

Research Progress on the Relationship Between Vitamin B and Geriatric Depression

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Abstract. In the context of global aging, the incidence of geriatric depression has increased significantly, and the existing drug treatment has limited effect, so it is urgent to explore new intervention methods. Vitamin B, as a water-soluble nutrient, plays an important role in the occurrence and development of depression by participating in physiological processes such as neurotransmitter synthesis, homocysteine metabolism, methylation reaction and energy metabolism. This article systematically reviews the relationship between vitamin B and geriatric depression in order to reveal its potential mechanism and therapeutic value. Studies have shown that insufficient vitamin B intake and decreased serum levels are significantly related to depressive symptoms in the elderly, and vitamin B supplementation can alleviate depressive symptoms by regulating neurotransmitter balance, reducing homocysteine toxicity, and improving methylation function. Clinical evidence shows that supplementation with B vitamins alone or in combination with antidepressants can improve the efficacy of treatment and is safe. However, there are still some problems in the current research, such as insufficient evidence of causality, lack of targeted studies in elderly groups and lack of standardization of supplementary programs. In the future, large-scale clinical studies should be conducted to clarify the therapeutic value of vitamin B, analyze the molecular mechanism combined with multidisciplinary technology, and optimize the vitamin B level in the elderly through nutritional intervention strategies, so as to provide scientific basis for the accurate prevention and treatment of geriatric depression.

Keywords: Vitamin B, Geriatric Depression, Supplement Therapy.

1. Introduction

At present, the global population aging process is gradually accelerating. According to international regulations, people aged 60 and above are classified as the elderly group. As of 2020, there were approximately one billion people aged 60 years and older worldwide. It is predicted that by 2030, this number will climb to 1.4 billion, representing one-sixth of the global population [1]. In the elderly population, depression has become a major factor affecting their physical and mental health. According to the survey data of the World Health Organization, the global prevalence of depression in the elderly is about 13.3% [2]. In China, the prevalence of geriatric depression is about 20%-25% [3]. Geriatric depression patients often present depression, slow thinking, hypochondriasis and somatization symptoms, which seriously affect their quality of life. At present, the treatment of geriatric depression is still dominated by antidepressants, but only about 30% of patients have satisfactory therapeutic effects, and on the whole, the treatment is difficult and the prognosis is poor [4]. Therefore, it is necessary and urgent to explore a variety of treatment methods for geriatric depression.

In recent years, mental disorders caused by nutritional disorders in the elderly have attracted more and more attention from all walks of life. B vitamins are a class of water-soluble compounds, mainly including vitamin B1 (ammonium sulfide), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B5 (pantothenic acid), vitamin B6 (pyridoxine), vitamin B7 (biotin), vitamin B9 (folate), vitamin B12 (cobalamin). These vitamins can be obtained from everyday foods. They play a crucial role in the regulation of brain function and the production of neurotransmitters [5]. B vitamins are essential for the methylation cycle, monoamine oxidase generation, DNA synthesis, and phospholipid repair and maintenance. Among them, vitamins B1, B3, B6, B9 and B12 are crucial for the normal maintenance of neuronal function, and thus have a significant impact on the generation of depressive symptoms

[6]. At present, the research on vitamin B assisted treatment of elderly depression mainly focuses on vitamins B9, B12 and B6. The purpose of this article is to discuss the current research progress on the relationship between B vitamins and geriatric depression.

