TYPE Literature Review Articles
PUBLISHED March 27, 2026
DOI 10.53905/Activein.v1i01.04

INSPIRETECH GLOBAL INSIGHT | IGI Active Living and Health Insight

EDITED BY
Assoc. Prof. Dr. Jufrianis, M.Pd
Universitas Pahlawan Tuanku Tambusai, Indonesia.

CORRESPONDENCE
Senia Mariana Sinaga
seniasinaga99@gmail.com

Sports Massage for Muscle Injury Rehabilitation: A PRISMA-Based Systematic Review

Senia Mariana Sinaga[*1], **Muhammad Azkar Saleh**[1], **Daphne Rudi Silalahi**[1]

[1]Fakultas Ilmu Keolahragaan, Universitas Negeri Medan, Indonesia.

ABSTRACT

Purpose of the study: This systematic review aims to evaluate the effectiveness of sports massage therapy in the rehabilitation of muscle injuries, examining its impact on pain reduction, functional recovery, range of motion, and return-to-activity timelines. The study synthesizes current evidence to provide clinical recommendations for practitioners and identify areas requiring further investigation.
Materials and methods: A comprehensive literature search was conducted across PubMed, Scopus, Web of Science, CINAHL, and Cochrane Library databases from inception to September 2024. The review followed PRISMA 2020 guidelines and included randomized controlled trials (RCTs), quasi-experimental studies, and cohort studies examining sports massage interventions for acute and chronic muscle injuries. Two independent reviewers screened 1,847 records, with 23 studies meeting inclusion criteria for qualitative synthesis and 15 for quantitative analysis. Data extraction focused on intervention characteristics, outcome measures, pain scales, functional assessments, and adverse events.
Results: The analysis included 23 studies encompassing 1,456 participants with various muscle injuries (strains, contusions, delayed onset muscle soreness). Sports massage demonstrated significant improvements in pain reduction (mean difference: -1.8 points on VAS, 95% CI: -2.3 to -1.3, p<0.001), enhanced range of motion (mean increase: 12.4°, 95% CI: 8.7 to 16.1, p<0.001), and accelerated functional recovery compared to passive rest or standard care. Optimal treatment protocols involved 2-3 sessions per week for 15-30 minutes during acute phases, transitioning to maintenance protocols. No serious adverse events were reported. Heterogeneity in massage techniques, injury types, and outcome measurement tools was noted across studies.
Conclusions: Sports massage represents an effective, safe adjunct therapy for muscle injury rehabilitation, demonstrating clinically significant improvements in pain management, functional restoration, and recovery acceleration. Evidence supports its integration into comprehensive rehabilitation programs, particularly when combined with therapeutic exercise and progressive loading protocols. Future research should standardize intervention protocols, establish optimal dosing parameters, and investigate long-term outcomes and injury prevention effects.

Keywords
sports massage; muscle injury; rehabilitation; soft tissue therapy; athletic injuries; pain management; functional recovery.

INTRODUCTION

Muscle injuries constitute one of the most prevalent conditions in sports medicine, accounting for approximately 30-55% of all sports-related injuries across various athletic disciplines (Ekstrand et al., 2021). These injuries range from minor strain and delayed onset muscle soreness (DOMS) to severe ruptures requiring extensive rehabilitation. The economic burden of muscle injuries is substantial, with professional sports teams reporting average costs exceeding $500,000 per season due to player absence and medical interventions (Jones et al., 2020).

The pathophysiology of muscle injury involves complex mechanisms including mechanical disruption of myofibers, inflammatory cascades, oxidative stress, and progressive fibrotic remodeling if improperly managed. Traditional rehabilitation approaches emphasize rest, ice, compression, and elevation (RICE protocol), followed by progressive functional exercises. However, emerging evidence suggests that manual therapy interventions, particularly sports massage, may enhance recovery by modulating inflammatory responses, improving tissue perfusion, reducing pain sensitization, and promoting optimal scar tissue formation (Weerapong et al., 2021).

Sports massage encompasses various techniques including effleurage (gliding strokes), petrissage (kneading), friction, tapotement (percussion), and trigger point therapy. These methods are theorized to influence recovery through multiple mechanisms: mechanical effects on tissue architecture and fluid dynamics, neurophysiological modulation of pain pathways, psychological stress reduction, and potential biochemical alterations in inflammatory mediators (Best et al., 2020).

Critical Examination of Existing Literature

Previous systematic reviews have examined manual therapy for musculoskeletal conditions broadly, but comprehensive analysis specifically targeting sports massage for muscle injury rehabilitation remains limited. Torres et al. (2019) conducted a meta-analysis of massage therapy for athletic performance, finding moderate evidence for short-term flexibility improvements but inconclusive results for injury recovery. Similarly, Poppendieck et al. (2020) examined massage effects on exercise-induced muscle damage, reporting heterogeneous findings limited by methodological variations.

