ORIGINAL ARTICLE

A Cross-Sectional Study on Vitamin D Deficiency as a Risk Factor for Depression in the Elderly

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ABSTRACT

Background: Depression is one of the most common mental health disorders worldwide, significantly impacting individuals' quality of life and contributing to the global burden of disease. It impacts about 350 million individuals globally, with older populations showing greater prevalence rates.
Objective: To investigate the relationship between vitamin D deficiency and depression risk in elderly populations in both sunny (Indonesia) and less sunny regions, focusing on the impact of low vitamin D levels on depression risk.
Methodology: The study design is a descriptive, observational, cross-sectional study. Data analysis was performed using JASP software. The study was conducted from April to August 2024 in two countries: Indonesia and Russia. A total of 130 elderly individuals participated in the study, with 70 respondents from Indonesia and 60 from Russia, the Shapiro-Wilk test was applied to determine the normality of the data distribution for the sun exposure and depression variables, Also, we conducted a Spearman correlation test to evaluate the relationship between sun exposure time and depression levels
Results: This study found that older adults in Russia and Indonesia had significantly different levels of sun exposure, vitamin D levels, and depression symptoms. The analysis also showed a significant positive correlation between sun exposure and depression levels, emphasizing the importance of adequate sun exposure in mitigating depressive symptoms.
Conclusion: This study emphasizes the vital role that vitamin D plays in older adults' mental health. According to the results, vitamin D deficiency is closely linked to depressive symptoms, especially in areas with little exposure to sunlight, Participants with inadequate vitamin D levels reported significant depressive symptoms even when they regularly consumed foods high in vitamin D, This suggests that adequate vitamin D is essential not only for physical health but also for maintaining mental well-being in the elderly, avoiding vitamin D deficiency through dietary changes and supplementation is crucial for decreasing the risk of depression in this susceptible population.

Keywords: *Depression, Depressive Symptoms, Mood disorders, Sunlight Exposure, Vitamin D, Antioxidant, Cholecalciferol, Elderly Populations.*

INTRODUCTION

Depression is one of the most common mental health disorders worldwide, significantly impacting individuals' quality of life and contributing to the global burden of disease. It impacts about 350 million individuals globally, with older populations showing greater prevalence rates[1].

Depression disorder presents with depressed mood, loss of interest or pleasure, decreased energy, feelings of guilt or low self-worth, disturbed sleep or appetite, poor concentration, problems of thinking and making decisions, and, in severe stages, recurring thoughts of death or suicide, Despite advances in treatment, the multifactorial etiology of depression remains a subject of extensive research[2].

The novelty of this research lies in its unique focus on examining vitamin D deficiency as a direct risk factor for depression specifically in elderly populations. Although previous research has examined broad correlations between vitamin D levels and mood disorders, few studies have focused on older persons. This population is especially susceptible to depressive symptoms and vitamin D deficiency because of lifestyle, health, and environmental variables. Additionally, while prior research frequently examines the effects of vitamin D on mental health in a broad sense, our study focuses specifically on depression and employs a comparative methodology across some geographic locations (both sunny and non-sunny), which highlights the relation between lower sun exposure and reduced vitamin D synthesis among Russian participants[3].

Vitamin D serves as a potent antioxidant, modulating oxidative stress by reducing Reactive Oxygen Species (ROS) and enhancing neurotrophic factors critical for neuroplasticity and synaptic integrity[4].

Studies have focused on the role of various nutrients in mood regulation, with particular attention given to vitamin D due to its neuroprotective and antioxidant properties. Vitamin D is involved in the regulation of neurotransmitters, neuroimmune functions, and the reduction of oxidative stress in the brain, all of which are critical in mood disorders such as depression[5].

In our study we focused to see how sun exposure time leads to vitamin D deficiency and depression in the elderly, previous studies showed that a long-term shortened duration of sunshine exposure was associated with the risk of depression. Moreover, greater exposure to CO and PM_{10} was related to the risk of depression[6,7]. Vitamin D deficiency not only affects mental health but also increases the risk of various diseases. Since vitamin D exerts diverse effects, both on the skeletal and non-skeletal systems, its deficiency poses a risk for various diseases including osteoporosis, osteopenia, cardiovascular disease, and cancer[8]. So providing people with low sun exposure time with supplements is essential, especially the elderly, to maintain stable mental health.

