Deep Tissue Massage Therapy: Effects on Muscle Recovery and Performance in Athletes

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Background: Deep tissue massage has been used in sports for improving performance and recovery on deep muscle layers. This study looks at its effectiveness across different sports, performance, and recovery.

Purpose: To assess the effect of deep tissue massage on muscle recovery and performance improvement across different sports, teams, strength, endurance, and individual sports.

Methods: A randomized controlled trial design was used, and 150 athletes aged 18–45 years received bi-weekly 40-min deep tissue massage for 8 weeks. Performance improvement, muscle recovery, and flexibility were measured with objective and subjective assessments. Chi-square tests, analysis of variance, and Tukey's post hoc tests were used for statistical analysis.

Results: Team and strength athletes in this study showed the greatest performance improvement, in contrast to individual and endurance athletes ($F = 6.61$, $p = 0.004$). Bi-weekly massage sessions showed better recovery outcomes ($\chi^2 = 9.41$, $p = 0.0243$). Longer massage sessions showed increased flexibility ($\chi^2 = 19.77$, $p < 0.001$). Gender differences were found in perceived effectiveness of massage ($\chi^2 = 9.46$, $p = 0.024$). Also, the intervention showed improvement in muscle strength and flexibility, especially in the lumbar region, knee, and shoulder, focusing on the effects of the massage protocol in joint mobility and muscle function.

Conclusion: Deep tissue massage therapy improves athletic performance and muscle recovery, especially for team and strength sports. With regular and continuous massage sessions, flexibility and recovery are improved among athletes.

KEYWORDS: Deep tissue massage; muscle recovery; athletic performance; flexibility; sports rehabilitation

INTRODUCTION

Deep tissue massage therapy became very popular among athletes and professionals with focus on its effects for improving performance and recovery.[1] Unlike other forms of massage, deep tissue massage targets the deeper layers of muscle tissue and connective fascia.[2] By applying pressure and slow intentional strokes, this technique works on areas of chronic tension, trigger points, and adhesions that are common in athletes due to repetitive movements, overworked muscles, and intense physical activity.[3] By addressing these basic muscle issues, this massage therapy aims to reduce pain and muscle stiffness, and promote a faster recovery process making it the predominant choice among athletic training and various rehabilitation programs.[4]

Deep tissue massage therapy is the applying of mechanical pressure affecting muscle fibers and connective tissues.[5] This pressure stimulates mechanoreceptors, signaling the central nervous system to release neurotransmitters such as serotonin and dopamine for promoting relaxation.[6] The pressure in deep tissue massage helps in the improvement of muscle fibers and the disintegration of adhesions and scar tissue.[7] With this, normal muscle function can be restored, including reduction in muscle stiffness and improvement in blood and lymphatic circulation[8] easingthe removal of metabolic waste products,[9] reducing inflammation, and stimulating the delivery of oxygen

and nutrients for cellular repair.[10] This general effect contributes to reduced pain and improved muscle recovery, making the massage a strong addition to athletic rehabilitation protocols.[11]

Whether participating in team sports, endurance events, or strength events, the physical demands often result in wear and tear on muscles.[12] Muscle fatigue, microtears, and delayed-onset muscle soreness can push the body to its limits which can impair performance and increase the recovery time.[13] While traditional recovery methods like rest, ice, stretching, and proper nutrition are often used to treat these symptoms, they may not always provide the relief needed to maintain peak performance levels.[14] In this situations, deep tissue massage has been shown to be a complementary approach that can provide relaxation and recovery.[15]

The benefits of deep tissue massage therapy are more than relaxation and relief. Many athletes suggest that this form of massage can contribute to muscle recovery, stimulating faster healing and reducing inflammation.[16] By stimulating blood flow and improving lymphatic drainage, this massage helps to clear metabolic waste products like lactic acid in muscles after intense exercise.[17] This improved circulation aids in the removal of these waste products and delivers nutrients and oxygen to the muscle tissue, helping repair and regeneration processes.[5]

Another important aspect of deep tissue massage is its potential to reduce pain and improve general well-being in athletes. The ability to release tension and pressure in muscles can cause reduction in pain accredited to the stimulation of the natural painkillers such as endorphins.[18] This massage can improve chest expandability and vital capacity with potential benefits for respiratory function.[19] The improved flexibility and range of motion (ROM) resulting from the effects of deep tissue massage can help prevent future injuries by keeping muscle elasticity and joint health.[20]

As the competitive perspective of sports continues to develop, the search for advanced recovery techniques that can provide athletes with a higher performance has become more critical than ever.[21] Deep tissue massage with its approach to muscles and its recovery presents a possibility for optimizing athletic performance.[22] The ability to not only address the symptoms of muscle overuse and strain but also to improve general muscle health and resilience makes it an important component of comprehensive athletic training and rehabilitation programs.[23,24]

METHODOLOGY

Study Design

This study used a randomized controlled trial design to evaluate the effectiveness of deep tissue massage on muscle recovery and sports performance. The study followed a pretest–posttest model in which participants were randomly assigned and assessed before and after the intervention. The primary objective was to determine whether massage affects recovery parameters and overall sports performance. Follow-up assessments were conducted to evaluate the long-term effects of the intervention.