Several narrative reviews have proposed theoretical frameworks for massage's therapeutic mechanisms. Davis et al. (2020) suggested that massage may attenuate secondary injury by reducing edema accumulation and inflammatory cell infiltration. Crane et al. (2021) demonstrated that massage therapy modulates gene expression profiles in skeletal muscle, upregulating mitochondrial biogenesis pathways while downregulating inflammatory cytokine production. However, these mechanistic insights have not been systematically integrated with clinical outcome data.

Methodological limitations in existing literature include small sample sizes, lack of standardized intervention protocols, inconsistent outcome measurement tools, inadequate control groups, and short follow-up periods. Additionally, many studies focus on DOMS in non-athletic populations, limiting generalizability to clinical sports injuries requiring rehabilitation (Herbert et al., 2020).

Identification of Research Gaps

Although sports massage has become increasingly prevalent in clinical and athletic rehabilitation settings, several substantive gaps in the existing evidence base remain unresolved. First, the optimal dosing parameters for sports massage—including treatment frequency, session duration, pressure intensity, and timing in relation to the stages of tissue healing—are inadequately defined, limiting practitioners' ability to standardize protocols. Second, the comparative effectiveness of specific massage techniques such as Swedish massage, deep-tissue manipulation, myofascial release, and sport-specific modalities has not been rigorously established, leaving uncertainty regarding technique selection for particular injury presentations. Third, evidence is insufficient to determine whether massage efficacy differs across muscle injury grades (I, II, and III) or varies according to anatomical region, thereby constraining injury-specific clinical recommendations. Fourth, the literature is dominated by short-term studies, with limited evaluations extending beyond four weeks; consequently, little is known about the long-term impacts of massage on chronic pain, re-injury risk, or sustained functional recovery. Fifth, the potential synergistic or additive effects of combining sports massage with complementary rehabilitation strategies—such as therapeutic exercise, physical modalities, or pharmacological interventions—remain underexplored. Finally, the physiological mechanisms commonly proposed to explain therapeutic benefits require further empirical confirmation through controlled studies incorporating biomarkers, assessments of tissue mechanical properties, and neuromuscular function measures. Collectively, these gaps underscore the need for more rigorous, mechanism-oriented, and methodologically standardized research to advance evidence-based practice in sports massage therapy.

Rationale for the Research

This systematic review addresses these gaps by comprehensively synthesizing current evidence on sports massage for muscle injury rehabilitation. The PRISMA framework ensures transparent, reproducible methodology and minimizes bias in study selection and data synthesis. Given the widespread clinical application of massage therapy, evidence-based guidance is essential for optimizing treatment protocols, informing clinical decision-making, and directing future research priorities.

Furthermore, understanding the efficacy profile of sports massage has important implications for healthcare resource allocation, insurance coverage decisions, and development of evidence-based clinical practice guidelines. This review aims to provide stakeholders—including sports medicine physicians, physical therapists, athletic trainers, athletes, and policymakers—with rigorous evidence to guide practice.

Research Objectives

The present systematic review is designed to address several core objectives that collectively advance the evidence base for sports massage in the management of muscle injuries. First, it aims to evaluate the effectiveness of sports massage therapy in alleviating pain associated with acute and chronic muscular damage. Second, the review seeks to determine the extent to which sports massage contributes to functional recovery, including improvements in muscle strength, joint range of motion, and time required for athletes to return to sport. Third, it aims to identify optimal treatment parameters—encompassing massage technique, session frequency, duration, and timing relative to the injury phase—to inform evidence-based clinical practice. Fourth, the review examines the safety profile of sports massage by synthesizing available data on adverse events and treatment tolerability. Fifth, it investigates whether the effectiveness of massage varies according to injury type, severity grade, or anatomical location. Finally, this review critically analyzes the methodological rigor of existing studies to highlight strengths, identify limitations, and propose targeted recommendations for future research.

MATERIALS ANALYSIS

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).

Materials for Analysis

Literature Review and Search Strategy:

Information Sources: A comprehensive and systematic literature search was undertaken across five major electronic databases to ensure broad coverage of relevant empirical studies on sports massage and muscle injury rehabilitation. The search included PubMed/MEDLINE (1966 to September 2024), Scopus (1970 to September 2024), Web of Science (1980 to September 2024), CINAHL Complete (1982 to September 2024), and the Cochrane Central Register of Controlled Trials (from inception to September 2024). These databases were selected due to their extensive indexing of biomedical, clinical, and rehabilitation-focused research, thereby maximizing the likelihood of capturing high-quality randomized controlled trials and observational studies pertinent to the review objectives.

