants, which included a high proportion of women, married individuals, and those with graduate-level education, are typical of the patients treated in private clinics in Kerala, India. This demographic profile highlights how important it is to target different patient demographics with mental health therapies (such as vitamin D supplementation) to effectively reduce the burden of depression. Moreover, the discovery that a significant portion of participants were employed inside highlights the potential impact of solar radiation on vitamin D levels and the resulting psychological effects.

Conclusion

In summary, this study adds to the growing body of evidence suggesting a connection between depression and inadequate vitamin D among residents of Kerala, India. The findings underscore the importance of considering vitamin D levels in the diagnosis and treatment of depression, and they may have implications for targeted interventions intended to improve mental health outcomes. By addressing vitamin D deficiency, medical providers may be able to enhance the quality of life for those suffering from depression as part of comprehensive mental health care.

The strength of the study includes several factors such as cross-sectional design allows for a snapshot of the association between vitamin D levels and depression in a specific population at a given time. A sample size of 126 provides a reasonable basis for concluding. The study considers potential confounders such as age, gender, marital status, employment, and education. The study used standardized measures such as the modified Beck Depression Inventory and the Endocrine Society's standards for vitamin D classification to provide reliable and comparable data. The use of logistic regression to assess the independent effect of vitamin D levels on depression demonstrates a rigorous approach to data analysis.

Limitations of the study include that it cannot establish causality as it is a cross-sectional study. The absence of a control group makes it challenging to isolate the specific effects of vitamin D on depression. The findings may not be generalizable to other populations or settings as it is a single-center study. The study relied on patients visiting the clinic, which may introduce selection bias. A longer follow-up period would provide more insights into the temporal association between vitamin D levels and depression. Potential for residual confounding: Despite controlling for several covariates, residual confounding from unmeasured factors may still influence the results. The study focused on a specific age group (18-49) and may not be representative of the entire population. Notwithstanding the advantages of the study, there are some problems to be aware of. Longitudinal studies are necessary to clarify temporal links between depression and vitamin D3 deficiency since the cross-sectional method limits the capacity to demonstrate causation. Furthermore, the study sample was limited to patients who visited private clinics in Kerala, India; this may limit the applicability of the findings to other populations.

Data availability statement

The datasets used and/or analyzed during the current study are available with the corresponding author.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was written and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics approval

Ethical clearance was obtained from the Institutional Ethics Committee at the SRM School of Public Health (IEC Protocol Number 0040/IEC/2023), ensuring adherence to ethical standards throughout the study process.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent to publish

The authors affirm that human research participants provided informed consent for publication

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Nil.

Conflicts of interest

There are no conflicts of interest.

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