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Review Article

The impact of dietary patterns and nutrient status on adolescent mental health and emotional well-being

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ABSTRACT

Adolescence is a pivotal period of strong neurodevelopment combined with high emotional and psychological vulnerability. This review explores the integral relationship between dietary status and adolescent mental health outcomes, examining how systemic dietary patterns often shaped by socioeconomic factors influence the gut-brain axis. It summarises current evidence elucidating the bidirectional communication through which the gut microbiome influences the synthesis and regulation of key neurotransmitters (e.g., serotonin and dopamine) required for mood stabilisation. The paper highlights the importance of certain micronutrients, including omega-3 fatty acids, B vitamins, and magnesium in maintaining structural brain integrity and modulating stress responses. In contrast, it analyses the impact of western dietary patterns, which are abundant in refined carbs and sugar, on systemic inflammation and glucose dysregulation, both of which exacerbate mood instability and cognitive impairments. By identifying nutrition as a key, modifiable predictor of emotional resilience, this synthesis underscores the importance of pushing beyond traditional psychological treatment. It concludes by advocating for targeted, integrated nutritional intervention and public health strategies that promote adolescent mental well-being during this critical developmental stage.

Keywords: Adolescent mental health, Nutrition psychiatry, Gut-brain axis, Western diet, Neurodevelopment, Public health intervention, Micronutrients, Emotional resilience

INTRODUCTION

Adolescence is a formative stage of human development that is increasingly characterised by a global mental health crisis. The World Health Organisation (WHO) estimates that approximately one out of seven people between the ages of 10 and 19 years experiences a mental health problem, which is nearly 15% of the disease burden in this age group globally. The leading causes of illness and disability among adolescents worldwide include behavioural disorders, anxiety, and depression. Additionally, suicide has been ranked third in mortality for those aged 15 to 29 years, apparently being one of the top causes of death among young people.[1] These disorders not only affect the individual's emotional well-being but can also disrupt cognitive development, academic success, and social functioning throughout this critical developmental period.

Emerging research highlights that the complex interaction of biological, environmental and lifestyle factors shape adolescents' mental health. Among these factors, diet has emerged as a significant modifiable determinant of psychological well-being.[2] Dietary habits formed during adolescence may influence brain development, stress tolerance and emotional regulation. However, the greater risk of experiencing depressive symptoms, anxiety and mood instability during adolescence has been associated with modern dietary patterns, which are characterised by high intake of ultra-processed foods and refined carbohydrates.[3,4]

Nutritional psychiatry has made recent developments elucidating the biological mechanisms by which mental health is influenced by diet. One of the best-known mechanisms includes the gut-brain axis, a bidirectional communication network between the gastrointestinal system and the central nervous system.[5] The microbiota significantly influences the production of neurotransmitters, immunological responses and inflammatory processes that impact both mood and cognitive functioning. A deficiency in certain nutrients may disrupt these processes, especially essential micronutrients such as omega-3 fatty acids, B vitamins, magnesium and zinc, increasing the likelihood of mental health issues.[6,7]

Despite the growing recognition of nutrition as a key component of mental health, traditional methods that address adolescents' mental health mainly focus on psychological and pharmacological aspects, often disregarding dietary patterns. Therefore, it is crucial to understand the impact of general dietary patterns on emotional well-being as this can provide important opportunities for early prevention and integrated public health initiatives, thereby benefiting the adolescent populations.

