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Originales

Extra Virgin Olive Oil as a Natural Ergogenic Aid: A Systematic Review on Injury Prevention and Recovery in Athletes

Laura Gil-Caselles[a,*]

[a] *Grupo de Investigación HUMSE, Facultad de Ciencias del Deporte, Universidad de Murcia, España.*

ABSTRACT

Extra virgin olive oil (EVOO) has gained attention in sports nutrition due to its antioxidant and anti-inflammatory properties. This systematic review aimed to analyse the effects of EVOO consumption on injury prevention, athletic performance, and post-exercise recovery. A comprehensive search in PubMed, Scopus, Web of Science, and SPORTDiscus identified empirical studies published between 2016 and 2025. Twelve studies (sample sizes: 3–69 athletes) were included, assessing EVOO's impact on inflammation, oxidative stress, muscle damage, and recovery. Overall, EVOO intake was associated with reduced levels of biomarkers such as creatine kinase (CK) and C-reactive protein (CRP), less muscle damage, and improved metabolic and cardiorespiratory function. Additional benefits included better joint health, reduced fatigue perception, and enhanced immune response post-exercise. Despite methodological heterogeneity, most studies supported EVOO as a complementary strategy for injury prevention and recovery. EVOO appears to be a promising natural ergogenic aid, although further large-scale research is needed to confirm long-term effects and optimal intake protocols.

Keywords: extra virgin olive oil; recovery; sports injuries; inflammation; athletes; ergogenic aid.

El aceite de oliva virgen extra como ayuda ergogénica natural: revisión sistemática sobre prevención de lesiones y recuperación en deportistas

RESUMEN

El aceite de oliva virgen extra (AOVE) ha despertado un creciente interés en la nutrición deportiva debido a sus propiedades antioxidantes y antiinflamatorias. Esta revisión sistemática tuvo como objetivo analizar los efectos del consumo de AOVE sobre la prevención de lesiones, el rendimiento deportivo y la recuperación post-ejercicio. Se realizó una búsqueda exhaustiva en las bases de datos PubMed, Scopus, Web of Science y SPORTDiscus, identificando estudios empíricos publicados entre 2016 y 2025. Se incluyeron doce estudios (n = 3–69 atletas), que evaluaron el impacto del AOVE en marcadores de inflamación, estrés oxidativo, daño muscular y recuperación funcional. En general, el consumo de AOVE se asoció con una reducción de biomarcadores como CK y PCR, menor daño muscular y mejoras en la función metabólica y cardiorrespiratoria. También se observaron beneficios en la salud articular, la fatiga percibida y la respuesta inmune. Aunque hubo heterogeneidad metodológica, la mayoría de los estudios respaldan su uso como ayuda ergogénica natural.

Palabras clave: Aceite de oliva virgen extra; recuperación; lesiones deportivas; inflamación; deportistas; ayuda ergogénica.

[*] **Autora para la correspondencia:** Laura Gil-Caselles. Teléfono: 868888473. Correo electrónico: laura.gilc@um.es. Dirección postal: Facultad de Ciencias del Deporte, Universidad de Murcia, Calle Argentina s/n, 30720 Santiago de la Ribera, Murcia, España (Laura Gil-Caselles)

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Azeite de oliva extra virgem como recurso ergogênico natural: revisão sistemática sobre prevenção de lesões e recuperação em atletas

RESUMO

O azeite de oliva extra virgem (AOVE) tem ganhado destaque na nutrição esportiva por suas propriedades antioxidantes e anti-inflamatórias. Esta revisão sistemática teve como objetivo analisar os efeitos do consumo de AOVE na prevenção de lesões, desempenho esportivo e recuperação pós-exercício. Foi realizada uma busca abrangente nas bases de dados PubMed, Scopus, Web of Science e SPORTDiscus, incluindo estudos empíricos publicados entre 2016 e 2025. Foram incluídos doze estudos (n = 3–69 atletas), avaliando o impacto do AOVE sobre marcadores de inflamação, estresse oxidativo, lesão muscular e recuperação funcional. No geral, o consumo de AOVE foi associado à redução de biomarcadores como CK e PCR, menor dano muscular e melhora na eficiência metabólica e cardiorrespiratória. Benefícios adicionais incluíram melhor saúde articular, menor fadiga percebida e modulação da resposta imune. Apesar da heterogeneidade metodológica, a maioria dos estudos apoia o uso do AOVE como estratégia nutricional complementar e ajuda ergogênica natural.

