International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
ISSN Online: 2349-4182 ISSN Print: 2349-5979
Received: 27-09-2025, Accepted: 27-10-2025, Published: 11-11-2025
Volume 12, Issue 11, 2025, Page No. 64-68

Therapeutic nutrition for controlling mental health: A review

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Abstract
Mental health disorders, including depression, anxiety, bipolar disorder, and schizophrenia, are among the leading causes of disability worldwide. Emerging evidence has shown that nutrition plays a crucial role in mental health regulation through the gut-brain axis, neurotransmitter synthesis, and modulation of inflammation and oxidative stress. Therapeutic nutrition—using diet as a preventive and supportive treatment—has become a promising field in managing mental health conditions. This review explores the role of specific nutrients, dietary patterns, and functional foods in maintaining and restoring optimal mental health. Furthermore, the paper highlights the biochemical mechanisms underlying the nutritional modulation of mood and cognition and provides evidence-based insights into nutritional strategies for mental well-being.

Keywords: Mental health, gut-brain axis, foods, therapeutic diet, anxiety, depression

Introduction

Mental health has emerged as a critical component of overall well-being, directly influencing quality of life, productivity, and physical health. According to the World Health Organization (WHO, 2022) [44], nearly one in eight people globally live with a mental disorder, with depression and anxiety being the most prevalent. While psychological and pharmacological therapies remain central to treatment, increasing evidence underscores the importance of dietary interventions in preventing and managing mental illnesses (Sarris *et al*., 2015) [36]. The concept of *therapeutic nutrition* focuses on utilizing nutrients and dietary patterns to modulate brain function, neurotransmission, and emotional stability.

The brain, being metabolically active, requires a constant supply of macro- and micronutrients to sustain neuronal activity, synaptic plasticity, and neurotransmitter synthesis (Jacka *et al*., 2017) [20, 21]. Nutritional inadequacies—especially of B vitamins, omega-3 fatty acids, minerals (zinc, iron, magnesium), and amino acids—can impair neurochemical pathways that regulate mood and cognition. Similarly, diets high in processed foods, refined sugars, and saturated fats have been associated with increased risk of depression and anxiety (O'Neil *et al*., 2014) [29]. Thus, diet serves both as a modifiable risk factor and a therapeutic target for mental health optimization.

Nutritional Neuroscience and the Gut-Brain Axis

Recent advances in *nutritional psychiatry* highlight the interplay between the gut microbiome and brain function through the *gut-brain axis*—a bidirectional communication system involving neural, immune, and endocrine pathways (Mayer *et al*., 2015) [25]. Gut microbes produce neuroactive compounds such as serotonin, gamma-aminobutyric acid (GABA), and short-chain fatty acids (SCFAs) that influence mood and behavior (Cryan *et al*., 2019) [9]. Dysbiosis, or imbalance of gut microbiota, has been linked to mental health disorders, particularly depression and anxiety (Clapp *et al*., 2017) [7].

Therapeutic nutrition emphasizes dietary components that restore microbial balance (Tewari, 2019) [41]. Diets rich in prebiotic fibres (inulin, resistant starch) and fermented foods (yogurt, kefir, kimchi) enhance the growth of beneficial bacteria such as *Lactobacillus* and *Bifidobacterium*, which produce SCFAs with anti-inflammatory and neuroprotective properties (Dinan & Cryan, 2017) [11]. In contrast, Western diets—high in fats and refined sugars—promote gut dysbiosis and systemic inflammation, worsening mental health outcomes (Dash *et al*., 2015) [10].

Key Nutrients Influencing Mental Health

1. Omega-3 Fatty Acids

Omega-3 polyunsaturated fatty acids (PUFAs), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play essential roles in neuronal membrane fluidity and neurotransmitter signaling (Bazinet & Layé, 2014) [4]. Several clinical trials demonstrate that omega-3 supplementation reduces depressive symptoms, especially when used adjunctively with antidepressants (Grosso *et al*., 2014) [18, 19]. DHA is vital for synaptic function and neurogenesis, while EPA exhibits anti-inflammatory effects that modulate cytokine activity implicated in depression pathophysiology (Su *et al*., 2018).

Fish, flaxseeds, chia seeds, and walnuts are dietary sources of omega-3s. Populations consuming diets rich in marine-based omega-3s, such as the Mediterranean and Japanese diets, consistently report lower rates of depression and

cognitive decline (Sanchez-Villegas & Martinez-Gonzalez, 2013) [34].

2. B Vitamins

B-complex vitamins, particularly B6, B9 (folate), and B12, are indispensable for one-carbon metabolism and neurotransmitter synthesis. Folate and vitamin B12 deficiency can elevate homocysteine levels, leading to neurotoxicity and increased risk of depression (Coppen & Bolander-Gouaille, 2005) [8]. Vitamin B6 acts as a coenzyme in serotonin, dopamine, and GABA synthesis, directly influencing mood regulation (Young, 2007) [45, 46].

