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Review Artical

Impact of Essential Fatty Acids Consumption in Combating Neurological Disorders

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ABSTRACT

Modernization of society have caused various momentous changes in dietary habits ofpeople in this era of modern world. The modern dietary patterns are typically composed of Fatty acids mainly saturated fatty acids along with refined carbohydrates. This present-day diet together with a lifestyle with reduced physical activity is a major determinant of various metabolic disorders like obesity and diabetes. All these factors are also causing a gradual increase in the prevalence of cognitive disorders mainly depressive disorders and mood disorders. Neuroinflammation is the link between the metabolic disorders and cognitive disorders and this correlation is evident by significant clinical and epidemiological data. Fatty acids are of major interest as they have twofold functions. They are major contributors of modern diet causing obesity, diabetes and other metabolic disorders and on the other hand they serve as signaling molecules in the inflammatory responses. Saturated fatty acids are the ones should be avoided as they are the components of high caloric obesogenic diets whereas, polyunsaturated including Omega-6 and Omega-3 fatty acids must be consumed through daily foods to prevent from Neuroinflammation considered to be the major cause of neuropsychiatric disorders.

INTRODUCTION

Fatty acids (FAs) are the basic unit of lipids, widespread within the nature. They are necessary component of the cellular membrane and aids in important structural, functional and biological roles. A large amount of energy as adenosine triphosphate (ATP) is produced as a result of their metabolism [1]. The classification of fatty acids is done in further three categories. Saturated fatty acids (SFA) are those that have carbon atoms in even amount in their structure and are direct chains of hydrocarbons. The double bond among carbon-carbon in monounsaturated fatty acids (MUFAs) is one, whereas, in polyunsaturated fatty acids (PUFAs) two or more double bonds are present [2]. PUFAs are further subdivided into three main categories, Omega-3 and Omega-6 fatty acids are essential FAs. The important functions of Omega-3 are to improve the heart and mood, to lose weight, to reduce the liver fat, to fight inflammation. Omega-3 is a Long-Chain PUFA and is divided into two types i.e. Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) [3]. Omega-6 PUFAs are characterized by two carbon-carbon double bonds between carbon atoms. One of the important ω-6 PUFAs, Linoleic acid (LA), is also the essential FAs because it cannot be formed in the human body and its requirement is attained by die [4]. Omega-9 fatty acids as the name indicates have the first double bond at their ninth carbon atom e.g. oleic acid [5]. PUFAs form the structure of brain cells, glial cells, signaling molecules, and neurons. They are the part of phospholipids of the membranes. Therefore, PUFAs are important in many brain functions like neurogenesis, neurotransmission, and cognitive functions

METHODS

For this review, articles have been collected from April 2021 to November 2021.A set of total 100 articles was collected, from which 66 authentic articles were selected. Various

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keywords like role of FAs, omega-3 FA, omega-6 FA, neuroinflammation, cognitive disorders etc. have been used to make the content more efficient and user friendly for the audience. Researches from the last decade i.e., from the year 2010 to 2020 were included. Different keywords like essential FAs, role of FAs, omega-3 and omega-6 FAs, neuroinflammation, cognitive disorders etc were used. Maximum data from review articles and minimum from clinical trials was gathered.

Fatty Acids and Neurological Disorder: Many brain activities are influenced by various nutrients, like ω-3 polyunsaturated fatty acids, which plays an important role on multiple processes including synaptic development and function, synaptic integrity and plasticity [7] attributing to neuronal plasticity, and thus improve the cognitive performance [8]. The prevalence of neurological and mental disease has been increasing tremendously since many decades [9]. The crucial role of omega-3Poly unsaturated fatty acids in neuronal cellular activity underpins their importance for neuropsychiatric disorders. Lipid abnormalities in internal metabolic pathways and nerve cell membranes can cause or worsen neuropsychiatric diseases by altering brain function [10].

