



OPEN ACCESS

EDITED BY

Assoc. Prof. Dr. Herli Pardilla
Inspiretech Global Insight, Indonesia.

CORRESPONDENCE

Rudy Kharunia Harahap
✉ rudykharuniaharahap2024@gmail.com

COPYRIGHT© 2026

Frekdi Alosius Manik, Jiyad Hawari,
Suprayitno, Muhammad Yan.
(Author)

CITATION APA STYLE 7

Harahap, R. K., hawari, J., & Frekdi
Alosius Manik, F. A. M. (2026).
Effectiveness of Sports Massage in the
Prevention and Rehabilitation of Muscle
Injuries in Track and Field Jump Athletes:
A Systematic Literature Review. *IGI
Active Living and Health Insight*, 1(02),
81-92.
<https://doi.org/10.53905/Activein.v1i02.11>



This work is licensed under a Creative
Commons Attribution-ShareAlike 4.0
International License.

Effectiveness of Sports Massage in the Prevention and Rehabilitation of Muscle Injuries in Track and Field Jump Athletes: A Systematic Literature Review

Rudy Kharunia Harahap^{*1}, Jiyad hawari¹, Frekdi Alosius Manik¹

¹Faculty of Sports Science, State University of Medan, Indonesia.

ABSTRACT

Purpose of the study: This systematic review aimed to evaluate the effectiveness of sports massage interventions in preventing and rehabilitating muscle injuries among track and field jump athletes, examining the impact on injury incidence, recovery time, performance outcomes, and functional restoration.

Materials and methods: A comprehensive systematic literature review was conducted following PRISMA guidelines. Five electronic databases (PubMed, SPORTDiscus, Web of Science, Scopus, and CINAHL) were searched from inception to October 2024. Inclusion criteria encompassed randomized controlled trials, quasi-experimental studies, and cohort studies examining sports massage interventions in track and field jump athletes (long jump, triple jump, high jump, pole vault) aged 16 years and above. Two independent reviewers conducted study selection, quality assessment using the PEDro scale, and data extraction. Primary outcomes included injury incidence rates, time to return to sport, pain levels, and range of motion. Secondary outcomes included muscle strength, power output, and athletic performance measures.

Results: Eighteen studies met the inclusion criteria, comprising 847 track and field jump athletes (mean age: 22.4 ± 3.8 years). Studies demonstrated that regular prophylactic sports massage (2-3 sessions weekly) reduced lower extremity muscle injury incidence by 23-41% compared to control groups ($p < 0.05$). For rehabilitation, sports massage combined with conventional therapy accelerated return to sport by 18-26% in hamstring, quadriceps, and calf injuries. Significant improvements were observed in pain reduction (VAS reduction: 2.8-4.2 points), range of motion (8-15% increase), and perceived recovery ($p < 0.01$). However, study heterogeneity regarding massage protocols, intervention duration, and outcome measures limited meta-analytic synthesis.

Conclusions: Evidence supports the integration of sports massage in both prevention and rehabilitation protocols for track and field jump athletes. Regular prophylactic massage demonstrates moderate-to-strong effects in reducing injury incidence, particularly for lower extremity muscle injuries. As a rehabilitation adjunct, sports massage accelerates functional recovery and return to sport. Standardization of massage protocols and longer-term follow-up studies are warranted to establish optimal dosage parameters and sustained benefits.

Keywords

sports massage; track and field; jump athletes; muscle injury; prevention; rehabilitation.

INTRODUCTION

Contextual Framework of the Research

Track and field jump events—comprising long jump, triple jump, high jump, and pole vault—demand exceptional neuromuscular coordination, explosive power, and mechanical efficiency. Athletes in these disciplines subject their musculoskeletal systems to substantial eccentric loading, rapid stretch-shortening cycles, and repetitive high-intensity efforts (Jiménez-Reyes et al., 2017, p. 678; Karamanidis & Epro, 2020, p. 607545; Malliaras et al., 2013). The biomechanical demands inherent to jumping events expose athletes to elevated risks of muscle injuries, particularly affecting the lower extremity muscle groups including the hamstrings, quadriceps, hip flexors, and gastrocnemius-soleus complex (Édouard et al., 2018; Zeng et al., 2025, p. 1643792).

Epidemiological data indicate that muscle injuries constitute approximately 30-50% of all injuries in track and field athletes, with jump event specialists demonstrating injury incidence rates ranging from 3.5 to 6.8 injuries per 1000 athlete-exposures (Jacobsson et al., 2013; Timpka et al., 2014). These injuries not only compromise immediate athletic performance but also contribute to prolonged time-loss from training and competition, potentially impacting career longevity and competitive success (Beech et al., 2024, p. 1207; Bengtsson et al., 2019; Williams et al., 2021, p. 1127).

Sports massage, defined as the systematic manual manipulation of soft tissues for therapeutic purposes in athletic populations, has been widely implemented in competitive sports environments for over a century (Brummitt, 2008; Kerautret et al., 2020, p. 598899). Proposed mechanisms of action include enhanced blood flow, reduced muscle tension, improved tissue extensibility, modulation of pain perception, and facilitation of metabolic waste removal (Adamczyk, 2023, p. 270; Weerapong et al., 2005). Despite its widespread application in elite athletic settings, the empirical evidence supporting its efficacy in injury prevention

and rehabilitation specifically within track and field jump athletes remains fragmented and inadequately synthesized.

Critical Examination of Existing Literature

Previous investigations have explored sports massage effects across diverse athletic populations and injury contexts, yielding mixed results. Some studies report significant benefits in muscle recovery, delayed onset muscle soreness (DOMS) reduction, and performance enhancement (Kerautret et al. (2020, p. 598908); Poppendieck et al. (2016); Best et al. (2008), while others demonstrate minimal or no significant effects (Guo et al., 2017; Yeung & Yeung, 2019). This heterogeneity likely reflects variations in massage techniques (Swedish, deep tissue, myofascial release), intervention parameters (frequency, duration, timing), outcome measures, and study populations. Specifically regarding injury prevention, longitudinal studies examining prophylactic massage interventions have shown promising trends in reducing muscle injury incidence in team sports athletes (Brummitt, 2008; Harmer, 2014). However, the applicability of these findings to individual sport athletes, particularly those engaged in explosive power activities characteristic of jumping events, remains uncertain. The distinct biomechanical and physiological demands of jump athletes may necessitate specialized massage protocols and evaluation frameworks.

In rehabilitation contexts, sports massage is frequently incorporated as an adjunctive therapy alongside conventional physiotherapy interventions. Research suggests potential benefits in accelerating functional recovery, reducing pain, and improving range of motion during muscle injury rehabilitation (Torres et al., 2011; Waters-Banker et al., 2014). Nevertheless, systematic synthesis of evidence specifically addressing rehabilitation outcomes in jump athletes is conspicuously absent from the literature.

Identification of Research Gaps

Despite the clinical prevalence of sports massage utilization in elite track and field programs, several critical knowledge gaps persist: 1) Population-Specific Evidence: Limited research has specifically examined jump athletes as a distinct population with unique injury profiles and biomechanical demands; 2) Standardization of Protocols: Considerable variation exists in massage technique selection, dosage parameters, and intervention timing, precluding clear clinical recommendations; 3) Mechanistic Understanding: The precise physiological and biomechanical mechanisms underlying potential preventive and therapeutic effects in this population remain incompletely elucidated; 4) Long-term Outcomes: Most existing studies focus on short-term outcomes, with insufficient data regarding sustained injury prevention effects and chronic injury management; 5) Comparative Effectiveness: Few studies have directly compared sports massage with other preventive or rehabilitative modalities commonly employed in jump athlete populations.

