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## **Omega-3 Supplementation in Athletes: Impact on Performance, Recovery After Physical Exercise and Effects on Injury Recovery – Systematic Review**

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**ABSTRACT**

**Introduction.** The process of recovering from strenuous physical activity is a concern for various groups, ranging from elite athletes to recreationally active individuals. High-force or unfamiliar eccentric exercise routines can cause significant damage to muscle fibers, often leading to soreness, inflammation, and a temporary decline in performance. Given these challenges, there is a growing interest in nutritional strategies, including omega-3 supplementation, to mitigate the adverse effects of intense training and facilitate faster recovery.

**Purpose of the work.** The aim of this article was to conduct a systematic review, characterize the effects of supplementation, and explore the practical benefits of omega-3 supplementation for athletes in terms of muscle performance, recovery, and brain and cardiovascular health. This

review synthesizes findings from recent studies to provide insights into the benefits, impact on performance, recovery, effects on injury recovery and potential limitations of omega-3 supplementation for athletes.

**Materials and methods.** A systematic search was conducted in PubMed, Scopus, and Web of Science for articles published between January 2010 and December 2024. Keywords included "omega-3 supplementation," "athletic performance," "sports recovery," and "injury recovery." Eligible studies included randomized controlled trials (RCTs), observational studies, and meta-analyses that focused on omega-3 supplementation in healthy athletes.

**Results.** Several studies have examined the potential ergogenic effects of omega-3 fatty acids. Key findings include endurance, muscle strength and power, reaction time, and cognitive function. Importantly, the evidence consistently supports the role of omega-3 fatty acids in recovery from injury, especially in reducing inflammation. Most studies used doses of 2 to 4 grams of EPA and DHA combined daily. Benefits were typically seen after 4 to 12 weeks of ongoing supplementation.

**Keywords:** Omega-3 acid supplementation; docosahexaenoic acid (DHA); eicosapentaenoic acid (EPA); athletes; recovery after injury

## **Introduction**

Omega-3 fatty acids are essential polyunsaturated fats with well-documented health benefits, including anti-inflammatory and cardioprotective effects. They are primarily found in fatty fish, such as salmon and mackerel, as well as in algae and some plant-based sources like flaxseed. The two most bioactive components of omega-3s, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play critical roles in modulating inflammation, supporting brain function, and maintaining cell membrane integrity. (1) The process of recovering from strenuous physical activity is a concern for various groups, ranging from elite athletes to recreationally active individuals. High-force or unfamiliar eccentric exercise routines can cause significant damage to muscle fibers, often leading to soreness, inflammation, and a temporary decline in performance. (2) Athletes are exposed to intense physical activity, which can cause oxidative stress, inflammation, and tissue damage. These factors often lead to muscle soreness, impaired recovery, and an increased risk of injuries. Therefore, dietary interventions that can mitigate these effects are of great interest to the athletic community. (3) Omega-3 supplementation has garnered attention due to its potential to reduce exercise-induced

inflammation and improve recovery times. Studies have suggested that omega-3 fatty acids may help attenuate muscle damage, reduce joint pain, and enhance overall recovery from training sessions or sports-related injuries. Based on the current state of knowledge figure 1 shows the most significant impacts of EPA and DHA in athletes. (figure 1.) Furthermore, there is growing interest in whether omega-3 supplementation can directly enhance athletic performance by improving endurance, strength, and cognitive function. There remains variability in study outcomes, possibly due to differences in supplementation protocols, dosages, and study populations. This review aims to synthesize the available evidence, evaluate the practical implications for athletes, and highlight areas where further research is needed to clarify the role of omega-3 supplementation in sports nutrition.(1,4,5)