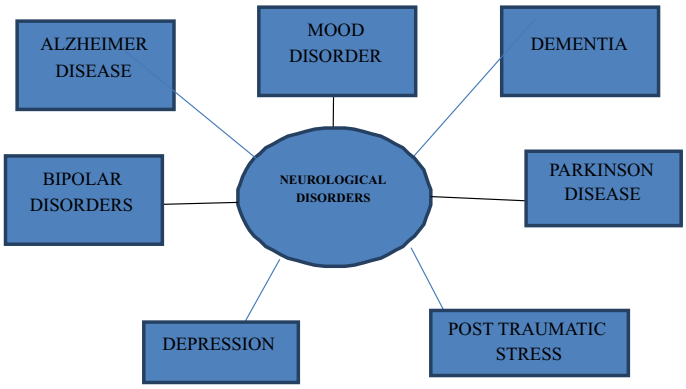

Figure 1: The major neurological disorders

Alzheimer's Disease and Dementia: Alzheimer disease is a neurodegenerative disease which affects approximately 35 million people worldwide and is inherent in most cases of dementia. Common clinical signs of Alzheimer's disease include memory loss, cognitive impairment, language difficulties, sudden changes in behavior and mood, clutter of space and time, and inhibition of patients' daily habits [11]. Epidemiological studies have been conducted in the Netherlands, United States and France. A Rotterdam study has for the first time revealed that fish consumption is inversely linked to dementia, mainly Alzheimer's disease. Subsequent research has shown that eating omega-3 or fish or eating a diet high in vegetables, fruits, fish and oils high in omega-3 fatty acids can decrease the incidence of Alzheimer's disease [12]. Participants with an average DHA intake of 0.18 g / dy (average fish consumption of 3 serving per week) had a significantly lower risk of dementia than patients with low DHA consumption of 0.15 g / dy (i.e. two fish servings). Consumption) week) [13].

Parkinson's Disease: Parkinson's disease is considered to be the second most common neurological ailment after Alzheimer's disease, which is affecting almost 1% of people over 60 years old and up to 4% of those in the old age groups.Motor symptoms like rigidity, bradykinesia, tremorsand impaired balance, along with thenon-motor manifestations like sleep problems, autonomic, gastrointestinal, sensory, and neuropsychiatric symptoms are characterized by Parkinson's disease [14]. Observational studies have shown a relationship between higher n-3 PUFA intake from fish and reduced rate of Parkinson disease [15]. The neuroprotective properties of omega-3 Polyunsaturated fatty acids, that lower oxidative stress and neuroinflammation, are likely to be responsible for their positive effects on Parkinson disease [16].

Fatty Acids and Mood Disorders: Diet rich in fats when consumed in large amounts for quite a long period of time bring on various changes in weight and as well as in metabolic processes of the body [17]. Neuro-inflammation can be a potential association between mood disorders and saturated fatty acids consumed through diet. Saturated fatty acids derived from diet such as palmitic acid when enter in our body in large quantities causes the activation of a trans-membrane protein receptors called Toll-like receptors 4 (TLR4) mainly present with microglial cells in hypothalamic area of the human brain. These receptors are important for the stimulation of pro-inflammatory response [18].

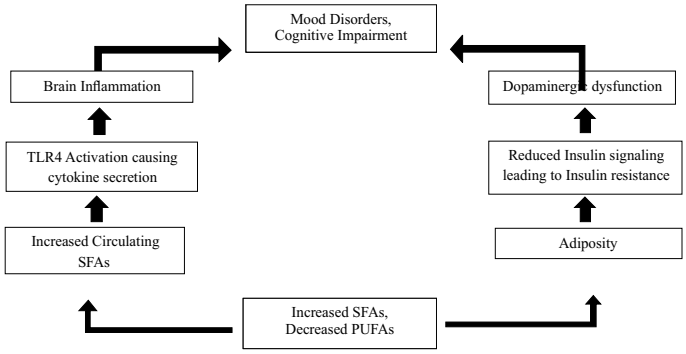

Figure 2: The Pathways linking HFD and Mental health

Depressive Disorder: Depressive disorder also known as depression is a psychiatric disorder associated with fluctuating mood, decrease in self-esteem and gradual deprivation of interest in day to day activities [19]. More than two hundred and sixty four million people suffer from depression and this number is constantly on the rise [20]. Symptoms of depression are observe in people that are suffering from any major physical illness.Low level of omega three fatty acid is related depression. Omega-3 fatty acid including DHA and EPA, seem to lower the production of inflammation causing eicosanoids from AA by two different mechanisms [21]. EPA and DHA also inhibit the formation of cytokines that are known inflammatory mediators, including interleukin-1, interleukin-6, interleukin-2, and interferon, which transmit eicosanoid release and are known to be linked with depression. In addition, omega-3 fatty acids affect the brain-derived neurotropic factor, which increases the plasticity of synapses, protects Neuro-transmission, protects neurons, and lowers the depressive like behavior [22].