ADOLESCENT BRAIN DEVELOPMENT AND NUTRITIONAL VULNERABILITY

The transition from infancy to adulthood is an important period of brain development, defined by anatomical and functional changes in the central nervous system. During this period, substantial synapse pruning, myelination, and neural network rearrangement occur extensively, notably in areas that govern emotions, decision making, and cognitive processes.[8,9] Adequate nutritional intake is essential to maintain teenagers' brain development and mental health because of an increase in neuroplasticity taking place during these developmental processes. Aside from neurodevelopmental changes, adolescence is marked by puberty, which is associated with major hormonal alterations.[9] These hormonal variations have an impact on mood regulation, stress reactions, and emotional processing. Henceforth, teenagers are more prone to experience mental health problems such as sadness and anxiety.[10,11]

Nutritional status may have an important role in either strengthening psychological resilience or increasing vulnerability to mental health disorders during this developmental stage.[9,11] Given the adolescent brain development and psychological sensitivity, nutritional consumption emerges as an environmental factor that might influence mental health outcomes.[8,9]

Both eating habits and nutritional deficits can affect neuronal signalling pathways and brain function, thereby influencing emotional and cognitive consequences.[10]

DIETARY PATTERNS AND MENTAL HEALTH OUTCOMES IN ADOLESCENTS

Dietary habits are a crucial part of daily life that may impact mental health outcomes, especially during adolescence.[12] Over the past few decades, the world has faced a tremendous shift in dietary trends toward the intake of high-energy, low-nutrient foods, particularly within westernized diets. The westernized diets are often typified by a frequent consumption of ultra-processed foods, refined carbs, saturated fats, and added sugars, alongside a reduced intake of fruits, vegetables, whole grains, and other nutrient-dense foods.[13] Research increasingly suggests that such food habits may contribute to the development of depressive symptoms, anxiety, and behavioural issues, henceforth harming the adolescents' psychological well- being.[3,13,14]

Western dietary patterns

The western dietary patterns have been extensively studied concerning their association with various mental health related outcome. This pattern is typically characterized by frequent consumption of fast foods, processed meats, sweetened drinks and refined snacks. These foods are often associated with excessive calories while lacking essential nutrients required for optimal brain development and function. Several studies have suggested that adolescents who frequently consume the western-style diets may be at an increased risk of experiencing mood disturbances, emotional dysregulation and symptoms of depression compared to those who consume more balanced dietary patterns.[9,13,14]

Ultra-processed foods

Another component that characterizes the Western dietary pattern is the high consumption of ultra-processed foods.3 Ultra-processed foods are defined as industrially manufactured products that contain multiple additives, including preservatives, taste enhancers, sweeteners, and fats. Packaged snacks, cereals, fast food products, and ready-to-eat meals are the most common examples of ultra-processed foods. A high intake of ultra-processed meals has been associated with poor nutritional quality. Studies have proposed that excessive intake of ultra-processed meals contributes to metabolic abnormalities, systemic inflammation, and gut microbiota changes. The brain function and emotional control may be affected by these biological changes, potentially increasing the risk of mental health issues in teenagers.[3,13]

Sugar/refined carbohydrates

High sugar consumption is another dietary factor that has been of significant interest in recent literature. Adolescents are considered to be amongst the highest users of sugar-sweetened drinks and high glycemic index diets. However, significant changes in blood homeostasis, cognitive performance, and mood stability have been associated with

these dietary patterns. Pro-inflammatory and oxidative stress responses, which are linked to depression and anxiety symptoms, may also be increased by consumption of diets high in sugar.[15,16]

In overall, the current evidence indicates that poor dietary quality, characterized by diet high in ultra-processed foods, refined carbohydrates, and sugary substances, may contribute to poor mental health outcomes in adolescents. Whereas, a well-balanced diet that includes whole foods, fruits, vegetables, and nutrients has been linked to improved mental health.[12] Understanding the connection between eating habits and mental health in teenagers is crucial for the establishment of preventative mental health treatments.[12,14,16]

PROTECTIVE DIETARY PATTERNS

Research by Zielinska et al highlights the protective role of healthy dietary patterns, particularly the Mediterranean diet, in supporting adolescent mental health.[17] Enhanced mental health and fewer depressive symptoms have been linked with the consumption of a diet rich in fruits, vegetables, whole grains, legumes, and healthy fats known as the Mediterranean diet.[2,17] Healthy brain function and emotional regulation are supported by the essential nutrients, antioxidants and anti-inflammatory compounds provided by these dietary patterns.[17] These balanced eating habits emphasise whole and minimally processed foods, which are important for maintaining stable blood glucose levels, improving gut microbiota composition, and lowering systemic inflammation, all of which are important for maintaining mental health in adolescents, unlike the Western eating habits, which emphasise many unhealthy foods.[17,9]