2. Association between Vitamin B Levels and Depression in the Elderly

2.1. Correlation Analysis between Vitamin B Intake Level and Depressive Symptoms

The results of the study showed that the level of vitamin B intake was negatively correlated with the severity of depressive symptoms, that is, the lower the level of vitamin B, the more severe the depressive symptoms tended to be. For example, a cross-sectional study of 1,635 adults with depression using a logistic regression model showed a reduced risk of depression in the group with the highest intake compared to the group with the lowest intake of each vitamin B. The odds ratios (OR) of vitamin B1, B2, B3, B6 and B12 were 0.64 (95%CI: 0.50-0.82), 0.78 (95%CI: 0.62-0.97), 0.60 (95%CI: 0.47-0.78) and 0.65 (95%CI: 0.65), respectively. 0.50-0.84), 0.71 (95%CI: 0.54-0.95). These results indicate that lower intakes of vitamins B1, B2, B3, B6, and B12 are associated with a higher risk of depression [7]. Another cross-sectional study conducted in Japan examined the association between vitamin intake and depressive symptoms in 1,634 older Japanese adults (914 women and 720 men) aged 65 years and older. A shorter version of the Geriatric Depression Scale (GDS) was used to assess depressive symptoms, and results showed a prevalence of 26.7% among participants with depressive symptoms, including 26.8% (245/914) in women and 26.6% (192/720) in men. Analysis of 15 vitamin intakes through the short self-administered Dietary History Questionnaire (BDHQ) found that in the female population, participants with depressive symptoms had significantly lower levels of the entire B vitamin group [8]. Taking into account the dietary habits of elderly patients, the intake of vitamin B is generally lower than that of healthy elderly people.

2.2. Correlation Analysis between Serum Vitamin B Level and Depressive Symptoms

Through a series of complex and orderly metabolic processes, all kinds of vitamin B are taken into the body, undergo multiple transformations, and finally exist in the form of active components in the serum. In the study to explore the difference in vitamin B levels between depressed patients and healthy people, the researchers used electrochemical luminescence immunoassay method to measure the serum vitamin B12 and B9 levels of 148 depressed patients and 160 healthy people. The results showed that the mass concentration of serum vitamin B12 in depression group was lower than that in control group, the specific data was (527.28 ± 173.74 vs. 669.67 ± 336.89) $\text{pg} \cdot \text{mL}^{-1}$, $P = 0.000$; Meanwhile, the mass concentration of serum vitamin B9 in depression group was also lower than that in control group (7.03 ± 3.52 vs. 7.93 ± 4.00) $\text{pg} \cdot \text{mL}^{-1}$, $P = 0.038$. These results showed that serum vitamin B12 and B9 levels were lower in depressed patients than in healthy people [9]. Another study used radioimmunoassay to determine serum vitamin B9 concentration in 11 elderly patients with depression and 20 normal elderly patients. The results showed that the serum vitamin B9 concentration in the elderly patients with depression was (13.55 ± 3.80) ng/mL , which was significantly lower than that in the normal elderly (18.86 ± 7.99) ng/mL , $P < 0.05$ [10]. In addition, 669 non-institutionalized Chinese adults aged 55 years and older living in the community were classified into depressed and non-depressed patients with the Geriatric Depression Scale (GDS) score of ≥ 5 . The mean serum vitamin B9 concentration in patients with depression ($n = 178$) was significantly lower than that in patients without depression ($n = 491$) (21.5 nmol/L vs. 24.0 nmol/L , $P = 0.04$). At the same time, it was observed that when serum B12 levels were deficient ($< 180 \text{ pmol/L}$), there was a significant association with depressive symptoms ($\text{OR} = 2.68$, $95\% \text{ CI} = 1.20-6.00$). Thus, decreased serum vitamin B9 levels and deficiency of B12 levels are closely associated with an increased risk of depressive symptoms in elderly Chinese [11].

3. Study on the Potential Mechanism of Vitamin B Group Affecting the Onset of Geriatric Depression

3.1. Neurotransmitter Synthesis Disorder

B vitamins are involved in the synthesis and metabolism of many neurotransmitters. For example, vitamin B6 is involved in the synthesis of serotonin, dopamine, norepinephrine, and GABA (gamma-aminobutyric acid), and a deficiency may lead to decreased levels of these neurotransmitters, triggering low mood and anhedonia; Vitamin B9 and vitamin B12 are involved in the methylation reaction, and deficiencies may lead to decreased serotonin and dopamine levels and worsen depressive symptoms; Vitamin B3 is involved in tryptophan metabolism and serotonin synthesis, and deficiency may lead to decreased serotonin levels and increase the risk of depression [12].