Palavras-chave: Azeite de oliva extra virgem; recuperação; lesões esportivas; inflamação; atletas; recurso ergogênico.

Introduction

Sports performance and longevity depend not only on physical skills and technical ability but also on effective injury prevention and recovery. Musculoskeletal injuries are one of the most frequent concerns among athletes, especially in endurance or high-performance sports. These injuries, such as muscle strains, sprains, or joint problems, are often related to prolonged physical stress, accumulated fatigue, and chronic inflammation, making nutritional intervention a key strategy for comprehensive athlete care[1,2].

Adequate nutrition helps reduce injury risk by strengthening the musculoskeletal system and mitigating adverse effects of intense exercise, such as inflammation and oxidative stress[3]. Among functional foods, extra virgin olive oil (EVOO) stands out for its antioxidant and anti-inflammatory effects, attributed to its high content of monounsaturated fatty acids and phenolic compounds[4,2]. These benefits make it a potential ally not only for post-exercise recovery but also as a preventive tool against sports injuries by reducing inflammation and protecting musculoskeletal structures[5,6].

EVOO is an exceptional source of natural antioxidants such as oleocanthal and hydroxytyrosol, which play a key role in reducing exercise-induced oxidative stress[7]. These compounds help protect muscle and joint cells, reducing the likelihood of repetitive micro-injuries and tissue deterioration. Its effectiveness has been demonstrated in active and athletic populations[8,9], and it has even been proposed as an ergogenic aid due to its modulatory potential[6].

Notably, oleocanthal has anti-inflammatory effects comparable to ibuprofen but without adverse side effects[10,11], which is key to preventing chronic injuries. Improvements in fatigue perception and inflammatory responses have been observed following acute EVOO supplementation[12,5]. Regular EVOO consumption has been shown to reduce pro-inflammatory cytokines and promote a more efficient immune response[13,2]. Similarly, Martínez González et al.[14] highlighted its ability to reduce systemic inflammation and oxidative stress induced by intense training.

Regarding joint health, athletes in endurance or impact sports experience high wear on joint structures, increasing the risk of tendinous, ligamentous, or degenerative injuries. EVOO improves joint lubrication and preserves structural integrity[4,10], and has been associated with better mobility and lower risk of overload-related injuries[9,15].

In terms of muscle recovery, EVOO is linked to more effective regeneration of muscle fibers damaged during exercise, due to its oleic acid and antioxidant content[16]. It improves circulation and nutrient transport to muscle tissues[1], and reduces inflammatory biomarkers such as CK and CRP after exercise[12,17].

Despite growing evidence, specific studies on EVOO in sports remain limited, and many focus on the Mediterranean diet as a whole without isolating EVOO's effects. Some recent studies report positive acute effects on cardiovascular function and sports performance, but findings on injury prevention remain scarce and methodologically heterogeneous[5,12].

Given this lack of consensus, it is necessary to systematically analyze recent literature on EVOO's effects on injury prevention, joint and muscle health, and functional recovery in endurance and high-performance athletes. Thus, the aim of this study is to examine, through a systematic review, the impact of EVOO consumption on injury prevention and muscle performance improvement, especially in endurance sports, exploring its antioxidant and anti-inflammatory properties to optimize joint and muscle function after intense exercise.

Methodology

Study design

This study was designed as a systematic review based exclusively on empirical studies (primary studies), following the classification proposed by Montero and León[18]. No original data were collected; instead, a critical and structured analysis of the existing scientific literature was conducted. Only primary studies providing direct evidence on the use of extra virgin olive oil (EVOO) in the sports context were included, excluding previous reviews and theoretical studies to ensure an empirical focus and strict application of the PRISMA protocol. This methodological approach allows for a rigorous response to the research question, integrating current and context-specific findings.

Search procedure and inclusion/exclusion criteria

The review was conducted following the PRISMA 2020 guidelines[19], with the aim of ensuring transparency, reproducibility, and methodological rigor. In addition, the recommendations from the Cochrane Handbook for Systematic Reviews[20] were considered.