Randomized controlled trials have shown that supplementation with B vitamins improves mood, cognitive function, and stress resilience (Lopresti, 2019). Whole grains, leafy vegetables, legumes, and animal products remain primary sources of these vitamins.

3. Minerals: Zinc, Magnesium, and Iron

Zinc plays a key role in neurogenesis and synaptic plasticity. Low serum zinc has been linked to depression severity (Swardfager *et al*., 2013) [39]. Supplementation has shown antidepressant-like effects, possibly through modulation of the NMDA receptor and neurotrophic factors (Nowak *et al*., 2013) [27].

Magnesium deficiency contributes to neuronal hyperexcitability and inflammation, both linked to anxiety and depression (Eby & Eby, 2010) [12]. Similarly, iron deficiency affects dopamine metabolism, leading to cognitive impairment and fatigue (Beard *et al*., 2005) [5]. Hence, adequate intake of these minerals through nuts, seeds, legumes, and green leafy vegetables supports mental well-being.

4. mino Acids and Neurotransmitters

Tryptophan and tyrosine are precursors for serotonin and dopamine, respectively—neurotransmitters central to mood regulation. Diets rich in tryptophan (eggs, soy, dairy, poultry) enhance serotonin synthesis, improving sleep and emotional stability (Richard *et al*., 2009) [32]. Branched-chain amino acids (BCAAs) and glutamine also contribute to neurochemical balance, energy metabolism, and cognitive performance.

Dietary Patterns and Mental Health

1. The Mediterranean Diet

The Mediterranean diet, characterized by high intake of fruits, vegetables, whole grains, olive oil, and fish, and moderate wine consumption, is strongly associated with reduced risk of depression and cognitive decline (Lassale *et al*., 2018). Its anti-inflammatory and antioxidant components, including polyphenols and omega-3 fatty acids, protect neuronal function and reduce oxidative stress (Adjibade *et al*., 2018) [1].

Clinical trials such as the SMILES study have demonstrated that adopting a Mediterranean-style diet significantly improves depressive symptoms compared to social support interventions (Jacka *et al*., 2017) [20, 21].

2. Plant-Based and Whole-Food Diets

Plant-based diets emphasize nutrient-dense foods such as legumes, nuts, seeds, fruits, and vegetables. These diets provide antioxidants and phytochemicals that counteract oxidative damage associated with neurodegenerative disorders (Berman *et al*., 2017) [6]. However, strict vegan diets may increase the risk of B12 deficiency, emphasizing the need for supplementation or fortified foods (Rizzo *et al*., 2016) [33].

Whole-food diets with minimal processed components have been associated with reduced anxiety and improved mental well-being (O'Neil *et al*., 2014) [29].

3. Western Diet and Mental Disorders

Western dietary patterns, characterized by high intake of refined carbohydrates, processed meats, and sugary foods, have been consistently linked to increased prevalence of depression and anxiety (Jacka *et al*., 2010) [20, 21]. These diets promote systemic inflammation, insulin resistance, and oxidative stress, all of which impair neuroplasticity and cognitive function (Molendijk *et al*., 2018).

Furthermore, excessive consumption of trans fats and simple sugars disrupts the gut microbiome and increases cortisol levels, contributing to mood disorders (Logan & Jacka, 2014) [20, 21, 23].

Role of Functional Foods and Probiotics

Functional foods such as fermented dairy, kimchi, kefir, and probiotic supplements enhance gut microbiota composition and promote mental health (Wallace & Milev, 2017) [42, 43]. Probiotic strains like *Lactobacillus rhamnosus* and *Bifidobacterium longum* have shown anxiolytic and antidepressant effects by modulating GABA receptor expression and reducing systemic inflammation (Messaoudi *et al*., 2011).

Polyphenol-rich foods, including berries, cocoa, and green tea, also offer neuroprotective benefits by improving cerebral blood flow and reducing oxidative damage (Gomez-Pinilla, 2008) [17]. Such *psychobiotic foods* represent a novel therapeutic frontier in nutrition-based mental health management.

Mechanisms of Nutritional Influence on Mental Health

Nutrients regulate brain health through multiple mechanisms:

1. **Neurotransmitter synthesis:** Amino acids, vitamins, and minerals serve as precursors or cofactors in serotonin, dopamine, and GABA production.

2. **Inflammation modulation:** Omega-3s and antioxidants reduce proinflammatory cytokines that contribute to depressive behavior (Miller *et al*., 2009) [26].

3. **Oxidative stress regulation:** Antioxidant nutrients protect neurons from oxidative injury, preserving cognitive functions.