Participants

One hundred and fifty athletes aged between 18 and 45 years participated in the study, with a balanced distribution of male (54.7%) and female (45.3%) participants. The majority of participants were between 25 and 34 years old, accounting for 47.3% of the sample, followed by the 18-to-24 age group at 24%, the 35-to-44 age group at 19.3%, and the 45+ age group at 9.3%. Athletes participated in a variety of sports, with team sports (38%) and strength sports (25.3%) making up the largest portion. Individual sports and endurance sports accounted for 20.7% and 16% of participants, respectively. Basic characteristics such as history of previous injuries were excluded to ensure a focus on active, healthy athletes.

Inclusion criteria for this study were athletes between 18 and 45 years old, with participation in competitive or semi-professional sports, at least three times a week, no injuries in the past 6 months, and willingness to the intervention schedule and to attend to all of the massage appointments.

Exclusion criteria for this study were history of recent surgeries or injuries (including fractures or ligament tears) within the past 12 months, and presence of systemic diseases such as cardiovascular

conditions and neurological disorders that may potentially interfere with deep tissue massage. Also, the usage of regular pain medications and any known allergies or skin conditions that would prevent the application of massage oils were assigned as exclusion criteria.

Randomization

Participants were randomly assigned to one of four groups (massage therapy, control, or other treatments if applicable) using a computer-generated random sequence. Randomization was performed by sport to ensure balanced representation of team sports, individual sports, strength sports, and endurance sports in each group. Randomization was performed by an independent researcher who was not involved in the evaluation or treatment of the participants.

Interventions

Massage intervention

The deep tissue massage sessions were performed by a certified massage therapist with more than 5 years of experience in massage. Each session lasted 40 min and was conducted in the home environment of the athletes in Skopje, North Macedonia to create a comfortable and familiar environment. The intervention was conducted twice per week for 8 weeks with a total of 16 massage interventions per athlete. The massage method was standardized according to a set protocol. To warm up the muscles, the session started on the back with effleurage strokes. Next, deeper elbow movements that targeted the scapular region were used and special focus was given to the erector spinae muscle and rhomboidei to relieve stress. On the back of the legs, especially m. gastrocnemius and the hamstrings received a deep friction massage with an emphasis on muscle healing and improving blood circulation in these regions. To relieve tension and increase flexibility, targeted deep pressure using kneading and friction techniques on m. quadriceps femoris was utilized. To ensure total relaxation and healing in the upper body, m. pectoralis major and m. deltoideus were massaged during the last part of the massage therapy. Every participant received the same massage protocol. This was implemented to maintain consistency.

Specifics of the massage protocol

The massage therapist began by warming up the back with effleurage strokes, then used the hypothenar and thenar eminences to work slowly and rhythmically in the direction of the head. The scapular region and the upper trapezius muscle received particular attention. The upper back was then subjected to severe friction and vibration techniques with the thumbs. The forearm would go from the lumbar area upward toward the scapula, progressively flexing as it reached the upper trapezius, where the forearm and upper arm joined. This unique action was used to apply forearm pressure to the lower back.

After that, the massage moved on to the back of the legs, starting with long strokes that went all the way down the thigh. Sitting on the massage table with the athletes' legs flexed and foot resting on the therapist's shoulder, the therapist used deep transverse movements and fast friction techniques to target the hamstrings and gastrocnemius. Using a bridge-like hand formation and upward strokes from the patella, the therapist repeated the process on the quadriceps femoris with the athletes lying supine. Additionally, vibrations and thumb pressure were used to target particular quadriceps spots. The upper limb was positioned at a 90-degree angle at the shoulder and elbow. After making deliberate techniques among the arm, the therapist supported the athlete's arm on the shoulder to make bilateral kneading from the distal end toward the shoulder.

Practitioner information

The certified physiotherapist who performed the massages had a master's degree in special education and rehabilitation of motor impairments and was a specialist in rehabilitation in orthopedic surgery and traumatology conditions. He has worked as a massage therapist and physiotherapist for more than 10 years. Additionally, the physiotherapist had 5 years of experience working in a sports center, where he massaged athletes who played handball, basketball, volleyball, tennis, and football. Furthermore, the physiotherapist at the University Clinic of Rheumatology in Macedonia completed the national professional exam for physical therapists.

Methods of Measurement

Principal outcome measures

Throughout the intervention, measurements were made several times to guarantee precise tracking of the changes. Before the 8-week intervention began, measurements were taken. To assess short-term effects, follow-up assessments were taken right after each session and on the very first start before the next session. At the end of the 8-week period and 1 week following the final session, final evaluations were carried out to look for any persisting effects.

Sport-specific performance tests (such as sprint timings for team sports and endurance metrics for individual sports) and subjective performance evaluations were used to assess performance improvement. A 5-point Likert scale was used to judge performance both before and after the intervention (from no improvement to significant improvement). Both quantitative data like recovery durations between training sessions and subjective evaluations of muscle soreness were measured using the visual analog scale (VAS) for muscle soreness. Additionally, a goniometer was used to quantify ROM, evaluating gains in join flexibility (hip flexion and knee extension) before and after the intervention.

