

Review on Omega-3-Supplementation in Eating Disorders

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ABSTRACT

Background: Eating disorders are complex, potentially life-threatening conditions, characterised by disturbances in eating behaviours and extreme fear of weight gain with significant morbidity and mortality rates. Individuals avoid fattening foods. This avoidance of fattening foods may lead to the avoidance of foods which may include those with omega 3 fatty acids. **Aim of the work:** Aim of the review is to explore the consequence of starvation on the brain both in adolescence and in adults and particularly due to omega 3 deprivation. It also aims to explore the role of the benefits and possible mechanisms of omega 3 supplementation on other mental health conditions and to consider these implications for eating disorders. **Methods:** The search was undertaken by using PubMed and the search terms , eating disorders, anorexia nervosa and Omega-3. Alternatively, search terms such as depression, schizophrenia or other mental health conditions and omega-3 were used. References lists of identified reviews and articles were also searched for relevant empirical studies. **Results:** According to a growing body of evidence, the role and importance of omega-3 fatty acids in mental health is well-recognised and well-established to be beneficial. Fatty acids are fundamental components of the brain and are necessary for normal body physiology. Since the body cannot synthesize these fats, it has to be completely obtained from the diet. Brain tissue is rich in omega-3 fatty acids. These acids have a major role within cell membranes and in connections between neurons. Omega-3 FAs deprivation may be correlated with the happening of many psychiatric conditions, such as obsessive-compulsive disorder, depression, bipolar disorder, and schizophrenia. **Conclusion:** The clinical research evidence on omega-3 supplements in eating disorders is preliminary and not definitive in comparison to other mental health disorders. Thus, this will be an important area for future research, and may lead to the development of newer interventions. **Keywords:** Omega-3 supplements, eating disorders, preliminary, mental health disorders.

INTRODUCTION

Eating disorders and fat deprivation

Eating disorders are serious psychological illnesses marked by disturbances in eating behaviour and extreme fear of weight gain. They have a core psychopathology centred on food, eating habits and body image concerns. These habits eventually lead to the deterioration of the individual's physical and mental health^[1,2]. Eating disorders have one of the highest death rates of all psychiatric diagnoses. The number of deaths in those with anorexia nervosa was 11.6 times higher in comparison with their healthy counterparts of the same age and sex. In those with bulimia, the rate is 1.3 times^[3]. Due to the core psychopathology and the cognitive distortion associated with these disorders, individuals restrict their dietary intake in order to prevent weight gain. This self-starvation may lead to serious nutritional deficiencies. The impact of nutritional self-deprivation ranged from general poor health to life-threatening conditions and could have huge consequences on the body and mind. Patients with anorexia have the tendency to deprive fat during their self-induced starvation due to the fat phobic nature of this disorder. Thus, these patients are more likely to develop severe omega-3 deficiency which may have serious impact on the brain^[4].

Omega-3 Fatty Acids

Omega-3 fatty acids are polyunsaturated fatty acids that are essential for human health and development. There are three types involved in human physiology, namely: **Alpha-Linolenic acid. (ALA):** it is an 18 carbon chain fatty acid with 3 double bonds. It is known as dietary essential FAs, so called because it cannot be synthesised *de novo* and it must be acquired from the diet. Dietary resources includes walnut and flaxseed oil.

Eicosapentaenoic acid. (EPA): It is a 20 carbon chain fatty acid with 5 double bonds. It could be acquired through the conversion of ALA within the liver cells. However, the conversion capacity in human is very limited and inefficient. Thereby, it's mainly acquired from dietary sources such as fish oil

Docosahexaenoic acid. (DHA): It is a 22 carbon chain fatty acid with 6 double bonds. It is the most abundant fatty acid in the brain which makes up an average of 10% of fat in our brains. Its acquisition is similar to EPA in that it could be synthesised from ALA inefficiently but the main source would be marine oils^[5,6].

