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Ocena czynników wpływających na skuteczność terapii integracji sensorycznej u dzieci w wieku przedszkolnym i wczesnoszkolnym

Assessment of factors influencing the effectiveness of sensory integration therapy in preschool and early school-aged children

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A review of massage on physiological and psychological performance

Przegląd wpływu masażu na wydajność fizjologiczną i psychologiczną

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Abstract

This paper aims to succinctly summarize the existing body of literature concerning the effects of massage on sports and exercise performance, particularly focusing on motor skills, neurophysiological factors, and psychological factors. The review adheres to the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-analysis) and encompasses a total of 76 articles. The findings suggest that, on the whole, massages do not exert a significant influence on motor skills, except for flexibility. Nevertheless, some studies propose that favorable changes in muscle force and muscular strength may be noticeable 48 hours after undergoing a massage. Regarding neurophysiological aspects, massages do not seem to impact factors such as clearance of blood lactate, circulation in the muscle, blood circulation, temperature in the muscle tissue, or activation of muscles. However, there is substantiated evidence supporting the idea that massages can alleviate pain and mitigate delayed-onset muscle soreness, potentially by reducing creatine kinase enzyme levels and through psychological processes. Additionally, the review underscores the psychological advantages of massage. It is documented that massage treatments lead to a reduction in feelings of depression, stress, anxiety, and perceived fatigue while simultaneously fostering enhancements in mood, relaxation, and opinion about recovery states. Massages may not have a direct impact on certain performance aspects, but they offer notable psychological benefits for sports, and exercise performance is questionable. They also play an indirect role as an important tool for promoting focus, relaxation, and recovery in athletes. Massages can aid athletes in staying mentally and physically prepared during competitions or training sessions.

Keywords:

massage, performance, physiological, psychological, review

Streszczenie

Celem niniejszego opracowania jest zwięzłe podsumowanie istniejącego korpusu literatury dotyczącej wpływu masażu na wydajność w sporcie i ćwiczeniach, ze szczególnym uwzględnieniem umiejętności motorycznych, czynników neurofizjologicznych oraz czynników psychologicznych. Przegląd przestrzega wytycznych PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) i obejmuje łącznie 76 artykułów. Wyniki sugerują, że w ogólnym rozrachunku masaż nie wywiera znaczącego wpływu na umiejętności motoryczne, z wyjątkiem elastyczności. Niemniej jednak, niektóre badania proponują, że korzystne zmiany w sile mięśniowej i siły mięśni mogą być zauważalne 48 godzin po przeprowadzeniu masażu. W odniesieniu do aspektów neurofizjologicznych, masaż nie wydaje się wpływać na czynniki takie jak usuwanie kwasu mlekowego z krwi, krążenie w mięśniu, krążenie krwi, temperaturę w tkance mięśniowej czy aktywację mięśni. Istnieją jednak uzasadnione dowody popierające ideę, że masaż może złagodzić ból i zmniejszyć opóźnioną bolesność mięśni, potencjalnie przez redukcję poziomów enzymu kinazy kreatynowej i poprzez procesy psychologiczne. Ponadto, przegląd podkreśla psychologiczne korzyści płynące z masażu. Udokumentowano, że zabiegi masażu prowadzą do zmniejszenia uczuć depresji, stresu, lęku i odczuwanego zmęczenia, jednocześnie wspierając poprawę nastroju, relaksacji i opinii na temat stanów regeneracyjnych. Masaże mogą nie mieć bezpośredniego wpływu na niektóre aspekty wydajności, ale oferują znaczące korzyści psychologiczne dla sportu, a wpływ na wydajność ćwiczeń jest kwestionowany. Odgrywają także pośrednią rolę jako ważne narzędzie promujące skupienie, relaksację i regenerację u sportowców. Masaże mogą pomagać sportowcom pozostać mentalnie i fizycznie przygotowanymi podczas zawodów lub sesji treningowych.

Słowa kluczowe:

masaż, wydajność, fizjologiczne, psychologiczne, przegląd

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Introduction

Fatigue refers to a decline in the ability to withstand physical exertion, and its underlying causes are often activity-specific [1]. Factors such as excessive physical activity, inadequate rest periods, poor physical fitness, insufficient or over-intensive training, and stress can contribute to the onset of fatigue [2]. There are two distinct types of fatigue: mental fatigue, which results from prolonged mental exertion and can manifest as disinterest or saturation, and physical fatigue, which arises from physical or muscular activity [3]. During short periods of high-intensity activities, the body's energy demand can significantly increase, in some cases by as much as a hundred times. Fatigue can be induced when the accumulation of lactic acid in the blood exceeds a critical threshold, often identified as 19.5 mmol/L. Previous research by [4] revealed a significant rise in blood lactic acid levels within 5 minutes following maximal training. The presence of lactic acid in muscles hampers enzyme functioning and interferes with chemical reactions within the muscles [5]. Consequently, muscle contractions are impaired, leading to weakened muscle performance and eventual exhaustion.

To minimize fatigue, it is essential to optimize the recovery process. Recovery allows the body to replenish energy reserves, decrease lactic acid build up, and alleviate fatigue in the central nervous system [6]. The recovery mechanism for lactic acid removal from muscles and blood is influenced by the type of activity performed, particularly after intense or anaerobic exercise [7]. This process affects how lactate is released from muscles into the bloodstream, enhances blood flow, and aids in the uptake of lactate by the liver, heart, and skeletal muscles [8]. There are various methods available to expedite recovery after experiencing fatigue, and one of them is through the practice of sports massage [9]. Sports massage is a specific type of therapeutic massage particularly aimed at athletes. This form of massage is known for its ability to enhance blood circulation, leading to its beneficial effects on recovery [10].

The term "massage" is typically defined as the manual manipulation of soft tissues through rhythmic movements and applied pressure with the intention of promoting overall health and well-being [11]. Sports often incorporate a variety of other massage techniques, such as vibro-massage, hydro-massage, acupressure massage, rolling massage involving myofascial release techniques, and massages conducted using a foam roller, also known as FR [12]. Currently, the foam roller is the most extensively utilized tool in the sports and fitness industry. The literature frequently highlights the positive impact of massage therapy on physiological, neurological, psychological, and biomechanical mechanisms [13].

Research aim

Past review studies have delved into the impact of massage therapy on different facets pertinent to sports and exercise. Nevertheless, a substantial portion of these studies is outdated and lacks the incorporation of the most recent discoveries. Additionally, some of these studies concentrated on distinct types of massage or particular research methodologies. In light of the crucial role played by massage therapy in sports and exercise recovery, there exists a pressing need for more comprehensive research in this domain. Hence, the primary objective of this review paper is to conduct a methodical examination of the contemporary literature pertaining to the effects of massages on sports and exercise performance, taking into account aspects related to motor skills, neurophysiological elements, and psychological mechanisms [14].