A 100-m track was used to test sprint performance, and electronic sensors were used to record timing to guarantee accuracy. A calibrated treadmill was used to measure endurance, giving objective information on the athlete's capacity for both cardiovascular and muscular endurance for their muscle strengthening workouts in the gym. A goniometer was used to test flexibility, with an emphasis on joint ROM for the main muscle groups impacted by the massage treatments.

A goniometer was used to measure flexibility and tests were regularly performed on each subject before to their second massage session. Athletes who only attended a single massage session were not measured. Goniometer measurements tracked ROM gains by focusing on important joints, such as the knee, shoulder, elbow, and lumbar mobility. The manual muscle testing (MMT) was used to measure the strength of muscle groups in addition to flexibility evaluations. The hamstrings, quadriceps femoris, trapezius, and biceps brachii were all subjected to MMT in order to give a thorough examination of muscle function and reaction to the massage intervention.

To guarantee consistent data gathering, measurements were made at regular intervals. Baseline measurements were conducted before the start of the intervention. Prior to beginning the interventions, baseline assessments were carried out. To track gradual changes, follow-up measurements were obtained right before the second weekly massage session. Because of the standardized evaluation window made possible by this schedule, all measurements were guaranteed to show a constant level of recovery following massage therapy. In order to evaluate the short-term recovery impacts, measurements were also taken 24 h following particular critical sessions for participants who received numerous sessions.

Measures of secondary outcomes

To determine whether deep tissue massage decreased athletes' risk of injury, a self-reported injury log was kept during the study period. After every session, athletes evaluated how rested and recovered they felt by rating their overall recovery experience on a 10-point scale.

Reliability and Validity

To minimize bias, all evaluations were carried out by a qualified physiotherapist who was blinded to the intervention groups. Assessments of pain and flexibility were conducted with standardized measurement instruments, such as VAS and goniometers. During the pilot phase, many performance test measures were used to guarantee test–retest dependability.

Statistical Analysis

By concentrating on group differences and correlations between important variables, statistical analysis in this study was created to assess the impact of deep tissue massage therapy on sports performance and muscle recovery. The recovery measures and thegeneral characteristics of the participants. For important factors such as performance improvement, muscle discomfort, flexibility improvement, and injury risk reduction mean, standard deviation, and ranges were calculated. These descriptive statistics found any possible anomalies or patterns in the data and gave a preliminary picture of the sample distribution. The

relationships between category variables were found using the chi-square test, including gender and perceived effects for determining any significant differences between males' and females' assessments of the effectiveness of deep tissue massage in comparison to alternative healing techniques. The chi-square test was also implemented for frequency versus results of recovery for determining if the frequency of deep tissue massage was linked to particular recovery outcomes.

Finding correlations between variables and determining the statistical significance of observed recovery differences were made possible thanks to the chi-square tests. The main statistics for comparing recovery and performance improvement outcome across several groups was one-way analysis of variance (ANOVA). Sport type and performance improvement were the main subjects of the ANOVA experiments. This analysis examined whether getting deep tissue massage resulted in significantly different degrees of performance improvement for athletes participating in the study. Post hoc Tukey's honestly significance difference (HSD) tests were used to identify which specific groups differed significantly from the mean when significant differences were found.

The significance level for all analyses was set at $p < 0.05$ and SPSS version 25 was used for all statistical tests. The study used chi-square tests and ANOVA to examine the relationships between the type of sport, gender, massage frequency, and recovery metrics, such as performance improvement and flexibility. These statistical methods were important for identifying the effects of deep tissue massage on athletic recovery and performance. The inclusion of post hoc tests revealed which groups benefited the most from the therapy.

Ethical Considerations

Informed consent was obtained from all participants, and they were assured of confidentiality. Participants were free to withdraw from the study at any time without penalty.

Limitations

The study acknowledges that conducting massage therapy within the athletes' homes may introduce environmental variability. Additionally, the use of self-reported recovery metrics may introduce some bias in the assessment of perceived recovery benefits.

RESULTS

Figure 1 shows the distribution of participants in four age groups. The group aged 25–34 had the highest representation with 47.3% of the total participants. Next, the 18-to-24 age group was 24% of all the participants, and the 35-to-44 age group was 19.3%. The least represented group was participants aged 45 years and above (9.3%).

The gender distribution of the 150 participants included in the study is shown in Table 1. The sample was composed of 54.7% (n = 82) males and 45.3% (n = 68) females. With a standard deviation of approximately 9.9, the mean number of participants for both genders was 75, indicating the range in participant counts. Although there was a modest preponderance of male participants, the percentage distribution showed a fairly balanced gender representation with a standard deviation of 6.6%. A representative sample for evaluating results

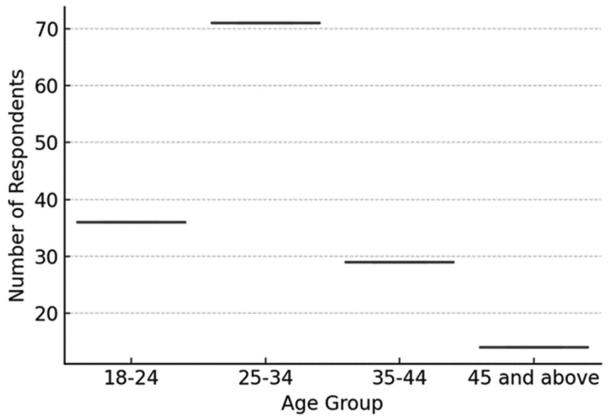

Figure 1. Distribution of respondents by age.

