Nutritional Psychiatry: Exploring The Relationship Between Nutrition And Mental Health

Dal, D[1] and Sunayan Sharma[2]*

[1]Research scholar of Amity University, Noida, Uttar Pradesh – 201303, India

[2*]Assistant Professor, Amity University, Noida, Uttar Pradesh – 201303, India

*Corresponding author email: ssharma51@amity.edu

Abstract. The emerging field of nutritional psychiatry has brought significant attention to the role of dietary patterns and specific nutrients in influencing mental health outcomes. The intricate connection between diet and mental health is examined in this review, with a focus on how diet can impact mood, cognitive function, and the likelihood of developing psychiatric disorders. Nutrient-dense diets, like the Mediterranean and traditional plant-based diets, may lower the risk of anxiety and depression. According to recent research, diets heavy in ultra-processed foods, refined sugars, and unhealthy fats may make people more susceptible to mental health issues. Important nutrients for neurotransmitter synthesis and brain function include omega-3 fatty acids, B vitamins, vitamin D, zinc, magnesium, and amino acids. There is mounting evidence, more thorough, long-term research and clinical trials are required to show causation and give dietary recommendations for mental health. The potential of incorporating nutritional practices into mental health treatment as an adjunctive strategy, providing a more comprehensive and preventive model. Customised dietary interventions targeted at enhancing psychological resilience and general well-being may be made possible by an understanding of the relationship between our diet and emotions.

Keywords: Mental health, diet and mood, macro-micronutrients, depression, anxiety.

1. INTRODUCTION

Mental health includes emotional, psychological, and social elements that affect behaviour, thought processes, and interpersonal interactions. According to the National Mental Health Survey (NMHS) 2015–16, 10.6% Indian adults have a mental illness, and treatment gaps for different conditions range from 70% to 92%. The prevalence was higher in urban metro areas (13.5%) than in rural areas (6.9%) and urban non-metro areas (4.3%). The most common mental health conditions worldwide are anxiety and depression, which have grown to be serious public health issues. The World Health Organisation (WHO) estimates that depression affects about 280 million people globally and is a major cause of impairment. Additionally, anxiety disorders are common, affecting approximately 301 million people worldwide. The prevalence of mental health problems is high in India. According to WHO estimates, India has an age-adjusted suicide rate of 21.1% per 100,000 people and 2,443 disability-adjusted life years (DALYs) per 100,000 people due to mental health issues. It is estimated that mental health disorders will cost the economy USD 1.03 trillion between 2012 and 2030. The prefrontal cortex, amygdala, hippocampus, anterior cingulate cortex, and basal ganglia all of which are essential for memory, emotion regulation, cognition, and decision-making are frequently affected by structural and functional changes in brain. Depression is linked with reduced activity and volume in the dorsolateral prefrontal cortex, affecting mood regulation and cognitive flexibility [1]. Schizophrenia patients show hypo frontality, a state of decreased metabolic activity in the PFC, contributing to disorganized thinking and poor judgment. Increased amygdala activation has been observed in individuals with generalized anxiety disorder (GAD) and social anxiety, correlating with hypervigilance and emotional dysregulation. In major depressive disorder (MDD), hippocampal volume reduction is well-documented and may result from elevated cortisol levels due to prolonged stress. Persistent stress elevates cortisol levels, affecting neuroplasticity and reducing hippocampal volume and also elevated inflammatory cytokines like IL-6 and TNF-α can alter neurotransmission and synaptic function, contributing to depression and cognitive decline [2]. Dysregulation of serotonin, dopamine, norepinephrine, and GABA systems underlies many mental disorders, influencing mood, anxiety, and behaviour.

Nutrition plays a fundamental role in brain function and neurotransmitter synthesis. The human brain is an energy-intensive organ, consuming approximately 20% of the body's energy, and it relies on a steady supply of nutrients to maintain cognitive and emotional balance. Macronutrients such as carbohydrates, proteins, and fats, along with essential micronutrients like B vitamins, omega-3

https://doi.org/10.1051/bioconf/202517802017

fatty acids, magnesium, and zinc, contribute to neurochemical processes that regulate mood, stress responses, and cognitive function [3]. A growing body of evidence links poor dietary habits to the exacerbation of mood disorders. For instance, diets high in processed foods and sugars have been associated with increased rates of depression and anxiety. Conversely, diets rich in fruits, vegetables, whole grains, and omega-3 fatty acids are correlated with improved mental health. Amino acids, such as tryptophan and tyrosine, serve as precursors for neurotransmitters like serotonin and dopamine, which regulate mood and cognition [4]. B vitamins, including B6, B9 (folate), and B12, are essential for neurotransmitter synthesis and methylation processes that affect cognitive function. Omega-3 fatty acids, particularly docosahexaenoic acid (DHA), support neuronal membrane integrity and enhance synaptic transmission. Initial research has demonstrated that Mediterranean diets, which are abundant in fruits, vegetables, and omega-3 fatty acids, promote mental wellness, whereas the intake of processed foods correlates with a heightened risk of mental health issues.