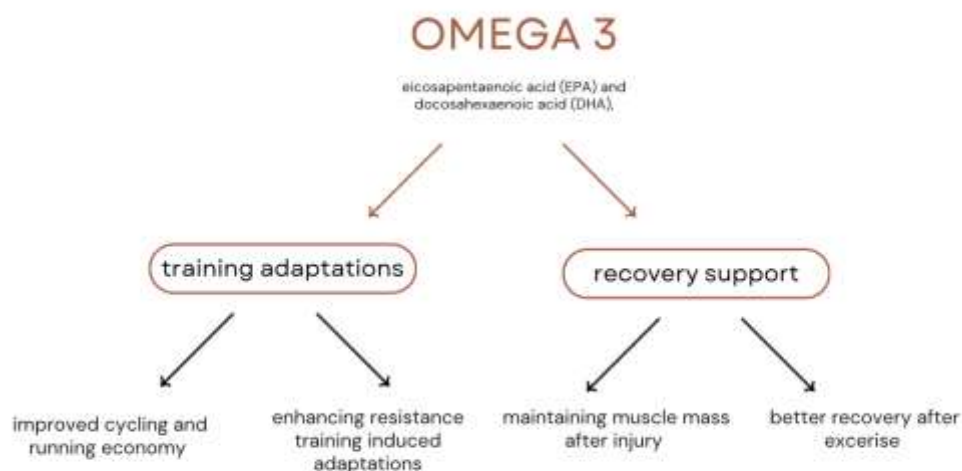


Figure 1. The most important effects of EPA and DHA in athletes based on the current state of knowledge.

EPA and DHA's Impacts and underlying factors

### 1. Impact on Inflammatory Response

Through their lengthy carbon chains, high levels of unsaturation, and double bonds adjacent to the third carbon atom from the methyl end, EPA and DHA exhibit special physical and biological characteristics. This is perhaps most evident in the anti-inflammatory effects of EPA and DHA, which include reduced production of bioactive oxylipins and inhibition of NFκB (nuclear factor kappa-light-chain-enhancer of activated B cells) activation, resulting in reduced expression of NFκB target genes encoding a number of proteins involved in inflammation. (6)

This characteristic is especially valuable for sportsmen since severe physical activity sometimes causes acute inflammation. Omega-3s have the potential to decrease the severity of exercise-induced muscle damage (EIMD) and speed up muscle recovery by preventing the synthesis of pro-inflammatory cytokines like TNF- $\alpha$  and IL-6. (7) What's more, DHA has been linked to improvements in muscle cell membrane stability due to its incorporation into phospholipids within cell membranes. This structural enhancement is believed to help protect muscle cells against oxidative stress and damage induced by high-force or eccentric exercises.(8)

## **2. The Effect of EPA and DHA on Recovery After Physical Exercise**

Doing near-maximum or maximal eccentric contractions, including downhill running, to cause muscle injury is one of the most popular ways to investigate the connection between supplementation of EPA and DHA and recovery. A decreased range of motion, muscular swelling, a reduction of force generation, and delayed onset muscle injury are some of the symptoms that are commonly associated with muscle damage. (9) XYZ links in their trials the correlation between muscle damage caused on by exercise and EPA and DHA supplementation. (10) Data from the literature suggest that EPA and DHA significantly reduce muscular pain at doses ranging from 0.54 to 4.20 g of EPA + DHA provided daily for periods ranging from 7 to 70 days. (11,12). Black et al. in a field-based study in rugby union players observed that EPA + DHA supplementation reduced fatigue after 20 days and reduced muscle soreness. (11) In a 4-week study, a daily intake of 2.7 g EPA + DHA significantly lowered muscle soreness and discomfort relative to placebo at 72 and 96 hours after an upper body injury protocol. (13) Van Dusseldorp et al. observed that, in contrast to muscle pain, maintaining strength and power might depend on the dosage. In their research, they provided 1.40, 2.80, or 4.20 g EPA + DHA each day for around 52 days prior to and during exercise-related muscle injury. (14) Jouris et al. discovered that, in contrast to a placebo, a week of DHA supplementation (3 g/d) notably decreased muscle soreness at 48 hours when pressure was exerted on the arm and during extension following an upper-body muscle damage protocol. (15)

