

The Impact of Various Dietary Strategies on Mental Health

Amina Shahid¹*, Muhammad Aftab Ali¹, Zahra Rashid¹, Yamna Afzaal¹, Tayyaba Nawaz¹, Aqsa Asif², Ansah Arshad³, Nisha Maqsood¹ and Fizza Shahid⁴

¹Department of Zoology, Faculty of Life Sciences, Government College University, Faisalabad, Pakistan

²University of Medical and Dental College, Faisalabad, Pakistan

³Department of Food Science and Technology, Faculty of Life Sciences, Bahauddin Zakariya University, Multan, Pakistan

⁴Department of Food Science and Technology, Faculty of Life Sciences, Government College University, Faisalabad, Pakistan

*Corresponding author: aminashahid689@gmail.com

Abstract

Dietary patterns are closely linked to one's mental health and abilities, as everyone is aware. This means that a healthy body and mind require a balanced diet that includes all the macronutrients (amino acids, fatty acids, and some carbs) and micronutrients (vitamins and minerals). It is estimated that dietary factors are responsible for almost 10.9 million deaths and 255 million adjusted life years of mental disorders. According to reviewed research, there are a number of dietary practices that people who consistently follow can have both beneficial and detrimental effects on their mental health. Most people between the ages of 18 and 60 follow the newest diet trends on social media, such as popular diets (ketogenic, Mediterranean, and plant-based diets) for long and healthy lives. However, some people used to love and follow unhealthy western diets (such as processed and refined food, high sugar, fried food, and fast food), which, in recent years, have caused more than 7.2% of people worldwide to suffer from mental and neurodevelopmental disorders like anxiety, sadness, and depression. Additionally, how these dietary practices affect the gut-brain axis reveals how certain substances, such as neurotransmitters, are not formed properly, which can lead to a variety of mental health problems at different ages, such as autism, schizophrenia, multiple sclerosis, bipolar disorder, and Parkinson's disease. This chapter also covered the negative consequences of screens on mental health, including interrupted sleep cycles, poor social relationships, obesity, and depression, as well as the effects of stress, emotional eating, and controlled eating on the mind. The overall goal of this review is to comprehend the advantages and disadvantages of various dietary approaches that reduce the risk of mental health issues in people of all ages.

Keywords: Nutrients, Diet, Microbiota, Neurotransmitter, Depression

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Introduction

A balanced diet is essential for maintaining excellent physical or mental health, according to many scientists and medical specialists. Healthy eating habits can influence mental health and wellbeing through immunological, neurogenesis, anti-inflammatory, and antioxidant pathways, as well as epigenetic changes (Marx W et al., 2017). Dietary profiles have an impact on endogenous hormones, neuropeptides, neurotransmitters, and the microbiota-gut-brain axis in addition to the composition, structure, and function of the brain. These factors are essential for decreasing stress and inflammation and also for maintaining cognitive functions (Adnan RAH et al., 2019).

Inappropriate mental health can arise when the diet is deficient in the nutrients. The nutrition transition process of the modern era is characterized by a global shift away from traditional dietary patterns towards the trending Westernized diets that are limited in consumption of plant-based foods while rich in processed, high energies foods refined sugar, trans-fatty acid and excessive sodium (Lancet, 2019).

The purpose of this chapter is to give a general overview of the connection between nutrition and mental health.

Role of Certain Nutrients in Mental Health: Micronutrients and Macronutrients

Since micronutrients (such vitamins and minerals) and macronutrients (like fatty acids) have a variety of biological functions:

Macro-nutrients

The central nervous system (CNS) has a large concentration of docosahexaenoic acid (DHA), a structural element of membrane phospholipids in the brain that is necessary for healthy development and subsequent cognitive functioning (Brenna JT, 2002). The two primary polyunsaturated fatty acids (PUFAs) that affect brain cells are docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). It has been suggested that EPA, an inhibitor of prostaglandins, thromboxanes, and leukotrienes and a precursor of anti-inflammatory cytokines might positively affect metabolic and immunological processes (Grosso et al., 2014). It has been demonstrated that omega-3 polyunsaturated fatty

acids (PUFA) alter the neuroendocrine transmission of dopamine and serotonin (Sartorius et al., 2012) and improve symptoms of depression, anxiety and sleep quality (as shown in Table 1). Figure 1 shows the list of micro and macronutrients.