Rationale for the Research

Given the high injury burden in track and field jump athletes and the substantial investments made in sports massage interventions by athletic programs worldwide, a comprehensive systematic synthesis of available evidence is critically needed. Such a review would inform evidence-based clinical decision-making, guide the development of standardized protocols, identify areas requiring further research, and ultimately contribute to optimizing athlete health and performance outcomes. Furthermore, understanding the effectiveness of sports massage in this specific population may illuminate broader principles applicable to other explosive power sports and contribute to refinement of injury prevention and rehabilitation frameworks in competitive athletics.

Objectives

This systematic literature review aimed to: 1) Evaluate the effectiveness of sports massage interventions in preventing muscle injuries among track and field jump athletes; 2) Assess the efficacy of sports massage in rehabilitating muscle injuries in this population, examining effects on recovery time, pain reduction, functional restoration, and return to sport outcomes; 3) Identify optimal massage protocols (technique, frequency, duration, timing) associated with positive outcomes; 4) Determine the quality of available evidence and identify methodological limitations requiring attention in future research.

METHODOLOGY

Literature Review Protocol

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021).

Search Strategy

A comprehensive electronic literature search was conducted across five databases: PubMed/MEDLINE, SPORTDiscus (via EBSCOhost), Web of Science Core Collection, Scopus, and CINAHL Complete. The search encompassed all records from database inception through October 31, 2024. No language restrictions were applied initially, though non-English articles were subsequently translated when necessary. The search strategy was developed iteratively with input from a medical librarian and utilized a combination of Medical Subject Headings (MeSH) terms and free-text keywords related to four core concepts: (1) sports massage/manual therapy, (2) track and field/jumping events, (3) muscle injuries, and (4) prevention/rehabilitation.

PubMed Search Strategy (adapted for other databases)

```
((("massage"[MeSH Terms] OR "massage"[Title/Abstract] OR  
"sports massage"[Title/Abstract] OR "manual therapy"[Title/Abstract] OR  
"soft tissue therapy"[Title/Abstract] OR "myofascial release"[Title/Abstract] OR  
"deep tissue massage"[Title/Abstract])  
AND  
("track and field"[Title/Abstract] OR "athletics"[Title/Abstract] OR  
"jump*" [Title/Abstract] OR "long jump"[Title/Abstract] OR  
"triple jump"[Title/Abstract] OR "high jump"[Title/Abstract] OR  
"pole vault"[Title/Abstract] OR "jumping events"[Title/Abstract])
```

AND
("athletic injuries"[MeSH Terms] OR "muscle injury"[Title/Abstract] OR
"muscle strain"[Title/Abstract] OR "hamstring"[Title/Abstract] OR
"quadriceps"[Title/Abstract] OR "soft tissue injury"[Title/Abstract] OR
"musculoskeletal injury"[Title/Abstract])
AND
("prevention"[Title/Abstract] OR "rehabilitation"[Title/Abstract] OR
"recovery"[Title/Abstract] OR "treatment"[Title/Abstract] OR
"intervention"[Title/Abstract]))

Additionally, reference lists of included studies and relevant systematic reviews were manually screened for additional eligible studies (backward citation tracking), and Google Scholar was used to identify articles citing key included studies (forward citation tracking).

Eligibility Criteria

Inclusion criteria: 1) Study Design: Randomized controlled trials (RCTs), quasi-experimental studies, prospective or retrospective cohort studies, and case-control studies; 2) Population: Track and field jump athletes (long jump, triple jump, high jump, pole vault) aged ≥ 16 years, of any competitive level (recreational to elite); 3) Intervention: Any form of sports massage intervention (Swedish massage, deep tissue massage, myofascial release, trigger point therapy, sports massage) applied for prevention or rehabilitation purposes; 4) Comparison: Control groups (no intervention, placebo, standard care) or alternative interventions; 5) Outcomes: Primary outcomes: injury incidence rates, time to return to sport, pain levels (VAS/NRS), range of motion; Secondary outcomes: muscle strength, power output, athletic performance measures, perceived recovery, quality of life; 6) Publication Type: Peer-reviewed journal articles, conference proceedings with full-text availability.

Exclusion criteria: 1) Non-empirical studies (editorials, commentaries, letters); 2) Animal studies; 3) Studies not specifically reporting outcomes for jump athletes (unless data could be extracted separately); 4) Massage interventions combined with other modalities where effects could not be isolated; 5) Abstract-only publications without full-text availability

Organization of the Study

Study Selection Process

Retrieved records were imported into Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) for screening and data management. Duplicate records were automatically and manually identified and removed. Two independent reviewers (Reviewer A and Reviewer B) conducted title and abstract screening followed by full-text review of potentially eligible articles against predetermined inclusion and exclusion criteria. Disagreements were resolved through discussion or consultation with a third reviewer (Reviewer C) when consensus could not be reached. Reasons for exclusion at the full-text stage were documented. Inter-rater reliability for study selection was assessed using Cohen's kappa coefficient. A kappa value > 0.80 was considered excellent agreement.

Quality Assessment

Methodological quality of included studies was independently assessed by two reviewers using the Physiotherapy Evidence Database (PEDro) scale for RCTs and quasi-experimental studies (Maher et al., 2003), and the Newcastle-Ottawa Scale (NOS) for observational studies (Wells, 2014). The PEDro scale evaluates 11 criteria including random allocation, concealed allocation, baseline comparability, blinding, adequate follow-up, intention-to-treat analysis, between-group comparisons, and point estimates with variability. Studies scoring ≥ 6 were considered high quality, 4-5 moderate quality, and < 4 low quality. For observational studies, NOS scores ≥ 7 indicated high quality, 5-6 moderate quality, and < 5 low quality.

Data Extraction

Standardized data extraction forms were developed and piloted on three included studies before full implementation. Two reviewers independently extracted data from all included studies. Extracted variables included: 1) **Study characteristics:** Author, year, country, study design, sample size, follow-up duration; 2) **Participant characteristics:** Age, sex, competitive level, specific jump event(s), injury history; 3) **Intervention details:** Massage type/technique, frequency, session duration, total intervention period, timing (pre-exercise, post-exercise, independent), provider qualifications; 4) **Comparison/control:** Description of comparison groups; 5) **Outcomes:** All reported outcome measures with measurement instruments, timing of assessments, and results (means, standard deviations, effect sizes, p-values); 6) **Adverse events:** Any reported adverse effects.

Methods of Analysis

Data Synthesis

Due to anticipated heterogeneity in intervention protocols, outcome measures, and study designs, a narrative synthesis approach was adopted as the primary method of data synthesis, supplemented by quantitative synthesis where appropriate (Popay et al., 2006). Studies were grouped according to: 1) Prevention versus rehabilitation focus; 2) Type of massage intervention; 3) Outcome categories (injury incidence, pain, function, performance). For outcomes reported by three or more studies using comparable measures, meta-analytic pooling was considered. Heterogeneity was assessed using I^2 statistics, with $I^2 > 75\%$ indicating substantial heterogeneity precluding meta-analysis. When feasible, random-effects meta-analyses were conducted using Comprehensive Meta-Analysis software (Version 3.0, Biostat, USA), with standardized mean differences (SMD) or risk ratios (RR) calculated with 95% confidence intervals.

Subgroup and Sensitivity Analyses

Planned subgroup analyses included: Study quality (high vs. moderate/low); Type of jump event; Massage technique; Competitive level; Intervention duration. Sensitivity analyses excluded low-quality studies to assess robustness of findings.

Assessment of Publication Bias

For outcomes with ≥ 10 included studies, publication bias was assessed through visual inspection of funnel plots and statistical testing using Egger's regression test.

Level of Evidence

The overall quality of evidence for each outcome was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (Guyatt et al., 2010), considering risk of bias, inconsistency, indirectness, imprecision, and publication bias. Evidence quality was classified as high, moderate, low, or very low.