The primary objective is to assess the overall impact of massage therapy on sports and exercise performance, analyzing studies from the past four decades regardless of their methodology, participant characteristics, massage techniques, and duration. The outcomes derived from this review paper will offer valuable perspectives regarding the potential utilization of massage therapy. This represents a pivotal stride toward further investigations and the enhancement of the recuperation process in the realm of sports and exercise.

Material and methods

This review was conducted following the guidelines outlined by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) [15] as presented in Figure 1.

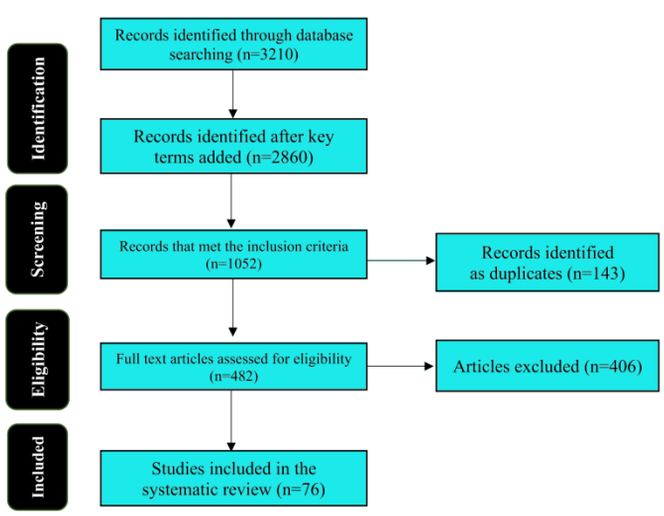

Fig 1. Preferred reporting items for systematic reviews and meta-analysis (PRISMA) flow

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Literature search parameters

A comprehensive search of the literature was conducted by utilizing several databases, including PubMed, Cochrane, Web of Science, Scopus, and Google Scholar. This approach was adopted to ensure the exhaustive nature of the search strategy. The literature search was conducted in June 2023. The search employed the following keywords and phrases: "massage" or "massage exercises" or "massage performance" or "muscle force" or "muscle strength" or "muscle power" or "velocity" or "flexibility" or "stamina" or "range of motion" or "lactate concentration" or "blood circulation" or "body temperature" or "creatine kinase" or "discomfort" or "electromyography" or "anxiety" or "emotional state" or "rejuvenation" or "tiredness" or "recovery from fatigue" or "stress."

Eligibility criteria

The inclusion criteria for eligible studies were as follows: they had to be related to massage therapy in the context of sport and exercise. The search was conducted specifically on studies involving human participants and written in English, spanning the period from 2013 through 2023. All types of study designs were considered, except for review papers. No restrictions were imposed on the type, technique, or duration of massage therapy, sport type, physical activity level, or age of the participants. Massage interventions were implemented in various conditions, such as before or after performance, during rest, or following fatigue protocols, and could target any body region. After conducting the initial search, duplicates and irrelevant articles were manually eliminated. Upon examination and sorting, these articles were categorized into three main groups: 41 articles assessing the impact of massage therapy on motor abilities, 26 on neurophysiological effects, and 9 on psychological mechanisms. It is important to note that out of the 76 included papers, there are 15 studies examined different mechanisms within the same study.

Results of research

A total of 76 studies that fulfilled the eligibility criteria were identified (see Figure 1). These studies involved a combined total of 2.021 participants, comprising 1.256 males, 765 females, and 221 participants with undefined gender. The average age of the participants was 26.3 years. Among the 76 studies, 41 focused on recreational individuals, 19 included athletes, 7 involved untrained individuals, and 9 studies did not specify the subjects' physical activity status. Regarding the interventions, 46 studies examined the effects of manual massage, while 30 articles explored different variations of a foam roller. Additionally, 26 articles investigated the impacts of massage therapy on the muscles in the legs, 6 articles on arm muscles, and 44 articles on various other muscles.

Massage therapy on motor skills

Based on the analysis, studies were focusing on the effects of massage therapy on motor abilities. The primary motor skills examined in the research being discussed encompassed power, potency, swiftness, stamina, and suppleness which presented in Table 1.

Table 1. Enhancing motor skills through massage therapy

Studies	Massage Variation MM = N (studies) FR = N (studies)	Motor Ability	Results
[2, 6, 8, 14, 16–24]	MM = 5, FR = 7	Force	Without effect on motor skills
[25–30]	MM = 3, FR = 3	Force	Increasing effect on motor skills
[31]	FR = 1	Force	Increasing effect on motor skills
[3]	FR = 1	Force	Decreasing effect on motor skills
[3, 6, 19, 20, 23, 28]	MM = 2, FR = 4	Strength	Without effect on motor skills
[8, 25, 27, 28, 32, 33]	MM = 3, FR = 3	Strength	Increasing effect on motor skills
[34–36]	MM = 1, FR = 2	Strength	Decreasing effect on motor skills
[37–40]	MM = 2, FR = 2	Speed	Without effect on motor skills
[13, 41]	MM = 1, FR = 1	Endurance	Without effect on motor skills
[29, 42, 43]	MM = 3	Endurance	Increasing effect on motor skills
[6, 8, 10, 11, 13, 16, 19, 21, 23, 25, 27, 30, 34, 44–52]	FR = 18	Flexibility	Increasing effect on motor skills
[20, 32, 51, 53]	FR = 4	Flexibility	Increasing effect on motor skills
[5, 7, 31, 54, 55]	MM = 2, FR = 3	Flexibility	Without effect on motor skills

MM: Manual Massage; FR: Foam Rolling

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Massage therapy on neurophysiological mechanisms

The analysis included studies examining the effects of massage therapy on neurophysiological mechanisms, as presented in Table 2.

