

Exploring the role of nutrition in mental health: A narrative review

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Abstract

Global burden of disease 2020 indicates that unipolar depression contributes the second most to increased DALY (disability-adjusted life years) worldwide, but it wasn't even on the top fifteen list in the 1990s. While some mental health problems may warrant pharmacological intervention, non-drug lifestyle behaviors also popularly known as lifestyle medicine and mental health tools present a promising avenue for mitigating depressive symptoms. Lifestyle psychiatry, a growing field pertains to lifestyle pillars such as diet, physical activity, stress, and sleep and their role in psychiatric disorders. Nutrition, a fundamental core in lifestyle medicine, presides over virtually all chronic diseases. Describing nutrition and mental health is challenging,

and studies of their interactions are even more complex. Nevertheless, gut microdata are critical to understanding this relationship. Thus, this narrative review aims to unravel the role of nutrition in the context of selected mental disorders. Simultaneously, it aims to empower practitioners and readers of Nepal to make informed lifestyle decisions regarding their nutritional choices. Additionally, it seeks to play as well as play a contributory role in the advancement of nutritional psychiatry as a discipline

Keywords:

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INTRODUCTION

Most research on nutrition and exercise has predominantly centered around physical health. Much remains to be discovered regarding the relationship between nutrition and mental health, considering its earlier stages of investigations. The range of ingredients in food and physiological responses to them makes research exploring the links between these two time-consuming and effort-intensive.¹

However, as scientific understanding has evolved, there has been an increasing recognition of nutrition and mental health in recent years. This realization has thus led to growing interest among researchers in delving into investigating

the relationship between nutrition and mental health.² Emerging findings have revealed a complex relationship between diet and mental health. Ruusunen et al.³ revealed that adhering to a prudent diet consisting of whole grains, and a high intake of fruits, vegetables, fish, and legumes was associated with a lower prevalence of depressive symptoms when compared to a Western diet or mixed diet. Similarly, Akbaraly et al.⁴ implied that a whole food dietary pattern is associated with a protective effect against depression, while a processed food dietary pattern increases the odds of depression. It may be attributed to a few plausible explanations. Firstly, living a healthy lifestyle positively impacts both mental and physical health. Second, disciplined adherence to proper dietary patterns that provide nutrient profiles with the essential elements is important for the brain, like any other organ. The association could also be driven by mental health status influencing people's dietary habits, which could affect their nutrition intake and profile. Healthy diets consisting of fruits and vegetables are abundant in folate and antioxidants, which prevent brain inflammation and oxidative stress.⁵ Our approach to reducing mental health burdens

can be most cost-effective when used in conjunction with the system's approach to target mental models of behavior change. The absence of such discourse among Nepal's medical community makes our review a good tool for practitioners to introduce their patients to the topic of diet for mental health and encourage them to take better measures for the overall improvement of mental health.

LIFESTYLE APPROACH TO MENTAL HEALTH:

A holistic approach to mental health is critical because it involves more than addressing mental health issues when they occur but ensuring wellbeing every day. The medication approach has been disappointing with evidence that many psychiatric medications imbalance neurotransmitters and result in dependence.⁶ Some mental health problems may necessitate the use of medication but non-pharmacological lifestyle behaviors and mental health tools can also significantly improve them (sometimes even more so). In 2020, the Summit on Lifestyle Medicine Research substantiated the intricate relationship mental health has with lifestyle pillars.⁷

Lifestyle psychiatry, which examines lifestyle factors such as diet, physical activity, stress, and sleep and their impact on the development of mental disorders, is an emerging field in lifestyle medicine. Patients benefit from lifestyle psychiatry because it is recovery-oriented and empowers them to take control of their lives. Meditation and exercise are two practices that activate reward pathways directly in the brain, thereby providing useful alternatives to detrimental and addictive reward stimuli.⁸

Systematic review and network meta-analysis conducted by Yu et al.⁹ underscored the importance of physical activity on mental health. The study asserted tailored exercise activities according to underlying mental health disorders for eg. Mind-body exercises for post-traumatic stress disorder, resistance exercises for depression, and multimodal exercises for anxiety. Studies have suggested the potential benefits of meditation on mental health disorders.^{10,11}

