

Micronutrients : Vital for Mental Health with Special Reference to Depression

Ratnesh Kumar Soni

Assistant Professor, Department of Zoology K.N. Government P.G. College, Gyanpur-Bhadohi (U.P.) , India

Dr. Sudhi Shrivastava

Assistant Professor, Department of Zoology, C.M.P. College, Prayagraj (U.P.) , India

ABSTRACT

Extensive research indicates that nutrition may play a vital role in the inception and treatment of mental disorders such as, anxiety, depression, and schizophrenia. Further, more recent evidence on brain metabolism and functions suggests that nutritional habits or deficiencies of specific micronutrients can induce the development and progression of mental illnesses. However, diet is an important component of mental health, People are still unaware about the importance and requirement of nutrition for mental health. Depression is a mental health disorder characterized by persistently depressed mood or loss of interest in activities, feeling of sadness causing considerable impairment in daily life. It may also lead to a range of behavioral and physical symptoms like changes in sleep patterns, appetite, energy level, concentration, loss of consciousness, Inability to make decisions and other cognitive functions, it can also be associated with thoughts of suicide. Depression is predominantly triggered by a chemical imbalance in the brain, Neurotransmitters are the chemicals which controls vital neural functions is often synthesized from an amino acid and other micronutrients. Deficiencies of micronutrients may lead to alter the pattern of brain chemical neurotransmitters production and altered activity of neural circuits resulting in mental illness like depression. Which is more commonly physiologically or emotionally driven. Line of treatment includes medication, meditation therapy and self-care like sleep, different types of exercise, and diet. There are evidence supporting the benefits of proper diet and nutrition in different diseases like cancer, cardiovascular diseases, kidney failure, diabetes, dementia, mental illness and depression. When indicated, suitable supplementation with vitamin C, folic acid, niacin, thiamine, iron, zinc, magnesium, potassium and sodium and omega-3 fatty acids is suggested. Evidence suggests that daily supplements of vital nutrients are generally effective in controlling symptoms of depression.

Keywords: Depression, Micronutrients, Vitamins, Minerals.

I. INTRODUCTION

Depression is a prevalent mental illness that is defined by prolonged melancholy, loss of interest in once-enjoyed pursuits, and the inability to carry out everyday tasks for at least two weeks. A lack of energy, a change in appetite, irregular sleeping patterns,

anxiety, poor attention, impulsivity, restlessness, feelings of worthlessness, remorse, or hopelessness, and suicidal or self-harm ideas are some common symptoms of depression [1]. The fourth most significant factor in early mortality and the top cause of disability globally, respectively, is major depression. There is a 20% lifetime risk of developing major

depression or dysthymic illness, and prevalence is estimated to be between 2-4% [2-10].

Depression frequently causes changes in weight because of possible changes in appetite. Overeating or comfort eating may happen to some people and result in weight gain. People who suffer from depressive illnesses may be undertreated because they feel unworthy of food, unmotivated, or unenthusiastic to prepare meals, or because they have somatic illusions that they cannot eat. Loss of weight and inadequate nutrient intake are caused by reduced food intake [3]. The relationship between nutrition and depression is not widely known. Depression's development, intensity, and duration can all be significantly influenced by nutrition. There are many readily observable food patterns that occur before depression and those that do so. Poor appetite, skipping meals, and an excessive preference for sugary foods are a few examples [4]. The severity of these nutrients' deficiencies is a prominent aspect of the diets of people with mental illnesses. A study has shown that daily nutritional supplements are frequently successful in lowering the symptoms of depression in patients [5].

Micronutrient and Neurons- Millions of neurons, also known as nerve cells, make up a portion of the brain and the rest of the nervous system. The brain functions as a result of electrical or chemical messages exchanged between these neurons, which enable for communication. Neurotransmitters are the molecules that transport the messages. The majority of neurotransmitters are produced in the brain from a variety of chemical molecules known as their "precursors." The brain cannot produce the neurotransmitter if the precursor is not present. This will prevent the brain cells from properly communicating with one another. Different protein/amino acids and micronutrients (vitamin and minerals) act as precursors of various neurotransmitters [4]. Since nutrients and neurotransmitters have a direct relationship, it is easy

to see how a dietary deficiency could cause alterations in the pattern of neurotransmitter production.

