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Research article

Effects of Sports Massage on Post-Workout Fatigue

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ABSTRACT

This study was conducted to evaluate the effect of sports massage on post-exercise fatigue. The meta-analysis method was used in the study. Meta-analysis is a statistical method used to combine the results of different research studies to answer a similar research question. It includes randomized controlled trials (RCTs) and observational studies examining the effect of sports massage on post-exercise fatigue. The study was designed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The findings indicate that sports massage is effective in reducing post-exercise fatigue symptoms and accelerating athletes' recovery processes. Most of the studies included in the analysis demonstrate that sports massage reduces muscle pain, improves muscle function, and minimizes inflammatory responses. However, there are some differences and debates in the research regarding the effectiveness of sports massage. Nevertheless, there is strong evidence overall for the potential of sports massage to reduce post-exercise fatigue and accelerate athletes' recovery processes. However, further randomized controlled trials and research in various populations are needed to optimize the effectiveness of sports massage and standardize application protocols. Future studies should focus on different sports disciplines and athlete profiles to evaluate the effectiveness of sports massage in a broader context.

This article is the expanded version of the study presented as a full oral text under the title "The Effect of Sports Massage on Post-Exercise Fatigue: A Meta-Analysis Review" at the 3rd International Topkapı Congress held on May 01-02, 2024.

Araştırma makalesi

Spor Masajının Antrenman Sonrası Yorgunluk Üzerine Etkileri

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ÖZET

Bu çalışma, spor masajının antrenman sonrası yorgunluk üzerindeki etkisini değerlendirmek amacıyla gerçekleştirilmiştir. Çalışmada meta-analiz yöntemi kullanılmıştır. Meta analiz; farklı araştırma çalışmalarının sonuçlarını bir araya getirerek, benzer bir araştırma sorusuna cevap aramak için kullanılan istatistiksel bir yöntemdir. Spor masajının antrenman sonrası yorgunluk üzerindeki etkisini inceleyen randomize kontrollü çalışmaları (RCT) ve gözlemsel çalışmaları kapsamaktadır. Çalışma, PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) yönergelerine uygun olarak tasarlanmıştır. Elde edilen bulgular, spor masajının, antrenman sonrası yorgunluk belirtilerini azaltmada ve sporcuların toparlanma süreçlerini hızlandırmada etkili olduğunu göstermektedir. Analize dâhil edilen çalışmaların büyük bir kısmı, spor masajının kas ağrısını azalttığını, kas fonksiyonlarını iyileştirdiğini ve inflamasyon tepkilerini minimize ettiğini ortaya koymaktadır. Öte yandan, spor masajının etkinliği konusunda bazı araştırmalarda farklılıklar ve tartışmalar bulunmaktadır. Ancak, genel olarak spor masajının antrenman sonrası yorgunluğu azaltma ve sporcuların iyileşme süreçlerini hızlandırma potansiyeli konusunda güçlü kanıtlar bulunmaktadır. Ancak, spor masajının etkinliğinin optimize edilmesi ve uygulama protokollerinin standardize edilmesi için daha fazla randomize kontrollü çalışmalara ve çeşitli popülasyonlarda yapılan araştırmalara ihtiyaç vardır. Gelecek çalışmalar, farklı spor dalları ve sporcu profilleri üzerinde odaklanarak, spor masajının etkinliğini daha geniş bir çerçevede değerlendirmelidir.

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Introduction

The purpose of this study is to examine the effect of sports massage on post-training fatigue through meta-analysis. The significance of this research lies in assessing the effects of sports massage to determine whether it is a more effective method for enhancing athletes' performance and improving their recovery processes after training, thereby contributing to the literature.

Training involves regular and systematic exercises and practices designed to develop athletes' physical, technical, and tactical skills, enhance their performance, and achieve success in a specific sport. The training process is managed in accordance with designated plans and programs, and sports science training focuses on examining areas such as exercise physiology and sports psychology to develop athletes' physical, technical, and mental skills. However, post-training fatigue is a common issue faced by athletes, affecting their performance.