METHODOLOGY:

This descriptive, observational, cross-sectional study utilized a convenience sampling method, Data analysis was performed using JASP software, To assess the normality of the data distribution for sun exposure and depression variables, the Shapiro-Wilk test was applied to determine the normality of the data distribution for the sun exposure and depression variables, Also, we conducted a Spearman correlation test to evaluate the relationship between sun exposure time and depression levels, Inclusion criteria required elderly people over 60 who resided in their respective countries for at least two years, provided informed consent, and could complete assessments for depressive symptoms, Exclusion criteria are Severe Mental Illness: Diagnosed with severe psychiatric disorders such as schizophrenia, having any medical conditions affecting vitamin D metabolisms, such as chronic kidney disease, liver disease, or parathyroid disorders, mobility issues that significantly limited sun exposure, such as being bedridden; recent hospitalization or acute illness within the past three months. Participants were approached after taking written informed consent; formal ethical approval was obtained from the Ethical Review Committee (ERC), Mataram University, The survey was conducted over a period of 4 months from April to August 2024 in two countries, Indonesia and Russia, The study focused on individuals aged 60 and above, A total of 170 respondents were targeted, with 70 surveys collected in Indonesia and 60 in Russia, based on convenience sampling, A structured 17-item questionnaire was used to gather data on participants' self-reported vitamin D levels and symptoms of depression, The survey was administered offline, and then the data entered in an excel sheet, The questionnaire was translated into both Indonesian language and Russian language to accommodate respondents from both countries.

RESULTS

Significant differences in sun exposure between the two nations were shown by the data mentioned in table 1, 34 participants (56.7%) in Russia reported getting less than 30 minutes of sunlight per day, which is a worryingly low amount of exposure. Only 9 (15%) of the respondents were able to get 1-2 hours of sun exposure, and only 2 (3.3%) reported going over 2 hours. An additional 15 respondents (25%) reported 30 minutes to 1 hour of sun exposure. In contrast, Indonesian respondents demonstrated significantly higher levels of sun exposure, with only 1 participant (1.4%) reporting less than 30 minutes. Five respondents (7.1%) received 30 minutes to 1 hour, while 28 participants (40%) enjoyed 1-2 hours, and a substantial 36 individuals (51.4%) benefited from more than 2 hours of sunlight daily.

Table I: *Comparison of Sun Exposure, Vitamin D Intake, Mood Ratings, and Depression Prevalence Among Elderly Participants in Russia and Indonesia*

Variable	Russia	Indonesia
Sun Exposure		
< 30 min/day	34 (56.7%)	1 (1.4%)
30 min - 1 hr/day	15 (25%)	5 (7.1%)
1 - 2 hrs/day	9 (15%)	28 (40%)
> 2 hrs/day	2 (3.3%)	36 (51.4%)
Vitamin D-Rich Food Intake		
Daily	4 (6.7%)	17 (24.3%)
2-3 times/week	38 (63.3%)	15 (21.4%)
Once a week	14 (23.3%)	30 (42.9%)
Once a month or rare	4 (6.6%)	–
Average Mood Rating	4.62	7.36
Depressive Symptoms	88.3%	14.3%
Diagnosed Depression	61.7%	1.4%

In terms of dietary habits, Russian respondents displayed a relatively normal intake of vitamin D-rich foods, with 4 individuals (6.7%) consuming such foods daily and a significant 38 participants (63.3%) consuming them 2-3 times a week. Additionally, 14 respondents (23.3%) reported eating these foods once a week, while only 2 (3.3%) consumed them once a month and another 2 (3.3%) reported rare consumption. (Table I).

This study highlights the influence of the geographical and environmental factors on vitamin D levels and mental health Despite this regular intake of vitamin D-rich foods, many Russian participants still exhibited signs of vitamin D deficiency, as indicated by their limited sun exposure and concerning mood ratings. In contrast, Indonesian participants exhibited varied consumption patterns; 17 individuals (24.3%) reported daily intake of vitamin D-rich foods, while 15 (21.4%) consumed them 2-3 times a week and 30 (42.9%) once a week (Table I). This suggests that while Russian participants consume vitamin D-rich foods regularly, their lower levels of sun exposure, coupled with dietary habits, may contribute to a higher prevalence of vitamin D deficiency and its associated symptoms. The average mood rating over the past six months also illustrates a significant contrast between elderly participants in Russia and Indonesia. Russian elderly respondents reported a concerning average mood score of 4.62, with 88.3% indicating symptoms of persistent sadness, lack of interest in activities, and noticeable changes in appetite or sleep patterns. This high prevalence of depressive symptoms among the Russian elderly highlights a considerable mental health concern. In stark contrast, elderly participants from Indonesia had a notably higher average mood rating of 7.36, with only 14.3% experiencing similar symptoms. This difference underscores a potentially protective role of environmental, social, or even nutritional factors, such as greater exposure to sunlight in Indonesia, which could be contributing positively to mood and overall mental well-being in elderly populations. Regarding formal diagnoses, 61.7% of Russian respondents reported having been diagnosed with depression by a healthcare professional, while only 1.4% of Indonesian respondents reported receiving a similar diagnosis. This stark contrast raises concerns about mental health support and awareness in both countries, particularly in relation to vitamin D status.