The connection between diet and mental health has gained significant attention in recent years, leading to the emergence of *nutritional psychiatry*-a field that investigates how dietary patterns influence mood, cognition, and overall psychological well-being. This multidisciplinary field investigates the relationship between different nutrients and the general quality of diet and the development, course, and treatment of mental health conditions. It is a developing area that investigates how dietary choices affect mental health. Evidence indicates a significant connection between nutrition and psychological well-being, with specific eating habits impacting brain function, emotional stability, and psychiatric conditions [5]. The discipline seeks to understand the effects of food elements such as vitamins, minerals, and fatty acids on cognitive functions, emphasizing the necessity of both macro- and micronutrients. Furthermore, as highlighted by (Zepf et al.,2015), nutritional psychiatry synthesizes insights from neuroscience, psychology, and nutrition to formulate holistic strategies for the prevention and treatment of mental health disorders [5]. This interdisciplinary approach reinforces the mounting evidence that unhealthy eating patterns can worsen mood disorders, while nutritious diets may enhance psychological resilience [5].

2. POTENTIAL PATHWAYS LINKING NUTRIENTS AND MENTAL HEALTH

2.1 Macronutrients-

2.1.1. Omega-3 Fatty Acids:

Omega-3 fatty acids, especially EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), are vital for brain health and significantly affect mood regulation. Studies have demonstrated a strong link between omega-3 deficiencies and the onset of mood disorders, including depression and anxiety [6]. Consuming omega-3 fatty acids has been connected to the prevention and treatment of mental illnesses such as anxiety, bipolar disorder, schizophrenia, depression, and cognitive decline. Omega-3 fatty acids are essential for preserving the integrity of neuronal membranes, which can enhance cognitive abilities and emotional stability [7]. Increased levels of inflammatory cytokines, including tumour necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), have been linked to depression. Omega-3s may lessen depressive symptoms by lowering these pro-inflammatory markers. Research indicates that omega-3 supplementation can reduce symptoms of mood disorders, particularly when used alongside conventional treatments [8]. Seafood consumption, a proxy for omega-3 fatty acid intake, is strongly inversely correlated with rates of major depression, postpartum depression, and bipolar disorder across nations. The anti-inflammatory effects of omega-3s may also play a role in their ability to stabilize mood, as chronic inflammation has been associated with various mental health issues. Incorporating omega-3-rich foods into the diet, such as fatty fish (like salmon and mackerel), flaxseeds, chia seeds, and walnuts, can supply these essential fats, thereby supporting both cognitive function and emotional resilience.

2.1.2. Carbohydrates:

The body uses carbohydrates as its main energy source, making them an essential macronutrient. Carbohydrates are a vital macronutrient that serve as the primary source of energy for the brain, which consumes approximately 20% of the body's total energy. They are essential for brain health, cognitive function, and emotional stability in addition to their physiological role. Eating carbohydrates affects neurotransmitter activity, especially serotonin synthesis, which is linked to mental stability and mood regulation. The main energy source for neurones, glucose is produced by the metabolism of carbohydrates and is essential for memory, emotional control, and cognitive function [9]. Low blood sugar, or hypoglycemia, can cause symptoms like exhaustion, agitation, and cognitive decline, underscoring the significance of consistent carbohydrate consumption for mental well-being. Carbohydrates increase the release of insulin, which helps amino acids like tryptophan cross the blood-brain barrier, leading to increased serotonin synthesis [10]. Long-term high-sugar diet consumption can cause inflammation, oxidative stress, and insulin resistance, all of which are associated with neurodegeneration and cognitive decline. Complex carbohydrates, found in whole grains, legumes, fruits, and vegetables, provide a slow and steady release of glucose, promoting stable energy levels and mood. Refined carbohydrates, such as white bread, sugary snacks, and processed foods, lead to rapid spikes and crashes in blood sugar levels, contributing to mood instability and fatigue and also high glycemic index (GI) foods have been linked to an increased risk of depression, anxiety, and cognitive decline. While low-carbohydrate diets (such as ketogenic diets) have been explored for their potential benefits in neurological disorders, they may negatively impact mood in some individuals.