Table 2. The impact of massage therapy on neurophysiological factors

Studies	Massage Variation MM = N (studies) FR = N (studies)	Motor Ability	Results
[5, 56–61]	MM = 6, FR = 1	Lactate Removal	Without effect on neurophysiology
[62]	MM = 1	Blood Flow	Increasing effect on neurophysiology
[63]	MM = 1	Blood Flow	Decreasing effect on neurophysiology
[9, 64]	MM = 2	Temperature	Increasing effect on neurophysiology
[65]	MM = 1	Temperature	Increasing effect on neurophysiology
[28, 44, 55, 66, 67]	MM = 5	Creatine Kinase	Decreasing effect on neurophysiology
[68]	MM = 1	Creatine Kinase	Increasing effect on neurophysiology
[14, 30, 36, 37, 69–75]	MM = 6, FR = 5	DOMS	Decreasing effect on neurophysiology
[61, 76–79]	MM = 3, FR = 2	EMG RMS	Without effect on neurophysiology
[80–82]	FR = 3	EMG RMS	Decreasing effect on neurophysiology
[83, 84]	MM = 1, FR = 1	EMG H-reflex, M-wave	Decreasing effect on neurophysiology

MM: Manual Massage; FR: Foam Rolling

Massage therapy on psychological mechanisms

The impacts of massage therapy on psychological processes are outlined in Table 3.

Table 3. The Effects of Massage Therapy on Psychological Aspects

Studies	Massage Variation MM = N (studies) FR = N (studies)	Motor Ability	Results
[85–88]	MM = 4	Anxiety	Decreasing effect on psychology
[87, 89]	MM = 2	Stress	Decreasing effect on psychology
[87]	MM = 1	Depression	Decreasing effect on psychology
[90]	MM = 1	Self-reported perceptions of physical symptoms	Decreasing effect on psychology
[75, 90–93]	MM = 5	Fatigue perception	Decreasing effect on psychology
[59, 89]	MM = 2	Perception of recovery	Increasing effect on psychology
[85, 86]	MM = 1, FR = 1	Mood state	Increasing effect on psychology
[94]	MM = 1	Mood state	Without effect on psychology
[85]	MM = 1	Relaxation	Increasing effect on psychology
[90]	MM = 1	Positive affect	Increasing effect on psychology

MM: Manual Massage; FR: Foam Rolling

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Discussion

Massage therapy on motor skills

In the majority of the studies, massage therapy showed no significant impact on muscle force. However, a small number of studies demonstrated a significant improvement in muscle force following massages. These investigations also revealed that providing massages before muscle strength or speed assessments typically had no discernible impact on the post-test outcomes [16, 17].

However, a number of studies, including those by [27] and [28] have reported positive effects on muscle force and strength, particularly 48 hours after administering fatigue protocols. [31] similarly observed favorable outcomes of massages on maximal voluntary contraction (MVC), specifically within the 30-minute timeframe after treatment. No significant improvements in muscle force were observed when measurements were taken immediately or 15 minutes after foam rolling (FR). Notably, this study was the first to report an increase in MVC following FR alone, suggesting that FR could help mitigate the effects of fatigue during submaximal tasks. The authors concluded that FR performed at least 30 minutes before an activity leads to more efficient muscle activation.

[39] conducted a study to investigate the impact of therapeutic massages on muscle force following a 40-minute downhill treadmill walk with a load equivalent to 10% of the participants' body weight. The massage was administered to one limb 2 hours after the walk, and muscle force was assessed before the walk. The findings revealed that the massage had a detrimental effect on muscle force only at the 1-hour mark, with no negative effects observed at 24, 72, and 120 hours after the walk. There was only one study that reported an adverse effect of massage therapy on muscle force development, indicating that a single session of foam rolling led to neuromuscular exhaustion, particularly in terms of maximal force production of knee extensors [3]. When evaluating muscle strength, two common methods were employed: dynamometer-based assessments and assessments involving jumping tasks [21, 35, 39]. Most studies indicated that massages did not significantly affect muscle strength [6, 14, 19, 20]. However, the majority of positive effects were observed 48 hours after receiving massage therapy [27, 28], whereas four studies demonstrated an immediate positive impact of massages on muscle strength [6, 23, 30]

In the initial study, participants underwent foam rolling (FR) massage combined with dynamic warm-up exercises, resulting in an increase in muscle strength [25]. In the second study, a comparison was made between vibration rolling (VR), non-vibration rolling (NVR), and static stretching as part of the warm-up, with VR notably increasing quadriceps muscle strength [32,46]. In the third study, both VR and NVR were found to increase jump heights among athletes [30], and the final study demonstrated that incorporating VR into dynamic stretching led to greater lower limb power [46,95]. These findings suggest that including foam rolling (FR) in warm-up routines may contribute to overall improvements in muscle strength.

Furthermore, [34] found that massage therapy did not lead to improvements in knee flexion peak torque. However, it beneficially affected the quadriceps muscles, with foam rolling (FR) enhancing knee extension peak torque at a velocity of 60°/s. [51] investigated the impact of therapeutic massage on hamstring strength and single-leg vertical jump height at various time points (1, 24, 72, and 120 hours) following a 40-minute downhill treadmill walk with a load. Isokinetic strength at a speed of 60°/s and vertical jump height were notably lower for the leg that received a massage at both 1 and 24 hours after the exercise.

[35] conducted another study examining the effects of foam rolling (FR) on squat jump (SJ) and countermovement jump (CMJ) performances, both immediately and 3 hours post-treatment. The results indicated that the FR intervention did not impact maximal lower limb strength during explosive efforts that didn't involve the use of elastic energy (SJ). However, it did enhance maximal power output during explosive efforts that relied on the storage of elastic energy (CMJ).

Additionally, studies by [24] and [44] showed that massage therapy had a direct negative effect on vertical jumps when compared to passive rest. While most of the studies analyzed did not find a significant impact of massage therapy on sprint performance [39] and did not alter dynamic reaction time [38], there were some effects observed. The results indicated that a massage did not affect the completion time of a 20-meter flying sprint or leg reaction time [22]. In the studies by [62] and [44], the massage protocol resulted in significantly shorter completion times for 10-meter and 30-meter runs.

A study conducted by [20] in 2018 revealed that foam rolling (FR) resulted in immediate improvements in dorsiflexion range of motion (ROM), but these improvements were not sustained over time [20]. Furthermore, enhancements in hip abduction were noted following FR for the gluteal muscle group, but not for the iliotibial band, as indicated by [51] in 2018. In a comparison between vibration rolling (VR) and non-vibration rolling (NVR), it was found that VR had an impact on both knee extension and flexion ROM, while NVR only affected knee extension ROM, as demonstrated in Lee's study in 2018.

Massage therapy on neurophysiological mechanisms

Most of the research that has delved into the neurophysiological mechanisms of the human body in relation to massage therapy has focused on muscle fatigue and soreness. Fatigue triggers the activation of recovery mechanisms that help protect the body [49]. One significant mechanism is the accumulation of lactic acid, which contributes to the development of fatigue. While massage therapy cannot directly remove lactate acid, it has been shown to reduce the levels of creatine kinase enzyme, which in turn can contribute to pain reduction and alleviate delayed onset muscle soreness [96].