Micronutrients:- The development of mental disease is caused by the combination of numerous factors that cause specific brain chemicals and neurotransmitters to malfunction. A change in the chemical structure of a neurotransmitter or an imbalance at any stage of this intricate process may have an impact on feelings, moods, thoughts, and behaviours [3]. Changes in brain signal transmission at the level of the chemical synapse are also crucial in the development of mental disorders. Depression is frequently correlated with deficiencies in neurotransmitters such as serotonin, dopamine, adrenaline, and gamma-aminobutyric acid (GABA) [6, 7].

The action of enzymes and coenzymes is dependent on the availability and balance of the macronutrients available for brain function. Many coenzyme systems depend on micronutrients, and they may also be responsible for the full activation of the enzymes involved in neurotransmitter synthesis [8]. For instance, the formation of biogenic amines requires the presence of riboflavin, vitamin B6, and iron [9]. People with mood disorders may have subclinical deficiencies as a result of genetic variances, to which some people are more susceptible, or historical changes in diet composition.

Impact of micronutrient's on depression- A variety of vitamins are required for neurotransmission. The vitamins folate, niacin, riboflavin, thiamin, vitamin B6, vitamin B12, vitamin C, vitamin D, vitamin E, and the vitamin-like substance choline are among those that have been investigated in relation to mood disorders. For the brain to operate normally, all vitamins are necessary. However, several of them play a crucial role in how neurons and other brain cells function. In fact, each vitamin can be given a specific efficacy rating for a range of cognitive activities [10,11].

Several micronutrient deficiencies have a negative impact on the brain and may aggravate mental

diseases such as depression. It is conceivable that paying attention to your diet and, when necessary, taking supplements of vitamins C, folic acid, niacin, thiamine, iron, zinc, omega-3 fatty acids, vitamin D, and vitamin E could help you take less antipsychotic medication and lessen its toxicity and adverse side effects [12,13].

Vitamin B complex:- A lack of vitamin B1 causes brain damage and serves as a coenzyme in the synthesis of glutamate, acetylcholine, and gamma-aminobutyric acid (GABA). The presence of vitamin B1 facilitates the utilisation of glucose by nervous tissue. B1 and B9 vitamins also protect the brain throughout development and maintain memory as people age. Premenstrual depression may be helped by vitamin B6, according to research. Premenstrual depression may be reduced by vitamin B6. The synthesis of neurotransmitters like dopamine and serotonin is directly influenced by vitamins B6 and B12 among others [9–14]. Tyrosine hydroxylase activity and dopamine synthesis in pheochromocytoma cells are increased by vitamin B nicotinamide adenine dinucleotide [12].

Evidence suggests that depression is frequently caused by vitamin B6 deficiency [15], and the underlying process may be linked to a drop in serotonin levels in the brain. Dopamine, serotonin, nor-epinephrine, epinephrine, histamine, and GABA are just a few of the neurotransmitters that are produced when pyridoxine, or vitamin B6, is present [14,15]. Additionally, it contributes to the synthesis of GABA, histamine, adrenaline, serotonin, and dopamine. Lack of tends to lower serotonin and GABA production. The synthesis of serotonin and GABA in the brain can be specifically decreased by vitamin B6 deficiency [16,17]. Dopamine, serotonin, histamine, epinephrine, and GABA are all synthesized with the help of cobalamine.

Numerous neurotransmitters are synthesized with the help of vitamin B12. The risk of depression in older individuals is directly correlated with vitamin B12 concentrations (19). Because vitamin B12 absorption is

so difficult and prone to failure, it is very typical for older persons to have low or inadequate quantities of the vitamin. Since treatment may result in a significant improvement in both mood and cognitive function, vitamin B12 levels should be checked in elderly individuals especially. According to studies, 30 percent of depressed people who were admitted to hospitals had vitamin B12 deficiencies (20).

The majority of micronutrient deficiencies thus have an impact on people's ability to think clearly. Folic acid deficiency promotes depression and reduces the effectiveness of antidepressant drugs [23,24]. In other situations, the initial clinical sign of vitamin B12 deficiency is a mental illness that is rather prevalent in older people and is typically accompanied by cognitive decline [25–27].