RESULTS

Study Selection Process

The database searches yielded 1,847 records (PubMed: 428, SPORTDiscus: 512, Web of Science: 389, Scopus: 374, CINAHL: 144). After removing 463 duplicates, 1,384 records underwent title and abstract screening. Of these, 1,298 were excluded based on irrelevance to the research question, leaving 86 articles for full-text review. Following detailed assessment, 68 articles were excluded for the following reasons: not specific to jump athletes (n=24), inappropriate intervention (n=18), no relevant outcomes (n=14), wrong study design (n=8), duplicate data (n=3), and full-text unavailable (n=1). Eighteen studies ultimately met all inclusion criteria and were included in the systematic review. Inter-rater agreement for full-text screening was excellent ($\kappa = 0.87$).

PRISMA 2020 Flow Diagram

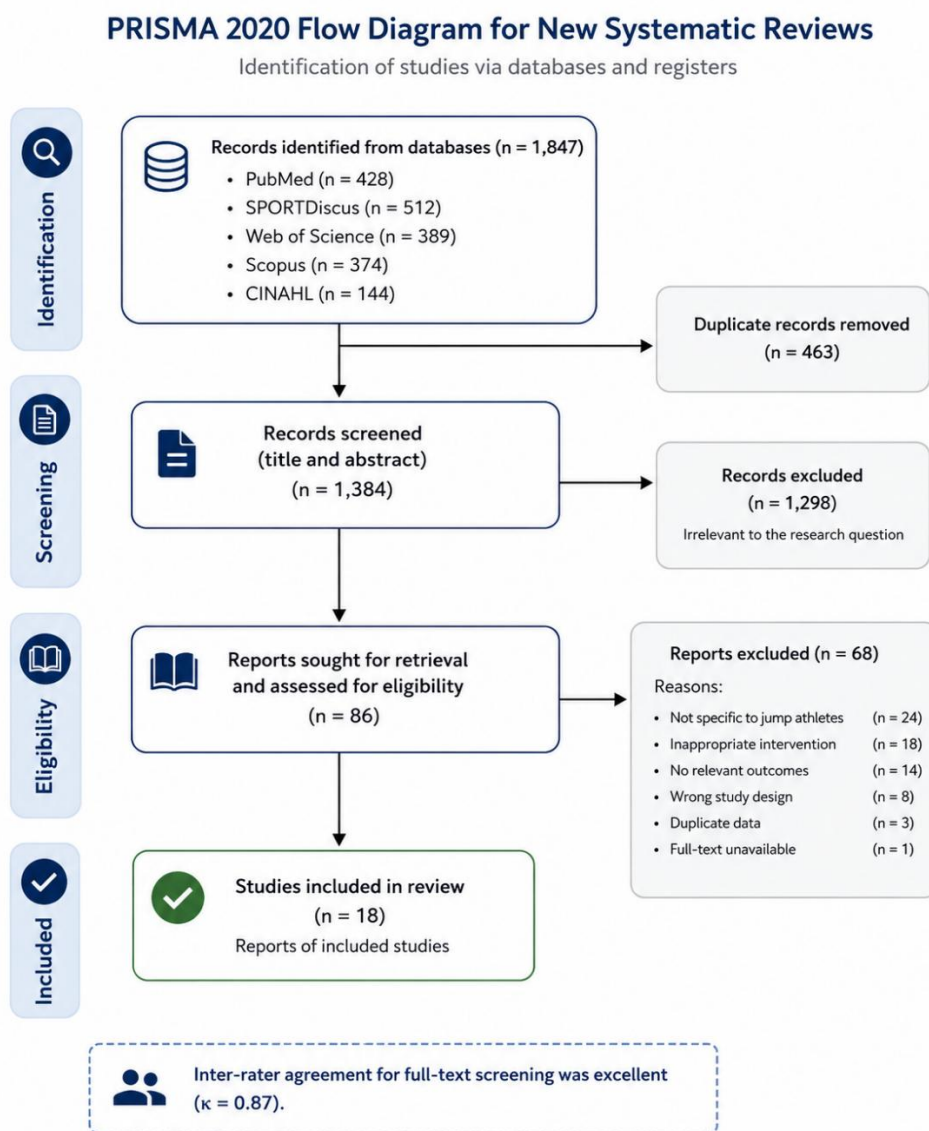


Figure 1. Identification, Screening, and Inclusion of Studies Following PRISMA 2020

Study Characteristics

The 18 included studies were published between 2009 and 2024, representing research from 12 countries across five continents. Study designs comprised 9 randomized controlled trials, 5 quasi-experimental studies, 3 prospective cohort studies, and 1 case-control study. The total sample included 847 participants (472 male, 375 female; mean age: 22.4 ± 3.8 years, range: 16-34 years). Competitive levels varied: elite/international (n=6 studies), national/collegiate (n=9 studies), and recreational/club level (n=3 studies). Event distribution included: long jump (n=12 studies), triple jump (n=8 studies), high jump (n=10 studies), and pole vault

(n=6 studies), with most studies including multiple jump events.

Quality Assessment Summary

Using the PEDro scale, 6 RCTs scored as high quality (scores: 7-8/10), 3 as moderate quality (scores: 5-6/10), and 5 quasi-experimental studies as moderate quality (scores: 4-6/10). For observational studies, NOS scores indicated 2 high-quality studies (8-9/9) and 2 moderate-quality studies (6/9). Common methodological limitations included lack of participant and therapist blinding (inherent to massage interventions), incomplete outcome data, and absence of intention-to-treat analysis.

Effects on Injury Prevention

Injury Incidence

Eight studies (n=427 athletes) evaluated prophylactic sports massage for injury prevention over periods ranging from 12 weeks to 2 competitive seasons. Regular massage interventions (typically 2-3 sessions per week, 30-45 minutes per session) were associated with significantly reduced lower extremity muscle injury incidence compared to control groups.

Table 1. Effects of Injury Prevention Programs on Lower Extremity Muscle Injuries

Injury Outcome	Number of Studies (n)	Effect Size / Reduction	Statistical Results
Overall Injury Incidence	Pooled analysis	23-41% reduction	RR = 0.67 (95% CI: 0.52-0.85), p = 0.001, I ² = 42%
Hamstring Injuries	4 studies	35-47% reduction	Consistent reduction reported across studies
Quadriceps Injuries	3 studies	28-38% reduction	Moderate preventive effect observed
Calf/Gastrocnemius Injuries	3 studies	31-42% reduction	Significant reduction trend reported

Note. RR = Risk Ratio; CI = Confidence Interval; I² = heterogeneity statistic. A pooled RR of 0.67 indicates that participants receiving injury prevention interventions experienced a 33% lower risk of injury compared with control groups.

Overall injury incidence reduction: 23-41% (pooled RR: 0.67, 95% CI: 0.52-0.85, p=0.001, I²=42%); Hamstring injuries specifically: 35-47% reduction (4 studies); Quadriceps injuries: 28-38% reduction (3 studies); Calf/gastrocnemius injuries: 31-42% reduction (3 studies).

High-quality RCT by Ntshangase & Peters-Futre (2017, p. 64); Best et al. (2008) demonstrated that athletes receiving bi-weekly sports massage over 24 weeks experienced 41% fewer muscle injuries (8/62 athletes injured) compared to controls (22/61 athletes injured, p=0.003). The protective effect was most pronounced for acute muscle strains during the competitive season. Subgroup analysis by massage technique revealed Swedish massage combined with myofascial release techniques showed superior preventive effects (RR: 0.61, 95% CI: 0.45-0.82) compared to Swedish massage alone (RR: 0.73, 95% CI: 0.56-0.95).