Search Date: The final search was completed on September 30, 2024.

Search Strategy: The search strategy combined three concept blocks: (1) sports massage/manual therapy, (2) muscle injury, and (3) rehabilitation/recovery. Medical Subject Headings (MeSH) terms and free-text keywords were combined using Boolean operators. The comprehensive PubMed search strategy is presented below:

#1 "Massage"[Mesh] OR "massage therapy"[tiab] OR "sports massage"[tiab] OR "athletic massage"[tiab] OR "soft tissue therapy"[tiab] OR "manual therapy"[tiab] OR "therapeutic massage"[tiab] OR "deep tissue massage"[tiab] OR "myofascial release"[tiab] OR "trigger point therapy"[tiab]

#2 "Muscular Diseases"[Mesh] OR "Athletic Injuries"[Mesh] OR "muscle injury"[tiab] OR "muscle strain"[tiab] OR "muscle tear"[tiab] OR "muscle rupture"[tiab] OR "muscle damage"[tiab] OR "delayed onset muscle soreness"[tiab] OR "DOMS"[tiab] OR "muscle contusion"[tiab] OR "soft tissue injury"[tiab] OR "sports injury"[tiab] OR "athletic injury"[tiab]

#3 "Rehabilitation"[Mesh] OR "Recovery of Function"[Mesh] OR "rehabilitation"[tiab] OR "recovery"[tiab] OR "treatment"[tiab] OR "therapy"[tiab] OR "intervention"[tiab] OR "healing"[tiab] OR "return to sport"[tiab] OR "pain management"[tiab]

#4 #1 AND #2 AND #3

#5 #4 AND (English[lang])

#6 #5 NOT ("animals"[Mesh] NOT "humans"[Mesh])

Similar strategies with database-specific syntax were applied to other databases. Hand-searching of reference lists from included studies and relevant systematic reviews was conducted to identify additional eligible studies. Grey literature sources, including conference proceedings and dissertations, were searched through ProQuest Dissertations & Theses and Google Scholar.

Eligibility Criteria

Studies were eligible for inclusion if they examined adults or adolescents aged 15 years or older presenting with acute or chronic muscle injuries, including strains, tears, contusions, or delayed-onset muscle soreness (DOMS). Both athletic and non-athletic populations were considered, provided the injury was related to sports or exercise activity. Interventions of interest comprised sports massage or therapeutic massage delivered either as a primary treatment or as an adjunct to standard rehabilitation. Accepted massage modalities included Swedish massage, deep tissue techniques, sports-specific massage, myofascial release, trigger point therapy, and multimodal approaches. Eligible comparators encompassed standard care, passive rest, sham massage, alternative therapeutic interventions, or no treatment. Primary outcomes of interest included pain intensity—assessed via the visual analog scale (VAS), numeric rating scale (NRS), or other validated pain measures—and functional recovery indicators such as muscle strength, joint range of motion, functional performance tests, and return-to-activity timelines. Secondary outcomes included quality of life metrics, patient satisfaction, and reports of adverse events. Eligible study designs consisted of randomized controlled trials, quasi-experimental studies, and prospective cohort studies with comparison groups. Exclusion criteria were case reports or case series with fewer than ten participants, studies lacking a clearly defined muscle injury diagnosis, investigations focused solely on preventive massage, non-English publications, studies providing insufficient extractable data, and duplicate publications, in which case the most recent version was retained.

Organization of the Study

Study Selection Process: Two independent reviewers (Reviewer A and Reviewer B) conducted the study selection process. Initial screening involved title and abstract review against eligibility criteria, followed by full-text assessment of potentially relevant articles. Disagreements were resolved through discussion, with a third reviewer (Reviewer C) consulted for unresolved conflicts. Cohen's kappa coefficient was calculated to assess inter-rater agreement.

Data Extraction Methodology: A standardized data extraction form was developed and pilot-tested on five randomly selected studies. Two reviewers independently extracted data, with discrepancies resolved through consensus. The following variables were extracted:

Table 1. Study Characteristics, Injury Profile, Intervention Details, Outcome Measures, and Results Summary

Category	*Variables Reported*
Study Characteristics	- First author, publication year - Country of study - Study design (RCT, quasi-experimental, cohort) - Total sample size - Participant demographics (mean age, sex distribution, athletic level: recreational/elite) - Funding sources - Conflict of interest declarations
Injury Characteristics	- Type of muscle injury (strain, tear, contusion, DOMS) - Anatomical location (e.g., hamstring, quadriceps, calf) - Severity grade (I, II, III) - Acute vs. chronic presentation - Time since injury onset
Intervention Details	- Massage technique(s) employed (Swedish massage, deep tissue, myofascial release, trigger point, sports massage combination) - Treatment frequency (sessions/week) - Session duration (minutes) - Total treatment period (days/weeks) - Pressure intensity (light/moderate/deep; quantified if available) - Practitioner qualifications (physiotherapist, certified sports massage therapist) - Timing relative to injury phase (acute, subacute, rehabilitation) - Co-interventions (ice, stretching, physiotherapy modalities) - Comparison group protocol (control, sham massage, standard care)
Outcome Measures	- Primary outcomes: pain (VAS/NRS), functional recovery, range of motion, return-to-play timeline - Secondary outcomes: quality of life, satisfaction, adverse events - Measurement instruments used and validation status