Another study by [37] demonstrated that massage was more efficient than passive recovery in eliminating blood lactate, particularly after a maximal effort 200-meter front crawl swim. However, there was one study that reported a negative effect of massage on LR. In this particular study, subjects performed 2 minutes of strenuous isometric handgrip exercise

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at 40% of maximum voluntary contraction (MVC) to elevate the level of lactic acid in the forearm muscles after receiving a 10-minute manual massage. This study was the first to examine venous lactate acid and investigate the influence of massage on its removal from exercised muscles. However, subsequent studies by other authors did not replicate these findings [12].

Studies examining the impact of massage therapy on muscle temperature have yielded conflicting outcomes. [97] and [9] have all suggested that massage therapy predominantly affects surface (skin) temperature rather than the temperature deep within the muscles. They conducted a more in-depth investigation of muscle temperature at various depths using a needle thermocouple under local anesthesia, and their findings did not support the hypothesis that post-exercise massage enhances limb blood flow, suggesting a limited impact on muscle temperature. The current body of evidence indicates that massage therapy predominantly impacts skin temperature and may offer limited effects on deep muscle temperature or the removal of lactic acid [48].

Instead, research has indicated that DOMS is associated with muscle fibre damage, which triggers the release of enzymes such as creatine kinase (CK) into the bloodstream [66]. The majority of studies examining the impact of massages on Delayed Onset Muscle Soreness (DOMS) have shown a reduction in muscle damage and CK (Creatine Kinase) levels, consequently alleviating DOMS symptoms. Nonetheless, it's important to highlight that one study did not identify a beneficial effect of massages in reducing CK levels, which might be attributed to the specific massage techniques employed in that particular research. Overall, the existing evidence suggests that massage therapy can contribute to the reduction of DOMS symptoms and muscle damage, potentially through mechanisms such as improved blood flow, decreased inflammation, and enhanced recovery processes.

Researchers have investigated the effects of massage therapy on muscle activity using surface electromyography (EMG), which measures and analyzes electrical activity in muscles. The root mean square (RMS) value of the myoelectric signal is a commonly used method to assess muscle activity and reflects the level of physiological activity in the motor unit during muscle contraction. The majority of studies in this area have found that massage therapy does not significantly alter the electromyographic characteristics of muscles [95]. This suggests that massages do not have a significant impact on muscle activation or the underlying physiological activities of the motor units.

It is important to note that individual studies may have different methodologies, target muscles, and massage techniques, which could contribute to variations in the results. However, the overall evidence indicates that massages generally do not produce significant changes in muscle activity as measured by surface electromyography [22]. [98] investigated the impact of rolling massage on corticospinal excitability in the quadriceps muscles. The root mean square (RMS) EMG recorded from the vastus lateralis (VL) and vastus medialis (VM) at 50% of maximum voluntary contraction (MVC) did not exhibit any differences between conditions.

However, at 10% MVC, the electromyographic activity recorded from VL was significantly lower after rolling massage. This indicates that rolling massages may affect central excitability, particularly in the VL muscle, but only at low-level contractions that require minimal central drive to recruit low-threshold spinal motoneurons and motor units [98]. These studies underscore that the effects of massages on EMG properties can be nuanced and reliant on factors such as the specific muscle involved, the massage technique employed, and the intensity of muscle contraction.

In addition to assessing EMG signals through the root mean square (RMS) method, some studies have used measures of the Hoffman reflex (H-reflex) and M-wave to investigate the effects of massage on spinal excitability. Two studies have shown an immediate return of the H-reflex to baseline levels after a massage, indicating that massage can modulate spinal excitability [96, 99, 100]. These findings suggest that massages may have an impact on the neurophysiological mechanisms related to muscle activation and spinal reflexes. Furthermore, the level of applied pressure during the massage has been shown to influence its effects on motoneuron activity. Higher levels of pressure applied during a massage have been associated with greater reductions in excitability, indicating that the intensity of the massage plays a role in modulating neural responses.

Overall, the findings from these studies suggest that massages can have a direct impact on motoneuron activity and spinal excitability, and the specific effects may vary depending on factors such as the type, duration, and location of the massage, as well as the amount of pressure applied. These insights into the neurophysiological mechanisms underlying the effects of massages on muscle activation are important for understanding how massages can influence muscle function and recovery in various contexts.

Massage therapy on psychological mechanisms

Limited research exists on the connection between massage and psychological mechanisms. However, available studies focusing on athletes and recreational sports participants indicate a positive relationship between massage and improvements in various psychological states. This suggests that massages can effectively alleviate stress, anxiety, depression, and perceived fatigue [47]. Furthermore, massages have been found to enhance emotional state, promote relaxation, and contribute to a sense of recovery from fatigue. It is crucial to acknowledge that, although the majority of studies endorse these positive effects, there is one study that did not detect a significant impact of massage on mood state.

In that particular study, participants completed a mood questionnaire, underwent a Wingate anaerobic cycling test, received a 30-minute massage or passive rest, and repeated the procedure. Overall, the current evidence suggests that massages can have positive effects on various psychological states in the athletic and recreational sport population. Additional research is necessary to further explore the connection between massage and psychological well-being in this population.

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Conclusion

In general, the application of massage does not appear to have a significant impact, whether positive or negative, on motor performance, except in the case of flexibility, where it has demonstrated positive effects. However, indications suggest that massage's positive effects become more pronounced 48 hours after intense physical activities. Concerning neurophysiological parameters, it appears that massage does not have a significant impact on factors such as blood lactate clearance, muscle blood flow, muscle temperature, or muscle activation. Consistently, research has shown that massage effectively reduces pain and alleviates delayed onset muscle soreness. These effects may be associated with the reduction of the creatine kinase enzyme and possibly involve psychological mechanisms.

Massage therapy continues to be a widely employed approach in exercise and sports settings, likely owing to its positive effects on various psychological states. These include reducing symptoms of depression, stress, and anxiety, as well as decreasing the perception of fatigue. Additionally, massage enhances mood, promotes relaxation, and contributes to an overall sense of recovery and well-being.