Vitamin C:- In the brain, ascorbate (vitamin C) is a crucial antioxidant molecule. However, it also performs a variety of additional crucial tasks, acting as a cofactor in many enzyme activities that result in the formation of collagen, the synthesis of catecholamines, and the regulation of HIF-1, a neuromodulator of glutamatergic, dopaminergic, cholinergic, and GABAergic transmission and related behaviours [28–30]. The sodium-dependent vitamin C transporter 2 (SVCT2) is responsible for carrying ascorbate into the brain and neurons and causing it to accumulate inside of cells against a gradient in concentration [30]. In tissues high in ascorbic acid, such the brain and the adrenal gland, catecholamines are biosynthesized. Additionally, eating foods rich in vitamin C is associated to lesser significant alterations in cognitive function [31,32]. Neuronal transmission and the metabolism of neurotransmitters are both impacted by vitamin C. In patients with low plasma vitamin C concentrations, long-term therapy with a multivitamin supplement containing adequate quantities of vitamin C improved mood [33]. Exhaustion and psychological idiosyncrasies might result from vitamin C insufficiency [34].

Principal minerals associated with depression

Calcium:- Vasodilatation, constriction, and neuronal impulse transmission are all mediated by calcium. It has been demonstrated that psychological problems have unusual calcium activity, and mood-stabilizing medications may control calcium ion hyperactivity. A higher level of platelet serotonin-stimulated intracellular calcium mobilization was found to be linked with depression in particular [35].

Iron:- Iron is essential for the synthesis of serotonin, norepinephrine, epinephrine, and dopamine. Iron, for instance, functions as a cofactor in the conversion of tyrosine into dopamine. Changes in iron metabolism have thus been suggested as potential clinical indicators in depressed patients [36]. Additionally, serotonin binding proteins in the frontal brain are thought to bind dopamine and serotonin more strongly [37].

Magnesium:- Magnesium is essential for the active transport of ions like potassium and calcium, which has an impact on how nerve impulses are conducted. Magnesium insufficiency is widely documented to cause neuropathology's. One of the most important minerals in the human body, magnesium is linked to neuronal membrane fluidity and brain biochemistry. Magnesium insufficiency was associated with a number of neuromuscular and psychiatric symptoms, including various forms of depression [38,39]. Magnesium is necessary for the synthesis of protein, DNA, and RNA as well as for reproduction. Additionally, magnesium is necessary for the control of cardiac excitability, blood pressure, insulin metabolism, muscle contraction, nerve conduction, and vasomotor tone [40].

Potassium and sodium:- Endogenous digitalis-like compounds (DLC) and sodium- and potassium-activated adenosine triphosphatase (Na^+ , K^+ -ATPase) in the brain have been linked to the pathophysiology of mood disorders. All cells, including neurons and glia, have Na^+ , K^+ -ATPase activity, which is a key mechanism that influences cell volume, electrical membrane potential, and different transport systems [40,41]. Na^+ , K^+ -ATPase activity anomalies in

erythrocytes have repeatedly been linked to bipolar illness [34].

Zinc:- More than 200 different enzymes in the body and brain require zinc to operate, including those involved in immune system, cell division and replication, and the synthesis of polyunsaturated fatty acids from the necessary fatty acid precursors found in plant sources. Low amounts of both zinc [41] and serotonin metabolites have been demonstrated to be related with the onset of depression [41]. and zinc and serotonin receptors have a biophasic interaction [40,41]. Additionally, it supports neurons and glial cells and aids in protein synthesis, structure, and gene expression regulation.

Conclusion:- Because micronutrients are the building blocks of the majority of brain chemicals, such as neurotransmitters, we must change our eating habits in order to increase the activity of our brain cells. Any shortage or surplus can lead to issues with mental health as well as other issues. Numerous Vitamin B deficiencies have long been associated to brain problems. Vitamin B9 aids in clinical improvement and enhances the therapeutic effects of fluoxetine. Vitamins B1, B6, and B12 can significantly reduce depressed symptoms and assist the patient in getting back to their full workload. Minerals including calcium, magnesium, potassium, and zinc lessen the symptoms of depression. In general, micronutrients (vitamins and minerals) are extremely important and strongly linked to mental health.

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