Mental Health and Nutrition: A Systematic Review of their Relationship

Gunjan Tewari¹, Lata Pande², Kamal Kishor Pande³

¹Junior Research Fellow, Department of Home Science, D. S. B. Campus, Kumaun University, Nainital-263002, Uttarakhand, India Corresponding Author E-mail: *tewarigunjan28[at]gmail.com* Contact-+91 9690110490

²Professor and Head, Department of Home Science, D. S. B. Campus, Kumaun University, Nainital-263002, Uttarakhand, India

³Professor and Principal, S. B. S. P. G. College, Rudrapur, Kumaun University, Nainital-263002, Uttarakhand, India

Abstract: Holistic health involves competent physical, mental, social, and spiritual components. As the incidence of mental health problems advances among the global population, it becomes pertinent to look into alternative methods of their prevention and treatment. As diet is an essential part of our daily life, it is easier to make modifications and understand its linkage with mental health if adequate awareness is generated. This review presents an analysis of the significance of mental health, various problems associated with it, and nutrients that directly or indirectly affect the ascent of these problems. Studies suggest that adequate nutrition is positively correlated to mental health, no matter where one lies in the spectrum. Therefore, it becomes important to understand the evident linkage between nutrition and mental well-being and recognize gaps in current knowledge.

Keywords: Depression, Mental Health, Mood, Neurotransmitters, Nutrition

1. Background

The sustentation of health is indispensable for the development of a society. It is essential for leading a joyous life irrespective of any discriminatory factor. World Health Organisation defines health as a state of complete mental, physical, spiritual, and social well-being and does not limit it to merely an absence of diseases (WHO, 1946). India has educated the world regarding holistic health which constitutes both physical and mental well-being. As it is famously said 'there is no health without mental health', ithighlights with certitudethat the concept of health is incomplete without mental wellness.

According to recent statistics of WHO with respect to India, the disability-adjusted life years (DALYs) per 10, 000 people is 2443 while the age-adjusted suicide rate is 21.1 per 100, 000 people. A loss of USD 1.03 trillion has been estimated to the Indian economy due to mental health problems between 2012-2030. In 2017, around 14.29 percent of Indians were suffering from different mental health problems. The proportion of mental disorders in total disease burden has magnified two times its 1990 statistics. (India State-Level Disease BurdenInitiative Mental Disorders Collaborators, 2020). Indian youth is now facing suicide as one of the prime causes of death (Patel et al., 2012). India observes more than 33 percent and 25 percent of all female and male suicides respectively on a global level (India Disease Burden Initiative Suicide State-Level Collaborators 2018). NMHS 2015-2016, reported that approximately 10percent of adult population in India meets the diagnostic basis for a mental disorder. The most common mental disorders constitute depression, anxiety, bipolar disorder, and eating disorders. These problems differ in their manifestation as morbid or co-morbid and range from mild to severe, acute to recurrent to chronic, and single to multiple symptoms. These conditions are typical of apparent abnormality in emotions, thoughts, behavior, and interactions (WHO, 2017). These disorders significantly increase the disease burden by contributing to the etiology and symptoms of other non-communicable diseases. They add to the existing load of disability and morbidity while some lead to fatality (NMHS, 2015-2016).

Mental health, hithertoneglected, has now been identified as a priority area at the national and global levels by policymakers and researchers. Mental health has also been incorporated into the United Nations Sustainable Development Goals in 2015 (NMHS, 2015-2016; Chokshi et al., 2016; WHO 2013).

The quality of diet determines the status of mental health and may mediate linkages to depression and anxiety. Individuals that are already at higher risk due to exposure to stress tend to develop poor dietary patterns, which eventually lead to symptoms of common mental disorders (**Lopresti et al., 2013**). A healthy and balanced diet comprises whole cereals, pulses, legumes, essential oils, fruits, vegetables, milk and milk products, nuts, legumes, meat, fish, and essential oils. It also involves restricted consumption of sugars, refined cereals, processed meat and saturated fats (**Vinke et al., 2018**). Around 47 percent of studies that involved the intervention of a whole diet revealed improvement in depressive symptoms (**Opie et al., 2015**).

Aim:

The aim of this review is to appraise and analyse the studies and research evidence that establish a bilateral relationship between mental health and nutrition. This review will compile the current knowledge and unfold the contradictions and gaps that will form a foundation for breakthrough research.