Table 1. Gender Distribution Between Participants

Gender	*Respondents*	*Percentage*
Male	82	54.7%
Female	68	45.3%
Mean	75	50.0%
Standard deviation	9.9	6.6%

without notable gender disparity is suggested by this balance.

Table 2 displays the distribution of participants according to the sport the participants play. Out of 150 participants, the highest representation is from team sports, with 38% (n = 57). Strength sport comes next, accounting for 25.3% (n = 38) of the sample. Individual sports are represented by 20.7% (n = 31), while endurance sports have the lowest representation at 16% (n = 24). With a standard deviation of almost 13, and an average of 37.5 participants across all sport categories, there appears to be a significant variation in participation between sports.

By comparing observed counts to the expected counts under the premise of equal distribution across all categories, Table 3 shows the distribution of participants according to how frequently they receive deep tissue massage therapy. The analysis shows that 27 participants receive weekly sessions, which is lower than the expected 37.5. In contrast, 62 participants reported bi-weekly sessions exceeding the expected 37.5. The number of participants receiving monthly massages (33) aligns more closely with the expected count of 37.5, while 28 participants underwent occasional massages, slightly below the expected value. The chi-square test result ($\chi^2 = 9.41$, $p = 0.0243$) indicates statistically significant differences at the 5% level, which implies that bi-weekly sessions are more common than expected.

The observed and predicted frequencies for the effectiveness of deep tissue massage in comparison to other recovery techniques are shown in Table 4 for both male and female participants. In contrast to the predicted results of 51.25 for men and 33.75 for women, the data show that 45 men and 40 women thought deep tissue massage was more successful than other techniques. In contrast to the projected 20.50 and 13.50, respectively, there were 25 males and 9 females observed in the equally effective category. Notably, compared to the anticipated numbers of 4.22 and 2.78, 7 men and 0 women gave it a worse effectiveness rating. Comparable percentages of both genders expressed uncertainty compared to the predicted levels (5 for each gender). The results of the chi-square test indicate a statistically significant difference in perceived efficacy by gender ($\chi^2 = 9.46$, $p = 0.024$). Deep tissue massage was more likely to be viewed as equally beneficial by men than by women, highlighting gender-specific patterns in views of healing techniques.

The findings of a chi-square test investigating the connection between the length of deep tissue massage and noted increases in flexibility are shown in Figure 2.

TABLE 2. Distribution of Participants by Type of Sport

Type of Sport	*Participants*	*Percentage*
Team sports	57	38.0%
Individual sports	31	20.7%
Strength sports	38	25.3%
Endurance sports	24	16.0%
Mean	37.5	25.0%

TABLE 3. Observed vs. Expected Frequency of Deep Tissue Massage Therapy Usage Among Participants

Frequency of Massage	*Observed Respondents*	*Expected Respondents*
Weekly	27	37.5
Bi-weekly	62	37.5
Monthly	33	37.5
Occasionally	28	37.5

TABLE 4. Gender vs. Perceived Effectiveness of Deep Tissue Massage Compared to Other Recovery Methods

Effectiveness Compared to Other Recovery Methods	*Observed (Male)*	*Observed (Female)*	*Expected (Male)*	*Expected (Female)*
More effective	45	40	51.25	33.75
Equally effective	25	9	20.50	13.50
Less effective	7	0	4.22	2.78
Not sure	5	5	6.03	3.97

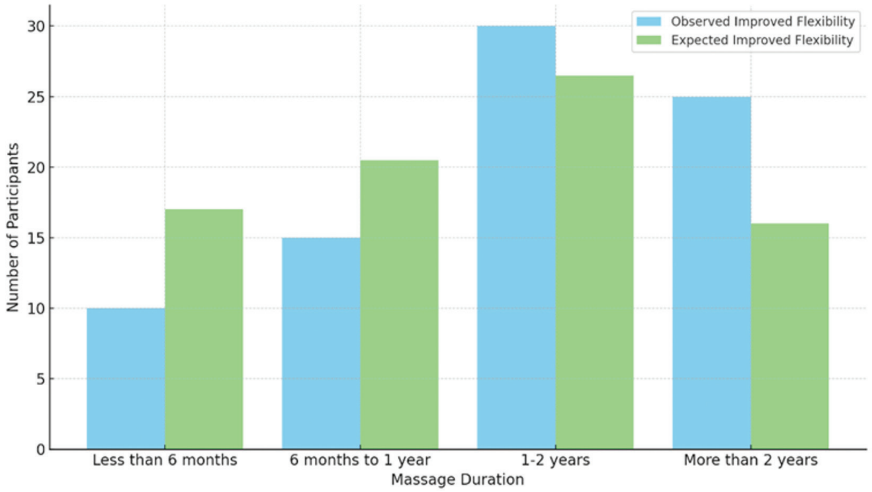

FIGURE 2. Massage duration vs. flexibility improvement.