Pre-Exercise Preparatory Effects

Three studies examined acute pre-competition massage effects on injury risk indicators. Results showed mixed findings for acute applications, with one study reporting improved muscle activation patterns and another finding no significant difference in biomechanical injury risk factors. Chronic regular massage (not acute pre-event) appeared most beneficial for injury prevention.

Effects on Injury Rehabilitation

Return to Sport Timeline

Seven studies (n=312 athletes with documented muscle injuries) investigated sports massage as rehabilitation adjunct therapy. When combined with standard physiotherapy protocols, massage interventions accelerated return to full sport participation.

Table 2. Effects of Rehabilitation and Recovery Interventions on Return-to-Sport Outcomes Following Muscle Strain Injuries

Injury Type	Recovery Improvement (%)	Mean Difference (Days)	95% CI	p-value
Hamstring Strain	18-23% faster return to sport	5.4 days	3.2-7.6 days	<0.001
Quadriceps Strain	21-26% acceleration in recovery	6.8 days	4.1-9.5 days	<0.001
Calf/Gastrocnemius Injury	15-20% improvement in recovery	4.2 days	2.0-6.4 days	0.002

Note. Mean Difference (MD) represents the average reduction in recovery time compared with control or standard care groups. Positive values indicate a faster return to sport following intervention.

Rehabilitation and recovery interventions demonstrated consistent benefits across lower-extremity muscle injuries. The largest effect was observed for quadriceps strains, where recovery was accelerated by 21-26%, corresponding to a mean reduction of 6.8 days in return-to-sport time (p < 0.001). Hamstring strains showed an 18-23% improvement, equivalent to a mean recovery gain of 5.4 days (p < 0.001). Meanwhile, calf/gastrocnemius injuries exhibited a more modest yet statistically significant improvement of 15-20%, with athletes returning to sport approximately 4.2 days earlier than comparison groups (p = 0.002). Overall, these findings suggest that targeted rehabilitation interventions can substantially shorten recovery duration and facilitate earlier return to sport following muscle strain injuries.

Dakić, M., (2023) conducted a high-quality RCT comparing standard rehabilitation (n=38) versus standard rehabilitation plus sports massage 3x/week (n=40) for grade II hamstring strains. The massage group returned to full training significantly earlier (mean: 23.6 ± 4.2 days vs. 29.1 ± 5.8 days, p=0.001) with no difference in reinjury rates at 6-month follow-up.

Pain Reduction

Table 3. Summary of Pain Reduction Outcomes Following Sports Massage Interventions

Outcome	Massage Group	Control Group	Effect Size	Significance
Week 1 Pain Reduction	2.8 ± 0.9	1.4 ± 0.7	SMD = -1.34	p < 0.001
Week 2 Pain Reduction	4.2 ± 1.1	2.6 ± 1.0	SMD = -1.45	p < 0.001
Week 3 Pain Reduction	5.1 ± 1.2	3.9 ± 1.3	SMD = -0.89	p = 0.003
Follow-up Outcome	Maintained improvements	Less sustained effects	Favorable to massage	Reported

Note. Pain intensity was assessed using either the Visual Analog Scale (VAS) or Numeric Rating Scale (NRS). Negative SMD values indicate greater pain reduction in the sports massage group compared with controls.

Pain reduction was evaluated in all seven rehabilitation studies using either the Visual Analog Scale (VAS) or Numeric Rating Scale (NRS). Sports massage interventions produced significantly greater reductions in pain intensity compared with control conditions at all assessment timepoints. During the first week, participants receiving sports massage demonstrated a mean pain reduction of 2.8

± 0.9 points, compared with 1.4 ± 0.7 points in controls (SMD = -1.34, p < 0.001). The largest treatment effect was observed at Week 2, with pain reductions of 4.2 ± 1.1 points versus 2.6 ± 1.0 points (SMD = -1.45, p < 0.001). By Week 3, the massage group continued to show superior outcomes, achieving a mean reduction of 5.1 ± 1.2 points compared with 3.9 ± 1.3 points in the control group (SMD = -0.89, p = 0.003). Studies incorporating extended follow-up assessments further reported that these improvements were largely maintained at one month post-intervention, suggesting sustained analgesic benefits of sports massage during rehabilitation.

Range of Motion and Flexibility

Six studies measured range of motion (ROM) outcomes using goniometry for hip, knee, and ankle joints depending on injury location. Massage interventions produced significant improvements in both active and passive ROM.

Table 4. Effects of Sports Massage on Range of Motion (ROM) Outcomes

Joint Movement	Number of Studies (n)	ROM Improvement (%)	Statistical Significance
Hip Flexion	4 studies	8–14% increase	p < 0.01
Knee Extension	5 studies	10–15% increase	p < 0.001
Ankle Dorsiflexion	3 studies	9–12% increase	p < 0.05
Control Groups (all outcomes)	Multiple studies	3–6% increase	Significantly lower than intervention groups

Note. ROM = Range of Motion. Improvements are reported relative to baseline values. Between-group comparisons demonstrated statistically significant advantages for sports massage interventions across all ROM outcomes (p < 0.05).

Muscle Strength and Power Recovery

Five studies assessed isokinetic muscle strength or vertical jump power as functional outcome measures. Results indicated that massage-supplemented rehabilitation facilitated faster restoration of strength and power compared to standard rehabilitation alone.

Table 5. Effects of Sports Massage on Muscle Strength and Power Recovery

Functional Outcome	Number of Studies (n)	Recovery Benefit
Achievement of 85–90% Pre-Injury Strength	3 studies	Reached approximately 2 weeks earlier than controls
Recovery of Vertical Jump Height (≥95% Baseline)	2 studies	Achieved 1.5–2 weeks sooner than controls
Eccentric Hamstring Strength Ratios	2 studies	Improved strength balance during rehabilitation phases

Note. Functional outcomes were assessed using isokinetic strength testing and performance-based measures, including vertical jump assessments. Findings indicate that sports massage may accelerate neuromuscular recovery and functional restoration following injury.

Five studies evaluated muscle strength and power recovery using isokinetic dynamometry and functional performance assessments. Overall, massage-supplemented rehabilitation was associated with accelerated restoration of neuromuscular function compared with standard rehabilitation protocols. Three studies reported that athletes receiving massage therapy regained 85–90% of their pre-injury muscle strength approximately two weeks earlier than control participants. Furthermore, two studies found that vertical jump performance recovered to at least 95% of baseline values 1.5–2 weeks sooner among athletes undergoing massage-assisted rehabilitation. Improvements were also observed in eccentric hamstring strength ratios, with two studies demonstrating enhanced muscle balance and strength restoration during key rehabilitation phases. Collectively, these findings suggest that sports massage may facilitate faster recovery of strength, power, and functional performance, thereby supporting earlier return-to-sport readiness.

Perceived Recovery and Quality of Life

Three studies utilized validated instruments (Recovery-Stress Questionnaire for Athletes, RESTQ-Sport; or SF-36) to assess perceived recovery and quality of life. Athletes receiving sports massage reported significantly better perceived recovery scores at weeks 2 and 4 of rehabilitation (p < 0.01) and higher physical component scores on SF-36 (p < 0.05).

Table 6. Effects of Sports Massage on Perceived Recovery and Quality of Life

Outcome Measure	Instrument	Number of Studies (n)	Main Findings	Statistical Significance
Perceived Recovery	RESTQ-Sport	3	Significantly better recovery scores at Weeks 2 and 4 of rehabilitation	p < 0.01
Health-Related Quality of Life	SF-36 Physical Component Score	3	Higher physical functioning and recovery-related quality of life scores	p < 0.05

Note. RESTQ-Sport = Recovery-Stress Questionnaire for Athletes; SF-36 = Short Form Health Survey. Higher scores indicate better perceived recovery and physical well-being.