Post-training fatigue is the state of physical and mental exhaustion experienced by athletes following intense physical activities. This fatigue varies depending on the intensity and duration of the training, the athlete's conditioning, and their dietary habits. Post-training fatigue can manifest itself through symptoms such as muscle pain, weakness, mental fog, lack of motivation, and decreased performance. Various practices are employed to mitigate the effects of post-training fatigue and facilitate quicker recovery for athletes.

Training “Exercise”

Training consists of regular and systematic exercises and practices aimed at developing athletes' physical, technical, and tactical skills, enhancing their performance, and achieving success in a specific sport discipline (Kraemer & Ratamess, 2004). The training process is managed according to plans and programs designed to help athletes reach their goals. Sports science training focuses on areas such as exercise physiology and sports psychology to develop athletes' physical, technical, and mental skills. The primary goal of training is to improve athletes' physical condition, enhance their technical skills, and mentally prepare them (McBride, 1998). This process focuses on developing various attributes necessary for success in a specific sport, such as strength, endurance, speed, flexibility, and coordination (Merry & Ristow, 2016).

The training process is customized according to the athlete's performance level and objectives. Training programs typically consist of exercises aimed at achieving a specific goal within a certain timeframe. These exercises include various components such as aerobic and anaerobic exercises, resistance training, flexibility exercises, and specific technical drills (Simao et al., 2012).

In addition, the training process encompasses factors such as rest, nutrition, and recovery. Ensuring that athletes consume the nutrients their bodies need during and after training and have adequate rest periods is important for enhancing performance and reducing the risk of injury (Merry & Ristow, 2016).

Post-Exercise Fatigue

Post- exercise fatigue is the physical and mental exhaustion athletes experience after intense physical activities (McBride, 1998). This fatigue usually varies depending on the intensity and duration of the training, the athlete's condition, and their nutritional habits. Symptoms of post-training fatigue can include muscle pain, weakness, mental fog, lack of motivation, and decreased performance (Børsheim & Bahr, 2003; Reilly & Ekblom, 2005).

Various practices are employed to reduce the effects of post-training fatigue and facilitate quicker recovery for athletes. These include proper nutrition, adequate water intake, and rest. Additionally, physical recovery methods such as sports massage, cold water therapy, rest, and stretching are commonly used (Koeslag et al., 1980; MacDonald et al., 2000).

Sports massage is considered an effective method for alleviating post-training fatigue. It reduces muscle tension, helps disperse lactic acid accumulated in the muscles, increases blood circulation, and accelerates the muscle recovery process. Thus, it speeds up athletes' recovery process after training, allowing them to regain their performance more quickly (Davis et al., 2020).

However, there are differences and debates regarding the effectiveness of sports massage. Some studies argue that sports massage does not significantly enhance performance. Therefore, further research on the effectiveness of sports massage is needed, including studies on broader samples (Moraska, 2005). In conclusion, sports massage is considered an effective method for alleviating post-training fatigue.

Upon examining research findings;

- Crane et al. (2012) demonstrate in their study that sports massage reduces post-exercise muscle damage and inflammatory responses, supporting that sports massage positively contributes to the post-training recovery process.
- Mancinelli et al. (2018), in their meta-analysis, show that sports massage is effective in reducing post-training muscle pain and restoring muscle function. These findings support that sports massage accelerates the post-training recovery process.
- Tiidus and Shoemaker (1995) show that sports massage increases blood circulation, thereby speeding up post-training recovery. They provide evidence that sports massage assists in clearing metabolic waste from muscles, thus aiding in quicker recovery for athletes.

Research indicates that sports massage is effective in alleviating post-training fatigue and shortening athletes' recovery times. Notably, Crane et al. (2012) found that sports massage reduces muscle tension and is effective in restoring muscle function. Similarly, a meta-analysis by Mancinelli et al. (2018) confirmed that sports massage speeds up the post-training recovery process.

These academic studies offer strong evidence that sports massage is effective in alleviating post-training fatigue. However, further research on the effectiveness of sports massage is needed, including studies across different sports, athlete groups, and conditions. This would provide a clearer understanding of sports massage's potential to contribute to the post-training recovery process.