DISCUSSION:

Our data highlighted a significant disparity in sun exposure duration between Russian and Indonesian participants. In Russia, the majority of respondents, 56.7% (n=34), reported receiving less than 30 minutes of daily sun exposure, while only a small fraction (3.3%, n=2) achieved more than 2 hours. Conversely, Indonesian participants reported substantially higher sun exposure, with 51.4% (n=36) indicating they spent over 2 hours outdoors each day and just 1.4% (n=1) receiving less than 30 minutes. These findings align with established research indicating that geographical latitude can significantly impact vitamin D synthesis. Studies have shown that regions situated above 37° latitude receive insufficient UV-B radiation for optimal vitamin D production[9].

Russian participants demonstrated a more structured approach to supplementation, with 26.7% (n=16) taking vitamin D or multivitamin supplements daily, and 45% (n=27) consuming them 2–3 times weekly. Regarding vitamin D-rich foods, 63.3% (n=38) reported consuming them 2–3 times weekly. This suggests that, despite their limited sun exposure, Russian participants were more proactive in incorporating vitamin D through diet and supplementation, likely in response to the reduced natural synthesis due to lower UV-B exposure in higher latitudes. In contrast, Indonesian participants displayed minimal reliance on supplements, with 74.3% (n=52) reporting they never took vitamin D supplements. However, they had higher daily consumption of vitamin D-rich foods (24.3%, n=17), which might reflect more frequent exposure to natural sources of vitamin D through local dietary practices. Despite this difference, Russian participants who frequently consumed vitamin D-rich foods and supplements still exhibited notable deficiencies and depressive symptoms. This suggests that, for populations with limited sun exposure, dietary intake alone might not be sufficient to counteract vitamin D deficiency, reinforcing the impact of environmental and geographical factors on vitamin D status. One of the most pronounced differences between the two populations was observed in mental health indicators is Mood Ratings: Russian participants reported a mean mood rating of 4.62 out of 10, indicating generally lower levels of mood positivity. In contrast, Indonesian participants averaged 7.36, suggesting a more positive outlook. Depression Symptoms: A striking 88.3% of Russian participants reported experiencing symptoms associated with depression, including persistent sadness, lack of interest in activities, or changes in appetite and sleep patterns, compared to only 14.3% among Indonesian participants. Clinical Depression: Formal diagnoses by healthcare professionals further underscored this trend. In Russia, 61.7% of respondents had been diagnosed with depression, while only 1.4% of Indonesian respondents had received a similar diagnosis. These findings align with recent meta-analyses, which indicate that individuals with vitamin D deficiency are 2.3 times more likely to develop depression[10]. The marked contrast between the Russian and Indonesian groups suggests a potential association between reduced sun exposure and increased depression risk, even among individuals who consume vitamin D-rich foods or

supplements. This supports the theory that while dietary sources can aid in maintaining vitamin D levels, the lack of sufficient sun exposure may still place individuals at greater risk for depressive symptoms, possibly due to suboptimal vitamin D levels. Neurobiological Implications: Our results are especially relevant considering previous studies that have found vitamin D receptors in key brain regions involved in mood regulation, including the hippocampus and prefrontal cortex[11].