Beyond overall dietary patterns, there are specific nutrients which play key roles in maintaining brain and emotional wellness. The formation of neuronal membranes requires omega-3 fatty acids and has been associated with improved mood and cognitive performance.[18] B vitamins, including folate and vitamin B12, are necessary for neurotransmitter production and have a role in serotonin and dopamine biosynthesis.[17,19] Minerals such as magnesium, zinc, and iron are also known to be vital for brain function: magnesium supports stress response and neurotransmitter activity, zinc for synaptic function and immunological response, and iron for transporting oxygen during brain development.[17] Emotional and cognitive deficits have been linked with deficiencies of these nutrients during adolescence.[19]

BIOLOGICAL MECHANISMS LINKING DIET AND MENTAL HEALTH

Increasing research highlights that nutrition can impact mental health by influencing the brain through multiple biochemical pathways, with the gut-brain axis being particularly important. This two-way connection links the gastrointestinal tract and the central nervous system via the neuronal endocrine and immune systems.[5,6] The brain processes and emotional behaviours can be altered by the composition of the gut microbiome, which is shaped by diet. Gut microbiota diversity and the production of beneficial chemicals such as short-chain fatty acids have been associated with the consumption of a diet rich in fruits, vegetables, whole grains and fibre. These changes can result in preservation of intestinal barrier function, immunological regulation, and neurochemical activity.[7]

Systemic inflammation is another key factor linking nutrition and mental health. Diets heavy in ultra-processed foods, refined carbohydrates, and saturated fats have been associated with chronic low-grade inflammation.[3,20] The function of the brain could be disrupted by these persistent inflammations, altering neuronal signalling and neuroplasticity, which are critical for emotional balance and cognitive performance.[21] Additionally, there are certain nutrients that play an important role in the production of neurotransmitters such as serotonin and dopamine. These hormones control mood, motivation, and emotional responses.[22] Nutrients such as omega-3 fatty acids, B vitamins, and amino acids are essential in the metabolic production of these compounds.

The bidirectional pathways of the gut-brain axis (adapted from 21) show how neuronal, immunological, and endocrine systems allow two-way communication between the gastrointestinal tract and the central nervous system. Gut microbiome composition is shaped by dietary habits; unhealthy diets contribute to dysbiosis and poor mental health outcomes, while nutritious diets promote microbial diversity and psychological well-being (Figure 1).[22]

Nutrition might impact psychological well-being by helping to regulate blood glucose levels. Diets high in refined carbohydrates and foods with a high glycaemic index can rapidly fluctuate blood glucose levels, resulting in fatigue, irritability, and impaired cognitive function. The body's stress response and appetite regulation can be influenced by frequent fluctuations in blood glucose.[22] A well-balanced diet rich in complex carbohydrates, fibre, and healthy fats will keep blood glucose levels stable, giving a steady source of energy to the brain and promoting optimal cognitive and emotional performance.[20]

PUBLIC HEALTH IMPLICATIONS

The established connection between eating habits and adolescent mental health has significant implications for both clinical and policy consequences. Schools are a key setting for intervention as they provide structured environments and access to nutritious meals rich in fruits, vegetables and whole grains. The implementation of dietary education programs in schools can also increase knowledge about the relationship between nutrition and mental health, empowering teenagers to make appropriate dietary choices.[13] Additionally, public health initiatives can focus on reducing the intake of ultra-processed foods

through regulatory measures such as marketing, labelling, and dietary guidelines.[3,24] From a policy perspective, to create a supportive food environment and affordable access to nutritious foods, a multi-sectoral strategy is essential, including collaboration between public health, agriculture, and the food industry stakeholders. Although considerable research in this area has been conducted, the existing evidence does not establish causation, and gaps remain unsolved. Longitudinal and intervention designs should be prioritised in future studies to clarify the direction and mechanism of the diet-mental health relationship, while also including diverse populations to improve generalizability.[3] Developing effective, evidence-based strategies requires addressing these gaps to enhance adolescent mental health through improved nutrition.