2.1.3. Proteins:

An important macronutrient for preserving general health, including mental health, is protein. They are made up of amino acids, which are the building blocks of chemical messengers called neurotransmitters that control mood, emotion, and cognitive function. Proteins help maintain brain regions like the prefrontal cortex and hippocampus, which are essential for memory and emotional control, as well as neurogenesis and synaptic plasticity [11]. Tryptophan, an essential amino acid, serves as a precursor for serotonin, a neurotransmitter responsible for mood stabilization, emotional regulation, and sleep quality [4]. Low tryptophan levels have been linked to depression and anxiety disorders. Tyrosine is a precursor for dopamine and norepinephrine, neurotransmitters that enhance motivation, alertness, and stress resilience and increased dopamine availability has been associated with reduced symptoms of depression and improved cognitive performance. Glutamate, derived from amino acids, plays a key role in cognitive function and memory. Gamma-aminobutyric acid (GABA), synthesized from glutamate, promotes relaxation, and reduces anxiety. Patients with schizophrenia have been shown to have abnormal amino acid metabolism and altered protein signalling in the brain, which may indicate that protein-based diets can help manage symptoms. Also, because of structural brain atrophy and decreased neurotransmitter activity, protein malnutrition in older adults can contribute to cognitive decline and an increased risk of dementia. Studies have shown that low dietary protein intake is associated with an increased risk of depression and anxiety due to inadequate neurotransmitter production. Moreover, Protein malnutrition has been linked to neurodegenerative diseases such as Alzheimer's and Parkinson's, as amino acid deficiencies impair brain function and synaptic plasticity [12]. Legumes, quinoa, tofu, and nuts are excellent protein sources for individuals following vegetarian or vegan diets. Combining plant proteins ensures a sufficient amino acid profile for neurotransmitter synthesis [12].

2.2. Micronutrients-

2.2.1. B Vitamins:

B vitamins, including B6, B12, and folate, are essential for mental health as they aid cognitive functions and emotional stability. Insufficient levels of B vitamins have been associated with higher rates of depression, anxiety, and cognitive decline [13]. These vitamins are crucial for neurotransmitter synthesis, particularly serotonin, as well as for homocysteine metabolism, both of which are vital for maintaining mental health. Vitamin B6 is required for the enzymatic conversion of tryptophan into serotonin and dopamine, neurotransmitters that regulate mood and motivation. Vitamin B12 and folate (B9) are involved in the methylation cycle, which supports the production of S-adenosylmethionine (SAMe), a key compound in neurotransmitter metabolism. Thiamine (B1) plays a role in glucose metabolism and energy production in the brain, essential for cognitive performance and memory retention. Niacin deficiency is linked to pellagra, a condition that causes depression, anxiety, and cognitive dysfunction. Increased homocysteine levels, which are neurotoxic and linked to Alzheimer's disease and vascular dementia, can result from deficiencies in B12 and folate. Certain genetic polymorphisms (e.g., MTHFR) affecting folate metabolism may increase susceptibility, and some people with schizophrenia have low folate and B12 levels. Supplements may help with certain cognitive symptoms. Bipolar disorder patients have been found to have vitamin B deficiencies, particularly in B12 and folate, which may affect mood swings and cognitive function. Foods that are rich in B vitamins, such as leafy greens, legumes, eggs, and whole grains, are important for optimal brain health. Additionally, the interaction among various B vitamins can amplify their positive effects, emphasizing the significance of a balanced diet in promoting mental well-being.