TABLE 5. Type of Sport vs. Performance Improvement

Type of Sport	*Performance Improvement*
Team sports	25, 30, 35, 40, 28
Individual sports	15, 18, 22, 20, 17
Strength sports	20, 25, 30, 35, 22
Endurance sports	18, 22, 25, 28, 21

A statistically significant connection (χ^2 = 19.77, $p < 0.001$) is revealed by the study. Compared to participants who reported having massage treatment for shorter periods of time (less than 6 months and 6 months to 1 year), those who reported receiving massage therapy for longer periods of time (e.g., 1–2 years and more than 2 years) showed greater rates of improved flexibility. This research highlights the significance of long-term massage therapy in enhancing flexibility outcomes, indicating that prolonged treatment has a greater impact on physical changes.

Table 5 summarizes the performance improvement scores in four categories of sports: team sports, individual sports, strength sports, and endurance sports. The data show that team sports athletes reported the highest range of performance improvements (25–40), followed closely by strength sports athletes with scores between 20 and 35. Individual sports athletes showed lower performance improvements (15–22) and athletes in endurance sports showed improvements between 18 and 28. Deep tissue massage treatment is most beneficial for athletes participating in team sports and strength sports, according to the findings of the ANOVA ($F = 6.61$, $p = 0.004$), which show a statistically significant difference in performance increases across the various sports.

The findings of Tukey's HSD post hoc analysis conducted after the ANOVA assessing the variations in performance improvement among athletes in team, individual, strength, and endurance sports after receiving deep tissue massage therapy are shown in Table 6. According to the table, athletes who participated in team sports had higher performance than those who participated in individual sports—the mean difference was +11.60 ($p = 0.003$). Athletes in team sports showed greater performance gains than those participating in endurance sports, with a mean difference of +8.40 ($p = 0.032$).

Team sports and strength sports did not differ from one another ($p = 0.542$), suggesting that these groups benefited from the massage similarly. Additionally, strength athletes outperformed individual athletes in terms of performance development (mean difference of −8.00, $p = 0.042$). Strength and endurance sports did not differ ($p = 0.348$) indicating similar outcomes. Athletes participating in team and strength sports benefited from the massage treatment the most and athletes participating in endurance and individual sports had more subtle gains in performance.

The distribution of individuals who improved on a variety of muscle strength and flexibility tests after all massage therapy sessions is shown in Figure 3. Data

TABLE 6. Post Hoc Tukey's HSD Test for ANOVA: Type of Sport vs. Performance

Group 1	*Group 2*	*Mean Difference*	*p-value*	*Significance (p < 0.05)*
Team sports	Individual sports	+11.60	0.003	Yes
Team sports	Strength sports	+3.60	0.542	No
Team sports	Endurance sports	+8.40	0.032	Yes
Individual sports	Strength sports	−8.00	0.042	Yes
Individual sports	Endurance sports	−3.20	0.764	No
Strength sports	Endurance sports	+4.80	0.348	No

ANOVA = analysis of variance; HSD = honestly significance difference.

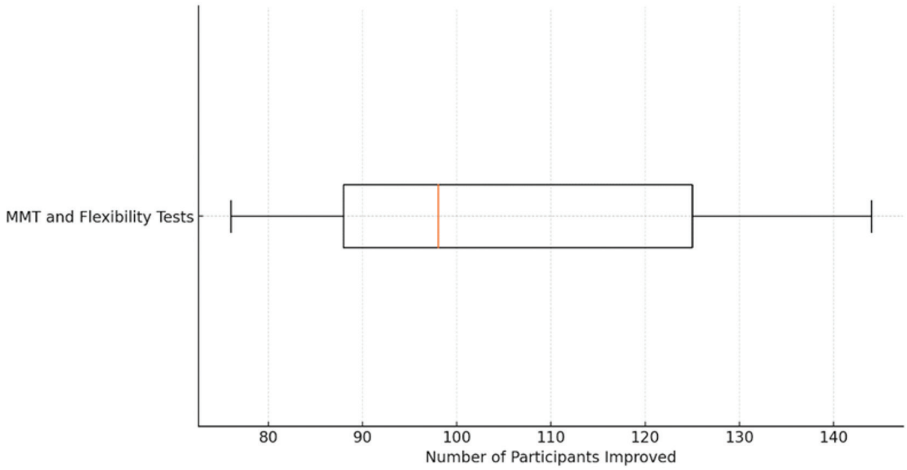

FIGURE 3. Summary of participants' improvements through MMT and goniometry assessment. MMT = manual muscle testing.

from the figure give a summary of changes observed through MMT and goniometric assessments. The median number of individuals demonstrating progress across the various muscle groups and flexibility metrics is graphically shown. With 134 participants showing increased strength through MMT and 144 showing improved motion flexibility, the lumbar region showed the biggest benefit. Knee flexibility (116 participants) and shoulder flexibility (98 participants) also showed gains, suggesting positive effects on joint mobility. The strength of the biceps brachii (82 participants) and the quadriceps (94 participants) showed notable gains, while hamstrings showed improvement in 76 participants.