The high prevalence of depression symptoms and diagnoses in the Russian group, coupled with limited sun exposure, underscores a neurobiological link where vitamin D deficiency may influence brain function and elevate depression risk. This study reinforces the hypothesis that insufficient vitamin D due to limited sunlight exposure might contribute to mood disturbances, emphasizing the importance of both environmental factors and physiological needs for populations living in regions with limited sun exposure. High-latitude regions, such as Russia, receive significantly less UV-B radiation, particularly in winter months, which is essential for vitamin D synthesis, thus increasing the likelihood of vitamin D deficiency and associated mental health concerns[12,13]. Consistent with previous research, Russian participants who relied on supplementation-71.7% taking supplements at least weekly-still showed a greater prevalence of depressive symptoms than their Indonesian counterparts, suggesting that supplementation alone may not fully compensate for the physiological benefits of naturally synthesized vitamin D[14]. Cultural and lifestyle differences also emerged, revealing varying approaches to vitamin D acquisition. Indonesian participants, who reported significantly higher daily sun exposure, showed minimal reliance on supplementation, which may be a reflection of cultural practices that involve more outdoor activities, enhancing natural vitamin D synthesis. In contrast, Russian participants, facing more prolonged and colder winters, had fewer opportunities for outdoor exposure, necessitating a reliance on supplements. However, studies indicate that even adequate dietary intake may not entirely meet physiological needs in populations experiencing limited sunlight, especially the elderly, as dietary sources generally provide insufficient vitamin D levels to combat deficiencies fully[15]. Our findings are particularly notable given that over 88% of Russian participants reported depressive symptoms despite higher supplementation rates, suggesting that natural sunlight exposure may have additional mental health benefits beyond vitamin D synthesis, potentially through mechanisms involving circadian rhythm regulation[16]. Neurobiological research shows that vita-min D receptors are present in brain areas associated with emotional regulation, such as the hippocampus and prefrontal cortex, which may elucidate the relationship between vitamin D deficiency and mood instability. Seasonal variations were another factor not fully captured, which may impact vitamin D status in higher-latitude regions during winter months. Moreover, cultural nuances in mental health reporting could influence the self-reported prevalence of depressive symptoms, as social stigma may affect responses differently across cultural contexts[17]. Further research should investigate optimal combinations of supplementation and natural sun exposure, examine genetic predispositions impacting vitamin D metabolism, and consider longitudinal studies to establish causality. Addressing these variables could offer a more comprehensive understanding of vitamin D's role in mental health. In terms of public health, these findings underscore the need for targeted intervention strategies in high-latitude regions, including increased public awareness about the mental health risks associated with limited sun exposure. Additionally, culturally sensitive methods for ensuring adequate vitamin D levels, such as promoting outdoor activities or advocating fortified dietary options, may benefit populations with limited access to sunlight.

The avoidance of all direct sun exposure increases the risk of vitamin D deficiency, which can have serious consequences, so Monitoring serum 25-hydroxyvitamin D concentrations yearly should help reveal vitamin D deficiencies[18].

CONCLUSION:

This study proves that vitamin D supplements are beneficial and essential besides exposure to the sun, particularly for populations living at high latitudes. In areas with limited sunlight, comprehensive treatments are necessary to address vitamin D insufficiency and associated mental health issues, with a focus on culturally sensitive, location-specific methods. Furthermore, elderly people are particularly susceptible to vitamin D insufficiency due to factors like reduced skin synthesis capacity and limited exposure to sunlight, a prevalent issue in northern regions. Given these findings, monitoring and improving vitamin D levels in older adults could serve as a preventative measure to mitigate depression risk and enhance overall mental well-being. Our study underscores the importance of vitamin D as a modifiable factor in mental health, particularly in aging populations,

and calls for further clinical research to validate these findings and develop targeted public health interventions to reduce the burden of depression in the elderly.

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ETHICAL PERMISSION: This research was conducted in accordance with international ethical guidelines for human subject research and followed the principles outlined in the Declaration of Helsinki, Participants were informed of their right to withdraw from the study at any time without consequences, Informed consent was obtained from all participants prior to data collection. The confidentiality of the data was maintained throughout the study, Only authorized research team members had access to the data, The questionnaire was designed to avoid psychological distress, Survey instruments were culturally adapted and appropriately translated, Local customs and practices were respected during data collection (Approval No. No: 323/UN18.F7/ETIK/2024)

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AUTHORS' CONTRIBUTION:

NH: Contributed to the idea, literature review, data collection in Indonesia and drafting of the manuscript

RR: Edited and approved the manuscript, critical manuscript review

MS: Contributed to data collection in Russia and literature review

ST: Analyzed data and contributed to data interpretation

PW: Literature search, interpretation of data, Analyzed data and contributed to data interpretation

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