## **3. EPA and DHA and their impact on performance and training adaptation**

There is a growing body of research suggesting that supplementing with EPA + DHA can improve training adaptations. (7,10,16) In the Heilesen et al. study of recreational exercisers, contrary to the authors' assumptions, the results showed that the protocol did not increase lean

body mass (LBM), which is a commonly observed effect in similar studies in healthy adults. In their study, resistance exercise training (RET) induced adaptations were assessed after a 10-week RET program taken three times per week with supplementation of 2275 g EPA + 1575 g DHA per day or 4.5 g safflower oil per day. The EPA + DHA group exhibited both absolute and relative enhancements in the 1-repetition maximal repetition bench press (1RMBP) and relative improvements in the 1-repetition maximal repetition squat (1RMSQT) compared to the placebo, indicating heightened adaptations from resistance exercise training (RET) in these individuals. As hypothesized by the authors, fiber type transformation, reduction in intramuscular fat, and increased neuromuscular activation may explain the improvements in muscle strength measures. (10) Philpott et al. conducted a 6-week study with resistance-trained men to assess the impact of 2 g EPA and 2 g DHA daily versus placebo on alterations in body composition and muscle strength during a brief weight loss regimen achieved through a 40% calorie reduction. By the conclusion of the experiment, the nondominant 1RM for the leg extension in the EPA + DHA group was considerably higher than it was at the start, even with notable weight loss. Similar to the earlier study, against the authors' prediction, there was no reduction in the decline of LBM in the EPA + DHA group. The findings of this research could be beneficial for athletes looking to reduce body weight while maintaining training benefits. (16) EPA and DHA have also been demonstrated to influence oxygen kinetics: cycling efficiency or peak/maximal oxygen consumption, though this does not directly lead to enhanced physical performance on its own. (17,18) Significantly, numerous authors highlight the lack of long-term research employing appropriate amounts of EPA and DHA along with other constraining elements. (10,19)

#### **4. Effects on Injury Recovery**

Nowadays, there has been growing interest in the possibility of supplementing omega-3 fatty acids in athletes, especially in the context of accelerating recovery from injuries. Athletes frequently experience musculoskeletal injuries due to the high physical demands of training and competition. Proper recovery is essential to ensure optimal performance and reduce the risk of re-injury. Inflammation is a natural response to tissue injury, essential for initiating the healing process. However, excessive or prolonged inflammation can hinder recovery and lead to chronic conditions. Omega-3 fatty acids are known for their anti-inflammatory properties. EPA and DHA compete with arachidonic acid (AA) for incorporation into cell membranes, resulting in the production of less inflammatory eicosanoids. This shift from pro-inflammatory to anti-inflammatory mediators can help reduce pain, swelling, and tissue damage, creating a more

favorable environment for healing. Omega-3 fatty acids influence the production of inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ). By reducing the levels of these cytokines, omega-3s can alleviate excessive inflammation and promote faster recovery. Exercise-induced oxidative stress can exacerbate tissue damage and delay recovery. Omega-3 fatty acids have been shown to enhance antioxidant defense system. Mickleborough et al. conducted a randomized controlled trial involving endurance athletes. The study found that omega-3 supplementation significantly reduced markers of muscle damage and inflammation following intense exercise. For 26 days before engaging in muscle-damaging exercise (downhill running), thirty-two untrained male participants were randomised to take 1200 mg/d of a green-lipped mussel oil mix or a placebo. They were also instructed to continue for 96 hours after the muscle-damaging exercise activity. The green-lipped mussel oil blend supplementation resulted in significantly less strength loss and a protective effect against joint range of motion loss at 96 hours after muscle damaging exercise, as compared to a placebo. (20) Calder in study discovered strong evidence that these fatty acids can partially suppress a variety of inflammatory processes, such as leukocyte chemotaxis, adhesion molecule expression and leukocyte-endothelial cell adhesion interactions, eicosanoids like PG and LT produced from the n-6 fatty acid ARA, and inflammatory cytokines like TNF- $\alpha$  and IL-1 $\beta$ . The study demonstrated that human inflammatory cells' fatty acid composition and exposure impact their activity, with ARA, EPA, and DHA levels appearing to be especially significant. EPA and DHA may be effective treatments for inflammatory illnesses and recovery after injury because of their anti-inflammatory properties. (21) Supplementing the omega-3 fatty acids has a lot of potential to help athletes recover from injuries. It is a useful supplement to recovery plans because of its ability to reduce inflammation, lower oxidative stress, and promote muscle repair. (22)