BIOPSYCHOSOCIAL PERSPECTIVE AND MENTAL HEALTH

An understanding of someone's mental health requires an assessment of several factors that affect their overall

well-being. The biopsychosocial perspective is a comprehensible framework for analyzing mental illness causes since it encompasses biological, psychological, and social factors. An important component of the social aspect of this framework is diet. The importance of understanding how our diets affect our biology, psychology, and social interactions cannot be overstated. On the biological level, nutrients affect brain function and gut health, while on the psychological level, diet can influence mood and eating habits. Dietary choices are influenced by factors such as social factors and socioeconomic status. Taking into account these interrelated aspects of diet within the broader biopsychosocial framework is critical to promoting mental health effectively.¹²

NUTRITION AND MENTAL HEALTH

In lifestyle medicine, nutrition is one of the foundational pillars that affect virtually all chronic diseases. It is recommended that dietary considerations are fundamental components of standard therapy for mood disorders in the Clinical Practice Guidelines for Mood Disorders of the Royal Australian and New Zealand College of Psychiatrists. This reflection highlights the growing impact of nutritional interventions on managing mental health.¹³ The intricate interplay between nutrition and mental health is rooted in the possible finding of its underlying mechanism, elucidated in later portions of the article. However, it is worth noting that the body's response to pathogenic exposure like bacteria and viruses can evoke symptoms akin to depression thereby resulting in low mood and low energy. Thus, such a relationship has led many studies to hypothesize that highly processed foods may be perceived by the human body as foreign invaders, resulting in depressive symptoms when consumed. High-processed foods with man-made origins can cause inflammation and may be deemed "anthropogens". It is important to note that all these anti-inflammatory and neutralizing agents are natural and have been used by humans for hundreds or thousands of years (e.g., fruits, and nuts).¹⁴ In the following section, we will delve into the basic mechanism through which diet impacts mental health

1. The gut microbiota

Research has consistently demonstrated the gut microbiota in controlling various neurophysiological processes, such as cognitive function, neuropsychiatric disorders, and behavior. Microbiota composition and/or activity can be altered by changes in gut microbial habitat because of diet. By modulating the vagus nerve and possibly the spinal nerve

directly, the brain can indirectly alter the gut microbial ecosystem and alter gut microbial composition through neuroimmune and neuroendocrine mechanisms. Similarly, microbiota produces neurotransmitters in the gut, which affects brain activities.

The sympathetic nervous system can also directly affect the functionality of gut bacteria through the modulation of gene expression profiles. If this bidirectional interaction is disrupted by diet, stress, or infection-related perturbations, it can result in brain-gut disorders.⁸ A dysbiosis of the gut microflora (increased pathogenic microbes that disrupt gut homeostasis) is consistently associated with chronic diseases. A tiny amount of oral *Campylobacter* Jejuni administered to rats induced anxiety-like behavior in them despite any immune reactions.¹⁵ Preclinical studies demonstrated that high-calorie diets increased the abundance of Clostridiales, Ruminococcaceae, and Bacteroidales, and resulted in poorer cognitive flexibility, as well as impaired social and object recognition.¹⁶ Leaky intestines that permit harmful bacteria to translocate, including gram-negative enterobacteria, can potentially result in depression. Currently, interest has grown significantly in the mood-enhancing role of fermented foods (probiotics) such as kimchi, sauerkraut, etc. Although findings support the usage of probiotics in maintaining mental health, the translation of preclinical studies to human studies has some major gaps attributing to the complex nature of nutrition-gut-brain interaction. Similarly, prebiotic fibers such as buckwheat have been identified to promote brain health by modulating gut bacteria.¹⁷ Fermented milk is recommended as a source of probiotic microbes in foods because of its symbiotic nature, which lowers inflammation in the gut.⁸ An illustration of the correlation between dietary quality and the mechanisms implicated in depression alleviation is depicted in Figure 2 by Marx et al.¹⁸