The search strategy was carried out between January 2016 and May 2025, using the following electronic databases: PubMed, Scopus, Web of Science, and SPORTDiscus. The following search terms were combined using Boolean operators: ("olive oil" OR "extra virgin olive oil" OR "EVOO") AND ("sports performance" OR "exercise" OR "athletes" OR "endurance") AND ("injury prevention" OR "muscle damage" OR "recovery" OR "muscle soreness" OR "joint health" OR

"inflammation" OR "oxidative stress"). Additionally, a manual search was performed in the reference lists of the selected studies.

Inclusion criteria

- Original articles published in English or Spanish between 2016 and 2025.
- Experimental, quasi-experimental, or observational studies (primary studies).
- Research specifically analyzing the impact of EVOO (not the Mediterranean diet as a whole) on injury prevention, muscle recovery, joint health, or physical performance.
- Athlete populations (amateur, semi-professional, or professional).

Exclusion criteria

- Studies focused exclusively on the Mediterranean diet without isolated analysis of EVOO.
- Research in animals, in vitro models, or non-athlete clinical populations.
- Reviews, meta-analyses, editorials, letters to the editor, or duplicate articles.
- Studies with unclear results or not addressing the research question.

Selection process

The selection of studies was performed in three phases: (1) title screening, (2) abstract screening, and (3) full-text review. Although the procedure was conducted by a single reviewer in this preliminary version, future phases will include peer review to validate reproducibility and reduce bias. The entire process was documented using the PRISMA flow diagram[19] (see Figure 1).

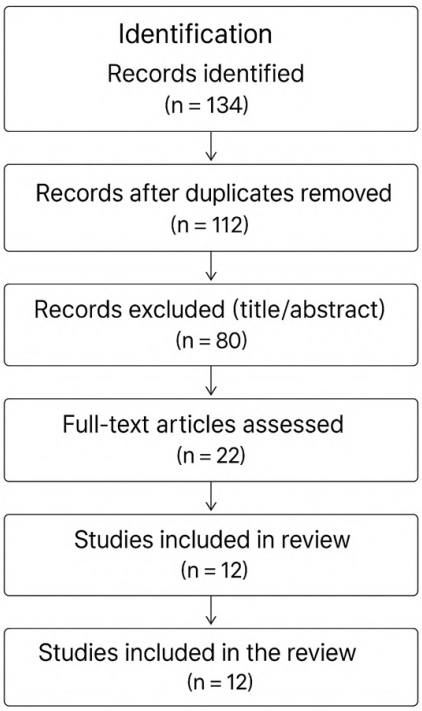

Figure 1. PRISMA flow diagram.

Quality assessment

Two assessment tools were applied depending on the study type: the Cochrane Risk of Bias Tool (RoB 2)[21] for experimental and quasi-experimental studies, and the adapted Newcastle-Ottawa Scale (NOS)[22] for observational studies. Both tools allow for the evaluation of risk of bias, methodological quality, internal validity, and consistency of findings.

Data analysis

Data extraction was performed using an ad hoc table that included: author and year, country, study design, sample, type and duration of EVOO intervention, analyzed variables (inflammation, oxidative stress, recovery, injuries, etc.), and main results. Due to methodological and conceptual heterogeneity, a qualitative narrative synthesis was chosen, systematically comparing the relevant findings of the included studies[23]. No meta-analysis was conducted; however, its inclusion is considered for future updates if a critical mass of homogeneous studies is reached.

Results

Table 1 summarizes the main empirical studies selected after applying the inclusion and exclusion criteria. The included studies encompass experimental interventions, controlled clinical trials, and observational studies with nutritional interventions, all conducted in athletic populations (amateur, semi-professional, or professional). These studies analyze the impact of EVOO or its main bioactive compounds on physiological and functional variables related to performance, recovery, and injury prevention.

Of the studies analysed, most adopted experimental designs (acute trials or controlled interventions), while a smaller number applied observational approaches or longer-term nutritional interventions. The samples included active athletes from various disciplines, with sample sizes ranging from 3 to 69 participants.

Overall, the results show a consistent pattern of positive effects associated with EVOO and its polyphenols. Improvements were observed in parameters related to oxidative stress, inflammation, muscle damage, and metabolic efficiency. For example, Mielgo-Ayuso et al.[26] reported reductions in CK and myoglobin levels after pre-marathon EVOO supplementation, while Helvaci et al.[30] found increased VO_2 max and reduced perceived fatigue in elite skiers. Roberts et al.[27,28] also highlighted improved systemic antioxidant capacity and better running economy after hydroxytyrosol-rich EVOO extracts. Likewise, benefits were detected in systemic antioxidant capacity, cardiorespiratory recovery, and reduction of functional recovery time after exercise.

