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The Role of Omega 3 Fatty Acids on Muscle Mass: A Literature Review

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Abstract

Omega 3 fatty acids are known to have many benefits for human health, such as regulating lipid metabolism, treating hyperlipidemia, having anti-inflammatory function, increasing brain function and maintaining the body's immune system. Nowadays, among individuals who like to exercise, especially in the field of sports nutrition, omega 3 fatty acids are starting to become popular in their function of maintaining and increasing muscle mass because of their benefits in increasing muscle protein synthesis, reducing muscle damage (exercise-induced muscle damage) after physical exercise or during recovery after exercise so that it can maintain and increase muscle mass. This literature review deepens the benefits of omega 3 fatty acids which can potentially maintain or increase muscle mass. This literature review will discuss the mechanism by which omega 3 fatty acids influence muscle mass through cellular signaling pathways related to muscle protein synthesis which has an impact on a person's muscle mass. This literature review also discusses research results in healthy individuals, the elderly and individuals with chronic ilness. Although several studies show the benefits of omega 3 fatty acids regarding their potential to maintain and increase muscle mass. However, several research results show an insignificant effect of omega 3 fatty acids on muscle mass, causing the benefits of omega 3 fatty acids on muscle mass to continue to be a topic that will continue to be researched, some of the causes may be due to the duration of administration, different doses of administration, different type of omega 3 fatty acids given.

Introduction

Regular exercise with *resistance* or *strength training* and adequate protein intake is a strong foundation to maintain muscle mass in carrying out its functions for daily activities in a person's life. However, many challenges that can affect muscle mass, such as the influence of age, being in a sick condition and even in individuals who routinely do *resistance training* can experience a decrease in muscle mass if they can meet their daily nutrition. Therefore, it takes a way in terms of intake to be able to maintain or slow down the decline in muscle mass and even increase muscle mass (Fry CS et al., 2011).

Omega 3 fatty acids are known to have many benefits for human health, such as in terms of regulation of fat metabolism, dealing with hyperlipidemia, having anti-inflammatory properties, brain function and maintaining endurance (Krupa et al., 2020; Tachtsis et al., 2018). Today among individuals who routinely exercise weights, especially in the field of sports nutrition, omega 3 fatty acids are gaining popularity in their function of maintaining and increasing muscle mass because of their benefits in increasing muscle protein synthesis, reducing muscle damage (exercise-induced muscle damage) after physical exercise or lifting

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weights so as to maintain training performance and increase muscle mass (Tsuchiya et al., 2019; Noreen et al., 2010).

Muscle mass is an important element useful in performing various physical performance, mobilization and for performing daily activities (Wang et al., 2020). Many factors affect muscle mass growth such as exercise (resistance / strength training), protein intake and various sports supplementation that have long been known to affect muscle mass growth such as whey protein and BCAAs. But the latest omega 3 fatty acids through their effects that can stimulate *Muscle Protein Synthesis (MPS)* are called can contribute to the formation of muscle mass (Rossato et al., 2020).

Various studies on omega 3 and muscle mass discuss the potential of omega 3 fatty acids in their effect on MPS, speed recovery after exercise and reduce muscle mass loss during inflammation or illness [7]. However, there is still much debate about the effects of omega 3 on muscle mass in its potential to increase muscle protein synthesis which can lead to increased muscle mass (Lalia et al., 2017; Cornish et al., 2022; Huang et al., 2020).

Therefore, further deepening of the role of omega 3 fatty acids on muscle mass is needed. The aim of this *Literature Review* is to provide a good understanding of the interaction between omega 3 fatty acids and their effects on muscle mass as well as their potential in daily practice and in the improvement of the field of sports nutrition.

Methods

The method in this literature review is to identify the source of information by searching the literature through academic databases such as Google scholar, Pubmed, AJCN, JISSN using keywords for search, namely "omega 3 fatty acid and muscle mass", "omega 3 and muscle growth", " fish oil and muscle mass", "omega 3 and lean mass". Furthermore, the search is expanded by examining the literature from the research taken.

Result and Discussion

Mechanism of omega 3 fatty acids against Muscle Protein Synthesis

Much of the literature shows the effects of omega 3 fatty acids on muscle protein synthesis. However, the exact mechanism of this is controversial, but there is evidence that omega 3 fatty acids are involved in *anabolic pathaways* specifically mTOR *pathaway* which has long been known to function as *a signaling pathaway* that controls muscle protein synthesis in its effect on a person's muscle mass (McCarthy et al., 2010). One of the activities carried out to maintain muscle mass is resistance training, but the obstacle to maintaining or increasing muscle mass is common in elderly individuals due to reduced ability to stimulate muscle protein synthesis after exercise (van der Meij et al., 2020). Anabolic *resistance* which is the main cause of reduced muscle mass in elderly individuals occurs due to a lack of response to anabolic stimuli such as the availability of amino acids. In elderly individuals, there is also a decrease in mTOR *signaling* , which has been known to be an important element in the initiation of translation and cell growth. Activation of mTOR is also important in the stimulation of muscle protein synthesis which then affects the increase in muscle mass (Fry et al., 2011).