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Piśmiennictwo/ References

1. Davis HL, Alabed S, Chico TJA. Effect of sports massage on performance and recovery: a systematic review and meta-analysis. BMJ Open Sport Exerc Med 2020;6:e000614. https://doi.org/10.1136/bmjsem-2019-000614.
2. Bedford S, Robbins D. The Acute Effects of Massage are Not Detrimental to Grip Strength in Sub-Elite Racquet Players. Medicine & Science in Tennis 2016;21.
3. Fleckenstein J, Wilke J, Vogt L, Banzer W. Preventive and Regenerative Foam Rolling are Equally Effective in Reducing Fatigue-Related Impairments of Muscle Function following Exercise. J Sports Sci Med 2017;16:474–9.
4. Jo E, Juache G, Saralegui D, Weng D, Falatoonzadeh S. The Acute Effects of Foam Rolling on Fatigue-Related Impairments of Muscular Performance. Sports 2018;6:112. https://doi.org/10.3390/sports6040112.
5. D'Amico A, Paolone V. The Effect of Foam Rolling on Recovery Between two Eight Hundred Metre Runs. J Hum Kinet 2017;57:97–105. https://doi.org/10.1515/hukin-2017-0051.
6. Behara B, Jacobson BH. Acute Effects of Deep Tissue Foam Rolling and Dynamic Stretching on Muscular Strength, Power, and Flexibility in Division I Linemen. J Strength Cond Res 2017;31:888–92. https://doi.org/10.1519/JSC.0000000000001051.
7. Couture G, Karlik D, Glass SC, Hatzel BM. The Effect of Foam Rolling Duration on Hamstring Range of Motion. Open Orthop J 2015;9:450–5. https://doi.org/10.2174/1874325001509010450.
8. MacDonald GZ, Button DC, Drinkwater EJ, Behm DG. Foam Rolling as a Recovery Tool after an Intense Bout of Physical Activity. Med Sci Sports Exerc 2014;46:131–42. https://doi.org/10.1249/MSS.0b013e3182a123db.
9. Boguszewski D, Adamczyk JG, Urbańska N, Mrozek N, Piejko K, Janicka M, et al. Using thermal imaging to assess the effect of classical massage on selected physiological parameters of upper limbs. Biomed Hum Kinet 2014;6. https://doi.org/10.2478/bhk-2014-0024.
10. Bradbury-Squires DJ, Noftall JC, Sullivan KM, Behm DG, Power KE, Button DC. Roller-Massager Application to the Quadriceps and Knee-Joint Range of Motion and Neuromuscular Efficiency During a Lunge. J Athl Train 2015;50:133–40. https://doi.org/10.4085/1062-6050-49.5.03.
11. Bushell JE, Dawson SM, Webster MM. Clinical Relevance of Foam Rolling on Hip Extension Angle in a Functional Lunge Position. J Strength Cond Res 2015;29:2397–403. https://doi.org/10.1519/JSC.0000000000000888.
12. Cè E, Limonta E, Maggioni MA, Rampichini S, Veicsteinas A, Esposito F. Stretching and deep and superficial massage do not influence blood lactate levels after heavy-intensity cycle exercise. J Sports Sci 2013;31:856–66. https://doi.org/10.1080/02640414.2012.753158.
13. Junker D, Stöggl T. The Training Effects of Foam Rolling on Core Strength Endurance, Balance, Muscle Performance and Range of Motion: A Randomized Controlled Trial. J Sports Sci Med 2019;18:229–38.
14. Casanova N, Reis JF, Vaz JR, Machado R, Mendes B, Button DC, et al. Effects of roller massager on muscle recovery after exercise-induced muscle damage. J Sports Sci 2018;36:56–63. https://doi.org/10.1080/02640414.2017.1280609.
15. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. International Journal of Surgery 2010;8:336–41. https://doi.org/10.1016/j.ijsu.2010.02.007.
16. Sullivan KM, Silvey DBJ, Button DC, Behm DG. Roller-massager application to the hamstrings increases sit-and-reach range of motion within five to ten seconds without performance impairments. Int J Sports Phys Ther 2013;8:228–36.
17. Mustafa MsK, Furmanek PMP, Knapik MsA, Bacik PB, Juras PG. The Impact of the Swedish Massage on the Kinesthetic Differentiation in Healthy Individuals. International Journal of Therapeutic Massage & Bodywork: Research, Education, & Practice 2015;8. https://doi.org/10.3822/ijtmb.v8i1.252.
18. Bedford S, Robbins D. The Acute Effects of Massage are Not Detrimental to Grip Strength in Sub-Elite Racquet Players. Medicine & Science in Tennis 2016;21.
19. Hodgson DD, Quigley PJ, Whitten JHD, Reid JC, Behm DG. Impact of 10-Minute Interval Roller Massage on Performance and Active Range of Motion. J Strength Cond Res 2019;33:1512–23. https://doi.org/10.1519/JSC.0000000000002271.
20. Aune AAG, Bishop C, Turner AN, Papadopoulos K, Budd S, Richardson M, et al. Acute and chronic effects of foam rolling vs eccentric exercise on ROM and force output of the plantar flexors. J Sports Sci 2019;37:138–45. https://doi.org/10.1080/02640414.2018.1486000.
21. García-Gutiérrez MT, Guillén-Rogel P, Cochrane DJ, Marín PJ. Cross transfer acute effects of foam rolling with vibration on ankle dorsiflexion range of motion. J Musculoskelet Neuronal Interact 2018;18:262–7.
22. Madoni SN, Costa PB, Coburn JW, Galpin AJ. Effects of Foam Rolling on Range of Motion, Peak Torque, Muscle Activation, and the Hamstrings-to-Quadriceps Strength Ratios. J Strength Cond Res 2018;32:1821–30. https://doi.org/10.1519/JSC.0000000000002468.
23. Grabow L, Young JD, Alcock LR, Quigley PJ, Byrne JM, Granacher U, et al. Higher Quadriceps Roller Massage Forces Do Not Amplify Range-of-Motion Increases nor Impair Strength and Jump Performance. J Strength Cond Res 2018;32:3059–69. https://doi.org/10.1519/JSC.0000000000001906.
24. Sykaras E. Effects of manual massage on peak torque following an exercise-induced muscle damage protocol of knee extensors in male elite Tae Kwon Do athletes. International Journal of Physical Education, Sports and Health 2017;4:196–9.