Additionally, improvements in cardiorespiratory coordination and reductions in immunological markers of inflammation after intense efforts suggest a possible protective effect against physical stress and micro-injuries derived from sports load. Studies by Esquius et al.[12,33] confirmed enhanced submaximal cardiorespiratory function and decreased dendritic cell maturation post-exercise, supporting an immunoprotective role.

Regarding performance and metabolic adaptation, favourable effects were identified in metabolome modulation and improved energy efficiency, factors that may contribute to reduced fatigue and greater adaptation to training, indirectly reducing injury vulnerability. Lemonakis et al.[31] demonstrated EVOO's impact on metabolome modulation and serotonin turnover, reinforcing its role in metabolic adaptation.

Finally, it was observed that including EVOO in the daily diet contributes to improved lipid profile, reduced perceived fatigue, and structural protection of muscles and joints. These findings reinforce the potential of EVOO as an ergogenic and preventive strategy in sports contexts.

Table 1. Studies on EVOO in athletes: design and main findings.

Reference (author, year)	Study type	Sample / Population	Main results	Conclusions	Relation to injuries
Capó et al.[24]	Nutritional intervention (EVOO in functional drink)	Young and senior athletes (specific n not detailed)	Improved lipid profile, ↑ erythrocyte DHA, oxidative protection, ↑ expression of antioxidant genes	EVOO in a functional drink improves antioxidant capacity and protects against oxidative damage	Prevention of oxidative damage
Costa et al.[25]	Acute experimental (EVOO)	Active individuals, n = 7	Improved cardiorespiratory coordination in moderate exercise, no changes in VO_2 max	Acute EVOO supplementation increases CRC	Functional recovery
Esquius et al.[12]	Acute experimental (EVOO)	Athletes, n = 7	Improved cardiorespiratory coordination in moderate exercise	Acute EVOO improves submaximal function	Functional recovery
Mielgo-Ayuso et al.[26]	Observational intervention (EVOO pre-marathon)	Marathon runners, n = 69	Reduced muscle damage (CK, myoglobin) and cardiac stress	EVOO pre-marathon protects muscle and cardiac structure	Damage prevention
Roberts et al.[27]	Experimental (HT-rich phyto-complex)	Active individuals, n = 29	Reduced post-exercise SOD, increased GSH, improved systemic antioxidant capacity	Improves antioxidant capacity; supports muscle recovery	Muscle recovery
Roberts et al.[28]	Experimental (HT-rich phyto-complex)	Active individuals, n = 29	Improved running economy, reduced recovery time, lower energy cost	Improves efficiency and functional recovery in athletes	Functional recovery
Ramos Campo et al.[29]	Controlled clinical trial (OliP polyphenols)	Active individuals, n = 29	Improved submaximal performance and cardiorespiratory recovery after 16 days	Olive polyphenols improve aerobic performance and recovery	Functional recovery
Helvaci et al.[30]	Dietary intervention (EVOO)	Elite athletes (skiing), n = 15	Increased VO_2 max, strength, and reduced perceived fatigue	EVOO in the diet improves performance and reduces fatigue	Prevention and recovery
Lemonakis et al.[31]	Experimental (oleuropein)	Male athletes, n = 9	Modulated metabolome, improved performance and serotonin turnover	Oleuropein promotes metabolic adaptations and performance	Adaptive prevention
Balcells et al.[32]	Acute crossover trial (EVOO)	Endurance athletes, n = 3	Decreased inflammation measured by mDCs at 24 h	EVOO improves immune recovery after intense exercise	Prevention and recovery
Esquius et al.[33]	Double-blind crossover trial (EVOO)	Athletes, n = 7	Reduced mDC maturation at 24 h, less post-exertion inflammation	EVOO reduces immune inflammation; improves immune recovery	Prevention and recovery
Gil-Caselles[6]	Experimental (nutritional intervention with EVOO)	Runners, n = 30 + 30 control	Positive changes in dietary habits, fat replacement with EVOO, ergogenic effect, improved lipid profile	EVOO is an ergogenic and protective aid for endurance runners	Prevention

In summary, the results support the proposed hypothesis, suggesting that EVOO and its polyphenol derivatives have a dual effect: on one hand, they promote functional recovery, and on the other, they contribute to injury prevention through antioxidant, anti-inflammatory, and metabolic modulation (Figure 2).