Muscle protein synthesis determines the size and composition of skeletal muscle. An increase in the composition of omega 3 fatty acids on the phospholipid membrane of skeletal muscle coincides with an increase in phosphorylation of mTOR which is key to the regulation of muscle protein synthesis. Muscle protein synthesis is the basis of muscle mass formation, muscle mass formation occurs when muscle *protein synthesis* exceeds muscle protein *breakdown.* In individuals who routinely do *resistance training,* protein synthesis and muscle protein breakdown occur. Muscle protein synthesis increases until 48 hours post-workout, while muscle protein breakdown begins to decline after 48 hours. This is where omega 3 fatty acids will take a role, namely in muscle protein synthesis. So that muscle protein synthesis is

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higher than the breakdown of muscle protein which will later maintain or increase muscle mass (McGlory et al., 2019).

The Role Of Omega 3 Fatty Acids On Muscle Mass

The latest data in 2022 from Engelen et al. (2022) Taken from the *American Journal of Clinical Nutrition* in a double-blind, randomized, placebo-controlled study conducted on COPD (Chronic Obstructive Pulmonary Disease) patients then evaluated muscle protein synthesis in COPD patients given supplementation from EPA 3.5 g / day and DHA 2.0 g / day and placebo group given *olive oil* For 4 weeks showed postprandial protein synthesis compared to the placebo group, as well as muscle mass, there was an increase in muscle mass in COPD patients (Engelen et al., 2022).

One of the studies conducted by Smith et al. (2015) was taken from the *American Journal of Clinical Nutrition*. in 2015 in healthy adult individuals aged 60-85 years with a *randomized controlled trial (RCT)* research method which was divided into two groups, namely the group given EPA supplementation 1.86 g / day and DHA 1.50 g / day and the group given corn oil (*corn oil*). After six months of intervention, it showed a significant increase in muscle mass, namely an increase in muscle mass volume and strength. This study shows the potential role of omega 3 fatty acids in the prevention of decreased function and muscle mass that occurs due to increasing age, so omega 3 fatty acids can be used to prevent sarcopenia and can be used in maintaining muscle mass in elderly individuals (Pollastri et al., 2022).

This supports a study that Pollastri et al. (2022) also conducted earlier in 2011 on 16 healthy elderly individuals with a *randomized control trial*. The study samples were divided into two groups, namely the group given omega 3 fatty acids and the control group given corn oil with a duration of 8 weeks then evaluated on muscle protein synthesis and elements of the anabolic signaling pathway (mTOR). The results of this study show the role of omega 3 fatty acids in the anabolic signaling pathway, namely mTOR phosphorylation which then increases muscle protein synthesis. This study suggests omega 3 fatty acids may be useful in prevention and therapy for sarcopenia (Smith et al., 2011).

In contrast to research from Calder et, al. in 2020 with a double-blind, randomized, controlled trial method in COPD patients aged 50 years and over who experienced weight loss or with low BMI who had the potential to experience pre cachexia or cachexia in COPD patients supplemented with 2 grams of omega 3 fatty acids daily for 12 weeks showed a decrease in symptoms such as fatigue and increased walking distance, There is also an increase in fat mass so that it can prevent more weight loss. However, no increase in muscle mass of was found (Calder et al., 2018).

In 2022, Cornish et, al. (2022) through his research on resistance *training individuals* who were given omega 3 fatty acid supplementation and compared to individuals who only did *resistance training* without being given omega 3 fatty acid supplementation did not show significant differences in muscle mass. The same was shown to have no significant effect on muscle mass in individuals who did not *do resistance training* without being given omega 3 fatty acids with those who did not *do resistance training* but were given omega 3 9 fatty acids.

Although some studies provide evidence of increased muscle protein synthesis and muscle strength in elderly individuals, also in younger individuals who experience muscle protein breakdown after resistance *training* and in individuals who are in acute / chronic pain conditions are said to occur due to the administration of omega 3 fatty acids. However, some research results show the insignificant effect of omega 3 fatty acids on muscle mass causing the potential of omega 3 fatty acids on muscle mass is still less consistent, some causes may be due to the duration of administration, dose of administration or from the type of omega 3 fatty acids given (Holmes & Mittendorfer, 2022).

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Conclusion

The benefits of omega 3 fatty acids for human health are widely known and have become one of the popular supplements for many people. This is an attraction for researchers to continue to conduct various studies to find out the various benefits of other omega 3 fatty acids on the body including in their benefits to a person's muscle mass through their potential to cause increased muscle protein synthesis. Several studies show the potential of omega 3 fatty acids in maintaining and increasing muscle mass. However, some studies do not show significant potential for muscle mass so further research is needed on the right dosage, duration of administration and other factors to be useful in everyday clinical practice.

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