3.2. Increased Homocysteine (Hcy) Levels

Vitamins B6, B9 and B12 work together to participate in the metabolism of Hcy. Vitamin B deficiency can lead to the increase of Hcy level, Hcy has neurotoxicity, can directly damage neurons, affect brain function; High levels of Hcy can increase the risk of cerebrovascular diseases, lead to reduced cerebral blood flow and insufficient oxygen supply, and then induce depression symptoms in the elderly. Elevated Hcy can aggravate oxidative stress, lead to neuronal damage and inflammatory response, and further aggravate depression in elderly patients [13, 14].

3.3. Impaired Methylation Process

Vitamins B9 (folic acid) and B12 are key coenzymes in the methylation reaction, involved in the methylation modification of DNA, RNA and proteins. Abnormal methylation may lead to dysregulation of gene expression related to mood regulation and increase the risk of depression; Impaired methylation process may affect the growth and repair of neurons, resulting in decreased neuroplasticity, and thus affect emotional regulation [14].

3.4. Energy Metabolism Disorders and Increased Inflammation

Vitamins B1 (thiamine), B2 (riboflavin) and B3 (niacin) are involved in the process of energy metabolism. Vitamin B deficiency may lead to reduced ATP production, affect neuronal function, and lead to fatigue and low mood; Vitamin B deficiency may affect mitochondrial function, resulting in insufficient energy supply, which in turn affects nervous system function. B vitamin deficiency may exacerbate the inflammatory response. Vitamin B deficiency may lead to increased levels of pro-inflammatory factors (such as IL-6 and TNF- α), causing neuroinflammation and affecting emotional regulation [15].

3.5. Myelination and Nerve Conduction Disorders

Vitamin B12 is essential for the formation and maintenance of myelin. Vitamin B12 deficiency may lead to myelin damage, affect the speed of nerve signal transmission, leading to nervous system dysfunction; Slowed nerve conduction: Myelin damage can slow down nerve conduction, which may lead to cognitive decline and emotional regulation disorders [16].

4. Effect of Vitamin B Supplement Therapy on Geriatric Depression

4.1. Use of Vitamin B Therapy Alone

B vitamins have shown some potential in the treatment of geriatric depression, especially in improving neurotransmitter metabolism, reducing homocysteine levels, and alleviating cognitive impairment. For elderly patients with depression, vitamin B12 supplementation can effectively improve the cognitive function and emotional state of elderly patients with depression. Studies have shown that vitamin B12 deficiency is more common in the elderly, and prospective cohort studies

have shown that good vitamin B12 status is associated with the maintenance of cognitive function, so vitamin B12 supplementation can be included in the category of routine supplementation [17, 18]. Studies have shown that combined treatment with vitamin B12 and B9 can reduce homocysteine (Hcy) levels and improve depressive symptoms, especially in the elderly population [19]. Vitamin B6 plays a key role in neurotransmitter synthesis, and supplementation with vitamin B6 may improve depressive symptoms by regulating serotonin and dopamine levels. In addition, comprehensive supplementation of a variety of B vitamins, such as B6, B9 and B12, may have a synergistic positive effect on elderly patients with depression. Studies have found that supplementation of B vitamins (B6, B9 and B12, etc.) can improve cognitive function in middle-aged and elderly patients with hyperhomocysteinemia. Compared with the control group (placebo group), the total score of the basic cognitive ability test and the four sub-test scores of the intervention group (supplementing B vitamins B6, B9 and B12, etc.) were significantly improved, suggesting that the comprehensive supplementation of multiple B vitamins in elderly patients with depression may have a synergistic effect and help to improve the condition of patients [20].