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2. Methodology

A systematic review of accessible qualitative and quantitative studies published between 2000-2021 was conducted using different databases such as Web of Science, Scopus, Cochrane Library, and PubMed. Keywords such as mental health, nutrition, nutrients, depression, mental health disorders and mood were used to search the studies which explored the relationship of various nutrients with mental health. A manual search was done to cite references from retrieved review articles.

The Cycle of Food and Mood

Food and mood have a bidirectional relationship and affect one another. The former requires as much attention as the latter because emotions influence food choices which may improve or degrade the disposition of mental health. This cycle needs to be analysed to do informed management of mental health.

The brain is another integral organ of the body which gets its nourishment from the nutrients present in the diet. The properties of food eaten by an individual such as taste, smell, texture, and feel can impact brain function, bringing changes in mood and emotion. These stimulations may induce rapid or slow responses in the brain (Shepherd &Raats, 2006). Feelings of satisfaction and fullness are generated by eating food as it leads to an opioid release in the brain (Tuulari et al., 2017). Foods serve as a natural source for substances that wield critical influence on the central nervous system including the brain. Neurotransmitters like acetylcholine, GABA, dopamine, serotonin, and histamine are some of these substances (Matteo et al., 2018). The interactions of these neurotransmitters and various foods lead to the development of nerve impulses and regulate one's emotions and behaviors (Banjari, 2014).

Foods that are increasingly eaten for pleasure like pizza release high amounts of endorphin in the brain. It was found that the feeling of pleasure was independent of the magnitude of opioid release. A popular association between food and mood is apparent in the worldwide consumption of coffee and chocolate. Most people believe that a bite of chocolate makes us happy and relieves stress while a sip of caffeine makes one more attentive and lessens sleep. The stimulants theobromine and caffeine added with sweet taste help in the development of these effects. Chocolate when eaten solely enhances the synthesis of serotonin, a precursor of tryptophan, which is known as the happy hormone. Lower levels of serotonin may lead to sleeplessness, depression, and anxiety (Shepherd & Raats, 2006). Both tryptophan and serotonin are known to promote adequate health (Rao et al., 2008).

Several studies have revealed that people generally eat according to their emotions. One may eat more or less than normal when sad or happy. It has also been recorded that people tend to eat more sweet than salty when their emotions guide their food choices (Van Strien et al., 2013). Optimistic people with positive emotions tend to give preference to healthy foods over junk and instant food. On the other hand, when one is bound by negative emotions, he/she tends to choose indulgent foods which provide an instant feeling of pleasure (**Gardner**, **2014**). This pertains to the fact that these indulgent foods provide a temporary sense of comfort which makes a person feel good. The psychological and physiological needs of a person may influence their attraction to certain foods (**Locher**, **2005**). The feelings of loneliness and sadness also trigger attraction toward comfort foods (**Spence**, **2017**).

Studies suggest that diet may lead to the emergence of mental disturbances and especially depression. Many studies have revealed a correlation between diet and susceptibility to depression (Phillips et al., 2018; Oddy et al., 2018). Malnutrition has been largely seen to be correlated with sensitivity to stress and regulation of mood. This suggests a significant association of mental health with diet and metabolism (Oliver & Wardle, 1999; Gibson, 2006; Dallman, 2010).

Nutrients Linked to Mental Health

The onus of increasing pervasiveness of mental disorders is on the deterioration of diet because of inclination to indulgent foods. The population is undergoing major lifestyle changes due to modernisation which involves less physical activity, malnourishment, overeating, sleep deprivation, social isolation and less exposure to sunlight. All these changes deteriorate physical health and influence the occurrence and treatment of mental disorders. (**Hidaka**, **2012**).

Food serves as a source of macronutrients (Carbohydrates, Fats, Proteins) and micronutrients (minerals, vitamins) (Mahan, 2008). An imbalance of these nutrients sustained for the long term may cause physiological and/or psychological problems. The psychological health of a person is affected by what generally misses out from his nourishment (Hidaka, 2012; Kroes et al., 2014; Levant, 2013; Banerjee, 2014; Anderberg, 2016). Balanced nutrition influences mental cognition, and memory and has a crucial effect on our thinking, emotions, and behaviours. Nutrients in the diet form a constituent of the nutritional intervention approach to obviate and treat mental disorders. (Banjari 2014).

On the other hand, unbalanced or poor quality diets heighten the susceptibility to physiological metabolic disorders and decline of mental cognition in the long term which worsens as the age advances (Agrawal & Gomez-Pinilla, 2012; Prenderville et al., 2015).

The most common nutritional deficiencies observed in people suffering from mental disorders are omega-3 fatty acids, vitamin B, essential amino acids and minerals. These nutrient deficiencies may also aggravate existing mental disorders. This could be due to the fact that these nutrients serve as precursors to certain neurotransmitters (Lakhan & Vieira, 2008). Therefore, sustaining a balance of nutrients in the diet is essential.

Carbohydrates

Researchers are increasingly focusing on the effect of carbohydrates on overall health outcomes and disorders (**Gopinath et al., 2016**). The property of carbohydrate rich foods to increase the blood glucose level is called their

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'glycaemic index (GI) ' which varies for different foods and serves as a measure of the quality of carbohydrates. Dietary glycaemic load (GL) refers to the product of Glycemic Index and total carbohydrate in a given amount of food. (Jenkins et al., 2002; Shaumberg et al., 2004; Sacks et al., 2014; Gopinath et al., 2016). Many studies have equivocally revealed that GI has a positive correlation while GL has a negative correlation with psychological distress and mental disorders (Mwamburi et al., 2011; Aparicio et al., 2013; Gangwisch et al., 2015; Haghighatdoost et al., 2016; Gopinath et al., 2017).

Carbohydrate in diets increase serum insulin levels, which is responsible to increase tryptophan (precursor of serotonin) uptake in brain [Pellegrin et al., 1998). Therefore, carbohydrate rich foods are expected to lower the chances of occurrence of depression (Wurtman et al., 2003; Murakami et al., 2010). Sweet foods have an instant and short-term effect on the emotions. However, high consumption of low GI foods like fruits, vegetables and whole grains is recommended to maintain mental wellbeing (Rao et al., 2008).

Proteins

Proteins are made up of amino acids. These amino acids affect the functioning of the brain as they are the precursors to neurotransmitters that influence emotions and behaviors. Tyrosine is the precursor to dopamine and tryptophan converts into serotonin. The deficiency of these amino acids lead to reduced formation of respective can neurotransmitters which may further lead to poor mental health and low mood. The excess of these amino acids may also lead to mental disorders and brain damage (Rao et al., 2008). Tryptophan affects neural processing in brain neurocircuits which regulate mood (Kroes et al., 2014). It has been seen that reduction of tryptophan has a greater impact on mood disruption than high carbohydrate intake. (Shepherd & Raats, 2006). However, tryptophan competes with LNAA to move from blood to brain, any discrepancy due to this mechanism can be alleviated by increasing the tryptophan/LNAA (large neutral amino acid) ratio. (Kroes et al., 2014).

Omega-3 fatty acids

Fatty acids constitute a large part of the brain. An estimate says that 50percent of the brain's grey matter consists of polyunsaturated fatty acids. One-third of this 50percent are n-3-fatty acids. The membrane of the brain is made of phospholipids, sphingolipids, and cholesterol (Rao et al., 2008). N-3 fatty acids are essential for the development and functioning of the brain as they are responsible for various brain functions such as neurotransmission, neurogenesis, and neuroinflammation. The deficiency of n-3 fatty acids may increase susceptibility to different mental disorders like anxiety, depression, dementia, bipolar disorders, attentiondeficit hyperactivity disorder, schizophrenia, autism. Eicosa pentaenoic acid (EPA) and Docosahexaenoic acid (DHA) are related to the sustentation of mental health, and their deficiencies may add to the pathophysiology of mental disorders if other contributing factors like genotype and stressors are also present (Lange, 2020; McNamara, 2009). DHA and EPA alleviate inflammation by regulating the magnitude and duration of inflammatory response. They provide resistance to depression and produce antidepressant effects through anti-inflammatory mechanisms (McNamara, 2009). DHA (22: 6n-3) represents around 15% (most abundant) of total fatty acids. DHA has to be taken through diet as it is not synthesized by mammals (Levant, 2013). A daily intake of 1.5 to 2 g of EPA affects depressive symptoms in patients (Lakhan & Vieira, 2008).