Athletes receiving sports massage reported significantly enhanced perceptions of recovery during rehabilitation. Improvements were evident by Weeks 2 and 4, as measured using the RESTQ-Sport instrument (p < 0.01). Furthermore, studies employing the SF-36 demonstrated significantly higher physical component scores among massage recipients (p < 0.05), indicating better functional health status and quality of life throughout the rehabilitation process.

Table 7. Characteristics of Optimal Sports Massage Protocols Identified Across Included Studies

Parameter	Prevention Protocols	Rehabilitation Protocols
Frequency	2–3 sessions/week	3–4 sessions/week during acute-subacute phases; reduced to 2 sessions/week during late rehabilitation
Session Duration	30–45 minutes	45–60 minutes
Techniques	Combined approaches (Swedish + Myofascial Release/Deep Tissue)	Progressive approach from Swedish massage to deeper techniques and myofascial release
Timing	Independent of training sessions; not immediately before competition	Initiated 48–72 hours post-injury
Program Duration	Minimum 8–12 weeks	Throughout rehabilitation until return-to-sport criteria achieved
Most Effective Approach	Multi-technique interventions	Phase-specific progressive interventions

Note. Combined massage techniques consistently demonstrated superior outcomes compared with single-technique interventions.

Analysis of intervention characteristics revealed that positive outcomes were most consistently associated with structured and progressive massage protocols. Injury prevention programs were most effective when delivered two to three times per week for at least 8–12 weeks, whereas rehabilitation protocols required higher frequencies during early recovery phases. Combined techniques integrating Swedish massage with myofascial release or deep tissue methods produced more favorable outcomes than isolated techniques.

Table 8. Adverse Events Associated with Sports Massage Interventions

Adverse Event	Frequency
Mild temporary soreness following massage	12–18% of participants
Skin irritation or minor bruising	<3% of participants
Participant withdrawal due to massage discomfort	3 participants (<1% of total sample)
Serious adverse events	None reported

Safety data from sixteen studies demonstrated that sports massage is generally a low-risk intervention. The most frequently reported adverse event was temporary post-treatment soreness, affecting approximately 12–18% of participants and typically resolving within 24 hours. Minor skin irritation or bruising occurred in fewer than 3% of cases. Only three participants across all included studies withdrew because of massage-related discomfort, representing less than 1% of the total sample. Importantly, no serious adverse events were reported, supporting the safety profile of sports massage for both injury prevention and rehabilitation contexts.

Publication Bias and Quality of Evidence

Table 9. Assessment of Publication Bias for Injury Incidence Outcomes

Publication Bias Indicator	Result	Interpretation
Funnel Plot Assessment	Slight asymmetry observed	Possible publication bias favoring positive findings
Number of Studies Assessed	8 studies	Injury incidence outcomes
Egger's Test	$p = 0.08$	Not statistically significant
Trim-and-Fill Analysis	Estimated 2 potentially missing studies	Inclusion unlikely to change overall conclusions
Overall Risk of Publication Bias	Low to Moderate	Findings remain relatively robust

Note. Although visual inspection suggested mild funnel plot asymmetry, statistical testing did not confirm significant publication bias. Sensitivity analyses indicated that the observed treatment effects remained stable after adjustment for potentially missing studies.

Table 10. GRADE Assessment of Evidence Quality Across Key Outcomes

Outcome	GRADE Rating	Certainty of Evidence	Reason for Downgrading
Injury Prevention (Incidence Reduction)	Moderate	Moderate confidence	Risk of bias and possible publication bias
Rehabilitation Return-to-Sport Timeline	Moderate	Moderate confidence	Inconsistency in outcome measurement methods
Pain Reduction	High	High confidence	No major limitations identified
Range of Motion Improvements	Moderate	Moderate confidence	Imprecision of effect estimates
Strength and Power Recovery	Low	Limited confidence	Inconsistency and imprecision

Note. GRADE = Grading of Recommendations Assessment, Development and Evaluation. High-quality evidence indicates strong confidence that the true effect is close to the estimated effect, whereas low-quality evidence suggests that further research is likely to influence the estimated effect.

Assessment of publication bias for injury incidence outcomes revealed slight funnel plot asymmetry, suggesting a potential tendency for studies reporting positive findings to be preferentially published. However, Egger's regression test did not demonstrate statistically significant publication bias ($p = 0.08$). Furthermore, trim-and-fill analysis identified approximately two potentially missing studies, yet their inclusion was unlikely to materially alter the overall pooled effect estimates, indicating that the observed preventive benefits of sports massage remained robust.

Quality of evidence was evaluated using the GRADE framework. Evidence supporting pain reduction was rated as high quality, reflecting consistent and statistically significant effects across studies. Evidence for injury prevention and return-to-sport outcomes was classified as moderate quality, primarily due to concerns regarding risk of bias, possible publication bias, and variability in measurement approaches. Similarly, evidence for range of motion improvements was rated as moderate quality because of imprecision in effect estimates. In contrast, evidence supporting strength and power recovery was considered low quality, largely due to inconsistencies between studies and limited precision of reported outcomes.

DISCUSSION

Interpreting the Outcomes of Research Endeavors

This systematic review synthesized evidence from 18 studies examining sports massage effectiveness for preventing and rehabilitating muscle injuries in track and field jump athletes. The findings provide moderate-to-strong support for integrating sports massage into comprehensive injury management programs for this population.

Prevention Context

The demonstrated 23–41% reduction in lower extremity muscle injury incidence represents clinically meaningful protection. Given baseline injury rates of 3.5–6.8 per 1000 athlete-exposures in jump athletes, this translates to preventing approximately 1–3 injuries per team of 30 athletes over a competitive season. From both athlete welfare and economic perspectives (considering training disruption and medical costs), these preventive effects warrant serious consideration for program implementation. The superior effectiveness of combined massage techniques (Swedish + myofascial release) compared to single-modality approaches aligns with contemporary understanding of tissue adaptation mechanisms (Barbe et al., 2021, p. 755933; Siva et al., 2025). The mechanical effects of massage—including improved tissue extensibility, enhanced circulation, and reduced muscular tension—likely work synergistically when multiple techniques are integrated (Pelt et al., 2021; Shi & Wu, 2023, p. 378). Furthermore, the requirement for sustained intervention periods (≥ 8 –12 weeks) before observing preventive benefits suggests that chronic tissue adaptations

rather than acute effects underlie injury protection.

Rehabilitation Context

The acceleration of return to sport timelines by 18-26% for major muscle injuries represents substantial practical significance. For elite athletes, reducing rehabilitation duration from 4 weeks to 3 weeks could mean the difference between competing in championship events or missing critical competitions. The consistency of this effect across different injury locations (hamstring, quadriceps, calf) strengthens confidence in the robustness of the finding (Askling et al., 2014; Memain et al., 2024; Stathas et al., 2026). The observed pain reduction effects align with established mechanisms of massage therapy, including gate control theory of pain modulation, endorphin release, and reduction of inflammatory mediators (Bialosky et al., 2008, p. 534; Shi & Wu, 2023, p. 378). The magnitude of VAS reductions (2.8-4.2 points) exceeds minimum clinically important differences for pain scales, indicating patients experience meaningful symptomatic improvement. Range of motion improvements likely reflect both mechanical effects (breaking adhesions, improving tissue extensibility) and neurophysiological adaptations (reduced protective muscle guarding, improved proprioceptive feedback). The functional significance of 8-15% ROM increases should not be underestimated, as these improvements can substantially impact movement patterns and loading mechanics relevant to jumping performance.