2. Neuroinflammation and stress:

Anthropogens cause neuronal oxidative stress, triggering an immune response inflammatory process by stimulating the production of auto-antibodies. Immunoglobulin binds to neuronal signal proteins, altering signaling pathways that affect neurotransmission, cell survival, and neuroplasticity. Moreover, oxidative damage has a detrimental impact on the membranes of neurons, altering cellular activity, decreasing apoptosis, and inhibiting neuronal growth. The process is aggravated in obese individuals as pro-inflammatory compounds (eg. TNF-alpha) are released by adipocytes. Therefore, plant-based diets rich in antioxidants can attenuate neuronal damage. In addition to improving

neuroplasticity, polyphenols (found in foods like berries, cocoa, flaxseeds, almonds, spices, beans, and curcumin) influence neurotrophic factors such as brain-derived neurotrophic factor (BDNF).⁸ There is evidence that people with severe mental illness have higher levels of 'dietary inflammation' than healthy individuals.¹⁹ Post-mortem examination reveals elevated oxidation stress markers in the brains of people with bipolar disorder, depression, and schizophrenia compared to healthy controls.²⁰

3. Individual nutrients

Nutrition plays a key role in the production of neurotransmitters. The amino acid tryptophan is the building block of serotonin, which requires vitamin B6, vitamin C, calcium, magnesium, zinc, and folate. Tyrosine is a building block of dopamine and norepinephrine and requires other nutrients similar to serotonin. Nutrient deficiencies in any of these minerals and vitamins may decrease the level of neurotransmitters that contribute to psychiatric disorders.⁸ Using zinc as an adjuvant treatment for depression, significant improvements were found in depressive symptoms and treatment-resistant depression.²¹

HISTORICAL PERSPECTIVE

Scientific contributions to finding a relationship between nutrition and mental health date back to 1940 at the University of Minnesota named as "Minnesota Starvation Experiment" where 24 volunteers male were provided with two-thirds of needed calories for six months and were monitored for changes in physiological, radiological, biochemical, and psychological parameters. The authors noted, "the bond between the physiological status of the organism and the 'psyche' is closer than is sometimes realized."²² Dr. Victor D. Herbert self-induced folate deficiency in 1962, causing insomnia, irritability, fatigue, and forgetfulness.²³

Later, several institutions researched diet and mental health, gradually integrating nutrition into the understanding of mental health. This importance parallels the prominent role of diet in reducing the risk of cardiovascular events in the 20th century. Predictably, the rise in mental health highlights the importance of nutrition as a potential strategy for addressing mental health challenges. As we contextualize with the dominant religion of Nepal, Hinduism also emphasizes diet as a means of ensuring mental health. Dietary choices are classified into three categories: Tamasic, Rajasic, and Sattvic. The consumption of tamasic foods, such as stale or impure items, is believed to trigger

negative emotions. A diet high in Rajasic foods, which include meat and spicy dishes, can cause restlessness and increased emotions. The most beneficial foods are Sattvic foods, such as fruits, nuts, and whole grains, which promote tranquility and mental clarity. So dietary codes encourage people to follow Sattvic practices to maintain emotional balance and inner harmony.²⁴

ROLE OF NUTRITION IN MENTAL WELL-BEING

A nationwide survey conducted in the Spanish population above the age of 18 found a small but statistically significant inverse relationship between adherence to the Mediterranean diet and negative effects. The association between Mediterranean diet adherence and evaluative well-being was also small but significant.²⁵ Young adults reported eating more fruit and vegetables on days when they experienced greater positive effects, according to White et al. Further, fruit and vegetables tended to be associated with positive affect the next day, suggesting that healthy foods are causing affective experiences.²⁶ Among children, O'Reilly et al found that higher fiber intake was associated with higher positive affect (PA) ratings and lower negative affect. Negative effects ratings were also lower in diets with lower usual glycemic loads.²⁷

ROLE OF NUTRITION IN PSYCHIATRIC DISORDERS

Mood disorders

The Mediterranean diet, based primarily on plant-based foods, is linked to a lower incidence of mood disorders. There is a moderate amount of fish and meat consumption, along with vegetables, legumes, whole grains, nuts, seeds, fruits, and olive oil. The use of omega-3 fatty acids, found mostly in cold water fatty fish such as salmon and mackerel as well as flaxseed oil significantly improved psychiatric symptoms when given adjuvantly to depression.²⁸ There was a significant improvement in depressive symptoms in adults with depression following adjunctive Mediterranean diet interventions versus control conditions in SMILES²⁹ and Healthy Eating for Life with Mediterranean Diet trials (HELFI-MED).³⁰ It has been shown that trans fatty acid consumption and consumption of trans-fat-rich foods, including fast food and commercial bakery goods, are associated with depression.³¹ A study of the overall dietary pattern is more relevant than a study of isolated nutrients. Considering that most of the evidence related to diet and depression is

similar to diet regarding Metabolic Equivalent of Task (MetS) or Cardiovascular Disease (CVD), it is reasonable to hypothesize that diets that promote cardiometabolic health may also influence depression.