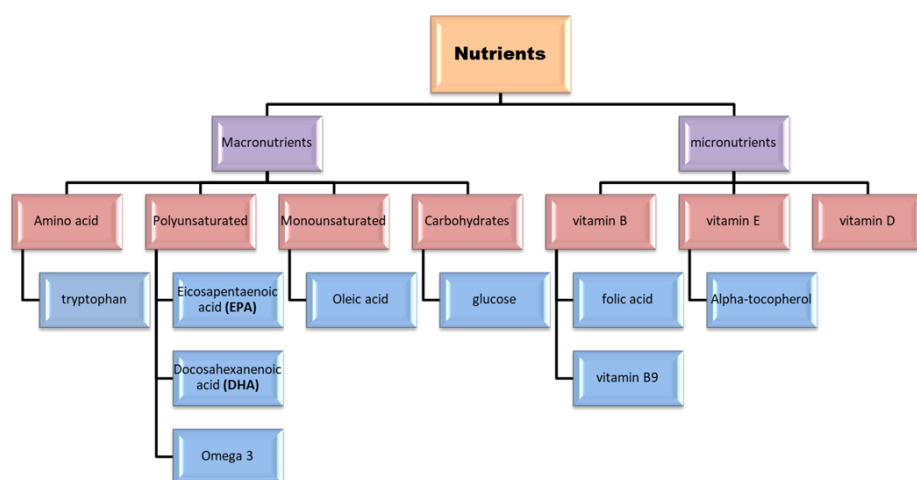


Fig. 1: List of micronutrients and macronutrients

Moreover, it has been demonstrated that monounsaturated fatty acids (MUFA) may influence glucose metabolism to modify brain activity and sleep patterns. For example, oleic acid that has been associated with depression (Glenn et al, 2019).

Tryptophan is a crucial amino acid that serves as an upstream precursor of bioactive metabolites associated with sleep, such as serotonin and melatonin. Although the brain uses glucose as its primary energy source, depression and other mood disorders because they increase the production of serotonin in the brain and improve symptoms of depression, anxiety level and sleep quality (Wurtman and Wurtman , 2018).

Table 1: Role of various macronutrients and it's function

Nutrient	Disorder	Effect	Reference
Magnesium oxide, folic acid and multivitamin supplementation	Stress	Pro-inflammatory cytokine profiles in the active group are positively influenced by nutrient supplementation, but emotional intellectual mental state is unaffected.	et al., 2018)
vitamin B6 and Magnesium	Stress	Considerable decrease in felt stress in comparison to the initial state; no discernible variation	(Pouteau et al., 2018)
DHA, EPA	Depression and anxiety	Decrease the levels of anxiety and depression symptoms in the n-3 PUFA group as compared to the placebo group	(Robinson et al., 2019)
Omega-3 and PUFAs	Depression	Substantial improvement of symptoms of depression, anxiety level and sleep quality	(Jahangard et al., 2018)}

Micro-nutrients

B-group vitamins are one important type. Niacin might be a suitable medication to help to treat schizophrenia (Hoffer and Prousky, 2008).

Folic acid is artificial version of folate, often known as water- soluble vitamin. As a way for folic acid and folate to carry out their varied functions, like in aiding mental health and controlling the production of unique neurotransmitters like dopamine, serotonin, and norepinephrine (Leahy, 2017).

Numerous B vitamins, such as B9 (as shown in fig-1), might lessen inflammation brought on by elevated homocysteine levels because they are cofactors in the breakdown of this amino acid (Elsherbiny et al., 2020).

Alpha-tocopherol is one of the most important molecules of vitamin E, helps to protect the neuronal membranes from oxidative damage, while vitamin D may help prevent neurodegenerative diseases (Bourre , 2006).

In the human body, Magnesium is the second abundant molecular cation that inhibits production of pro-inflammatory substances and development, it also has anti-inflammatory effects (Nielsen, 2018).

Impacts

The development of mental diseases and brain function is thought to be significantly influenced by nutrition, especially in light of industrialization, over processing of food, urbanization, cultural and technological shifts, and climatic change (Grajek et al., 2022).

Positive Impacts

Numerous dietary regimens have been linked to positive health outcomes.

Mediterranean Diet

Chronic illness and early death may be avoided with Med Diet. This eating pattern takes environmental and health concerns into account. It is primarily plant-based however it does occasionally include modest amounts of animal-derived foods. It also favors local and seasonal food production and consumption. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) listed Med Diet as part of humanity's intangible cultural heritage in 2010 as a result of these qualities (Dernini and Berry, 2015).

