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Vitamin D and Its Effect on Psychological Well Being

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ABSTRACT: Vitamin D deficiency is common in the healthy population. An estimated 1 billion people worldwide, across all ethnicities and age groups, have a vitamin D deficiency (VDD). This Vitamin deficiency can mainly be attributed to lifestyle (for example, reduced outdoor activities) and environmental (for example, air pollution) factors that reduce exposure to sunlight, which is required for ultraviolet-B (UVB) induced vitamin D production in the skin.
Vitamin D is crucial not only for bone health but for proper brain development and psychological functioning. Effective detection and treatment of inadequate vitamin D levels in persons with depression and other mental disorders may be an easy and cost-effective therapy which could improve patients' long-term health outcomes as well as their quality of life. Although vitamin D has recently gained widespread interest, little information relative to its impact on psychological well-being is available. Therefore in this review, we will focus on the biology of vitamin D and summarize a relationship between vitamin D and psychological well-being.
Keywords: Vitamin D, Deficiency, psychological well-being

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I. Introduction

Vitamin D also known as sunshine vitamin is an essential component for a number of physiological functions such as muscle performance, bone metabolism, calcium and phosphorus homeosthasis and immunity. It is mainly synthesized in the body through ultraviolet B (UVB) exposure on the skin or taken orally through food and/or supplements.

It plays a pivotal role in the prevention and treatment of multiple diseases [1]. Taking this into account, the serious public health problem appeared, as vitamin D insufficiency is estimated to affect about 50% of the global population, and vitamin D deficiency affects 1 billion people, independent of their age and ethnicity [2]. This problem was addressed in a prominent meta-analysis conducted by Garland et al. [3], which demonstrated that low serum levels of 25-hydroxyvitamin D (25(OH)D) are associated with an increased rate of all-cause mortality. This finding prompted other authors to provide recommendations to protect the global population from deficiency by increasing the recommended vitamin D intake levels [4], as well as applying fortified products and through supplementation [5].

During the twentieth century, vitamin D was primarily investigated in relation to musculoskeletal health, starting with the prevention of rickets in children and later the prevention of osteoporosis in elderly [6]. Later studies revealed a much broader protective role of vitamin D in diseases related to the immune system, such as influenza, respiratory tract infections, cancer, and autoimmune diseases [7], as well as cardiovascular diseases [8]. In addition to these effects on physical health, there is also evidence that vitamin D status impacts cognitive, behavioral, and mood disorders [9- 11].

Vit D also plays an important role in mental health and cognitive functions (8, 9). Vit D receptors are present in various parts of the brain, including the amygdala, which is associated with the regulation of emotions and behavior (10). Increasing evidence is available suggesting that vitamin D insufficiency may, in addition to physical health, also negatively impact mental wellbeing [10 ,12]. In fact, several studies have confirmed a link between vitamin D insufficiency and mental disorders such as schizophrenia, autism, and depression.

The positive effect of vitamin D supplementation was also associated with a reduction in the occurrence of negative emotions, as indicated in the meta-analysis by Cheng et al. [13], and for improvement of quality of life, as indicated in the systematic review by Hoffmann et al. [14].

Although vitamin D has recently gained widespread interest, little information relative to its impact on psychological well-being is available. Therefore in this review, we will focus on the biology of vitamin D and summarize a relationship between vitamin D and psychological well-being.

2. Vitamin D deficiency: Prevalence & Cause

When serum 25-hydroxyvitamin D reaches a level < 20 ng per mL (50 nmol per L) in adults, it is said that the person is affected by vitamin D deficiency. According to the previous findings, nutritional sources alone cannot provide the sufficient amount of vitamin D. As a result, 90% of vitamin D required for the human body is typi¬cally provided by sunlight (15, 16). There are several risk factors related to vitamin D deficiency such as obesity, dark skin, living in countries with low sunlight incidence, gastrointestinal malabsorption, renal insufficiency, liver disease, and the use of covered clothing and sunscreen (17-18). Furthermore, reduced exposure to sunlight, thereby reducing the biosynthesis of vitamin D in the skin, is a strong factor in the pathophysiology of vitamin D deficiency and studies have been demonstrated that sun exposure can enhance vitamin D synthesis (19).

After adequate exposure to sunlight, the conversion of 7-dehydrocholesterol (7-DHC) to 25-hydroxycholecalciferol [25(OH)D] takes approximately 8 h and an additional time to enter the dermal capillary bed. The daily exposure of 20% of the body surface is sufficient to increase 25(OH)D, which points toward the importance of sunlight in the maintenance of vitamin D levels at the appropriate concentration (16, 20).

Social isolation and lockdown measures caused a reduction in the time spent outdoors and possibly less exposure to sunlight necessary to maintain vitamin D concentrations. When associated with a change in eating habits, with a predominance of meals ordered through food delivery joints, which have a reduced nutritional and vitamin D content, it could also reduce the daily amount of vitamin D for organism maintenance. In fact, the diminished vitamin D intake and sun exposure might result in severe manifestations since the worldwide prevalence of vitamin D deficiency had been documented as a health concern even before the pandemic (21-23).

3. The serotonergic pathway of vitamin D

Every tissue in the body has vitamin D receptors, including the brain, heart, muscles, and immune system, which means vitamin D is needed at every level for the body to function.

Vitamin D is also the only vitamin that is a hormone. After it is consumed in the diet or absorbed (synthesized) in the skin, vitamin D is transported to the liver and kidneys where it is converted to its active hormone form. Vitamin D as a hormone assists with the absorption of calcium, helping to build strong bones, teeth and muscles. In addition to its well-known role in calcium absorption, vitamin D activates genes that regulate the immune system and release neurotransmitters (e.g., dopamine, serotonin) that affect brain function and development. Researchers have found vitamin D receptors on a handful of cells located in regions in the brain-the same regions that are linked with stress, mood changes and other depression disorder.