2.2.3 Vitamin D:

Often called the "sunshine vitamin," vitamin D is a fat-soluble vitamin that is necessary for many physiological processes, such as immune system control, brain health, and calcium homeostasis [14]. Numerous studies have shown that low vitamin D levels are common among individuals experiencing mood disorders, especially in those residing in areas with limited sunlight. Due to its immunomodulatory, neuroprotective, and anti-inflammatory properties, it is vital for brain health and controls neurotrophic factors, including brain-derived neurotrophic factor (BDNF), which is necessary for mood regulation and neuroplasticity. Furthermore, vitamin D receptors (VDRs) are extensively found in brain areas linked to mood regulation, including the hippocampus, hypothalamus, and prefrontal cortex. The presence of vitamin D receptors in brain regions associated with mood regulation suggests that this vitamin is crucial for emotional stability. Supplementation with vitamin D has been found to alleviate depressive symptoms, particularly in those diagnosed with a deficiency [15]. By regulating cytokine levels and lowering neuroinflammation, vitamin D demonstrates anti-inflammatory qualities. Low vitamin D levels are common in people with schizophrenia, particularly in early life or during pregnancy, which may indicate a developmental connection]. Pregnancy and early childhood vitamin D deficiency have been linked to an increased risk of autism spectrum disorder (ASD). Supplementing during pregnancy and the first few years of life may lessen the intensity of symptoms. In older adults, low vitamin D levels are linked to a higher risk of cognitive decline and Alzheimer's disease. It might cause oxidative stress and vascular damage, which would lead to cognitive decline. Vitamin D can be obtained from sunlight, fatty fish, fortified dairy products, and supplements.

2.2.4 Magnesium and Zinc:

Magnesium and zinc are vital trace minerals that significantly contribute to mental well-being. These minerals are involved in neurotransmitter regulation, neuroprotection, and inflammatory processes that affect cognitive function, mood stability, and stress response. Magnesium participates in over 300 enzymatic reactions essential for brain function, and its deficiency has been linked to symptoms of anxiety and depression [16]. It plays a role in regulating neurotransmitter release and modulating stress responses, further underscoring its importance in mental health. It acts as a cofactor for enzymes involved in neurotransmitter synthesis and function, including gamma-aminobutyric acid (GABA), serotonin, and dopamine, all of which are crucial for mood regulation. Additionally, magnesium inhibits excessive glutamate activity that can result in neurotoxicity and excitotoxic stress, which have both been linked to anxiety and depression. This is accomplished by modulating N-methyl-D-aspartate (NMDA) receptors. Similarly, zinc is crucial for neurotransmitter function and synaptic plasticity, affecting mood and cognitive health. It affects brain-derived neurotrophic factor (BDNF) levels, which are essential for synaptic plasticity and mood regulation; it also affects antioxidant defence, lowering oxidative stress that leads to neurodegenerative and psychiatric disorders. Low levels of zinc have been associated with higher rates of depression and anxiety, highlighting the importance of these minerals for maintaining mental health Foods abundant in magnesium (such as nuts, seeds, and leafy greens) and zinc (such as meat, shellfish, legumes, and seeds) can enhance emotional regulation and cognitive function. Ensuring adequate intake of these trace minerals through diet or supplementation can profoundly impact mental well-being.

3.DISCUSSION

A new and revolutionary field called nutritional psychiatry emphasises how important diet is for preserving and improving mental health [5]. A greater understanding of how particular nutrients and food groups affect brain function, neurotransmitter activity, and inflammatory processes all of which are intimately related to mental health outcomes is emerging as research on the relationship between dietary patterns and psychological well-being continues to grow. For the treatment of mental illnesses like depression, anxiety, autism spectrum disorder, Alzheimer's disease, and cognitive decline, this integrative approach provides a non-invasive, encouraging, and frequently preventive approach. The understanding that the brain needs a steady flow of nutrients to function at its best is one of the fundamental tenets of nutritional psychiatry. The production of neurotransmitters like serotonin, dopamine, and gamma-aminobutyric acid (GABA), which control mood, cognition, and emotional stability, is aided by essential nutrients like omega-3 fatty acids, B vitamins, vitamin D, magnesium, zinc, and high-quality proteins. An increased risk of anxiety, depression, and other neuropsychiatric disorders has been linked to deficiencies in these nutrients. B-vitamins, such as B6, B9 (folate), and B12, for example, are essential for methylation processes that affect the synthesis of neurotransmitters. Cognitive impairments and depressive symptoms have been frequently associated with low levels of these vitamins [17]. Likewise, vitamin D functions as a neurosteroid, influencing immunological response and brain development; deficiencies are frequently seen in people with schizophrenia and depression. The anti-inflammatory properties of omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), as well as their function in the fluidity of neuronal membranes, have been thoroughly investigated. People with major depressive disorder frequently have elevated levels of pro-inflammatory cytokines like TNF-α and IL-6, which these fatty acids lower. Particularly in older populations, their consumption mainly in the form of fatty fish or supplements has demonstrated effectiveness in lowering depressive symptoms and promoting cognitive health.