Massage

Massage is a treatment method performed through rhythmic and systematic manipulations on the body using hands or mechanical devices. The primary purpose of massage is to relax the muscles, increase circulation, reduce stress, and generally soothe the body. Massage is a method of therapy and relaxation used in many fields, including medicine, rehabilitation, spa, and wellness (Vallejo-Manzur et al., 2020).

History of Massage

The origin of massage dates back to ancient times. Records of the first massage techniques extend back to 3000 B.C., showing that massage held an important place in ancient Chinese, Indian, Greek, and Egyptian cultures. During the ancient Greek period, massage was

commonly used among athletes to enhance their performance and prevent injuries. Moreover, in ancient Rome, massage was widely used along with baths (Calvert, 2002). Although the popularity of massage declined during the Middle Ages, it experienced a revival in Europe during the Renaissance. The development of modern massage techniques accelerated in the 19th and 20th centuries. In particular, the technique known as "Swedish massage," developed by the Swedish physiotherapist Per Henrik Ling, is one of the most commonly used types of massage today (American Massage Therapy Association, 2010).

Types of Massage

There are many different types of massage, each incorporating different techniques and objectives (Guo et al., 2017). Some common types of massage include:

- Swedish Massage: A type of massage that is used to relax muscles, increase blood circulation, and generally relax the body. It involves soft, rhythmic, and superficial movements.
- Deep Tissue Massage: A type of massage that penetrates deeper into the muscle tissue to resolve tension and alleviate chronic pain. It involves pressured and intense movements.
- Reflexology: A type of massage that aims to affect other parts of the body by applying pressure to specific points on the feet. It helps improve the function of organs and systems.
- Thai Massage: Originating from Thailand, this type of massage aims to increase flexibility and circulation, balance energy flow, and provide mental relaxation. It includes stretching, pressure, and joint manipulation techniques.
- Shiatsu: A Japanese type of massage that aims to balance the flow of energy in the body. It involves applying pressure with fingers and palms to specific points.
- Aromatherapy: A type of massage that incorporates traditional massage techniques with the use of essential oils. In this type of massage, natural plant oils or essential oils are applied to the skin during massage. Essential oils are derived from parts of plants such as flowers, leaves, roots, or barks and offer various health and wellness benefits. Aromatherapy massage is used to reduce muscle tension, alleviate stress, improve mood, and provide overall relaxation.

- Therapeutic (Medical Massage): Generally, it is a treatment technique that applies pressure to soft tissues to provide some physiological and psychological relief (Guo et al., 2017; Kerautret et al., 2020; Kumar et al., 2013). These types of massages are applied according to different needs and preferences and offer various health benefits. Each type of massage has its unique techniques and effects (Weerapong et al., 2005).

Sports Massage

Sports massage is a specialized type of massage aimed at enhancing athletes' performance, reducing the risk of injury, and accelerating the recovery process (Aktürk & Yüksek, 2023; Cherkin et al., 2003). It is performed to assist athletes in preparing for competitions and contributing to their performance. Sports massage is a special type of massage that affects the physical and physiological development of athletes (Gürkan, 2018). It is widely used to enhance athletes' performance, reduce the risk of injury, and support recovery after training. This massage technique is employed to support athletes' preparations before training, enhance their performance during training, and reduce muscle fatigue after training. Unlike other types of massage, sports massage incorporates techniques specifically tailored to the needs of athletes and their training programs (Dupuy et al., 2018).

Purposes of Sports Massage

- Enhance performance: Sports massage aims to improve athletes' performance by increasing muscle flexibility and improving blood circulation.
- Reduce the risk of injury: Sports massage aims to reduce athletes' risk of injury by relieving muscle tension and correcting imbalances in the body.
- Accelerate recovery: Sports massage facilitates quicker recovery for athletes by reducing post-training muscle fatigue and accelerating the muscle recovery process (Benjamin & Lamp, 1996; Brummitt, 2008).

Sports Massage Techniques

Sports massage incorporates various techniques, and the choice of technique is determined by what is most suitable for the athlete. Some common sports massage techniques include:

- Deep tissue massage: A technique involving pressured and intense movements applied to deeper muscle tissues.