The serotonergic pathway of vitamin D can potentially also be useful to explain some of the mixed effects reported in studies investigating interventions containing vitamin D supplementation

4. The vitamin D and our mental and physical wellbeing

Increasing your intake of vitamin D can help reduce stress, improve your happiness, improve your sleep and motivation, and overall improve your quality of life.

So what can vitamin D do for your wellbeing?

a) Relieve your stress

Dark, winter months can bring stress to many, and the science suggests it's more than just feeling cold and stuck indoors. Low levels of vitamin D are associated with depression (e.g. low mood, low energy, increased irritability), making seasonal affective disorder (SAD) a common experience for all in wintertime, but even more prevalent in geographical locations that don't get a lot of regular sunshine (24-25).

b) Boost your mood and energy

Although this might sound similar to relieving stress, strong levels of vitamin D not only correlate with reduced stress – it also improves the production of "feel good" hormones. Vitamin D actively fights depression by increasing serotonin, the hormone key to stabilising mood and increasing happiness.

c) Improve your sleep

Accessing regular sunlight helps us to better align with our biological clock, and it fosters a healthy balance of melatonin (rest hormone) and cortisol (alert hormone) production so that we are more likely to get deeper quality sleep when we do hit the sheets (26). You might even recall those long days of playing in the sun and the

delicious sleep that you got afterwards! Simultaneously, getting good sleep has phenomenal mental health benefits of psychological regulation, restoration and repair.

d) Motivate you

This one is a bit of a no-brainer – we are more motivated to get outside if the weather isn't inclement. Yet, science comes through once again to back us up. Dopamine has also been found to increase when we access those sweet rays of sunshine (27). This is great, because dopamine is known as the "motivation molecule" for its ability to keep us action-focused, mentally clear and attentive. So increasing your sunshine intake can be a great brain-fog buster.

e) Improve your overall quality of life

There's a good reason people flock to sunny beach vacations – it creates the perfect conditions for feeling good. Studies have shown that people who spend more time in the sun are more likely to live longer [alongside protective skincare routines] (28) and also more likely to report higher life satisfaction

5. Scientific evidence regarding the potential effects of vitamin D on supplementation on Psychlogical well being

It is generally stated that if taking dietary supplements to correct vitamin D deficiency improves mental well-being, it would be a simple and cost-effective solution for patients at risk of depression and possibly other mental disorders [29]. The positive effect of vitamin D supplementation was also associated with a reduction in the occurrence of negative emotions, as indicated in the meta-analysis by Cheng et al. [13], and for improvement of quality of life, as indicated in the systematic review by Hoffmann et al. [14].

Vieth, Kimball, Hu, and Walfish (30) conducted a randomized trial that examined the effect of vitamin D supplementation on well being. Well being was measured using a brief questionnaire based on conventional depression screening tools. One group of patients (n = 33) received 600 IU per day while the other group (n = 33) received 4000 IU per day for three months. A significant improvement in well being over time in both groups was noted following treatment (December to February) (p < .012). Although the group receiving the higher dose had a greater response than the lower dose group, the difference was not statistically significant.

A recent study was conducted with an aim to understand the correlation between Vitamin D deficiency, incidences of depression and anxiety and its influence on academic performance amongst University dental students. It was found that vitamin D deficiency showed significant correlation with anxiety and GPA scores, but no correlation with depression among the students. (31)

Researchers have also found that a significant proportion of monoamines can also be increased by Vitamin D relieving depression (32, 33). Various studies have explored the link between Vitamin D levels & depression (34). A research study in Norway revealed more signs of depression are observed in people with low Vitamin D levels in their blood (35). A strong link was found in relation to levels of Vitamin D and the occurrence of depressing symptoms at a 2-year follow-up (36). Cross-sectional research in Finland has shown that depression and Vitamin D status are significantly associated (37).

Various cross-sectional studies have detected an association between vitamin D deficiency and depression and cognitive performance (38-40). Some studies also reported an association between vitamin D deficiency and cognitive impairment (41-42). The other studies also reported vitamin D deficiency and the presence of psychosis in adolescents (43-46).

Although a majority of the high-quality studies indicate that vitamin D supplementation may have a positive impact on depression, other studies do not support the positive influence of vitamin D supplementation on other mental health problems. Patil R et al, studied the effects of vitamin D supplementation and multimodal group exercise on psychosocial functions of wellbeing, including quality of life QoL, mental wellbeing and fear of falling (FoF). When comparing with the placebo withoutexercise group, there were no statistically significant differences between groups receiving eithervitamin D, exercise or both treatments for changes in QoL or mental wellbeing (although a slightdecline was seen in mental wellbeing in those receiving vitamin D only, p = 0.044)(47).

Moreover, physical activity should also be promoted as the confirmed factor associated with mental health [48], additionally supporting the positive influence of vitamin D.

6. Conclusion

Vitamin D is crucial not only for bone health but for proper brain development and psychological functioning. However, low levels of vitamin D are associated with Psychological wellbeing, seasonal affective disorder, depression, and schizophrenia in adults, but there is conflicting evidence about the relationship between vitamin D deficiency and psychological disorders.

The reasons behind these inconsistent findings may lie in the fact that these studies had small patient populations and utilized dissimilar methods for the assessment of parameters for mental health..

Our review is consistent with the hypothesis that, low vitamin D concentration is associated with psychological wellbeing and mental health. Further studies are required to shed sufficient light on this issue.

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