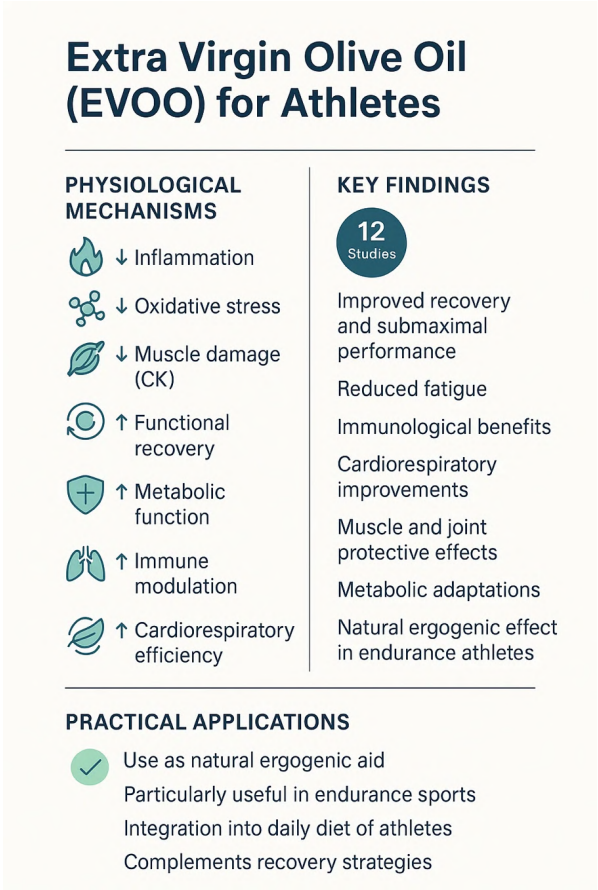

Figure 2. Graphical summary of main findings.

Discussion

The present study confirms and extends previous evidence regarding the beneficial role of EVOO in sports settings, particularly in relation to injury prevention and functional recovery. As stated in the introduction, EVOO stands out for its high content of monounsaturated fatty acids and phenolic compounds, such as oleocanthal and hydroxytyrosol, known for their antioxidant and anti-inflammatory properties[4,7].

The results obtained reveal a consistent pattern of improvement in oxidative stress, inflammation, and muscle damage parameters, in line with previous findings suggesting that appropriate nutrition can reduce injury risk and optimize recovery[1,3]. In particular, the reduction of inflammatory and muscle damage biomarkers, such as creatine kinase and myoglobin, observed in several included studies[24,26,27,32], supports EVOO's potential as a physiological modulator in sports practice. For example, Capó et al.[24] demonstrated increased erythrocyte DHA and upregulation of antioxidant gene expression in athletes, while Mielgo-Ayuso et al.[26] found a significant decrease in CK and myoglobin levels following pre-marathon EVOO supplementation, emphasizing its muscle-protective effects. Similarly, Roberts et al.[28,29] and Helvaci et al.[30] reported improvements in systemic antioxidant capacity and reductions in perceived fatigue, further supporting these outcomes. This aligns with the ergogenic benefits proposed by Gil-Caselles[6] and Estruch et al.[16].

Moreover, the protective effect of EVOO on joint structure and the reduction of perceived fatigue are consistent with research highlighting its capacity to preserve joint integrity and reduce the risk of chronic injuries, such as tendinopathies or joint degeneration[8,9], as also indicated in studies involving athletes from different disciplines[30,33]. Helvaci et al.[30] reported improved VO_2 max and reduced perceived fatigue in elite skiers after dietary EVOO intervention, suggesting enhanced endurance and lower mechanical stress. In endurance and high-impact sports, where repeated mechanical loads generate significant musculoskeletal wear, these effects are particularly relevant to prolong athletic careers and prevent recurrent injuries.

The results also confirm that EVOO may contribute to enhanced performance through energy metabolism optimization and metabolome modulation, as observed in the study by Lemonakis et al.[31] and supported by findings in athletes demonstrating improved running economy and energy efficiency[28,29]. Roberts et al.[28] observed a reduction in recovery time and lower energy cost in runners consuming a hydroxytyrosol-rich olive phytocomplex, while Ramos Campo et al.[29] reported enhanced aerobic capacity and cardiorespiratory recovery after polyphenol supplementation. This ability to improve energy efficiency, reduce fatigue, and facilitate training adaptation reinforces its potential as a natural ergogenic aid in sports.