In contrast to eating patterns in the West including high in extremely processed and processed foods that are high in calories but extremely

low in nutrients (often known as "empty calories"), Med Diet is characterized by its incorporation of foods that have not been processed, which are rich inessential nutrients (Dominguez et al., 2019).

In the brain, apoptotic cell death, low-grade inflammation, and oxidative stress are all reduced when cytokine expression is reduced. C-reactive protein (CRP) is another biomarker for inflammation, and an extended Med Diet intake lowers CRP and an abnormal amount both of adipokines and cytokines regardless of body mass reduction (Richard et al., 2013).

Ketogenic Diet

Dietary carbohydrates are kept to a minimum while protein and fat levels vary, which is the cornerstone of the ketogenic diet. A diet consisting of one gram of protein per kilogram of body weight, 10 to 15 grams of carbohydrates per day, and the rest calories coming from fat is known as the standard ketogenic diet (Roehl and Sewak, 2017).

The quantity of disability-adjusted life from 29 years resulting from disorders of the mind climbed dramatically from 80.8 million to 125.3 million. Approximately 7.2% people all throughout the world experience the symptoms of anxiety and sadness, both with and without an official diagnosis (Dattani et al., 2023).

Because the ketogenic diet is known to "calm the schizophrenic mind" (Sarnyai, 2016) it has been discovered that individuals who followed it shown markedly improved psychological health, including reduced stress, anxiety, depression, loneliness, and feelings of tranquility, contentment, and attentiveness outside of the clinical sample. A case study revealed that a ketogenic diet devoid of gluten and casein helped a youngster with autism and epilepsy become calmer (Herbert & Buckley, 2013). According to a case study, Bipolar II illness in a female who followed a ketogenic diet reported feeling much ease and self-assured (Phelps et al., 2013). According to Chen et al. (2023), glutamate is the brain's main excitatory neurotransmitter, whereas g-aminobutyric acid (GABA) is an inhibitory neurotransmitter.

Plant based Diet

Food habits consisting number and frequency of food and drinks that are regularly consumed, as well as the diversity and the caliber of these food dishes and drinks all included in plant-based diet. According to Satija et al. (2017), there are a number of subcategories of plant-based diets that are low in animal products, but the two primary categories are vegan and vegetarian. Therefore, eating a lot of fresh fruit, vegetables, nuts, seeds, legumes, whole grains, and water is a sign of a healthy plant-based diet, albeit lean meats and dairy may be excluded (Brown et al., 2018; Rajaram et al., 2019)

For instance, sources of fiber found in grains, legumes, nuts, seeds, and greens—all of which are common in vegan and vegetarian diets (as shown in Table 2) that are crucial for promoting changes in the gut microbiota, controlling inflammation, and regulating blood sugar levels (Taylor et al., 2020; Taylor and Holscher, 2020).

On the other hand, vegetarians who eat fish have higher intakes of nutrients like omega-3 polyunsaturated fatty acids (PUFAs), which are protective for the neuronal modulation of dopamine and serotonin, crucial for attitude, feelings and some other state of mind conditions, and the amino acids tryptophan and tyrosine. Vegan diets have lower intakes of these nutrients (Guu et al., 2019; Marx et al., 2021).

Table 2: Effects of different food trends on mental health, both positive and negative.