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Schizophrenia: Schizophrenia is a mental disorder associated with a series of symptoms, including hallucination, delusion, weakens cognitive ability and disorganizes behavior or speech. The level of omega 3 was below the normal range in cell membranes of patient suffering from schizophrenia. Irregular neurotransmission is associated with schizophrenia and schizophrenic symptoms occur as a result of change neuronal membrane structures [23]. Omega 3 deficiency is linked to psychotic symptoms and abnormality in cognition in schizophrenia. Poly unsaturated fatty acid reduction in schizophrenia patients can occur as result of an increase in oxidative stress. Pawelczyk et al. conducted an RCT to test the effectiveness of 2.2 g/day of PUFAs with an olive oil placebo added to an antipsychotic drug in individuals with first-episode schizophrenia in terms of symptom severity. The improvement was shown in psychopathology and level of functioning [24].

Post-Traumatic Stress Disorder: Post-traumatic stress disorder c(PTSD) an be illustrated as a condition that may occur due to extreme traumatic events like being a victim of assault, violence, rape, sudden life-threatening accidents, natural disasters. It may occur after a single traumatic event or prolonged exposure to trauma. All memories in the brain are completely reliant on the hippocampus. This hippocampal dependence decreases over time. This whole process is related to the gradual increase in dependence on another additional hippocampal area. This area is called the neocortex [25]. Supplementation of Omega-3 fatty acid helps in the reduction of depressive symptoms, promotes process of neurogenesis in adults and also enhances the hippocampal volume [26]. Omega-3 facilitates in clearance of fear memory from hippocampus and in this way, it helps in reducing the symptoms of PTSD [27]. A recent Japanese study looked at the link between necessary omega-3 and omega-6 fatty acid levels in the blood and the incidence of accident-related PTSD.

Bipolar Disorder: Bipolar disorder also termed as "manic depressive illness". It is considered as one of the most difficult psychiatric disorders to manage [28]. This disorder affects 1% of the population in the world. In young children, it is one the major cause of disability, impairment of functioning and cognition [30]. 6% of the patients die through suicide after diagnosis within two decades [29]. Recurrent episode of elevated depression and mood is characterized as bipolar disorder. It is a severe chronic mood disorder. It is linked with mania, hypomania, behavioral, cognitive, and physical symptoms. It also involves intertwining episodes of severe depression [31]. Following are the subclasses of bipolar disorders:Bipolar I,Bipolar II,Cyclothymia: This disorder is often treated with mood stabilizer drugs. These may include lithium, carbonate, and valproate. These severe depressive episodes may reoccur. Omega-3 fattyacidsupplementation is very helpful in controlling these mood disorders [31]. Omega-3 polyunsaturated fatty acids (PUFAs) play many crucial roles in the development of brain and its functioning [32]. Omega-3 also helps in treating other psychiatric conditions that may involve mood disturbance.

CONCLUSION

Neurodegenerative condition is a challenging issue in clinical medicine and its prevalence is predicted to increase significantly in the coming centuries. Currently, there is no standard etiological treatment, and medical treatment is primarily symptomatic. It would be highly recommended to take a nutritious approach. As mentioned in this review, Omega-3 fatty acids plays significant role in managing various neurological diseases. Thus, there must be a proper balance of omega-3 and omega-6 fatty acids in brain cells' membranes for the proper functioning and improved mental health. Nerve function is mostly influenced by DHA and AA. This paper has reviewed that Higher doses of omega-3 fatty acids (2 to 4g daily) may alleviate the symptoms of a variety of psychiatric illnesses.

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