25. Peacock CA, Krein DD, Silver TA, Sanders GJ, VON Carlowitz K-PA. An Acute Bout of Self-Myofascial Release in the Form of Foam Rolling Improves Performance Testing. Int J Exerc Sci 2014;7:202–11.
26. Halperin I, Aboodarda SJ, Button DC, Andersen LL, Behm DG. Roller massager improves range of motion of plantar flexor muscles without subsequent decreases in force parameters. Int J Sports Phys Ther 2014;9:92–102.
27. Hiruma E, Umimura M, Naito H, Katamoto S. Effects of massage and compression treatment on performance in three consecutive days. Medical Express 2014;1. https://doi.org/10.5935/MedicalExpress.2014.06.07.
28. Kargarfard M, Lam ETC, Shariat A, Shaw I, Shaw BS, Tamrin SBM. Efficacy of massage on muscle soreness, perceived recovery, physiological restoration and physical performance in male bodybuilders. J Sports Sci 2016;34:959–65. https://doi.org/10.1080/02640414.2015.1081264.
29. Molouki A, Hosseini SM, Rustaee M, Tabatabaee SM. The Immediate Effects of Manual Massage of Forearm on Power-Grip Strength and Endurance in Healthy Young Men. J Chiropr Med 2016;15:112–20. https://doi.org/10.1016/j.jcm.2016.02.013.
30. Romero-Moraleda B, González-García J, Cuéllar-Rayo Á, Balsalobre-Fernández C, Muñoz-García D, Morencos E. Effects of Vibration and Non-Vibration Foam Rolling on Recovery after Exercise with Induced Muscle Damage. J Sports Sci Med 2019;18:172–80.
31. Macgregor LJ, Fairweather MM, Bennett RM, Hunter AM. The Effect of Foam Rolling for Three Consecutive Days on Muscular Efficiency and Range of Motion. Sports Med Open 2018;4:26. https://doi.org/10.1186/s40798-018-0141-4.
32. Lee C-L, Chu I-H, Lyu B-J, Chang W-D, Chang N-J. Comparison of vibration rolling, nonvibration rolling, and static stretching as a warm-up exercise on flexibility, joint proprioception, muscle strength, and balance in young adults. J Sports Sci 2018;36:2575–82. https://doi.org/10.1080/02640414.2018.1469848.
33. Willems MET, Hale T, Wilkinson CS. Effects of Manual Massage on Muscle-Specific Soreness and Single Leg Jump Performance After Downhill Treadmill Walking. Medicina Sportiva 2009;13:61–6. https://doi.org/10.2478/v10036-009-0011-8.
34. Su H, Chang N-J, Wu W-L, Guo L-Y, Chu I-H. Acute Effects of Foam Rolling, Static Stretching, and Dynamic Stretching During Warm-ups on Muscular Flexibility and Strength in Young Adults. J Sport Rehabil 2017;26:469–77. https://doi.org/10.1123/jsr.2016-0102.
35. Giovanelli N, Vaccari F, Floreani M, Rejc E, Copetti J, Garra M, et al. Short-Term Effects of Rolling Massage on Energy Cost of Running and Power of the Lower Limbs. Int J Sports Physiol Perform 2018;13:1337–43. https://doi.org/10.1123/ijspp.2018-0142.
36. Naderi A, Rezvani MH, Degens H. Foam Rolling and Muscle and Joint Proprioception After Exercise-Induced Muscle Damage. J Athl Train 2020;55:58–64. https://doi.org/10.4085/1062-6050-459-18.
37. Rey E, Padrón-Cabo A, Costa PB, Barcala-Furelos R. Effects of Foam Rolling as a Recovery Tool in Professional Soccer Players. J Strength Cond Res 2019;33:2194–201. https://doi.org/10.1519/JSC.0000000000002277.
38. Jo E, Juache G, Saralegui D, Weng D, Falatoonzadeh S. The Acute Effects of Foam Rolling on Fatigue-Related Impairments of Muscular Performance. Sports 2018;6:112. https://doi.org/10.3390/sports6040112.
39. Delextrat A, Calleja-González J, Hippocrate A, Clarke ND. Effects of sports massage and intermittent cold-water immersion on recovery from matches by basketball players. J Sports Sci 2013;31:11–9. https://doi.org/10.1080/02640414.2012.719241.
40. Pearcey GEP, Bradbury-Squires DJ, Kawamoto J-E, Drinkwater EJ, Behm DG, Button DC. Foam rolling for delayed-onset muscle soreness and recovery of dynamic performance measures. J Athl Train 2015;50:5–13. https://doi.org/10.4085/1062-6050-50.1.01.
41. Monedero J, Donne. Effect of Recovery Interventions on Lactate Removal and Subsequent Performance. Int J Sports Med 2000;21:593–7. https://doi.org/10.1055/s-2000-8488.
42. Rinder AN, Sutherland CJ. An investigation of the effects of massage on quadriceps performance after exercise fatigue. Complement Ther Nurs Midwifery 1995;1:99–102. https://doi.org/10.1016/S1353-6117(05)80048-4.
43. R. Ali N.F. HSD. Formulation and Stability of Bedda Lotong Body Scrub Preparations with Variation of Triethanolamine Concentration Media Farmasi. Jurnal Farmasi Indonesia 2019;7:16–24. https://doi.org/https://doi.org/10.32382/mf.v15i1.852.
44. SMITH JC, WASHELL BR, AINI MF, BROWN S, HALL MC. Effects of Static Stretching and Foam Rolling on Ankle Dorsiflexion Range of Motion. Med Sci Sports Exerc 2019;51:1752–8. https://doi.org/10.1249/MSS.0000000000001964.
45. Junker DH, Stöggl TL. The Foam Roll as a Tool to Improve Hamstring Flexibility. J Strength Cond Res 2015;29:3480–5. https://doi.org/10.1519/JSC.0000000000001007.
46. Lin W-C, Lee C-L, Chang N-J. Acute Effects of Dynamic Stretching Followed by Vibration Foam Rolling on Sports Performance of Badminton Athletes. J Sports Sci Med 2020;19:420–8.
47. Mohr AR, Long BC, Goad CL. Effect of Foam Rolling and Static Stretching on Passive Hip-Flexion Range of Motion. J Sport Rehabil 2014;23:296–9. https://doi.org/10.1123/JSR.2013-0025.
48. Markovic G. Acute effects of instrument assisted soft tissue mobilization vs. foam rolling on knee and hip range of motion in soccer players. J Bodyw Mov Ther 2015;19:690–6. https://doi.org/10.1016/j.jbmt.2015.04.010.
49. Škarabot J, Beardsley C, Štirn I. Comparing the effects of self-myofascial release with static stretching on ankle range-of-motion in adolescent athletes. Int J Sports Phys Ther 2015;10:203–12.
50. Kelly S, Beardsley C. Specific and Cross-Over Effects of Foam Rolling on Ankle Dorsiflexion Range of Motion. Int J Sports Phys Ther 2016;11:544–51.
51. Hall M, Chadwick Smith J. The Effects of an Acute Bout of Foam Rolling on Hip Range of Motion on Different Tissues. Int J Sports Phys Ther 2018;13:652–60.
52. Guillot A, Kerautret Y, Queyrel F, Schobb W, Di Rienzo F. Foam Rolling and Joint Distraction with Elastic Band Training Performed for 5-7 Weeks Respectively Improve Lower Limb Flexibility. J Sports Sci Med 2019;18:160–71.
53. Vigotsky AD, Lehman GJ, Contreras B, Beardsley C, Chung B, Feser EH. Acute effects of anterior thigh foam rolling on hip angle, knee angle, and rectus femoris length in the modified Thomas test. PeerJ 2015;3:e1281. https://doi.org/10.7717/peerj.1281.
54. Murray AM, Jones TW, Horobeanu C, Turner AP, Sproule J. Sixty Seconds of Foam Rolling Does Not Affect Functional Flexibility or Change Muscle Temperature in Adolescent Athletes. Int J Sports Phys Ther 2016;11:765–76.
55. Rodenburg J, Steenbeek D, Schiereck P, Bär P. Warm-up, Stretching and Massage Diminish Harmful Effects of Eccentric Exercise. Int J Sports Med 1994;15:414–9. https://doi.org/10.1055/s-2007-1021080.
56. Pinar S, Bicer B, Kaya F, Erzeybek M, Cotuk H. Different Recovery Methods and Muscle Performance After Exhausting Exercise: Comparison of The Effects of Electrical Muscle Stimulation and Massage. Biol Sport 2012;29:23–9. https://doi.org/10.5604/20831862.1019664.
57. Gupta S, Goswami A, Sadhukhan A, Mathur D. Comparative Study of Lactate Removal in Short Term Massage of Extremities, Active Recovery and a Passive Recovery Period After Supramaximal Exercise Sessions. Int J Sports Med 1996;17:106–10. https://doi.org/10.1055/s-2007-972816.
58. Martin NA, Zoeller RF, Robertson RJ, Lephart SM. The comparative effects of sports massage, active recovery, and rest in promoting blood lactate clearance after supramaximal leg exercise. J Athl Train 1998;33:30–5.
59. Hemmings B. Effects of massage on physiological restoration, perceived recovery, and repeated sports performance. Br J Sports Med 2000;34:109–14. https://doi.org/10.1136/bjsm.34.2.109.
60. Robertson A, Watt JM, Galloway SDR. Effects of leg massage on recovery from high intensity cycling exercise. Br J Sports Med 2004;38:173–6. https://doi.org/10.1136/bjsm.2002.003186.
61. Cè E, Limonta E, Maggioni MA, Rampichini S, Veicsteinas A, Esposito F. Stretching and deep and superficial massage do not influence blood lactate levels after heavy-intensity cycle exercise. J Sports Sci 2013;31:856–66. https://doi.org/10.1080/02640414.2012.753158.
62. Hotfiel T, Swoboda B, Krinner S, Grim C, Engelhardt M, Uder M, et al. Acute Effects of Lateral Thigh Foam Rolling on Arterial Tissue Perfusion Determined by Spectral Doppler and Power Doppler Ultrasound. J Strength Cond Res 2017;31:893–900. https://doi.org/10.1519/JSC.0000000000001641.