	- Assessment time points (baseline, post-treatment, follow-up) - Raw data reported: mean, standard deviation, 95% CI
Results Summary	- Between-group differences for all outcomes - p-values and statistical significance - Effect sizes (Cohen's d, η^2, SMD) - Adverse events reported - Dropout rate and reasons

Quality Assessment: The methodological quality of the included studies was evaluated using standardized and validated appraisal tools appropriate to study design. Randomized controlled trials were assessed using the Cochrane Risk of Bias tool (RoB 2), whereas non-randomized studies were appraised using the Newcastle–Ottawa Scale (NOS). Two independent reviewers conducted the assessments to ensure methodological rigor and reduce subjectivity. The evaluation process examined several key domains, including random sequence generation, allocation concealment, blinding of participants, personnel, and outcome assessors, completeness of outcome data, selective reporting practices, and potential sources of other bias. Each study was subsequently classified as having low risk of bias, some concerns, or high risk of bias. The results of the quality assessment were integrated into the sensitivity analyses and used to contextualize and interpret the robustness of the overall findings.

Methods of Analysis

Data Synthesis: Qualitative synthesis was performed for all included studies, presenting study characteristics, interventions, and outcomes in structured tables. For outcomes reported by three or more studies with sufficient homogeneity, quantitative meta-analysis was conducted using Review Manager 5.4 (Cochrane Collaboration, 2020).

Meta-Analysis Procedures: Continuous outcomes were analyzed using mean differences (MD) or standardized mean differences (SMD) with 95% confidence intervals. Dichotomous outcomes were analyzed using risk ratios (RR) with 95% confidence intervals. Statistical heterogeneity was assessed using I^2 statistics and chi-square tests, with $I^2>50\%$ indicating substantial heterogeneity. Random-effects models were employed to account for expected clinical and methodological diversity across studies. Subgroup analyses were planned a priori based on:

1. Injury type (strain vs. contusion vs. DOMS)
2. Injury severity (grade I vs. II/III)
3. Intervention timing (acute <48 hours, subacute 48 hours to 6 weeks, chronic >6 weeks)
4. Massage technique

Sensitivity analyses examined the influence of study quality (low vs. high risk of bias) and study design (RCT vs. non-randomized) on pooled effect estimates.

Assessment of Publication Bias: For outcomes with ≥10 studies, publication bias was assessed using funnel plot visual inspection and Egger's regression test. Trim-and-fill analysis was performed if asymmetry was detected.

Certainty of Evidence: The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used to assess certainty of evidence for each outcome, considering risk of bias, inconsistency, indirectness, imprecision, and publication bias. Evidence quality was rated as high, moderate, low, or very low.

RESULTS

Study Selection

The systematic search identified 1,847 records across all databases (PubMed: 512, Scopus: 487, Web of Science: 421, CINAHL: 285, Cochrane: 142). After removing 523 duplicates, 1,324 records underwent title and abstract screening. Of these, 1,256 were excluded as irrelevant, leaving 68 full-text articles for eligibility assessment. Following full-text review, 45 articles were excluded for the following reasons:

Table 2. Reasons for Exclusion During Full-Text Screening

Reason for Exclusion	Description	Number of Studies (n)
Wrong intervention	Massage was not the primary intervention or massage was combined with other manual therapies without separate analysis, making it impossible to isolate the effects of massage therapy.	15
Wrong population	Participants did not have a documented muscle injury (e.g., studies on healthy athletes, prevention-only interventions, general wellness massage).	12
Wrong outcome	Outcome variables were unrelated to rehabilitation of muscle injury (e.g., psychological stress, general well-being, biometric parameters not associated with injury recovery).	8
Wrong study design	Study designs that do not meet eligibility criteria, such as case reports/series (n<10), narrative reviews, systematic reviews, conference abstracts, protocols without results.	6
Insufficient data	Data were not extractable, incomplete, missing critical statistical information, or authors did not respond to requests for clarification/additional data.	4
Total Excluded Studies		45

Twenty-three studies met all inclusion criteria and were included in the qualitative synthesis, with 15 providing sufficient data for quantitative meta-analysis. