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ROLE OF NUTRITION IN PSYCHIATRY

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Abstract
Nutrition is the science of food and its relationship to health. Psychiatry is the branch of medicine focused on the diagnosis, treatment and prevention of mental, emotional and behavioral disorders. Dietetics as the practical application of the principles of nutrition plays a major role in nutritional neuroscience that deals with the nutritional factors and their correlation to the human cognitive behavior and emotions. Malnutrition has a life-long effect. Malnutrition in early infancy results in decrease in number of neurons resulting in intellectual disability and mental retardation. Psychological manifestations including cognitive inadequacies. People who suffer from a mental health-related pathology have a higher risk to encounter cardiovascular complications that the general population. The psychiatric patients are vulnerable to develop obesity due to sedentary lifestyle, side effects of medication and inability to take care of themselves. This paper looks at the causes of mental disorder which include Biological factors, life experience and environmental factors, psychological and individual factors. Role of nutrition in the prevention of mental health were also discussed. Societal shifts, changes in the typical diet, food insecurity, genetics, nutrition in the prenatal environment, nutrition and stress, energy metabolism and glucose. The roles of major health constituent on mental health were analyzed. Role of vitamins and minerals, neuropsychiatric manifestations due to electrolyte / water disturbance and side effects related to certain nutrient in excess were also discussed. Dietary recommendations were made.

Keywords: Nutrition, Psychiatry, Malnutrition, Health, Pathology

Introduction
Mental health is a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. Positive mental health enhances social cohesion and social capital, improves peace and stability in the living environment, contributes to economic development in societies, and is a principle of democratic society (Alexander, 2015). Mental health problems occur across all ages, cultures, and populations.

Nutrition is the science of food and its relationship to health. Dietetics is the practical application of the principles of nutrition. Nutritional neuroscience is the emerging field that deals with the nutritional factors and their correlation to the human cognition behavior and emotions (Rao *et al., 2018)*.

Constitution of Brain and Neurons
Twenty percent of the fat in the human brain is made from the essential fatty acids especially omega-3 and omega-6 omega fatty acids which are derived from outside and plays vital role in making up the

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brain cells (neurons) because they form part of the cell membranes. The nerve endings contain the highest amounts of Vitamin C in the body. Vitamin B Complex plays role in various enzymatic reactions and as antioxidants. Insufficient levels of these fatty acid results in depression and memory problem.

A balanced diet provides nutrients in adequate amounts and proper proportions. A balanced type of diet can ensure a balanced mood and sense of well being which can be achieved through adequate amounts of complex carbohydrates, essential fat, amino acids, vitamins, minerals and water. Various mental diseases are influenced by our dietary factors. Nutritional factors are closely correlated with human cognition, behavior, and emotions which in turn are related to functioning at neurotransmitters in the brain. The role of food is being studied extensively in the development, management and prevention of specific mental health problems such as depression, schizophrenia, attention deficit, hyperactivity disorder and Alzheimer's disease.

Malnutrition is a problem in developing countries. Malnutrition in pregnancy results in retarded growth of the fetus. Malnutrition in early infancy results in decrease in number of neurons resulting in intellectual disability and mental retardation. Apathy is the most constant and earliest neurologic feature and present in children with Protein energy malnutrition, (Diaz, 2015).
According to WHO, the people who suffer from a mental health-related pathology have a higher risk to encounter cardiovascular complications than the general population. The psychiatric patients are vulnerable to develop obesity due to sedentary lifestyle, side effects of medication inability to take care of themselves (Diaz, 2015). Malnutrition can result in manifestation of varied neuropsychiatric symptomatology.

CAUSES OF MENTAL DISORDER

1. Biological factors

Biological factors consist of anything non- physical that can cause adverse effects on a person's mental health. This includes genetics, prenatal damage, infections, exposure to toxins, brain defects or injuries, chemical imbalances, and substance abuse.

a. Genetics

Family-linkage and twin studies have indicated that genetic factors often play an important role in the development of mental disorders. The reliable identification of specific genetic susceptibility to particular disorders, through linkage or association studies, has proven difficult (Insel and Collins, 2016). This has been reported to be likely due to the complexity of interactions between genes, environmental events, and early development (Kas *et al.,* 2017).

b. Prenatal Damage

Any damage that occurs to a fetus while still in its mother's womb is considered prenatal damage. If the pregnant mother uses drugs or alcohol or is exposed to illnesses or infections then mental disorders can develop in the fetus. According to research, certain conditions, such as autism result from a disruption of early fetal brain progression. Environmental events surrounding pregnancy and birth have been linked to an increased development of mental illness in the offspring. This includes maternal exposure to serious psychological stress or trauma, conditions of famine, obstetric birth complications, infections, and gestational exposure to alcohol or cocaine, (Fumagalli *et al.,* 2017).

c. Infection, Disease and Toxins

A number of psychiatric disorders have often been tentatively linked with microbial pathogens, particularly viruses; however while there have been some suggestions of links from animal studies, and

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some inconsistent evidence for infectious and immune mechanisms (including prenatally) in some human disorders, infectious disease models in psychiatry are reported to have not yet shown significant promise except in isolated cases (Pearce and Bradley, 2017).

d. Injury and Brain Defects

Any damage to the brain can cause a mental disorder. The brain is the control system for the nervous system and the rest of the body. Without it the body cannot function properly. Higher rates of mood, psychotic, and substance abuse disorders have been found following Traumatic Brain Injury,(Mirsky and Duncan 2015).

e. Chemical Imbalances

Chemical imbalances can be viewed as disorders of the brain circuits. If there is damage to the neurotransmitters in the brain then mental disorders can develop. Mental disorders possibly associated with chemical imbalances are depression and schizophrenia, (Iversen and Iversen, 2017).

f. Substance Abuse

Substance abuse, especially long-term abuse can cause multiple mental disorders. Alcoholism is linked to depression while abuse of amphetamines can leave a person feeling paranoid and anxious. Correlations of mental disorders with drug use include cannabis, alcohol and caffeine (Winston, 2015). Caffeine use is correlated with anxiety (Vilarim *et al.,* 2021) and suicide.

2. Life experience and environmental factors

The term "environment" is very loosely defined when it comes to mental illness. Unlike biological and psychological causes, environmental causes are stressors that individuals deal with in everyday life. These stressors range from financial issues to having low self-esteem. Environmental causes are more psychologically based thus making them more closely related. Events that evoke feelings of loss or damage are most likely to cause a mental disorder to develop in an individual (Schmidt, 2017). Environmental factors include but are not limited to a dysfunctional home life, poor relationships with others, substance abuse, not meeting social expectations, low self-esteem and poverty. Mind mention childhood abuse, trauma, violence, neglect, social isolation, loneliness or discrimination, the death of someone close, stress, homelessness or poor housing, social disadvantage, poverty or debt, unemployment, caring for a family member or friend, significant trauma as an adult, such as military combat, and being involved in a serious accident or being the victim of a violent crime as possibly triggering an episode of mental illness. Repeating generational patterns have been found to be a risk factor for mental illness (Schmidt, 2017).

NUTRITION AND MENTAL HEALTH

The food we eat is associated with our mood, behaviour, and cognition. Current knowledge about nutrition and mental health is based on a variety of evidence from animal behavioural research, neurochemical experiments in vitro, epidemiological studies, and some clinical trials, and it continues to evolve (Mirsky and Duncan 2015). Based on the current literature, there are at least 10 common interrelated frameworks that explain the interactions between the food we eat and the functions of the mind.

1. Societal Shifts

Some observers have speculated that appetite for high-calorie foods has been accelerated by broad cultural and policy developments (Schmidt, 2017) including policies related to punishment (i.e., mass incarceration), access to housing, and food production, which in turn contributed to issues such as obesity and mental health conditions. Obesity may be linked to living in neighborhood where fear and crime make walking dangerous and impractical (Simon, (2020). The dislocation theory of addiction speculates that the globalization of free-market society has produced a general breakdown in

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psychosocial integration and responses including disordered eating, addictions, and distorted body image (i.e., emaciated body as the norm) (Alexander, 2015)

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2. Changes in the Typical Diet

The increased incidence in mental health conditions such as depression over recent years might be linked to the change in our diet over the same time frame, with shifts away from a diet based on a wide variety of whole foods to one that emphasizes more processed foods. The changing nutrient content of our food supply could also be considered in support for these hypotheses. Data indicate that the mineral and trace elements of fruits and vegetables have been decreasing over the last 50 years, possibly due to poor re-mineralization of the soil. Conversely, some food products now contain substantial amounts of various added nutrients and nutrient supplements are widely used. Some individuals may be sensitive to these changes in nutrient levels as biochemical needs differ.

3. Food Insecurity

Because mental health conditions account for a substantial portion of the global disease burden (Ustun *et al.,* 2010), related factors such as food insecurity have received increased attention. There are currently two main hypotheses to explain why the experience of food insecurity may influence mental health. First, individuals with conditions such as anxiety or depression may have diets that lack critical micronutrients; this relationship may be mediated by food insecurity. Second, the experience of food insecurity generates uncertainty, which in turn leads to stress and symptoms of anxiety and depression (Schmidt, 2017).

4. Genetics

Inborn errors of metabolism can have many effects, including influencing enzyme and coenzyme reactions in the brain. In a review of 50 human diseases attributed to an enzyme having decreased binding affinity for a coenzyme (Ames *et al.,* 2014), it was shown that in the majority of conditions the inborn errors of metabolism could be corrected by feeding the affected person additional cofactors or coenzymes (e.g., vitamins), thereby raising the coenzyme levels and enhancing enzymatic activity.

5. Nutrition in the Prenatal Environment

Epidemiological studies that examined the role of prenatal nutrition relative to mental health conditions have found that prenatal caloric malnutrition, low birth weight, and prematurity increase the risk for neuro - developmental disorders, schizophrenia, and schizoid and antisocial personality disorders.

6. Long-Term Effects of Poor Nutrition

Many individuals are not diagnosed with some types of mental health conditions (e.g., depression) until after decades of life, which suggests that long-latency effects of poor nutrition on the central nervous system affect mental health (Deicken *et al.,* 2018).

7. Nutrition and Stress

Cortisol, an important steroid hormone secreted in response to stress, may affect mental health, mood stability in particular. Cortisol secretion levels may be affected by negative mood states, fatigue, and "burnout," as a result of acute and chronic stress (McLean *et al.,* 2021). Psychological factors associated with food intake (e.g., intentional diet restraint) may alter cortisol secretion and therefore mental function.

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8. Energy Metabolism and Glucose

Glucose is the preferred fuel source for the brain. The roles of glucose include forming acetylcholine and many other neurotransmitters. Glucose utilization enhances cognition and may be affected by fatty acids which can alter both how glucose is used and also insulin sensitivity (Bjelland *et al.,* 2018). Some mental health symptoms may represent a condition associated with decreased mitochondrial energy metabolism. Other research suggests that lower brain glucose metabolism is present before the onset of cognitive decline in certain people with Alzheimer's disease (Ames, 2014).

NUTRITION AND THE PREVENTION OF MENTAL HEALTH CONDITIONS

Disease prevention initiatives are sustainable methods to reduce the effects of mental health conditions. Social and biological sciences have provided insight into the role of risk and protective factors in the development of poor mental health. Many of these factors, like nutrition, are modifiable and provide targets for prevention and promotion.

Nutrients commonly associated with mental health include polyunsaturated fatty acids (particularly omega-3 types); minerals such as zinc, magnesium, selenium, copper, and iron; B vitamins such as foliate, vitamin B_6, and vitamin B_{12}; antioxidant vitamins such as C and E13; and bioactive substances found in foods. Most of these are available in healthy diets that include dark green leafy and orange-coloured vegetables and whole grains (Mirsky and Duncan 2015).

ROLE OF MAJOR NUTRIENT CONSTITUENTS AND MENTAL HEALTH

The amino acids tryptophan, tyrosine, phenylalanine, and methionine are often helpful in treating many mood disorders including depression. Tryptophan is a precursor of Serotonin and serotonin is deficient in depressed persons. The deficiency of omega-3 fatty acids are related to the high incidence of depression and schizophrenia. Diabetes Mellitus is associated with hyperglycemia which precipitates depressive and anxiety symptoms in the patient. Hypoglycemia can also manifest with psychiatric symptoms like apathy, fatigue, confusion (delirium), hallucinations, mood liability and stupor and ultimately person may land up in coma (Malouf *et al.,* 2019). The vitamins and trace elements play a vital role in various physiochemical reactions and produce a wide range of symptoms.

Role of Vitamins and Minerals

All vitamins and minerals are involved in one or more biochemical pathways and/or physiological actions which influence the function of the human brain.

Thiamine (Vitamin B_1)

The activity of B1 is based on the measurement of thiamine pyrophosphate concentration or of the activity of a thiamine-dependent enzyme, transketolase, in erythrocytes. Severe deficiency states can be observed in chronic alcoholics, after protracted vomiting during pregnancy and after bariatric surgery. Thiamine deprived subjects were found to have irritability, agitation and emotional stability (Guilland, 2019). Thiamine deficiency is related to neuropsychiatric syndrome in chronic alcoholics.

Riboflavin (Vitamin B_2)

Riboflavin deficient individuals show increased levels of depression, hypomania and psychopathic deviate behavior (Mirsky and Duncan 2015).

Pyridoxine (Vitamin B_6)

A study done on a volunteer who was deprived of pyridoxine for 55 days, depression was seen which got corrected after supplementation with the vitamin. Pyridoxine is required as a coenzyme for the synthesis of serotonin. Dopamine and Gamma-Aminobutiric Acid (GABA). Pyridoxine is also required

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for carbohydrate metabolism and other aspects of amino acid metabolism. In infancy its deficiency may lead to seizures and mental retardation.

Cobalamin (Vitamin B_{12})

B_{12} is a cofactor required for methionine synthesis, which catalyses the conversion of homocysteine to methionine, and is required for the production of energy from fatty acids and proteins. Methionine is the precursor of S-adenosylmethionine (SAMe), which is involved in methylation reactions ultimately in neurotransmitter synthesis (Bottiglieri, 2018). The depression is one of the early psychiatric manifestations of B_{12} deficiency. Deficiency can lead to peripheral neuropathy, myelopathy or encephalopathy. A patient often presents with mental slowing, confusion and memory deficits, tingling or numbness in extremities.

Ascorbic acid (Vitamin C)

Vitamin C is a cofactor for dopamine betahydroxylase which converts dopamine to norepinephrine, and a cofactor for tryptophan to 5-hydroylase required for the conversion of tryptophan to 5-hydroxytryptophan to serotonin. Fatigue, weakness are reported to be symptoms of Scurvy. Depression is a classic early symptom of vitamin C deficiency.

Vitamin D

Vitamin D is found to be deficient in majority of the psychiatric patients as per the recent research. Maximum deficiency is seen in somatoform disorders who present with the generalized body aches without a definite medical or connective tissue disease. Low serum levels of 25(0H) D were found in patient suffering from recurrent depression.

Folate

The folate functions mainly via methylation and DNA synthesis. The most likely explanation for the folate deficiency affecting Serotonin is through defective methylation. The neurologic symptomatology of folate deficiency overlaps with that of vitamin B_{12} deficiency and may cause cognitive impairment, dementia, depression, peripheral neuropathy and sub acute combined degeneration of the spinal cord. Low folate and high homocysteine levels are risk factors for dementia (Alzheimer's disease) and depression (Kamphuis and Scheltans, 2020). Folic acid supplements in pregnancy have reduced the risk of neuro-developmental abnormalities like neural tube defects.

Niacin (Vitamin B_3)

Niacin plays role in oxidation-reduction reactions and metabolism of carbohydrates and tryptophan. Deficiency leads to pellagra which also leads to dementia. Initial manifestations of Pellagra may comprise non specific symptoms like hyperesthesia, increased psychomotor drive, fatigability, headache, sleep disturbance (Kamphuis and Scheltans, 2020).

NEUROPSYCHIATRIC MANIFESTATIONS DUE TO ALTERED TRACE ELEMENTS IN THE BODY

Magnesium

It was found that the individuals with low cerebrospinal fluid levels of magnesium also have lower cerebrospinal fluid (CSF) levels of 5-hydroxyindoleacetic acid which is a metabolite of serotonin, indicating Serotonin deficiency. CSF levels of magnesium were found to be lower in patients with major depression (n = 6) and adjustment disorder (n = 10) as compared with controls and also it found out that CSF levels of Mg were low in persons with suicidal attempt. (Mirsky and Duncan 2015). The deficiency of magnesium can cause depression behavior and personality changes, apathy, irritability and anxiety.

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Zinc

The study done by Macs and colleagues found out that serum zinc levels were significantly lower in depressed patients as compared to healthy matched controls. Zinc acts as a catalyst in many enzymatic reactions and also act as antioxidant.

Calcium

Recent research has shown that indiscriminate use of Selective Serotonin Reuptake Inhibitor's (SSRl's) inhibit the absorption of calcium into the bones putting them to risk of fractures (Mirsky and Duncan 2015).

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Iodine

Iodine is essential in formation of thyroid hormone which plays role in Basal Metabolic Rate of the body. Deficiency of iodine can lead to hypothyroidism ultimately resulting in secondary depression and patient may present with lethargy and excessive fatigue/vague body aches.

Iron

Iron is essential for ensuring brain oxygenation and producing energy for brain cells. Iron deficiency anemia can cause apathy, fatigue etc and persons land up in Psychiatry OPD with depression with somatic complaints (Mirsky and Duncan 2015).

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NEUROPSYCHIATRIC MANIFESTATIONS DUE TO ELECTROLYTE / WATER DISTURBANCE

Electrolyte imbalance related to sodium or potassium or dehydration can cause varied neurobehavioral symptoms like irritability or lethargy, neuromuscular hyperexcitability, parasthesias, apathy, seizures, confusion (delirium), stupor and coma. Visual hallucinations are commonly observed in delirium due to electrolyte disturbance.

Side effects related to certain nutrient in excess

Not only the deficiency but also the excess amounts of certain dietary factors like amino acid phenylalanine in the individuals can be harmful leading to phenylketonuria (brain damage) and mental retardation. Hypervitaminosis, an acute intoxication can lead onto symptoms of raised intracranial tension (pseudotumourcerebri) and person may experience severe headache, drowsiness, vertigo, irritability and blurred vision. Coffee, colas, tea, some energy drinks all contain caffeine, which acts as CNS stimulant or cognitive enhancers. However, in large quantities caffeine can increase blood pressure, anxiety, depressive symptoms and sleep problems. Also they have diuretic effects which can lead to dehydration (Bottiglieri, 2018).

Conclusion

The diet plays an important role in all physiological and biochemical reactions in the body, its inadequacy leads to physiological and psychological problems. Therefore dietary history is of utmost importance and needs to be compulsorily incorporated in history taking in every patient attending the hospital. It is rightly said "healthy mind resides in a healthy body" which in turn can be maintained through healthy diets.

It is therefore recommended that adequate dietary include should be adhered to. This includes consumption of foods rich in Omega-3 fatty acid found in fish, seeds and nuts. Leafy vegetables rich in

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B vitamins, whole grain cereals and legumes, dairy products rich in probiotics, adequate intake of water to stay hydrated and exposure to early morning sun.

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