Dietary patterns	Sources	Main components	Impacts on mental health	References
Mediterranean diet	Unadulterated olive oil, Whole grains and cereals, Fish, nuts, fruits, chickpea, Green tea etc	oil, The antioxidants and anti-inflammatory compounds include hesperidin, polyphenols, beta-carotene, vitamins C and E, anthocyanins and carotenoids among others	MD shields against oxidative stress, inflammation, cognitive decline, and certain neurodegenerative & illnesses like Parkinson's or Alzheimer's	(Grodzicki & Dziendzikowska, 2020)
Ketogenic Diet	Olive, coconut, avocado, butter, fatty meats and fish (like salmon, tuna, and mackerel), eggs, lard, butter and cream etc	Fat: Accounting for 70–80% of daily caloric intake. Protein: Accounts for 10–20% of daily caloric intake. Carbohydrates: Accounts for 5–10% of daily caloric intake.	KD may be useful in treating psychiatric conditions like depression, eating disorders, anxiety, bipolar disorder, and schizophrenia as well as neurodegenerative conditions like Alzheimer's disease (AD), Parkinson's disease (PD), amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), Bipolar II illness or headaches.	(Yang et al., 2019)
Plant based diet	Water, seeds, legumes, lentils, tempeh, entire grains, hemp seeds, nuts, all fresh fruit(e.g. Berries) and vegetables etc	Fiber, probiotics and antioxidants (such as polyphenols, Flavonoids, Anthocyanins)	In addition to reducing oxidative stress and chronic inflammation, improvements in the brain-gut axis, microbiome axis significantly mitigate depression symptoms and safeguard dopamine and serotonin neuronal regulation.	(Brown et al., 2018; Rajaram et al., 2019)
Western Diet	Refined cereals, processed meat, high-sugar drinks, candy, sweets, fried foods, conventionally farmed animal products, high-fat dairy goods, high-fructose products, and prepackaged meals etc	Saturated and trans fatty acids (SFAs and TFAs) including Propionate, butyrate, and acetate	Chronic inflammation, allergies, diabetes, autoimmune diseases, depression, metabolic syndrome, mitochondrial dysfunction, neuropsychiatric disorders (such as bipolar disorder, major depressive disorder (MDD), Alzheimer's and Parkinson's diseases, and schizophrenia), emotional disorders, and cognitive impairment are all brought on by WD.	(Martinez et al., 2017)

Negative Impacts

These including some diets that have non-significant impact on mental health.

Western Diet

Pre-packaged meals, refined cereals, red and processed meat, high-sugar beverages, candies, sweets, fried foods, conventionally produced animal products, high-fat dairy products, and high-fructose products are all common components of the Western diet (as shown in table 2), a contemporary dietary pattern (Clemente-Suárez et al., 2023).

Thus, the Western diet pattern, which is marked by a high consumption of saturated fats and processed carbs each day, has been linked to emotional disorders and cognitive impairment in both humans and animal prototypes. It also frequently results in obesity and overweight. By changing the makeup of the gut microbiota, such eating patterns affects brain function through a variety of gut-brain axis pathways. Chronic stress-related dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and addictive-like eating patterns may also result from prolonged exposure to the very appetizing meals typical of WD (López-Taboada et al., 2020).

Gut-brain axis

The enteric nerve system is located in the gut, the main organ for hormone control, immunity, and digestion. It functions mostly independently of the brain. Both the ENS and the central nervous system (CNS) are formed from neural crest cells during fetal development. These two systems share traits such as neuronal components, neurotransmitters, and functional independence (Petrof et al., 2013; Wallace and Redinbo, 2013; Young, 2017).

The gut-brain axis notion is thought to be derived from the gut microbiota's association with the neuro-endocrine-immune pathways (as shown in Figure 2). An army surgeon who tracked the gastric contents discharged via an intragastric fistula and found a link between mood and intestinal function offered the first evidence of the gut-brain axis (Mangiola et al., 2016).