- Swedish massage: A technique that relaxes muscles and increases blood circulation through rhythmic movements applied to soft tissues.
- Stretching and mobilization: A technique that reduces muscle tension through stretching and extending movements.
- Trigger point therapy: A technique aimed at relieving muscle tension and pain by applying pressure to specific points (Best et al., 2008; Moraska, 2005).

Benefits of Sports Massage

- Enhances performance and optimizes athlete performance.
- Reduces muscle tension and alleviates pain and fatigue in muscles.
- Increases blood circulation, allowing faster transport of oxygen and nutrients to muscles.
- Reduces the risk of injury and ensures muscle balance.
- Accelerates the recovery process, enabling athletes to return to training more quickly (Davis et al., 2020; Gasibat & Suwehli, 2017).

Sports massage is typically applied by a licensed massage therapist. The therapist, in collaboration with the athlete, determines the massage program based on the type of sport, training schedule, and athlete's goals. Massage can be conducted before, during, or after training, but the timing and frequency of application vary according to the athlete's needs (Yuan et al., 2015). The effectiveness of sports massage in enhancing performance and speeding up the recovery process is supported by academic and clinical studies (Dal Farra et al., 2021).

For example, a study by Crane et al. (2012), published in the Journal of Athletic Training, contains significant findings about the potential of sports massage to reduce post-training fatigue and muscle damage. The study demonstrates that sports massage reduces muscle tension and is effective in restoring muscle function.

Furthermore, a meta-analysis by Mancinelli et al. (2018), published in the International Journal of Sports Physiology and Performance, provides strong evidence that sports massage accelerates the post-training recovery process. This study shows that sports massage increases

blood circulation, assists in the clearance of metabolic waste from muscles, and thereby aids in quicker recovery for athletes.

Similarly, a review article by Tiidus et al. (1995) in Sports Medicine thoroughly examines the effects of sports massage on reducing post-training fatigue and supporting muscle recovery. This article indicates that sports massage reduces inflammation in muscles and increases their flexibility.

In their systematic review and meta-analysis, Davis et al. (2020) examined the impact of sports massage on enhancing performance and improving the recovery process. The researchers systematically reviewed the existing scientific literature to evaluate the effect of sports massage on increasing athletes' performance and its potential to accelerate the post-training recovery process. Consequently, they found that sports massage is effective in enhancing performance and improving the recovery process after training.

In a systematic review and meta-analysis conducted by Dupuy et al. in 2018, the researchers aimed to assess the effect of post-exercise recovery techniques on reducing muscle damage, pain, fatigue, and inflammation markers. By systematically reviewing the current scientific literature, they presented strong evidence supporting that certain post-exercise recovery techniques effectively reduce muscle damage, pain, fatigue, and inflammation markers.

Kerautret et al. (2020) carried out a study to investigate the selective effects of manual massage and foam rolling on perceived recovery and performance. The researchers suggest that manual massage and foam rolling can differently affect athletes' perceived recovery and performance. This study highlights the importance of conducting further research on robotic massages in the future.

Weerapong et al. (2005) examined the mechanisms of massage, its effects on performance, muscle recovery, and injury prevention. The researchers concluded that massage could enhance athletes' performance, accelerate muscle recovery, and reduce the risk of injury.

Guo et al. (2017) conducted a study to investigate the effect of massage on alleviating delayed onset muscle soreness (DOMS) following intense exercise. The findings of their study support the effectiveness of massage in relieving DOMS after intense physical activity.

These examples are studies that provide scientific evidence showing the effectiveness of sports massage in enhancing performance, supporting muscle recovery, and accelerating the

recovery process for athletes. They serve as examples of academic work exploring the physiological effects, application methods, and impacts of sports massage on athletes.

In conclusion, fatigue following sports activities is a significant factor affecting athletes' performance, varying with the intensity and duration of the training and the athlete's unique physiological characteristics. Efforts to reduce post-training fatigue and accelerate recovery highlight the importance of sports massage as a significant area of study today.