Micronutrients

Some neurotransmitters are synthesised with Vitamin B6 and B12 as precursors. Vitamin B12 supplementation protects the myelin sheath of nerve fibers and improves mental cognition and cerebral capacity (**Rao et al., 2008**). **Benton et al., 1995**revealed that excess supplementation of vitamins for a year improved emotions and behavior in all test subjects. These improvements were primarily due to vitamins B1, B2, and B6.

Vitamin E or alpha-tocopherol is a constituent of cell membrane. It is responsible for neurological processes and increasing the regularity of lipid packaging. It inhibits lipid peroxidation by exerting a protective antioxidant and antiinflammatory activity and accumulates at places like mitochondrial membranes where the production of free radicals is high (**Rizvi et al., 2014**). It regulates immune response and its deficiency can affect both innate and adaptive immunity (**Lewis et al., 2019**), increase pregnancy adversities, and cause neurological anomalies (**Traber, 2014**).

Water-soluble vitamin B9 or Folic acid or folate is metabolized into its bioavailable form L-methyl folate. Lmethyl folate significantly affects mental cognition and function as it modulates the synthesis of serotonin, norepinephrine, and dopamine (Leahy, 2017). Folate deficiency manifests in the form of depressive symptoms. Studies have shown that patients who suffer from depression have 25percent less blood folate concentration than healthy individuals (Rao et al., 2008). The deficiency of Vitamin B9 is caused by inadequate dietary intake and may cause neural tube defects in fetuses and neurological disorders in adults (Polavarapu & Hasbani, 2017).

The roles of magnesium include cell energy metabolism, synaptic transmission, nerve conduction, and cell membrane stability. It shows anti-inflammatory properties and releases pro-inflammatory molecules (**Nielsen, 2018**). Deficiency of magnesium occurs due to poor dietary patterns, alcohol, drugs, and gastrointestinal/renal malabsorption (**Polavarapu and Hasbani, 2017**).

3. Conclusion

The occurrence of mental illnesses is increasing exponentially with the inevitable modernization of society as people are getting heavily burdened with stress. Various studies have revealed that diet and nutrients have a close linkage with the prevention, incidence, and treatment of mental disorders. This suggests that comprehensive nutritional intervention strategies can be adopted to preclude mental health problems. This might be useful for patients who are not well adapted to allopathic medicines or psychotherapy. A balanced diet is likely to help all

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individuals who are normal, at risk for mental disorders, undergoing treatment, or at the rehabilitation stage. As the field of nutritional psychiatry has just emerged, there is a dearth of solid evidence on the bidirectional relationship between mental health and specific nutrients. Breakthrough studies need to be carried out in order to verify common beliefs and guide public health policy on diet and mental health. Further prospects in research include examining the effect of different meal patterns, eating behavior, and food responses on mental health problems. It is crucial to generate awareness regarding the importance of a healthy diet to maintain mental well-being and to pair it with a favorable lifestyle and adequate physical activity. Suitable information regarding this subject will let people maintain brain longevity and significantly reduce the economic losses that occur due to poor mental health and cognitive decline at the individual and societal levels.

Conflict of Interest

There was no conflict of interest faced during the review process.

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Author Profile



Gunjan Tewari is a UGC-NET-JRF qualified doctoral candidate at Department of Home Science, D. S. B. Campus, Kumaun University, Nainital. She has pursued her masters in Foods and Nutrition with minor in Biochemistry from G. B. Pant University of Agriculture and Technology, Pantnagar. She has a specialization in food analysis and dietetics and is currently working on the nutritional aspects related to mental health.



Professor Lata Pande is the Head, Department of Home Science, D. S. B. Campus, Kumaun University, Nainital and has more than 30 years of experience in the field. Her expertise and specialization involves foods, nutrition and community studies. She has more

than 30 articles and papers published in various national and international journals/publications. She is also leading various government schemes and programmes at state and national level.



Professor Kamal Kishor Pande the Principal, S. B. S. P. G. College Rudrapur affiliated toKumaun University Nainital. He has more than 30 years of experience in the field of chemistry and specializes in it. He has held various significant administrative posts

in the University and State Higher Education Department. He has various publications in national and international journals.