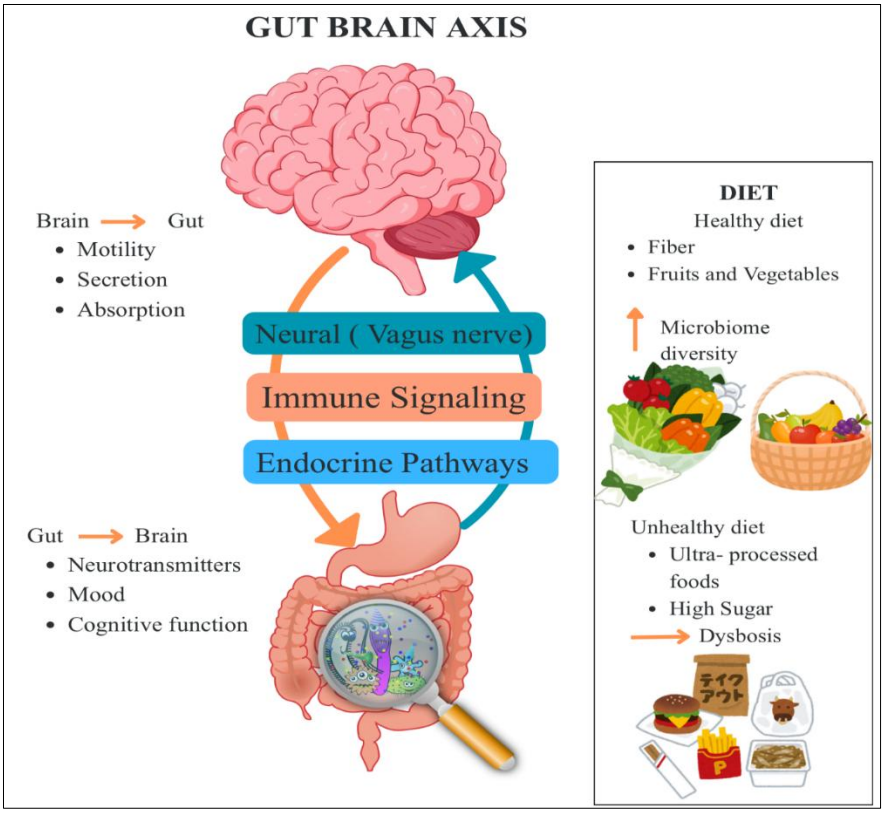

Figure 1: Gut brain axis.

CONCLUSION

Adolescent nutrition and dietary habits are crucial for their mental health and well-being. Diets high in ultra-processed foods, refined carbs, and sugars are associated with higher risks of depression, anxiety, and emotional issues. Meanwhile, cognitive skills, emotional control and optimal brain development can be supported by balanced diets rich in essential nutrients. To boost adolescent well-being, nutrition as a modifiable lifestyle factor can be strategically employed. Schools, families, and public health initiatives play vital roles in encouraging healthy eating habits. Implementing effective school meal programs, nutrition education, and policies that restrict the marketing of ultra-processed food can help adolescents make healthier choices. Focusing on long-term intervention studies that better understand the impact of diet on mental health, including diverse populations, should be the main aim of future research. Ultimately, a comprehensive approach for improving adolescent mental health that combines good nutrition, psychological support, and public health efforts is required. Promoting healthy eating can significantly advance teenagers' mental well-being and lay a foundation for healthier adult lives.

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