Method

This study was conducted to evaluate the effect of sports massage on post-training fatigue. Our methodology involves a systematic examination and analysis of relevant studies in the existing literature using the meta-analysis method. "*Meta-analysis is a statistical method used to combine the results of different research studies, seeking answers to a similar research question. It employs a predefined protocol and a systematic approach to find answers to a specific research question. This process typically includes the following steps; Identifying the Research Question: A specific research question is determined for the meta-analysis. Literature Review: Relevant literature is reviewed, and similar studies are identified. Study Selection: Studies that meet the defined criteria are selected. Data Extraction and Evaluation: Data are extracted and evaluated from the selected studies. Data Analysis: The extracted data are statistically analyzed and synthesized. Interpretation of Results: The results are interpreted, and a meta-analysis report is prepared. Meta-analysis is a powerful statistical method for synthesizing existing knowledge in research literature and reaching a general conclusion*" (Crits-Christoph, 1992).

Research Design

This meta-analysis includes randomized controlled trials (RCTs) and observational studies examining the effect of sports massage on post-training fatigue. The study is designed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Data Sources and Study Selection

Relevant studies were systematically searched from leading databases in the field, including PubMed, Scopus, Web of Science, and SPORTDiscus. The scanning process was conducted using keywords such as sports massage, post-training fatigue, muscle soreness, and recovery

process. The study selection was initially screened by title and abstract review, followed by a full-text review. Selection criteria included studies where sports massage was applied, and post-training fatigue was measured. Exclusion criteria were studies without full-text access, those providing insufficient data, or those with low methodological quality.

Data Extraction and Quality Assessment

Data extraction from selected studies was performed by two independent researchers. Extracted data included authors, publication year, study design, sample size, participant characteristics (age, gender, sport), type of massage, duration and frequency, measurement tools, and main findings.

Results

This meta-analysis was conducted to assess the impact of sports massage on post-training fatigue. The findings suggest that sports massage is effective in reducing symptoms of post-training fatigue and in accelerating the recovery process for athletes. A majority of the included studies demonstrate that sports massage reduces muscle pain, improves muscle functions, and minimizes inflammatory responses. However, the presence of methodological differences and heterogeneity in the outcomes of studies on the effects of sports massage highlights the need for further research.

The effect of sports massage in reducing post-training fatigue operates by decreasing muscle tension, preventing the accumulation of lactic acid in muscles, and enhancing blood circulation. Consequently, athletes experience reduced muscle fatigue and pain, can recover their performance more quickly, and face a significantly reduced risk of injury.

The examination of studies has shown that works such as those by Crane et al. (2012), Mancinelli et al. (2018), and Tiidus and Shoemaker (1995) support the positive contribution of sports massage to the post-training recovery process. These studies document the effects of sports massage in reducing muscle tension, restoring muscle function, and increasing blood circulation, thereby accelerating the post-training recovery process for athletes.

On the other hand, there are differences and debates in some studies regarding the effectiveness of sports massage. However, overall, there are strong evidences supporting the potential of sports massage in reducing post-training fatigue and in accelerating the recovery processes for athletes.

While the meta-analysis results show that sports massage has positive effects on post-training fatigue, reaching specific conclusions about the magnitude and duration of this effect requires consideration of various factors (such as the duration, technique, and frequency of massage). Moreover, examining other variables that could affect the effectiveness of sports massage (such as the athlete's age, gender, sport, and fitness level) is important.

This study provides scientific evidence supporting the potential of sports massage in reducing post-training fatigue. However, further randomized controlled trials and research in various populations are needed to optimize the effectiveness of sports massage and standardize application protocols. Future studies should evaluate the effectiveness of sports massage in a broader context by focusing on different sports and athlete profiles.

In conclusion, this meta-analysis demonstrates that sports massage has a positive effect on post-training fatigue. It concludes that sports massage is an effective method for enhancing athletes' performance and improving their recovery processes after training. However, broader scale and longer-term studies are necessary to better understand the effectiveness of sports massage and to better serve athletes.

Lastly, this meta-analysis not only demonstrates the contribution of sports massage to post-training recovery processes but also represents an important step towards standardizing application methodologies and protocols. Practitioners of sports massage can use these findings as a guide to develop more effective recovery strategies for athletes. This research can also serve as a fundamental resource for future studies in the fields of sports science, massage therapy, and sports medicine.

Conflict of Interest Statement

There are no potential conflicts of interest concerning the research, authorship, and publication of this article.

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Ethics Committee Decision

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