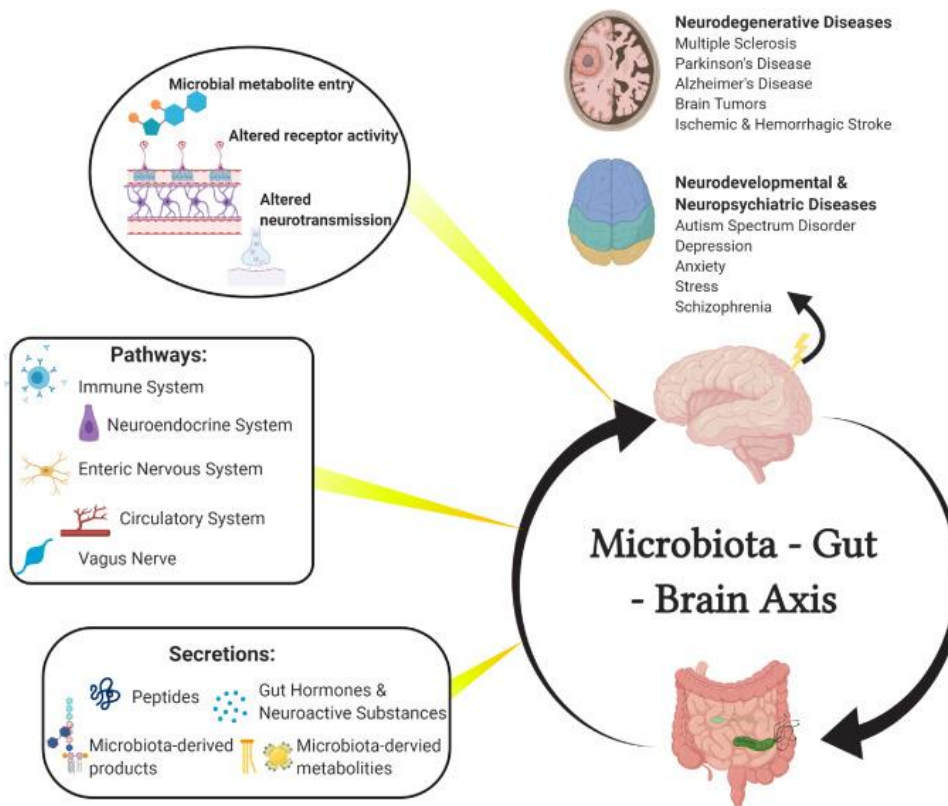


Fig. 2: The two-way communication between the gut microbiota and the brain is mediated by several pathways, such as the circulatory system, vagus nerve, enteric neurological system (ENS), immunological system, and neuroendocrine system. A variety of neuroactive compounds, peptides, gut hormones, metabolites, and products generated by microorganisms are found along these pathways. Upon entry in the brain, metabolites can impact neurodevelopment and neurodegeneration in a number of conditions, including multiple sclerosis, Alzheimer's disease, stroke, autism spectrum disorder, depression, etc. (Liu et al., 2022)

4.2. Pathways of Communication of Gut-brain axis

The neuronal, neuroendocrine, and immunological pathways are the three primary pathways that make up the microbiota-gut-brain axis.

Nerve-pathway

Through neuronal pathways that include neural conduction, neurotransmitters, neurogenesis, apoptosis, and neurodegeneration, microbiota most fastly affects the brain and behavior. (Forsythe et al., 2014; Wall et al., 2014; Ogbonnaya et al., 2015; Thion et al., 2017; Westfall et al., 2017).

Neurotransmitters

In the stomach, the microbiota directly produces neurotransmitters, including 50% of dopamine (DA) and 90% of serotonin (5-HT). A variety of bacteria, such as lactic acid bacteria (LAB) and Bacillus strains, produce acetylcholine (ACh) and catecholamines (Wall et al., 2014).

Furthermore, serotonin is produced by *Streptococcus*, *Escherichia*, *Enterococcus*, and *Candida* species (Holzer & Farzi, 2014). Whereas glutamate (Glu) is produced by coryneform bacteria and other LAB strains. (Diaz Heijtz et al., 2011; Lyte, 2014; Sudo, 2014; Wall et al., 2014; Mazzoli & Pessione, 2016).

Endocrine-pathway

The largest endocrine organ, the gut, has more than twenty types of enteroendocrine cells that produce more than 100 hormonal peptides and express more than thirty hormone genes. Through the endocrine system, which involves neuroendocrine cells, neuropeptides, and neuroactive chemicals, the microbiota in the gut influences the brain and behavior. (Raybould, 2010; Liang et al., 2012; Holzer & Farzi, 2014; Rehfeld, 2014; Sudo, 2014; Wall et al., 2014).

Neuroendocrine

The brain and gut are connected via the neuroendocrine system, which includes the pituitary, hypothalamus, and peripheral endocrine glands. The hypothalamic-pituitary-adrenal (HPA) axis plays a key role in neuroendocrine communication and the stress response. The development and function of the HPA axis depend on the microbiota of the gut, since its absence results in aberrant development (Sudo et al., 2005; Liang et al., 2012; Sudo, 2014; Keightley et al., 2015)

Behavioral and Psychological Analysis

How Emotions Affect Eating

It is still difficult to predict how emotions will affect eating. Previous research, which concentrated on individual differences, could not adequately account for the twofold diversity of emotion-induced changes in eating variability across both persons and moods. Emotional control over food selection, emotional consumption suppression. The links between emotions and biologically based motivations are explained by three basic functional principles: interference, concomitance, and control. As a result, emotional eating behaviors could be the result of regulatory mechanisms, a byproduct of emotions, or an emotional interference with eating (Macht, 2007).

Moderators of stress and eating

As previously mentioned, the kind of meal that was eaten in reaction to stress could be a major moderator, with Certain foods, such as unhealthy, high-fat foods, are more likely to be consumed than others, such as nutrient-dense, low-fat, low-sugar foods. We organized our analysis of additional moderators by food type because of the possible significance of this factor i.e., looking into the moderating effects of both nutritious and harmful foods as well as all foods (Gibson, 2012; Tomiyama, 2019).