Role of Omega-3 in the Brain

These types of lipids play a key part in the body growth, development and metabolism as they are involved in cell signalling and constitute an integral part of cell

membranes throughout the body especially the brain. From these fatty acids many bioactive-metabolites are produced. These metabolites have anti-inflammatory properties such as docosanoids from DHA and EPA-derived eicosanoids; collectively known as specialized pro-resolving mediators [7]. DHA of the omega-3 fatty acids is the most abundant lipids in the brain and it's crucial in maintaining baseline regulatory functions. The reason why it is crucial is that DHA comprises about 50% of the neurons' plasma membranes. Drops in DHA levels have been associated with cognitive decline and many other mental health problems [8]. One of the proposed mechanisms of action by which DHA and EPA help maintain the integrity of the brain function is by reducing the inflammatory reactions and protecting the brain tissue against damage. This mechanism may be achieved by DHA itself and DHA-derived docosanoids as they have anti-inflammatory properties and neuro-protective function [9,10]

METHODS

A comprehensive literature review was conducted to systematically identify all the studies that were potentially relevant. Firstly, the literature review focussed on articles studying the impact of omega-3 supplements on various mental health conditions. Then, it focused on articles studying the impact of omega-3 supplements on eating disorders particularly anorexia nervosa.

The search was undertaken by using PubMed and the search terms , eating disorders, anorexia nervosa and Omega-3. Alternatively, search terms such as depression, schizophrenia or other mental health conditions and omega-3 were used. References lists of identified reviews and articles were also searched for relevant empirical studies. Additionally, Google Scholar was used. It offered a wider coverage and led to different literature that weren't available in PubMed. Advance search on Scholar was used as appropriate to achieve more specific results and to reduce the results to a more manageable number. Ninety-eight papers were generated and inspected for relevance and quality. of which, fifty-five papers were included. **Inclusion criteria** were based on the relevance of these trials to the topic of this paper. In addition, quality measures such as: trials being randomised double-blinded and placebo controlled have been taken into considerations. A series of drafts were then prepared and refined leading to the final draft. The final draft was then reviewed by Dr Sarah Prasad, a consultant psychiatrist in St. Patricks University Hospital.

RESULTS

Role of Omega-3 in Mental Health

According to a growing body of evidence, the role and importance of omega-3 fatty acids in mental health is

well-recognised and well-established to be beneficial. The scientific-clinical trials have provided sufficient evidence about the link between omega-3 deficiency and various mental health disorders. Such evidence was established in the following disorders:

Depression

Many studies have suggested that consuming sufficient amount of omega-3 FAs will provide a powerful protection against depression. For example, a large Norwegian study of nearly 22,000 participants revealed that the longer the participants took cod liver oil, the less likely they were to have high levels of depression [11]. According to other studies, omega-3 supplements can also enhance the mood in those who already suffer from depression [12].

Schizophrenia

There was a considerable evidence to suggest that omega-3 FAs supplements may be an effective adjunct to anti-psychotic therapy for managing schizophrenic patients. Most studies have focussed on the EPA fatty acid and have demonstrated clinical improvement in the vast majority of patients. On the other hand, some studies have shown a preventive effect of omega-3 against schizophrenia in highly susceptible individuals. This was done by examining individuals who have a strong family history of schizophrenia or had shown early signs of schizophrenia such as delusions or hallucinations [13,14].

Bipolar Disorders

Although many studies have demonstrated the effect of omega-3 fatty acid in improving the depressive symptoms in bipolar patients, there is still no evidence, that it has any effect on attenuating the maniac symptoms [15].

Attention Deficit Hyper-activity Disorder

From meta-analysis of omega-3 supplementation trials, there was some evidences that omega-3 supplements could create modest improvement in ADHD symptoms. So, it could be part of the established therapy as well have also shown that omega-3 levels are reduced in children with ADHD [16].

Other Psychiatric Disorders

Smaller clinical trials on omega-3 supplementation have been conducted on other mental health disorders such as borderline personality disorder, obsessive-compulsive disorder and Alzheimer's disease. Results from these trials were often mixed ,but they were usually in favour of omega-3 supplements as preventive and therapeutic tools [17,18].

The Impact of Starvation

Brain tissue is rich in omega-3 fatty acids. These acids have a major role within cell membranes and in

connections between neurons. DHA and EPA in particular are major structural components of neuronal membranes, and any change in the fatty acid composition of neuronal membranes can lead to functional changes in the activity of receptors and other proteins embedded in the membrane phospholipid and thus can result in neuro-inflammation^[19]. Therefore, any decrease in concentration of these fats can lead to neuronal membrane deformity and thus, neuronal inflammation, serotonin depletion, decreased energy metabolism in the neurons and eventually neuronal death^[20]. Omega-3 FAs deprivation may be correlated with the happening of many psychiatric conditions, such as obsessive-compulsive disorder, depression, bipolar disorder, and schizophrenia. It has been also argued that deformities in the membrane phospholipid are present in patients with mental health disorders^[21]. Exploration of the mechanism of action of omega-3 in these disorders may help establish newer protocols that feature omega-3 supplements as an adjunctive therapy in the treatment of other mental health conditions such as eating disorders.