DISCUSSION

The findings of this study focus on the role of deep tissue massage in improving sports performance and helping muscle recovery. Athletes who participated in team sports and strength sports showed the highest levels of improvement after receiving deep tissue massage. This was confirmed by the ANOVA test. These results give information that athletes in physically demanding and repetitive activities will benefit more from deep tissue massage compared to other sports. In terms of massage frequency, this study showed that bi-weekly sessions were more commonly reported than expected, with 62 participants receiving bi-weekly therapy compared to an expected 37.5 (χ^2 = 9.41, p = 0.0243).

Gender differences also appear in the perceived effectiveness of massage therapy. Males were more likely to rate deep tissue massage as equally effective or less effective, while no females responded that the massage was less effective. The chi-square test (χ^2 = 9.46, p = 0.024) confirmed

significant differences between genders in how they perceive the effects of deep tissue massage. The duration of therapy was associated with flexibility improvement. Participants who received massage therapy for longer periods reported greater improvements in flexibility compared to those with shorter durations of therapy ($\chi^2 = 19.77$, $p < 0.001$).

One systematic review by Gasibat et al.[25] explored the effectiveness of therapeutic massage on muscle recovery, physiological, psychological, and performance metrics in athletes. They found that massage has its benefits when compared to inactive and active controls in some studies, but the results were mixed when compared to other interventions. Massage therapy was effective in some cases but did not always exceeded other alternative therapies. Our research identified the benefits of deep tissue massage therapy, especially in terms of performance improvement and flexibility.

Another study by Srokowska et al.[26] assessed the effects of deep tissue massage therapy on mobility and pain in the thoracic spine for people performing office work. The results showed improvements in spine mobility and chest circumference, as well as a reduction in pain immediately after the therapy ($p < 0.001$), but spinal extension slightly deteriorated after 30 days. Our study primarily focused on athletes and found that deep tissue massage therapy improved performance and flexibility, especially with longer durations of therapy.

The study by Liza et al.[27] investigated the combination of deep tissue massage and stretching in treating lower back pain. The results showed improvements in pain reduction, mobility, and functional performance after 3 weeks of combined therapy, with a p-value of <0.05 indicating a profound effect. This gives information about the effectiveness of integrating massage with stretching exercises in managing low back pain. Our research focused on the impact of deep tissue massage therapy on muscle recovery and performance improvement in athletes. While our study also found benefits, especially in performance and flexibility with longer massage durations, the research by Liza et al. focused on the added value of combining massage with stretching for injury recovery.

Another research by Hassan et al. (2016)[17] on modern pentathletes with plantar fasciitis showed that 15 days of daily 15-min deep friction massage improved both pain levels and endurance performance. Pain scores decreased from an average of 3.5 pre-intervention to 7 post-intervention and endurance measured by the yo-yo intermittent endurance test increased substantially. These results focus on the potential of selected massage therapy as an effective treatment for pain management and performance improvement in athletes facing specific musculoskeletal conditions.

The research by Bhutta et al. (2023)[28] investigated the comparative efficacy of post-facilitation stretch (PFS), post-isometric relaxation, and friction massage for improving hamstring flexibility and general athletic performance. The study included 60 young athletes 18–25 years old and used the YMCA (Young Men Christian Association) sit and reach test, agility run test, vertical jump test, and 100-m run test to assess performance at the 10th day and the 20th day of intervention. Results indicated that PFS was the most effective technique, showing improvements across all tests after the 10th day and outperforming other tests by the 20th day ($p < 0.05$).

Another study by Pitsillides and Stasinopoulos (2019)[29] investigated the practice, beliefs, and guideline compliance among Cypriot physical therapists using deep friction massage. The study found out that 70% of surveyed therapists incorporated deep friction massage into their daily practice. The study provides an understanding of how closely physical therapists align their massage practice with protocols, revealing potential discrepancies and empirical variations in application.

One randomized clinical trial by Noreen et al. (2024)[30] compared the effectiveness of deep neck friction massage and the post-isometric relaxation technique in treating cervicogenic headaches. Over 4 weeks, participants received either deep tissue massage or post-isometric relaxation three times a week. The primary result measure was the Headache Disability Index with secondary outcomes focused on the upper cervical ROM. Results indicated both techniques were effective in reducing symptoms, but deep tissue massage had a larger effect size, showing greater benefits for upper cervical ROM improvement compared to post-isometric relaxation.

Another study by Dabkara et al. (2022)[31] aimed to compare two soft-tissue techniques—Active Release Technique and deep tissue massage—in the management of chronic lateral epicondylitis. This condition often results in pain, reduced grip strength, and functional impairments. The study involved 30 participants divided into two groups, each receiving one of the treatment techniques along with conventional therapy. Assessments were conducted on the 1st, 11th, and 21st days using standard numeric pain scale, a hand dynamometer, and the Patient Rated Tennis Elbow Evaluation questionnaire. The results showed that both methods improved pain levels, grip strength, and functional activity.