Emotional Eating

The emotional nervous system is triggered by cognitively significant and threatening events, and this system partially controls behavioral output (e.g., fight-or-flight). Hyper palatable foods are thought to function as "comfort food," acting as a kind of taking care of oneself to alleviate undesirable distress., given the rewarding qualities of food. It has been demonstrated that people in depressive states prefer to eat hedonistically rewarding foods that have a lot of sugar or fat, while people in positive states choose to eat less appetizing dried fruits (Garg et al., 2007).

Effects of Screen-time on Mental Health

Children and adults are becoming more and more dependent on technology for working, studying, and spending their time on mobiles and computers. Unhealthy eating patterns, such as consuming more fast food and snacks, consuming more energy overall, and consuming less fruits and vegetables, have all been connected to screen time. When kids eat while utilizing electronics, these eating habits are more worrisome. Screen distraction can make it difficult for kids to understand their bodies' satiety cues, which can lead to thoughtless eating. This conduct has the potential to eventually lead to overeating and a higher chance of gaining weight which can ultimately lead to obesity which in turn have a great impact on mental health issues like depression or anxiety (as shown in Figure 3). Addressing these problems requires careful observation of eating habits when using screens (Sisson et al., 2003; Wansink, 2010).

Restrained Eating

Restricting one's food intake through conscious cognitive control is known as "restrained eating." This is usually done to lose or maintain weight. Cognitive limitation has been connected to food consumption under stress; highly restricted eaters typically eat more during stressful situations, while uncontrolled eaters typically eat less (Polivy et al., 2020).

This reaction is different from emotional eating, which is connected to increased food intake following an ego-threat stressor, whereas restraint is linked to increased food intake following stressors (Wallis & Hetherington, 2024).

The Effects of Food Insecurity on the Mind

Food insecurity is seen as a psychosocial stressor that negatively impacts mental health and increases the incidence of psychological disorders such the screening rates for depression, anxiety, and high felt stress were 54.9%, 58.9%, and 66.3%, respectively, for low-income individuals with extremely low food security compared to 14.3%, 20.5%, and 17.8% for low-income adults with moderate food security (Wolfson et al., 2021). A previous study examined how the gut microbiota influenced metabolites that impacted mood changes in major depressive disorder (MDD) using actions in the gut-brain axis (Caspani et al., 2019). The cognitive development of youngsters depends on iron, zinc, iodine, omega-3 fatty acids, and vitamins B, C, D, and E., memory, attention, and emotional control, among other things (Roberts et al., 2022).

Study Case war in Palestine

Children in Gaza suffer from severe food insecurity, which leads to inadequate diets and pervasive nutritional deficiencies. The World Food Programme (WFP) reports that 59.4% of Palestinian children live in Gaza and 63% in the West Bank, making food insecurity among Palestinian children a severe issue that is made worse by ongoing conflict, political divisions, economic instability, and restricted access to resources. Out of the 5.3 million people living in the State of Palestine, about 2.2 million people, including 576,600 who are suffering from catastrophic hunger, are acutely food insecure in the Gaza region (Palestine|World Food Programme, 2024).

Conclusion

Diet has a significant impact on wellbeing and mental health. For the brain to operate at its best, essential nutrients like vitamins, proteins, and omega-3 fatty acids are necessary. Deficits or imbalances in these nutrients can result in mental health issues including anxiety, depression, and weakened stress reactions. Different dietary patterns, including plant-based, ketogenic, and Mediterranean diets, have different effects on mental health. While processed foods and a high sugar intake are connected to mental health illnesses, diets abundant in fruits, vegetables, and healthy fats are associated with improved psychological results. Dietary alterations in the gut microbiota impact neurotransmitter synthesis and stress responses, which in turn contribute to anxiety, depression, autism, and neurodegenerative disorders. This relationship between nutrition and mental health is known as the gut-brain axis. The potential of dietary measures to promote mental health and avoid illnesses is highlighted by the fact that food insecurity exacerbates mental health by raising stress and bad eating habits. Stress frequently triggers emotional eating, which results in bad eating patterns that impair long-term mental health and mood stability. Similarly, eating under constraint can exacerbate stress, leading to cycles of overeating and deprivation, which further affects mental health.

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