doi.org/10.56984/8ZG2EF8b3T

63. Wiltshire EV, Poitras V, Pak M, Hong T, Rayner J, Tschakovsky ME. Massage Impairs Postexercise Muscle Blood Flow and “Lactic Acid” Removal. Med Sci Sports Exerc 2010;42:1062–71. https://doi.org/10.1249/MSS.0b013e3181c9214f.
64. Mori H, Ohsawa H, Tanaka TH, Taniwaki E, Leisman G, Nishijo K. Effect of massage on blood flow and muscle fatigue following isometric lumbar exercise. Med Sci Monit 2004;10:CR173-8.
65. Hinds T, Mcewan I, Perkes J, Dawson E, Ball D, George K. Effects of Massage on Limb and Skin Blood Flow after Quadriceps Exercise. Med Sci Sports Exerc 2004;36:1308–13. https://doi.org/10.1249/01.MSS.0000135789.47716.DB.
66. Imtiyaz S, Veqar Z, Shareef MY. To Compare the Effect of Vibration Therapy and Massage in Prevention of Delayed Onset Muscle Soreness (DOMS). JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH 2014. https://doi.org/10.7860/JCDR/2014/7294.3971.
67. Zainuddin Z, Newton M, Sacco P, Nosaka K. Effects of massage on delayed-onset muscle soreness, swelling, and recovery of muscle function. J Athl Train 2005;40:174–80.
68. Arkko P, Pakarinen A, Kari-Koskinen O. Effects of Whole Body Massage on Serum Protein, Electrolyte and Hormone Concentrations, Enzyme Activities, and Hematological Parameters. Int J Sports Med 1983;04:265–7. https://doi.org/10.1055/s-2008-1026047.
69. Jakeman JR, Byrne C, Eston RG. Efficacy of Lower Limb Compression and Combined Treatment of Manual Massage and Lower Limb Compression on Symptoms of Exercise-Induced Muscle Damage in Women. J Strength Cond Res 2010;24:3157–65. https://doi.org/10.1519/JSC.0b013e3181e4f80c.
70. Bushell JE, Dawson SM, Webster MM. Clinical Relevance of Foam Rolling on Hip Extension Angle in a Functional Lunge Position. J Strength Cond Res 2015;29:2397–403. https://doi.org/10.1519/JSC.0000000000000888.
71. Andersen LL, Jay K, Andersen CH, Jakobsen MD, Sundstrup E, Topp R, et al. Acute Effects of Massage or Active Exercise in Relieving Muscle Soreness. J Strength Cond Res 2013;27:3352–9. https://doi.org/10.1519/JSC.0b013e3182908610.
72. Han J-H, Kim M-J, Yang H-J, Lee Y-J, Sung Y-H. Effects of therapeutic massage on gait and pain after delayed onset muscle soreness. J Exerc Rehabil 2014;10:136–40. https://doi.org/10.12965/jer.140106.
73. Jay K, Sundstrup E, Søndergaard SD, Behm D, Brandt M, Særvoll CA, et al. Specific and cross over effects of massage for muscle soreness: randomized controlled trial. Int J Sports Phys Ther 2014;9:82–91.
74. Visconti L, Capra G, Carta G, Forni C, Janin D. Effect of massage on DOMS in ultramarathon runners: A pilot study. J Bodyw Mov Ther 2015;19:458–63. https://doi.org/10.1016/j.jbmt.2014.11.008.
75. Heapy AM, Hoffman MD, Verhagen HH, Thompson SW, Dhamija P, Sandford FJ, et al. A randomized controlled trial of manual therapy and pneumatic compression for recovery from prolonged running – an extended study. Research in Sports Medicine 2018;26:354–64. https://doi.org/10.1080/15438627.2018.1447469.
76. Halperin I, Aboodarda SJ, Button DC, Andersen LL, Behm DG. Roller massager improves range of motion of plantar flexor muscles without subsequent decreases in force parameters. Int J Sports Phys Ther 2014;9:92–102.
77. Barlow A, Clarke R, Johnson N, Seabourne B, Thomas D, Gal J. Effect of Massage of the Hamstring Muscles on Selected Electromyographic Characteristics of Biceps Femoris during Sub-maximal Isometric Contraction. Int J Sports Med 2007;28:253–6. https://doi.org/10.1055/s-2006-924295.
78. Killen BS, Zelizney KL, Ye X. Crossover Effects of Unilateral Static Stretching and Foam Rolling on Contralateral Hamstring Flexibility and Strength. J Sport Rehabil 2019;28:533–9. https://doi.org/10.1123/jsr.2017-0356.
79. Tanaka TH, Leisman G, Mori H, Nishijo K. The effect of massage on localized lumbar muscle fatigue. BMC Complement Altern Med 2002;2:9. https://doi.org/10.1186/1472-6882-2-9.
80. Cavanaugh MT, Aboodarda SJ, Hodgson DD, Behm DG. Foam Rolling of Quadriceps Decreases Biceps Femoris Activation. J Strength Cond Res 2017;31:2238–45. https://doi.org/10.1519/JSC.0000000000001625.
81. Aboodarda SJ, Greene RM, Philpott DT, Jaswal RS, Millet GY, Behm DG. The effect of rolling massage on the excitability of the corticospinal pathway. Applied Physiology, Nutrition, and Metabolism 2018;43:317–23. https://doi.org/10.1139/apnm-2017-0408.