One study by Kousar et al. (2022)[32] aimed to compare the effectiveness of transverse friction massage and ultrasound therapy combined with eccentric exercises in treating chronic Achilles tendinopathy. The study involved 76 patients divided into two groups. Both groups performed eccentric exercises. Outcome measures included the Victorian Institute of Sports Assessment-Achilles numeric pain scale for severity and goniometry. The study's results showed improvements in both groups.

CONCLUSION

The effects of deep tissue massage therapy on muscle recovery and performance improvement especially for athletes participating in team and strength sports are shown in this study. Over 8 weeks, the regular bi-weekly sessions showed improvements in general athletic performance, muscle strength, and flexibility. These findings are supported by the statistical data that show improvements, especially in flexibility with long-term therapy. Our research focuses on statistical results unique to the applied deep tissue massage protocol in contrast to other studies that compare massage techniques or therapeutic applications in a general sense. Athletes who participated in team sports and strength training profited the most from these massage sessions, while gender disparities in perceived efficacy show reactions that seek more research.

The study's limitations include potential environmental variability due to home-based massage sessions and reliance on self-reported measures for recovery metrics. These factors could introduce biases in perceived recovery results. Future research should incorporate larger sample sizes, controlled environments, and integration with complementary therapies such as stretching or resistance training. This would offer a more comprehensive understanding of how deep tissue massage can be optimized to meet various sports requirements.

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CONFLICT OF INTEREST NOTIFICATION

The author declares there are no conflicts of interest.

REFERENCES

1. 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):110. https://doi.org/10.3390/sports11060110
2. Chaves P, Simões D, Paço M, Pinho F, Duarte JA, Ribeiro F. Pressure applied during deep friction massage: characterization and relationship with time of onset of analgesia. *Applied Sciences*. 2020;10(8):2705. https://doi.org/10.3390/app10082705
3. Bingölbali Ö, Taşkaya C, Alkan H, Altındağ Ö. The effectiveness of deep tissue massage on pain, trigger point, disability, range of motion and quality of life in individuals with myofascial pain syndrome. *Somatosensory & Motor Research*. 2023;41(1):11–17. https://doi.org/10.1080/08990220.2023.2165054
4. Brummitt J. The role of massage in sports performance and rehabilitation: current evidence and future direction. *N Am J Sports Phys Ther*. 2008;3(1):7–21.
5. Weerapong P, Hume PA, Kolt GS. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Med*. 2005;35(3):235–256. https://doi.org/10.2165/00007256-200535030-00004