## **5. Potential Negative Effects of EPA and DHA Supplementation**

It is crucial to take into account any negative effects in addition to the positive effects of EPA and DHA and their usefulness for athletes. Questions concerning lipid peroxidation, decreased platelet function and the resulting increased risk of bleeding, and gastrointestinal (GI) disorders are some of the most commonly mentioned. Villani et al., in a study of EPA and DHA supplementation, noted that people often reported gastrointestinal problems, including fishy taste and fishy “burps.” Ten randomized controlled trials of EPA and DHA, either alone or in combination (doses up to 1.86 g EPA and/or DHA/day and durations up to 52 weeks) were

included in the meta-analysis. The results showed that gastrointestinal disturbance was the most frequently reported adverse event, that there was no difference in adverse events between EPA + DHA and placebo, and that no serious adverse events occurred. (23) When comparing EPA + DHA to a placebo, Chang et al. discovered no difference in the proportion of subjects reporting gastrointestinal distress. Notably, studies utilising dosages of EPA + DHA of 2 g/day or above were excluded from this study. There was no evidence of serious adverse events in a more recent meta-analysis of 21 randomised, controlled trials of prescription EPA + DHA, which provided 1.8 to 4 g of EPA + DHA/day for periods ranging from 6 weeks to 5 years. However, the combination increased fishy taste, fishy "burps," and nausea when compared to a placebo. (24,25)

## **6. Future Directions in Omega-3 Research**

Much progress has been made in understanding omega-3 supplementation in athletes after injury, but much remains to be understood. Future research should examine the doses or ratios of omega-3 fatty acids that maximize muscle adaptation to exercise and recovery from injury.(26) There has been limited research on how long an athlete should supplement with omega-3, DHA, and EPA, meaning it is not known how long before exercise or creatine supplementation would be best to take to see the effects. (27) The timing of dosing is important, with particular attention to the frequency and amount of omega-3 intake in the days preceding significant exercise. One issue with omega-3 supplementation that has not yet been clarified is the interaction with various supplements. (28) Finally, most of the work on omega-3 in health populations has largely ignored athletes and would be helpful in clarifying the dosing and effects of omega-3 supplementation. Emerging research directions involve the use of indirect assessment methods and novel evaluation techniques to identify previously underappreciated outcomes of omega-3 fatty acids supplementation. Compared to pharmacological agents or stimulants, omega-3 fatty acids demonstrate a high safety profile across diverse populations, as they are not classified as controlled substances and are associated with a low incidence of adverse effects. Furthermore, some studies have reported rapid physiological responses to omega-3 intake, with statistically significant effects observable within 24 hours of supplementation in healthy individuals. (29) Although certain individuals may require caution due to the potential for acute adverse effects, the overall favorable safety and tolerability profile of omega-3 fatty acids supports their consideration as a viable strategy for enhancing athletic performance and recovery after injuries. (30)

## **Conclusion**

This systematic review highlights the multifaceted benefits of omega-3 supplementation in athletes. Only oily fish and certain types of algae contain large concentrations of the most physiologically active n-3 PUFAs, EPA and DHA. The various effects of EPA and DHA are mostly linked to better physiology and health advantages. As a result, EPA and DHA, ideally from fish, are advised to be consumed by the general population. Omega-3 fatty acids, particularly EPA and DHA, have demonstrated the potential to reduce inflammation, lower oxidative stress, and enhance muscle repair, all of which are critical for effective recovery following physical exercise and injury. The anti-inflammatory properties of these essential fatty acids are especially valuable for athletes seeking to mitigate the impact of exercise-induced muscle damage and accelerate recovery processes.

While the findings are promising, there is still a need for further research to establish standardized dosing protocols and better understand the long-term effects of omega-3 supplementation in athletes. Nonetheless, incorporating omega-3s into recovery strategies provides a natural and science-backed approach to enhancing athletic performance and reducing recovery time.

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