Dietary recommendations

1. Adjuvant Eicosapentaenoic acid (EPA) omega-6 fatty acids
2. Adjuvant zinc.
3. The Food and Drug Administration (FDA) has approved L-methylfolate for treating depression in patients with insufficient folate levels.
4. Adjuvant to Selective serotonin reuptake inhibitors (SSRI): 15 mg L-methylfolate.
5. A Mediterranean diet, along with standard care, can be beneficial for patients who have poor dietary status⁸

Bipolar

A study by Jack et al.³² revealed women with Western diets were 88% more likely to develop bipolar disorder. Limited evidence implies that nutrients such as glutathione, omega-3, cysteine, selenium, and broad-spectrum micronutrient formulas reduce bipolar episodes. Among them cysteine is found in curd, oats, and cruciferous vegetables; selenium is found in Brazilian nuts.⁸

Dietary recommendations

1. Omega-3 supplementation
2. In acute mania, branched-chain amino acids (BCAA) - 60 g x 7 days - are used in adjuvant to standard treatments. If BCAAs and valproate are taken together, liver damage may occur.
3. There are reports that a ketogenic diet alleviates bipolar symptoms.

Schizophrenia

Peet et al.³³ recommend the negative impact of consuming red meat, dairy products, and refined sugar on the outcome of patients with schizophrenia over two years, while consuming beans and fish significantly improved the outcome. Cholecalciferol impacting neural development was linked to schizophrenia by Kinney et al.³⁴ who noticed higher rates of schizophrenia in cold weather and high latitude correlated (up to ten times higher than in Equador). In high-latitude regions, individuals with dark skin (which inhibits the production of cholecalciferol) and those who consumed little fish (a source of cholecalciferol and omega-3) had greater occurrences of schizophrenia. Conversely, people who consumed 23 kg or more fish in high latitudes had similar schizophrenia rates to equatorides, implying a substantial role of diet in the prevention of

schizophrenia. Bozzatello et al.³⁵ observed eight out of eleven randomized controlled trials found omega-3 supplements significantly improved psychiatric symptoms in people with non-acute schizophrenia spectrum disorders. Higher levels of anti-gliadin antibodies were found in schizophrenics than in the normal population. But gliadin antibodies induced by schizophrenia can differ from those resulting from celiac disease, their immunogenic activities may be targeted to the central nervous system.³⁶

Dietary recommendations

1. Negative symptoms may require adjuvant therapy with N-acetylcysteine.
2. The addition of folate and L-methylfolate can help with core symptoms associated with schizophrenia, especially when the metabolism of folate is abnormal. In schizophrenia patients with hyperhomocysteinemia, L-Methylfolate has been approved by the FDA.
3. Docosahexaenoic acid (DHA) and EPA are omega-3 fatty acids that may help non-acute schizophrenia patients with core symptoms. In patients with acute psychosis, omega-3 supplementation should be avoided.
4. Gestation and perinatal cholecalciferol if cholecalciferol deficiency⁸

Attention Deficit Hyperactivity Disorder (ADHD)

A study tracking 2,868 people from gestation through 14 years found double the risk of ADHD by the age of 14 among those who consumed processed foods (Western diet pattern) after adjusting the results for socioeconomic status, antenatal stress, screen time, and exercise.³⁷ A study in Korea found an inverse dose-response relationship between healthy foods (such as kimchi, whole grain, vegetables, minimally processed foods, dairy meat, and fish) and ADHD diagnosis.³⁸ Hyperactivity is well-established to be caused by artificial food additives as the findings of Shareghfarid et al.,³⁹ suggest that "healthy" eating patterns reduce the ADHD odds (OR = 0.63) and "junk food" eating patterns increase them (OR = 1.51). A meta-analysis (eight studies, 486 participants) found that blood levels of polyunsaturated fatty acids (PUFAs)- Omega-3- 3- docosahexaenoic acid (DHA) in subjects with ADHD were lower than controls.⁴⁰ Nutrient deficiency inflammation (such as magnesium, iron, zinc, copper, and selenium), dysregulation of the HPA axis, gut dysbiosis, and ANS hyperactivity all may play a role in ADHD.⁴¹ Among theories supporting the role of gut dysbiosis, ADHD was associated with *Faecalibacterium*⁴² and decreased microbial diversity.⁴³ According to the largest trial to date (N=100), a five-week "restricted elimination" diet could reduce ADHD symptoms by 40% or more. A restricted elimination diet simplifies to only a few

ingredients and then adds or removes foods according to the symptomatic response. Foods that triggered symptoms were eliminated.⁴⁴