It is important to highlight that, although some previous studies focused on the overall effects of the Mediterranean diet, this review successfully isolated the specific impact of EVOO, strengthening the evidence for its independent role. Nevertheless, the included studies showed marked heterogeneity not only in sample size and design but also in intervention duration and EVOO dosage, which limits direct comparability and generalizability of findings. Future studies should standardize these aspects to enable more robust conclusions.

Regarding inflammation, the role of oleocanthal as a natural anti-inflammatory agent comparable to NSAIDs (but without their adverse side effects) is confirmed[10,11]. Additionally, Balcells et al.[32] and Esquius et al.[33] demonstrated significant reductions in dendritic cell maturation and pro-inflammatory markers post-exercise, supporting EVOO's immunomodulatory capacity. This reinforces the proposal to consider EVOO not only as a healthy food but also as a potential ergogenic and preventive aid against musculoskeletal and joint injuries.

Furthermore, improvements in cardiorespiratory recovery and reductions in functional recovery time observed in several included studies[25,29,33] provide practical evidence of interest to coaches and sports health professionals, enabling safer and faster return to training while minimizing the risk of relapses or overload.

Limitations

This study presents several limitations that should be considered when interpreting the results. First, there is significant methodological heterogeneity among the included studies, both in design (acute vs. prolonged) and in the duration and type of EVOO or derivative intervention. Additionally, sample sizes in some studies were small ($n < 10$), which may limit statistical power and the generalizability of the findings.

Another important limitation is the lack of standardization in EVOO dosing and form of administration (isolated supplementation, dietary inclusion, or extracts), making it difficult to establish precise and comparable recommendations. Furthermore, most studies focused on endurance athletes and individual sports, leaving the effects in team sports and other disciplines to be explored.

In Addition, the available evidence is mainly based on short-duration studies with limited follow-up, preventing assessment of long-term effects on injury prevention and functional performance. Moreover, potential confounding factors such as genetic variability or overall dietary adherence were not controlled, which may influence individual responses to EVOO.

Finally, although current evidence is promising, it remains necessary to conduct longitudinal studies with larger samples and standardized designs to confirm these effects and establish precise dietary recommendations for athletes.

Practical implications

The results of this systematic review suggest that regular EVOO consumption may constitute an effective complementary nutritional strategy for athletes, helping to optimize functional recovery, protect musculoskeletal health, and reduce injury risk.

For coaches and sports health professionals, including EVOO in athletes' daily diets could be considered a natural ergogenic tool, especially in disciplines involving high training loads and mechanical stress. Furthermore, the observed improvements in inflammatory and oxidative parameters reinforce its potential as part of comprehensive prevention and recovery programs.

However, it is recommended to personalize intake according to physiological profiles and individual energy needs and to accompany it with other recovery and joint care strategies (hydration, rest, physiotherapy, etc.).

Future research directions

Based on the results and identified limitations, several future research lines are proposed. It will be necessary to conduct controlled clinical trials with larger sample sizes, standardizing EVOO dosing and intervention duration, to confirm the observed efficacy and establish specific usage guidelines for sports settings.

Moreover, it is suggested to investigate EVOO's impact in other athletic populations (team sports, explosive sports) and in contexts of chronic overload or long competitive seasons.

Another promising line is to explore EVOO's interaction with other nutritional and recovery strategies, as well as its synergistic effects with physiotherapeutic or pharmacological interventions. Finally, longitudinal studies assessing long-term effects on injury incidence, performance, and athletic longevity will be crucial to consolidate its role as a preventive and ergogenic tool.

Conclusion

The findings confirm that EVOO, due to its richness in phenolic compounds and monounsaturated fatty acids, exerts a dual effect: protecting against muscle and joint damage and promoting post-exercise metabolic and functional recovery. These results support its potential as a complementary nutritional strategy in endurance and high-performance disciplines, consolidating EVOO as a natural and effective ergogenic resource to optimize performance and prolong athletic careers. Ultimately, EVOO emerges as a strategic ally to enhance performance and protect athletes' overall health. Future trials should focus on establishing standardized dosing protocols and intervention durations to inform evidence-based sports nutrition guidelines.

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