82. Madoni SN, Costa PB, Coburn JW, Galpin AJ. Effects of Foam Rolling on Range of Motion, Peak Torque, Muscle Activation, and the Hamstrings-to-Quadriceps Strength Ratios. J Strength Cond Res 2018;32:1821–30. https://doi.org/10.1519/JSC.0000000000002468.
83. Behm DG, Peach A, Maddigan M, Aboodarda SJ, DiSanto MC, Button DC, et al. Massage and stretching reduce spinal reflex excitability without affecting twitch contractile properties. Journal of Electromyography and Kinesiology 2013;23:1215–21. https://doi.org/10.1016/j.jelekin.2013.05.002.
84. Young JD, Spence A-J, Behm DG. Roller massage decreases spinal excitability to the soleus. J Appl Physiol 2018;124:950–9. https://doi.org/10.1152/japplphysiol.00732.2017.
85. Weinberg R, Jackson A, Kolodny K. The Relationship of Massage and Exercise to Mood Enhancement. Sport Psychol 1988;2:202–11. https://doi.org/10.1123/tsp.2.3.202.
86. Leivadi S, Hernandez-Reif M, Field T, O’rourke MA, Arienzo SD’, Lewis D, et al. Massage Therapy and Relaxation Effects on University Dance Students. Journal of Dance Medicine & Science 1999;3:108–12.
87. Zadkhosh SM. The effect of massage therapy on depression, anxiety and stress in adolescent wrestlers. International Journal of Sport Studies 2015;5:321–7.
88. Wilczyńska D, Łysak-Radomska A, Podczarska-Głowacka M, Zajt J, Dornowski M, Skonieczny P. Evaluation of the effectiveness of relaxation in lowering the level of anxiety in young adults – a pilot study. Int J Occup Med Environ Health 2019;32:817–24. https://doi.org/10.13075/ijomeh.1896.01457.
89. Wiewelhove T, Schneider C, Döweling A, Hanakam F, Rasche C, Meyer T, et al. Effects of different recovery strategies following a half-marathon on fatigue markers in recreational runners. PLoS One 2018;13:e0207313. https://doi.org/10.1371/journal.pone.0207313.
90. Szabo A, Velenczei A, Kovács Á. Psychological Effects of Massage on Running. J Soc Behav Health Sci 2008;2:1–7. https://doi.org/10.5590/JSBHS.2008.02.1.01.
91. Nunes GS, Bender PU, de Menezes FS, Yamashitafuji I, Vargas VZ, Wageck B. Massage therapy decreases pain and perceived fatigue after long-distance Ironman triathlon: a randomised trial. J Physiother 2016;62:83–7. https://doi.org/10.1016/j.jphys.2016.02.009.
92. Monteiro ER, Neto VGC. Effect of Different Foam Rolling Volumes on Knee Extension Fatigue. Int J Sports Phys Ther 2016;11:1076–81.
93. Ogai R, Yamane M, Matsumoto T, Kosaka M. Effects of petrissage massage on fatigue and exercise performance following intensive cycle pedalling. Br J Sports Med 2008;42:534–8. https://doi.org/10.1136/bjsm.2007.044396.
94. Micklewright D, Griffin M, Gladwell V, Beneke R. Mood State Response to Massage and Subsequent Exercise Performance. Sport Psychol 2005;19:234–50. https://doi.org/10.1123/tsp.19.3.234.
95. Killen BS, Zelizney KL, Ye X. Crossover Effects of Unilateral Static Stretching and Foam Rolling on Contralateral Hamstring Flexibility and Strength. J Sport Rehabil 2019;28:533–9. https://doi.org/10.1123/jsr.2017-0356.
96. Young JD, Spence A-J, Behm DG. Roller massage decreases spinal excitability to the soleus. J Appl Physiol 2018;124:950–9. https://doi.org/10.1152/japplphysiol.00732.2017.
97. Oranchuk DJ, Flattery MR, Robinson TL. Superficial heat administration and foam rolling increase hamstring flexibility acutely; with amplifying effects. Physical Therapy in Sport 2019;40:213–7. https://doi.org/10.1016/j.ptsp.2019.10.004.
98. Aboodarda SJ, Greene RM, Philpott DT, Jaswal RS, Millet GY, Behm DG. The effect of rolling massage on the excitability of the corticospinal pathway. Applied Physiology, Nutrition, and Metabolism 2018;43:317–23. https://doi.org/10.1139/apnm-2017-0408.
99. Behm DG, Peach A, Maddigan M, Aboodarda SJ, DiSanto MC, Button DC, et al. Massage and stretching reduce spinal reflex excitability without affecting twitch contractile properties. Journal of Electromyography and Kinesiology 2013;23:1215–21. https://doi.org/10.1016/j.jelekin.2013.05.002.
100. Dakić M, Toskić L, Ilić V, Đurić S, Dopsaj M, Šimenko J. The Effects of Massage Therapy on Sport and Exercise Performance: A Systematic Review. Sports (Basel) 2023; 11(6):1-15. doi: 10.3390/sports11060110