4.2. Study on the Combined Use of Vitamin B and Antidepressants

B vitamin supplementation may enhance the efficacy of antidepressants, especially in older patients. In this randomized controlled study, 141 healthy subjects (48 males and 93 females, mean age (49.03 ± 17.25) years) were selected. The patients were randomly divided into group A (intramuscular vitamin B12 injection for one week + oral capsules of adenosyl cobalamin and mecobalamine), group B (group A plus venlafaxine sustained-release tablets) and group C (only venlafaxine sustained-release tablets), with 39 cases in each group. The results showed that compared with before treatment, HAMD (Hamilton Depression Scale), HAMA (Hamilton Anxiety Scale), SDS (Self-rating Depression Scale) and SAS (Self-rating Anxiety Scale) scores of the three groups were decreased after 3 months of treatment ($P < 0.05$). After 3 months of treatment, the above scores of group B were lower than those of groups A and C, and the anxiety and depression scores of group C were lower than those of group A ($P < 0.05$). This indicates that vitamin B12 treatment can improve the anxiety and depression state of patients, reduce the scale score, and no obvious adverse reactions, and compared with anti-anxiety and depression drugs alone, the effect of combined vitamin B12 is better [21]. Another study of 70 patients with depression, randomly divided into a control group (oral citalopram only) and a study group (oral citalopram plus vitamin B12 treatment), showed a significantly higher response rate for depression after 8 weeks in the study group than in the control group (94.3% vs. 74.3%, $P < 0.01$). There was no significant difference in TESS score between the two groups ($P > 0.01$). It has been shown that supplementing vitamin B12 for adjuvant therapy can significantly improve the therapeutic effect of patients with depression without increasing adverse reactions [22].

5. Conclusion

In this paper, the relationship between vitamin B and geriatric depression was reviewed from the aspects of correlation, potential mechanism and therapeutic effect. There is a close relationship between vitamin B and geriatric depression, and lower vitamin B intake and serum level are often associated with a higher risk of depression, which suggests that we can adjust the diet structure of the elderly or carry out appropriate nutritional supplements to maintain adequate vitamin B levels in the body, so as to reduce the incidence of geriatric depression. B vitamins play an indispensable role in several key physiological processes such as neurotransmitter synthesis, homocysteine metabolism, methylation process, energy metabolism, inflammatory response, and myelination and nerve conduction. Any link caused by vitamin B deficiency disorders, may cause or aggravate the symptoms of geriatric depression, which provides a theoretical basis for us to understand the effects of vitamin B on the internal causes of geriatric depression. In terms of therapeutic effect, vitamin B supplementation alone can improve neurotransmitter metabolism, reduce homocysteine level, and

alleviate cognitive impairment. When used in combination, B vitamins can enhance the efficacy of antidepressants and improve the effectiveness of treatment.

However, there are still some limitations in the current study. On the one hand, most of the existing studies are observational studies, and it is difficult to determine the causal relationship between vitamin B and depression in the elderly. On the other hand, most studies focus on depression patients of all ages, and there is a lack of targeted research on the elderly group, a special and high incidence group. In addition, when vitamin B is used in the treatment of geriatric depression, the optimal supplement type, dosage and course of treatment are not clear. Future studies need to further optimize the design, conduct large-scale and long-term randomized controlled trials, and further study elderly patients to determine the optimal supplemental dose and course of vitamin B in the treatment of geriatric depression. At the same time, combining biochemistry, imaging, genetics and other multidisciplinary technologies, in-depth exploration of the molecular mechanism of vitamin B's influence on geriatric depression, to provide a more solid scientific basis for personalized and accurate treatment of geriatric depression. In terms of prevention, it is necessary to strengthen the popularization and publicity of nutrition knowledge for the elderly, improve their awareness of the importance of vitamin B, and promote their initiative to take healthy diet and nutritional supplement measures to prevent and improve geriatric depression.

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