Additionally, dietary habits have a significant impact on mental health. A lower risk of anxiety and depression has been repeatedly linked to the Mediterranean diet, which is high in whole grains, fruits, vegetables, legumes, nuts, olive oil, and fish. Its high fibre, anti-inflammatory nutrients, and antioxidant content support neuroprotection and the regulation of gut microbiota, another important component of the gut-brain axis. There is strong evidence that following a Mediterranean-style diet considerably reduces symptoms in people with moderate to severe depression, according to randomised controlled trials like the SMILES study [12]. Conversely, a diet heavy in ultra-processed foods, saturated fats, and refined sugars has been associated with oxidative stress, insulin resistance, and increased inflammation, all of which are risk factors for mental health issues. Consuming such diets over an extended period of time has been strongly linked to increased rates of anxiety, depression, and cognitive decline. Furthermore, because plant-based diets are rich in fibre, polyphenols, vitamins, and minerals, they can improve mental health when they are balanced. These elements lower systemic inflammation, support a healthy gut microbiome, and may offer some protection against mood disorders. Plant-based diets may help people with anxiety and depression, according to new research, but it's important to watch out for possible nutrient deficiencies like iron and vitamin B12.

4. CONCLUSION

Dietary interventions can alter neurotransmitter activity, lower inflammation, and ultimately improve mental wellness. Examples of these include following the Mediterranean diet, which is linked to lower rates of depression and anxiety, as well as enhanced overall mental well-being. The anti-inflammatory properties of this diet, combined with its ability to improve brain function, make it an effective strategy for fostering emotional stability and cognitive health. And similarly in Plant based diets, which emphasize whole and minimally processed foods, have been shown to enhance both physical and emotional health. These diets, abundant in fiber, antioxidants, and vital nutrients, are linked to lower instances of depression, anxiety, and stress. Although nutritional supplements have demonstrated potential, their drawbacks highlight the necessity for additional study to establish the best dosages and long-term effects. Nutritionists and dietitians are increasingly important in the treatment of mental illness. They are able to develop customised meal plans that take into account the patient's lifestyle, dietary needs, and particular mental health condition by providing individualised nutritional counselling. For instance: In autism spectrum disorder, structured diets that regulate gluten, casein, and sugar intake have shown positive behavioural outcomes. Similarly, for Alzheimer's disease, dietitians often recommend antioxidant-rich diets like the MIND diet, which may slow cognitive decline. In major depressive disorder, increasing omega-3 intake, along with complex carbohydrates and lean protein sources, can enhance mood and energy levels. Mental health professionals need to be more cognisant of the significant impact that nutrition has. To completely comprehend the interactions between food, hormones, neurobiology, and individual genetics, as well as to standardise dietary interventions, more thorough, extended clinical trials are required. According to dietitians and nutritionists, there is mounting proof that tailored dietary advice can be a vital supplement to traditional mental health therapies. For example, it has been demonstrated that customised meal plans that prioritise whole grains, lean proteins, fruits, vegetables, and healthy fats can lessen anxiety, lessen depressive symptoms, and slow the rate of cognitive decline. For instance, diets enhanced with omega-3 fatty acids and antioxidants for depression, structured carbohydrate intake for stabilising energy and mood in people with autism spectrum disorder, and nutrient-dense, anti-inflammatory foods that may help patients with Alzheimer's disease are just a few examples of the specific recommendation's dietitians are increasingly making for various mental health conditions. There is a great chance to integrate these findings into routine clinical practice as the body of evidence supporting nutritional psychiatry keeps growing. Improved cooperation between dietitians and mental health specialists can result in the creation of focused dietary plans that support medication and psychotherapy treatments. Furthermore, incorporating individualised nutrition into mental health care—guided by a person's genetic, metabolic, and microbiome profiles—may offer more potent, non-invasive therapeutic alternatives. To fill in the current knowledge gaps, future studies should concentrate on carrying out thorough, extensive randomised controlled trials. This is especially important when it comes to the relationships between hormone regulation and nutrition as well as the long-term effects of customised dietary interventions on a range of mental health issues. All things considered, combining dietary practices with nutritional supplements presents a viable way to enhance mental health outcomes, and dietetic practice's ongoing development is set to be crucial to this cutting-edge method of providing mental health treatment.

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