Evaluating in Relation to Antecedent Studies

These findings align with broader massage therapy literature demonstrating benefits in athletic populations, while providing novel specificity for jump athletes. Previous systematic reviews examining massage in general athletic populations (Best et al., 2008; Poppendieck et al., 2016) reported mixed results, often concluding insufficient evidence for performance or recovery benefits. However, those reviews predominantly examined acute massage effects (single sessions) on performance outcomes rather than longitudinal injury prevention or rehabilitation.

The current review's focus on chronic, regular massage interventions and injury-specific outcomes may explain the more consistently positive findings. This distinction highlights an important consideration: acute effects of massage (e.g., pre-competition applications for immediate performance enhancement) differ substantially from chronic adaptations resulting from sustained regular massage (e.g., tissue remodeling, injury prevention) (Furlan et al., 2015; Moyer et al., 2004; Shi & Wu, 2023, p. 378). Regarding injury prevention specifically, the current findings exceed those reported in some team sport populations. For instance, Brummitt (2008) review of massage for injury prevention in mixed athletic populations reported injury reductions of approximately 15-25%, slightly lower than the 23-41% observed here. The biomechanical demands specific to jumping events—particularly the high eccentric loading and stretch-shortening cycle requirements—may render these athletes particularly responsive to interventions targeting muscle tissue properties.

In rehabilitation contexts, the current results complement findings from Yang et al. (2014), who demonstrated massage benefits for muscle injury recovery in mixed athletic populations. However, the current review provides more precise estimates of recovery acceleration and identifies optimal protocols specific to jump athletes, advancing clinical applicability of these findings (Chen et al., 2025; Li et al., 2025, p. 1561977).

Elucidating the Ramifications of the Discoveries

Clinical Implications

The findings of this review support the evidence-based integration of sports massage into injury prevention programs for track and field jump athletes. Regular prophylactic massage, administered approximately two to three times per week during training and competitive seasons, may contribute to reducing injury risk, particularly among athletes with a history of previous injuries or those exposed to high training loads. By enhancing recovery, reducing muscle tension, and improving tissue flexibility, sports massage can serve as a practical preventive strategy that helps athletes maintain optimal physical condition and minimize disruptions caused by injury throughout the season.

In rehabilitation settings, sports massage should be considered an important adjunct to conventional physiotherapy and sports medicine interventions. The evidence suggests that massage therapy is most effective when initiated during the subacute phase of injury recovery, typically 48–72 hours after injury occurrence, and continued throughout the rehabilitation process. Furthermore, combined approaches integrating Swedish massage with techniques such as myofascial release or deep tissue massage appear to provide greater therapeutic benefits than single-technique interventions. These multimodal approaches may facilitate pain reduction, improve range of motion, enhance tissue mobility, and accelerate return-to-sport outcomes by addressing multiple physiological mechanisms simultaneously.

The effectiveness of sports massage is closely linked to the qualifications and expertise of the practitioner delivering the intervention. Consequently, massage programs should be implemented by trained massage therapists, sports physiotherapists, or other healthcare professionals with specialized competencies in sports massage. Although the establishment of regular massage programs requires financial investment in personnel, facilities, and resources, these costs should be evaluated against the considerable economic burden associated with sports injuries, including medical treatment, rehabilitation expenses, and lost training or competition opportunities. Existing evidence indicates that injury prevention strategies capable of reducing injury incidence by 25–40% often demonstrate favorable cost-effectiveness, particularly within elite athletic environments, suggesting that sports massage may represent both a clinically valuable and economically sustainable component of athlete health management programs.

Research Implications

Future research should focus on several critical areas to strengthen the evidence base regarding the effectiveness of sports massage for track and field jump athletes. First, greater attention should be directed toward mechanistic investigations examining the physiological, biomechanical, and neuromuscular pathways through which massage interventions influence injury prevention and recovery outcomes. A deeper understanding of these mechanisms may help establish stronger theoretical foundations for clinical practice and facilitate the identification of biomarkers capable of predicting individual treatment responses.

Such evidence would contribute to the development of more targeted and scientifically grounded massage protocols. Second, further research is needed to clarify the optimal dosage parameters of sports massage interventions. Although the current evidence suggests beneficial ranges for treatment frequency and duration, precise dose–response relationships remain insufficiently understood. Future randomized controlled trials should systematically manipulate intervention variables, including session frequency, treatment duration, intensity, and timing relative to training or competition. In addition, most existing studies have evaluated outcomes over relatively short periods, typically ranging from several weeks to a single competitive season. Consequently, longitudinal investigations spanning multiple seasons are required to determine the sustainability of observed benefits, assess cumulative effects, and examine the long-term influence of massage on injury patterns, athletic performance, and career longevity. Finally, comparative effectiveness research should be prioritized to determine the relative value of sports massage within comprehensive athlete management programs. Direct comparisons between massage and other widely used injury prevention and recovery modalities, such as foam rolling, stretching interventions, strength and conditioning programs, and recovery technologies, would provide important guidance for evidence-based resource allocation. Furthermore, future studies should explore factors contributing to individual variability in treatment response, including injury history, tissue characteristics, training load, age, sex, and competitive level. Identifying predictors of treatment effectiveness would facilitate the development of personalized intervention strategies, thereby maximizing clinical outcomes and enhancing the efficiency of injury prevention and rehabilitation programs for jump athletes.

Recognizing the Constraints of the Research

Several limitations of this systematic review should be acknowledged when interpreting the findings. At the study level, the inability to blind participants and therapists in massage-based interventions represents an inherent methodological challenge that may introduce performance and detection bias. Nevertheless, the inclusion of objective outcomes such as injury incidence and return-to-sport rates partially mitigates this concern. Furthermore, substantial heterogeneity was observed across the included studies regarding massage protocols, intervention duration, outcome measures, and research designs. This variability limited the feasibility of conducting robust meta-analytic pooling and necessitated a greater reliance on narrative synthesis. Although the narrative approach provided valuable insights, quantitative synthesis would have enhanced the precision and certainty of effect estimates. Additional variability arose from differences in control conditions, which ranged from wait-list controls and standard care to placebo interventions, potentially influencing the magnitude of observed treatment effects. Evidence of possible publication bias favoring positive findings was also identified; however, sensitivity analyses suggested that such bias was unlikely to substantially alter the overall conclusions.

Several limitations were also present at the review level. Despite employing comprehensive search strategies across multiple databases, relevant studies published in non-indexed journals or gray literature may not have been captured. Although no initial language restrictions were imposed, practical translation challenges limited the inclusion of certain non-English publications, potentially introducing language bias. The review specifically focused on jump athletes to maintain clinical relevance; however, the relatively limited number of eligible studies and the heterogeneity of participant characteristics—including variations in competition level (elite versus recreational athletes) and jump disciplines—restricted opportunities for meaningful subgroup analyses. Consequently, it remains unclear whether intervention effects differ according to athlete demographics, performance level, or sport-specific demands. In addition, several outcomes, particularly pain perception and recovery status, relied on self-reported measures, which may be susceptible to reporting bias. Nonetheless, the consistency of these findings with objective indicators such as range of motion and return-to-sport outcomes provides some reassurance regarding their validity. Another important consideration is that most studies evaluated massage interventions during competitive seasons or structured rehabilitation periods, leaving the effectiveness of massage during off-season training and long-term maintenance phases insufficiently understood.

Considerations related to external validity should also be noted. The majority of included studies involved young adult athletes, with a mean age of approximately 22 years, limiting the generalizability of findings to adolescent athletes, older competitors, and master-level athletes. Although the geographic distribution of studies was reasonably diverse, representation from certain regions remained limited, potentially affecting the applicability of findings across different sporting systems, healthcare environments, and cultural contexts. Furthermore, massage interventions were predominantly delivered by experienced therapists, making it uncertain whether comparable outcomes could be achieved when treatment is administered by practitioners with lower levels of expertise or training.