6. Stekelenburg A, Gawlitta D, Bader DL, Oomens CW. Deep tissue injury: how deep is our understanding? *Arch Phys Med Rehabil*. 2008;89(7):1410–1413. https://doi.org/10.1016/j.apmr.2008.01.012
7. Koren Y, Kalichman L. Deep tissue massage: what are we talking about? *J Bodyw Mov Ther*. 2018;22(2):247–251. https://doi.org/10.1016/j.jbmt.2017.05.006
8. 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(5):CR173–CR178.
9. Cong Z, Tai Y, Gao T, Zhang L, Jiang R, Li P, et al. The effect of therapeutic massage on patients with obesity: a systematic review and meta-analysis. *Heliyon*. 2024;10(7):e28791. https://doi.org/10.1016/j.heliyon.2024.e28791
10. Crane JD, Ogborn DI, Cupido C, Melov S, Hubbard A, Bourgeois JM, et al. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. *Sci Transl Med*. 2012;4(119):119ra13. https://doi.org/10.1126/scitranslmed.3002882
11. Mak S, Allen J, Begashaw M, Miake-Lye I, Beroes-Severin J, De Vries G, et al. Use of massage therapy for pain, 2018–2023: a systematic review. *JAMA Netw Open*. 2024;7(7):e2422259. https://doi.org/10.1001/jamanetworkopen.2024.22259
12. Suchomel TJ, Nimphius S, Stone MH. The importance of muscular strength in athletic performance. *Sports Med*. 2016;46(10):1419–1449. https://doi.org/10.1007/s40279-016-0486-0
13. Cheng AJ, Jude B, Lanner JT. Intramuscular mechanisms of overtraining. *Redox Biol*. 2020;35:101480. https://doi.org/10.1016/j.redox.2020.101480
14. Braun-Trocchio R, Graybeal AJ, Kreutzer A, Warfield E, Renteria J, Harrison K, et al. Recovery strategies in endurance athletes. *J Funct Morphol Kinesiol*. 2022;7(1):22. https://doi.org/10.3390/jfmk7010022
15. Davis JK, Oikawa SY, Halson S, Stephens J, O'Riordan S, Luhrs K, et al. In-season nutrition strategies and recovery modalities to enhance recovery for basketball players: a narrative review. *Sports Med*. 2022;52(5):971–993. https://doi.org/10.1007/s40279-021-01606-7
16. Khalid M, Madvin J. Precision grounding combined with precision deep tissue massage. *Eur J Med Health Sci*. 2022;4(4):18–21. https://doi.org/10.24018/ejmed.2022.4.4.1365
17. Hassan S, Hafez A, Seif H, Kachanathu S. The effect of deep friction massage versus stretching of wrist extensor muscles in the treatment of patients with tennis elbow. *Open J Ther Rehabil*. 2016;4(1):48–54. https://doi.org/10.4236/ojtr.2016.41004
18. Skillgate E, Pico-Espinosa OJ, Côté P, Jensen I, Viklund P, Bottai M, et al. Effectiveness of deep tissue massage therapy, and supervised strengthening and stretching exercises for subacute or persistent disabling neck pain. The Stockholm Neck (STONE) randomized controlled trial. *Musculoskelet Sci Pract*. 2020;45:102070. https://doi.org/10.1016/j.msksp.2019.102070
19. Trybulec B, Macul B, Kościńska K, Nawrot-Porąbka K, Barłowska M, Jagielski P. The effect of deep tissue massage on respiratory parameters in healthy subjects-a non-randomised pilot study. *Heliyon*. 2023;9(4):e15242. https://doi.org/10.1016/j.heliyon.2023.e15242
20. Yildiz S, Gelen E, Çilli M, Karaca H, Kayihan G, Ozkan A, et al. Acute effects of static stretching and massage on flexibility and jumping performance. *J Musculoskelet Neuronal Interact*. 2020;20(4):498–504.
21. Cossich VRA, Carlgren D, Holash RJ, Katz L. Technological breakthroughs in sport: current practice and future potential of artificial intelligence, virtual reality, augmented reality, and modern data visualization in performance analysis. *Appl Sci*. 2023;13(23):12965. https://doi.org/10.3390/app132312965
22. Fakhro MA, Chahine H, Srour H, Hijazi K. Effect of deep transverse friction massage vs stretching on football players' performance. *World J Orthop*. 2020;11(1):47–56. https://doi.org/10.5312/wjo.v11.i1.47
23. Khan S, Arsh A, Khan S, Ali S. Deep transverse friction massage in the management of adhesive capsulitis: a systematic review. *Pak J Med Sci*. 2024;40(3Part-II):526–533. https://doi.org/10.12669/pjms.40.3.7218
24. Joseph MF, Taft K, Moskwa M, Denegar CR. Deep friction massage to treat tendinopathy: a systematic review of a classic treatment in the face of a new paradigm of understanding. *J Sport Rehabil*. 2012;21(4):343–353. https://doi.org/10.1123/jsr.21.4.343
25. Gasibat Q, Rafieda A, Aween M. The influence of therapeutic massage on muscle recovery, physiological, psychological, and performance in sport: a systematic review. *Sport Mont J*. 2024;22(1):3–20. https://doi.org/10.26773/smj.240220
26. Srokowska A, Bodek M, Kurczewski M, Srokowski G, Siedlaczek M, Lewandowski A. Deep tissue massage and mobility and pain in the thoracic spine. *Balt J Health Phys Act*. 2019;11(2):99–108. https://doi.org/10.29359/BJHPA.11.2.10
27. Liza L, Bafirman B, Masrun M, Samodra YTJ, Suganda MA, Rifki MS, et al. Can the combination of deep tissue massage and stretching influence the recovery process of lower back pain injuries? *SPORT TK-Revista EuroAmericana de Ciencias del Deporte*. 2024;13:33. https://doi.org/10.6018/sportk.570621
28. Bhutta NI, Haneef K, Rasheed S, Bashir S, Shah S. Effectiveness of muscle energy techniques and friction massage in hamstring tightness amongst young athletes of Pakistan. *Rehabil J*. 2023;7(03):42–47. https://doi.org/10.52567/trehabj.v7i03.24
29. Pitsillides A, Stasinopoulos D. The beliefs and attitudes of Cypriot physical therapists regard-

ing the use of deep friction massage. *Medicina*. 2019;55(8):472. https://doi.org/10.3390/medicina55080472
30. Noreen A, Ijaz B, Lijuan A, Sanaullah M, Asha, Rashad A, et al. Comparison of deep friction massage and post isometric relaxation technique in cervicogenic headache: a randomised clinical trial. *J Clin Images Med Case Rep*. 2024;5(2):2858. https://doi.org/10.52768/2766-7820/2858
31. Dabkara P, Daniel J, Sharma M, Bose A. A study to compare the effectiveness of active release technique versus deep friction massage on pain, grip strength and functional performance in patients with chronic lateral epicondylitis. *Indian J Public Health Res Dev*. 2022;13(3):222–227. https://doi.org/10.37506/ijphrd.v13i3.18202
32. Kousar R, Sanaullah M, Ikram M, Aleem A, Memon AG, Rehman SS. Effects of ultrasound therapy versus transverse friction massage along with eccentric exercise program on chronic Achilles tendinopathy. *Rehabil J*. 2022;6(02):333–337. https://doi.org/10.52567/trj.v6i02.110

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