DISCUSSION

Mode of Action and Pathophysiology

As it widely accepted, the brain neurotransmitter serotonin has a huge influence on cognitive functions and behaviours including social behaviour, decision-making, mood and impulsive behaviour. Serotonin depletion is a unifying feature of many clinical mental disorders such as attention deficit hyperactivity disorder (ADHD), bipolar disorder, schizophrenia and depression^[22]. Continues inflammation in the brain tissue may be the key to serotonin depletion and the development of mental disorders. This is because inflammation results in neuronal malfunction which lead to various neurotransmitters depletion which will eventually lead to neuronal death^[23]. By giving omega-3-supplements to patients with mental health disorders, we are aiming to restore the balanced structure of the neuronal membrane phospholipid and thus prevent further inflammation. This is achieved by the bio-active derivatives of both DHA and EPA fatty acids which act as inflammatory signalling molecule inhibitors and thus can result in maintenance of neurotransmitters level^[24]. Consumption of omega-3-supplements can maintain a healthy and balanced structure of the neuronal membrane phospholipid. This will aid in neuronal functioning and will subsequently prevent neuro-inflammation which may negatively impact serotonin levels in the brain.

Omega-3-Supplements and Eating Disorders

As in other psychiatric disorders, it is thought that malfunction of serotonin pathways in the limbic system and prefrontal cortex and thus depletion of serotonin is evident in eating disorder patients. In addition, few

studies with anorexia nervosa patients revealed that these patients had a change in the phospholipid membrane composition in addition to a decreased level of omega-3 fatty acids^[25]. Recent studies have also demonstrated that the lack of omega-3 fatty acids modulate changes in the level of anorexigenic neuropeptides in the brain. These neuropeptides reduce appetite and food intake, and, as a result, causes weight loss to occur^[26]. Therefore, it's predicted that omega-3-supplements can work in the direction of repairing these brain abnormalities i.e. act in the same way as in depressive disorders, as an anti-inflammatory agents, preventing neuronal damage by stabilizing and enhancing the neuronal membrane integrity and function, and by restoring nerves conduction throughout the serotonin affected pathways. Also, they would have a role in stimulating the production and release of orexigenic neurotransmitters such as neuropeptide Y which are responsible for stimulating the appetite and increase food intake^[26,27]. Furthermore, we can argue that omega-3-supplements can be used as a treatment for the other clinical manifestations of eating disorders such as ventricular arrhythmias, osteoporosis and sudden death syndrome. All of the previous have been shown in research and trials to be reduced in incidence upon the consumption of omega-3 supplements^[27]. Other mental health problems are also common in patients with eating disorders especially depression, bipolar and borderline personality disorders. The role of omega-3-supplements in these disorders has also been established to be beneficial.

CONCLUSIONS AND RECOMMENDATIONS

Most scientific literatures suggested that omega-3 fatty acids act on many mechanisms involved in the physiopathology of mental illnesses. However, it is impossible, at the moment, to establish clinical evidence on their role in anorexia nervosa. This is due to the little body of research studying the link between omega-3-supplements and the symptoms and consequences of eating disorders. So far, only limited number of clinical trials has explored the therapeutic effect of omega-3-supplements on eating disorders and these trials have given mixed and conflicted results. That's probably due to the lack of control group in some of these trials and the very low number of participants in others. Because the previous and the ongoing work done with omega-3 fatty acids lacked standardization of therapeutic doses and were generally conducted with small samples and no control groups, further clinical trials are necessary to establish the evidence for the therapeutic potentials of these supplements. In order for these trials to be viable and produce accurate results, they need to be large, randomised, double blinded, standardised and more complex placebo-controlled. **In summary**, the clinical research evidence on omega-3

supplements in eating disorders is preliminary and not definitive in comparison to other mental health disorders. Thus, this will be an important area for future research, and may lead to the development of newer interventions.

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