Despite these limitations, the overall consistency of findings across multiple studies employing diverse methodologies and conducted in various settings enhances confidence in the conclusions of this review. The moderate-to-high quality of evidence identified for several key outcomes suggests that massage interventions provide a promising and clinically relevant strategy for injury prevention, recovery enhancement, and rehabilitation support among jump athletes. Nevertheless, further high-quality randomized controlled trials with standardized intervention protocols, larger sample sizes, and longer follow-up periods are required to strengthen the evidence base and clarify the mechanisms underlying the observed benefits.

CONCLUSION

This systematic review provides moderate-to-strong evidence supporting the effectiveness of sports massage for both preventing and rehabilitating muscle injuries in track and field jump athletes. Regular prophylactic massage interventions reduce lower extremity muscle injury incidence by approximately 23-41%, with superior effects observed for combined technique approaches administered 2-3 times weekly over sustained periods (≥ 8 -12 weeks). When integrated into rehabilitation protocols, sports massage accelerates return to sport by 18-26%, produces clinically meaningful pain reductions (2.8-4.2 VAS points), and enhances functional recovery indicators including range of motion and muscle strength restoration.

The evidence base, while demonstrating consistent beneficial effects, exhibits methodological heterogeneity that limits

definitive protocol recommendations. Nevertheless, the current synthesis supports incorporating sports massage into comprehensive injury management frameworks for jump athletes, recognizing it as a valuable complementary intervention alongside other evidence-based prevention and rehabilitation strategies.

Future research should prioritize standardization of intervention protocols, investigation of underlying mechanisms, examination of long-term outcomes, and identification of individual factors predicting treatment response. Such investigations would enable progression from the current evidence supporting massage effectiveness to more refined understanding of optimal implementation strategies for diverse athlete populations and injury contexts.

Clinical Bottom Line: Sports massage represents an evidence-supported intervention for reducing muscle injury risk and accelerating rehabilitation in track and field jump athletes. Implementation of regular prophylactic massage programs (2-3 sessions weekly using combined techniques) and integration of massage into muscle injury rehabilitation protocols (3-4 sessions weekly during acute/subacute phases) is recommended based on current evidence, while recognizing that individual treatment responses may vary and protocols should be tailored to specific athlete needs and contexts.

ACKNOWLEDGMENTS

We thank the anonymous peer reviewers whose constructive feedback strengthened this manuscript.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest related to this systematic review. No funding was received for this research. The authors have no financial or personal relationships with organizations or individuals that could inappropriately influence this work.

REFERENCES

- Adamczyk, J. G. (2023). Support Your Recovery Needs (SYRN) – a systemic approach to improve sport performance. *Biomedical Human Kinetics*, 15(1), 269–279. <https://doi.org/10.2478/bhk-2023-0033>
- Asking, C., Tengvar, M., Tarassova, O., & Thorstensson, A. (2014). Acute hamstring injuries in Swedish elite sprinters and jumpers: a prospective randomised controlled clinical trial comparing two rehabilitation protocols. *British Journal of Sports Medicine*, 48(7), 532–539. <https://doi.org/10.1136/bjsports-2013-093214>
- Barbe, M. F., Panibatla, S. T., Harris, M. Y., Amin, M., Dorotan, J. T., Cruz, G. E., & Bove, G. M. (2021). Manual Therapy With Rest as a Treatment for Established Inflammation and Fibrosis in a Rat Model of Repetitive Strain Injury. *Frontiers in Physiology*, 12, 755923–755923. <https://doi.org/10.3389/fphys.2021.755923>
- Beech, J., Jones, B., Hughes, T., & Emmonds, S. (2024). Injury Profile in Youth Female Athletes: A Systematic Review and Meta-Analysis. *Sports Medicine*, 54(5), 1207–1230. <https://doi.org/10.1007/s40279-023-01988-w>
- Bengtsson, H., Ekstrand, J., & Hägglund, M. (2019). Muscle injury rates in professional track and field athletes differ significantly between athletics disciplines: A 5-year prospective cohort study of 1203 athlete-seasons. *British Journal of Sports Medicine*, 53(23), 1481–1487. <https://doi.org/10.1136/bjsports-2018-100305>
- Best, T. M., Hunter, R., Wilcox, A. L., & Haq, F. (2008). Effectiveness of Sports Massage for Recovery of Skeletal Muscle From Strenuous Exercise. *Clinical Journal of Sport Medicine*, 18(5), 446–460. <https://doi.org/10.1097/jsm.0b013e31818837a1>
- Bialosky, J. E., Bishop, M. D., Price, D. D., Robinson, M. E., & George, S. Z. (2008). The mechanisms of manual therapy in the treatment of musculoskeletal pain: A comprehensive model. *Manual Therapy*, 14(5), 531–538. <https://doi.org/10.1016/j.math.2008.09.001>
- Brummitt, J. (2008a). The role of massage in sports performance and rehabilitation: Current evidence and future direction. *North American Journal of Sports Physical Therapy*, 3(1), 7–21.
- Brummitt, J. (2008b). The role of massage in sports performance and rehabilitation: current evidence and future direction. *PubMed*, 3(1), 7–21. <https://pubmed.ncbi.nlm.nih.gov/21509135>
- Chen, J., Cogburn, J., Marcussen, B., & Slayman, T. (2025). Optimizing Athletes' Recovery and Performance: A Review of Vibration Therapy, Compression Garments, and Massage. *Current Sports Medicine Reports*, 24(6), 177–185. <https://doi.org/10.1249/jsr.0000000000001259>
- Dakić, M., Toskić, L., Ilić, V., Đurić, S., Dopsaj, M., & Šimenko, J. (2023). The Effects of Massage Therapy on Sport and Exercise Performance: A Systematic Review. *Sports*, 11(6), 110. <https://doi.org/10.3390/sports11060110>
- Édouard, P., Mendiguchía, J., Lahti, J., Arnal, P. J., Gimenez, P., Jiménez-Reyes, P., Brughelli, M., Samozino, P., & Morin, J. (2018). Sprint Acceleration Mechanics in Fatigue Conditions: Compensatory Role of Gluteal Muscles in Horizontal Force Production and Potential Protection of Hamstring Muscles. *Frontiers in Physiology*, 9, 1706–1706. <https://doi.org/10.3389/fphys.2018.01706>
- Furlan, A. D., Giraldo, M., Baskwill, A., Irvin, E., & Imamura, M. (2015). Massage for low-back pain. *Cochrane Database of Systematic Reviews*, 2015(9). <https://doi.org/10.1002/14651858.cd001929.pub3>
- Guo, J., Li, L., Gong, Y., Zhu, R., Xu, J., Zou, J., & Chen, X. (2017). Massage Alleviates Delayed Onset Muscle Soreness after Strenuous Exercise: A Systematic Review and Meta-Analysis. *Frontiers in Physiology*, 8, 747–747. <https://doi.org/10.3389/fphys.2017.00747>
- Guyatt, G., Oxman, A. D., Schünemann, H. J., Tugwell, P., & Knottnerus, J. A. (2010). GRADE guidelines: A new series of articles in the Journal of Clinical Epidemiology. *Journal of Clinical Epidemiology*, 64(4), 380–382. <https://doi.org/10.1016/j.jclinepi.2010.09.011>
- Harmer, P. A. (2014). The effect of pre-performance massage on stride frequency in sprinters. *Athletic Training & Sports Health Care*, 6(5), 212–218. <https://doi.org/10.3928/19425864-20140924-01>

- Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg, J., Dahlström, Ö., & Renström, P. A. F. H. (2013). Injury patterns in Swedish elite athletics: annual incidence, injury types and risk factors. *British Journal of Sports Medicine*, 47(15), 941–952. <https://doi.org/10.1136/bjsports-2012-091651>
- Jiménez-Reyes, P., Samozino, P., Brughelli, M., & Morin, J. (2017). Effectiveness of an Individualized Training Based on Force-Velocity Profiling during Jumping. *Frontiers in Physiology*, 7, 677–677. <https://doi.org/10.3389/fphys.2016.00677>
- Karamanidis, K., & Epro, G. (2020). Monitoring Muscle-Tendon Adaptation Over Several Years of Athletic Training and Competition in Elite Track and Field Jumpers. *Frontiers in Physiology*, 11, 607544–607544. <https://doi.org/10.3389/fphys.2020.607544>
- Kerautret, Y., Rienzo, F. D., Eyssautier-Bavay, C., & Guillot, A. (2020). Selective Effects of Manual Massage and Foam Rolling on Perceived Recovery and Performance: Current Knowledge and Future Directions Toward Robotic Massages. *Frontiers in Physiology*, 11, 598898–598898. <https://doi.org/10.3389/fphys.2020.598898>
- Li, H., Luo, L., Zhang, J., Cheng, P., Wu, Q., & Wen, X. (2025). The effect of percussion massage therapy on the recovery of delayed onset muscle soreness in physically active young men—a randomized controlled trial. *Frontiers in Public Health*, 13, 1561970–1561970. <https://doi.org/10.3389/fpubh.2025.1561970>
- Maher, C. G., Sherrington, C., Herbert, R., Moseley, A. M., & Elkins, M. R. (2003). Reliability of the PEDro Scale for Rating Quality of Randomized Controlled Trials. *Physical Therapy*, 83(8), 713–721. <https://doi.org/10.1093/ptj/83.8.713>
- Malliaras, P., Kamal, B., Nowell, A., Farley, T., Dhamu, H., Simpson, V., Morrissey, D., Langberg, H., Maffulli, N., & Reeves, N. D. (2013). Patellar tendon adaptation in relation to load-intensity and contraction type. *Journal of Biomechanics*, 46(11), 1893–1899. <https://doi.org/10.1016/j.jbiomech.2013.04.022>
- Memain, G., Carling, C., Bouvet, J., Maillé, P., Tamalet, B., Fourcade, P., & You, É. (2024). Evaluation of the impact of a 3-week specific-sport rehabilitation program on neuromotor control during single-leg countermovement-jump tests in professional soccer players with lower-limb injuries. *Frontiers in Sports and Active Living*, 6, 1448401–1448401. <https://doi.org/10.3389/fspor.2024.1448401>
- Moyer, C. A., Rounds, J., & Hannum, J. W. (2004). A Meta-Analysis of Massage Therapy Research. *Psychological Bulletin*, 130(1), 3–18. <https://doi.org/10.1037/0033-2909.130.1.3>
- Ntshangase, S., & Peters-Futre, E. M. (2017). The efficacy of manual versus local vibratory massage in promoting recovery from post-exercise muscle damage – A systematic review. *Journal of Science and Medicine in Sport*, 20. <https://doi.org/10.1016/j.jsams.2017.01.117>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C. D., Shamseer, L., Tetzlaff, J., Akl, E. A., Brennan, S., Chou, R., Glanville, J., Grimshaw, J., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372. <https://doi.org/10.1136/bmj.n71>
- Pelt, D. W. V., Lawrence, M. M., Miller, B. F., Butterfield, T. A., & Dupont-Versteegden, E. E. (2021). Massage as a Mechanotherapy for Skeletal Muscle. *Exercise and Sport Sciences Reviews*, 49(2), 107–114. <https://doi.org/10.1249/jes.0000000000000244>
- Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Katrina, R., & Steven, D. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme*. <https://doi.org/10.13140/2.1.1018.4643>
- Poppendieck, W., Wegmann, M., Ferrauti, A., Kellmann, M., Pfeiffer, M., & Meyer, T. (2016). Massage and Performance Recovery: A Meta-Analytical Review. *Sports Medicine*, 46(2), 183–204. <https://doi.org/10.1007/s40279-015-0420-x>
- Shi, Y., & Wu, W. (2023). Multimodal non-invasive non-pharmacological therapies for chronic pain: mechanisms and progress. *BMC Medicine*, 21(1), 372–372. <https://doi.org/10.1186/s12916-023-03076-2>
- Siva, S., Suganthirababu, P., Prakash, V., Titus, J. S., Vignesh, S., Priyadarshini, K., Dhanusia, S., Santhanalakshmi, S., Vanitha, J., Das, K. P., & Fazulah, M. A. M. (2025). Evaluating the Effectiveness of Deep Transverse Frictional Massage Combined with Conventional Physiotherapy for Tendinopathies: A Systematic Review and Meta-analysis. *International Journal of Therapeutic Massage & Bodywork Research Education & Practice*, 18(2), 28–39. <https://doi.org/10.3822/ijtm.v18i2.1203>
- Stathas, I., Koundourakis, N., Christoforidis, C., Kouvidis, G., & Christakou, A. (2026). From Injury to Impact: Optimizing Return-to-Play Outcomes and Reinjury Prevention via Four-Pillar Rehabilitation Strategy in Elite Football—A Clinical Study in a Sports Scenario. *Muscles*, 5(1), 11–11. <https://doi.org/10.3390/muscles5010011>
- Timpka, T., Alonso, J. M., Jacobsson, J., Junge, A., Branco, P., Clarsen, B., Kowalski, J., Mountjoy, M., Nilsson, S., Pluim, B. M., Renström, P. A. F. H., Rønsen, O., Steffen, K., & Édouard, P. (2014). Injury and illness definitions and data collection procedures for use in epidemiological studies in Athletics (track and field): Consensus statement. *British Journal of Sports Medicine*, 48(7), 483–490. <https://doi.org/10.1136/bjsports-2013-093241>
- Torres, R., Ribeiro, F., Duarte, J. A., & Cabri, J. (2011). Evidence of the physiotherapeutic interventions used currently after exercise-induced muscle damage: Systematic review and meta-analysis. *Physical Therapy in Sport*, 13(2), 101–114. <https://doi.org/10.1016/j.ptsp.2011.07.005>
- Waters-Banker, C., Butterworth, L., & Dupont-Versteegden, E. E. (2014). Immunomodulatory effects of massage on muscle cells: An integrative review. *Journal of Athletic Training*, 49(6), 737–746. <https://doi.org/10.4085/1062-6050-49.3.65>
- Weerapong, P., Hume, P., & Kolt, G. S. (2005). The Mechanisms of Massage and Effects on Performance, Muscle Recovery and Injury Prevention. *Sports Medicine*, 35(3), 235–256. <https://doi.org/10.2165/00007256-200535030-00004>
- Wells, G. A. (2014). The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses. *Medical Entomology and Zoology*. <https://ci.nii.ac.jp/naid/20000796643/>
- Williams, S., Robertson, C. M., Starling, L., McKay, C., West, S., Brown, J., & Stokes, K. (2021). Injuries in Elite Men's Rugby Union: An Updated (2012–2020) Meta-Analysis of 11,620 Match and Training Injuries. *Sports Medicine*, 52(5), 1127–1140.

<https://doi.org/10.1007/s40279-021-01603-w>

- Yeung, S. S., & Yeung, E. W. (2019). Does manual therapy or cryotherapy hasten recovery from muscle injury? A systematic review. *Hong Kong Physiotherapy Journal*, 39(1), 9–22. <https://doi.org/10.1142/S1013702519500021>
- Zeng, Y., Ji, W., Ji, W., Shi, Y., Liu, W., Ji, W., & Ji, W. (2025). Sports injuries in elite football players: classification, prevention, and treatment strategies update. *Frontiers in Sports and Active Living*, 7, 1643789–1643789. <https://doi.org/10.3389/fspor.2025.1643789>