Dietary recommendations

1. Artificial colors and preservatives should be avoided
2. Broad-spectrum micronutrients⁴⁵
3. Restricted elimination diets for improving core symptoms of ADHD
4. PUFAs should be considered as an augmentation strategy, but the child should be monitored regularly for adverse effects such as laboratory changes, skin changes, and GI symptoms.²¹

Autism Spectrum Disorder (ASD)

Children with autism often suffer from vitamin D deficiency.⁴⁶ A significant association was found between persistent gestational cholecalciferol deficiency and autism characteristics found in a prospective cohort study (N=4,229).⁴⁷ Sanchez et al. in their meta-analysis of 32 publications evaluated 684,775 children and reported that pre-pregnancy overweight increased the odds of any neurodevelopmental disorders by 1.17.⁴⁸ Sulforaphane, a broccoli compound significantly decreased symptoms on the Aberrant Behavior Checklist. Febrile illness subsidized ASD core symptoms in 35% of cases. Heat shock protein that is activated by febrile illness is activated by sulforaphane, thus underpinning this research. The role of gluten-free and casein-free diets in autism spectrum disorders remains inconclusive.²¹

Dietary recommendations

1. Prepregnancy weight maintenance and optimum gestational cholecalciferol level
2. Inconclusive results have been found regarding cholecalciferol supplementation on core symptoms of Autism Spectrum Disorder but may be recommended.⁸

Cognitive disorders

A high-resolution structural MRI study found a five-year difference in brain age and significantly larger frontal and temporal lobe volumes in Mediterranean dieters. Greater fish consumption and lower red meat consumption correlated significantly with increased brain volume.⁴⁹ Likewise, mothers who consumed more DHA while breastfeeding had better cognitive development in their children.⁸ Folate notably improved cognition, memory, and reaction time in subjects with high homocysteine levels, but did not significantly improve word fluency. Homocysteine levels are elevated due to low folate and vitamin B12.⁵⁰ Flavonoids present in berries may improve cognitive function in women who are 70 or older.⁵¹ Improved blood flow and

activation of the dentate gyrus in the hippocampus, thus improved mental performance was associated with cocoa flavanols intake.⁵²

There were three diets in the PREMED-NAVARRA trial (N=522) for patients with high cardiovascular risk: Mediterranean diets with olive oil or Mediterranean diets with walnuts, almonds, and hazelnuts, as well as low-fat control diets. On the Mini-Mental State Examination and the Clock Drawing Test, the low-fat controlled diet had significantly lower scores when compared with the other two groups after accounting for confounding factors.⁵³

Dietary recommendations

1. Children's cognitive function can be improved by DHA
2. Omega-3 DHA may be beneficial to adults with mild cognitive impairment
3. Omega-3 fatty acids may benefit carriers of APOE4.
4. Long-term folate supplementation may benefit patients with folate-deficit hyperhomocysteinemia.
5. Cognitive performance can be improved by consuming high-flavanol chocolates.
6. Adopting a Mediterranean diet can improve cardiovascular health and prevent cognitive decline

CONCLUSION

A growing body of research underscores a direct relationship between nutrition and mental health. However, there is little translatable evidence and little understanding of how these effects arise due to a lack of methodologically rigorous research. Nutritional interventions, in comparison to pharmacological interventions, are more challenging to conduct as their target is not specific, and are not consumed in a specific amount. Therefore, nutritional research is now more focused on dietary patterns rather than individual nutrients or supplements. The takeaway message of this review is that eating plenty of fruits, vegetables, whole grains, seeds, and nuts could be one of the best ways to prevent mental illnesses. Foods containing added sugars or flours, as well as animal fats, processed meats, and butter are recommended to be avoided.

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