4. **Gut microbiota modulation:** Probiotics and prebiotics maintain microbial homeostasis, influencing mood through the gut-brain axis.

5. **Epigenetic regulation:** Nutrients such as folate and B12 influence gene expression linked to neuronal resilience (Fischer *et al*., 2010) [15]

Table: 1 Therapeutic Nutritional Interventions for Mental Health Management

Nutrient / Dietary Component	Mechanism of Action	Target Mental Health Condition(s)	Key Findings	References
Omega-3 Fatty Acids (EPA & DHA)	Anti-inflammatory action; modulation of neurotransmitter function (serotonin and dopamine); improves neuronal membrane fluidity.	Depression, anxiety, bipolar disorder, schizophrenia.	Supplementation reduces depressive symptoms and improves emotional stability.	Freeman *et al*. (2006) [16]; Grosso *et al*. (2014) [18, 19].
B Vitamins (B6, B9, B12)	Involved in methylation, neurotransmitter synthesis (serotonin, dopamine, norepinephrine), and homocysteine regulation.	Depression, cognitive decline, anxiety.	Deficiencies linked to elevated homocysteine and depressive symptoms; supplementation improves mood and cognitive function.	Almeida *et al*. (2015) [2]; Young (2007) [45, 46].
Vitamin D	Regulates neurotrophic factors, serotonin synthesis, and immune modulation.	Depression, seasonal affective disorder, schizophrenia.	Low serum vitamin D is associated with higher risk of depression and mood disturbances.	Parker *et al*. (2017) [30]; Anglin *et al*. (2013) [3].
Probiotics and Prebiotics (Gut–Brain Axis)	Modulate gut microbiota composition; enhance production of neurotransmitters and short-chain fatty acids; reduce systemic inflammation.	Depression, anxiety, stress-related disorders.	Probiotic supplementation improves mood, stress resilience, and anxiety scores.	Wallace & Milev (2017) [42, 43]; Steenbergen *et al*. (2015) [37].
Polyphenols (Flavonoids, Curcumin, Resveratrol)	Antioxidant and anti-inflammatory effects; modulation of brain-derived neurotrophic factor (BDNF); neuroprotection.	Depression, anxiety, neurodegenerative diseases.	Curcumin and resveratrol improve cognitive performance and reduce depressive symptoms.	Lopresti *et al*. (2014) [24]; Esfahani *et al*. (2021) [13].
Magnesium	Acts as an NMDA receptor antagonist; reduces neuronal excitability and inflammation.	Depression, anxiety, sleep disturbances.	Magnesium supplementation significantly reduces depressive and anxiety symptoms.	Tarleton *et al*. (2017) [40]; Eby & Eby (2010) [12].
Zinc	Cofactor for neurotransmitter metabolism; modulates BDNF and NMDA receptors; antioxidant role.	Depression, schizophrenia, cognitive dysfunction.	Low zinc levels correlate with depression severity; supplementation enhances antidepressant response.	Swardfager *et al*. (2013) [39]; Nowak *et al*. (2015) [28].
Amino Acids (Tryptophan, Tyrosine, Glutamine)	Precursors for neurotransmitters serotonin, dopamine, and GABA.	Depression, anxiety, stress, insomnia.	Tryptophan supplementation increases serotonin and improves mood and sleep quality.	Richard *et al*. (2009) [32]; Fernstrom (2012) [14].
Antioxidant-Rich Diet (Fruits, Vegetables, Whole Grains)	Reduces oxidative stress and inflammation; improves mitochondrial and neuronal health.	Depression, anxiety, cognitive decline.	Diets rich in antioxidants are linked with better mental well-being and lower risk of depressive disorders.	Lassale *et al*. (2019) [22]; Jacka *et al*. (2017) [20, 21].
Mediterranean Diet	Combines high intake of fruits, vegetables, whole grains, olive oil, and fish; reduces inflammation and oxidative stress.	Depression, anxiety, cognitive decline.	Adherence to the Mediterranean diet significantly lowers risk of depression and cognitive impairment.	Sanchez-Villegas *et al*. (2009) [35]; Psaltopoulou *et al*. (2013) [31].

Conclusion

Therapeutic nutrition offers a holistic, preventive, and adjunctive approach to mental health management. Diets rich in omega-3 fatty acids, B vitamins, minerals, antioxidants, and probiotics have demonstrated consistent benefits for mood regulation and cognitive performance. Conversely, Western dietary patterns exacerbate inflammation, oxidative stress, and neurotransmitter dysregulation. Integrating nutritional strategies into public health and clinical practice can significantly reduce the global burden of mental disorders.

Future research should focus on personalized nutrition approaches that account for genetic variability, gut microbiome diversity, and individual nutrient metabolism. Collaborative efforts among psychiatrists, dietitians, and neuroscientists are essential to translate nutritional psychiatry findings into effective mental health interventions.

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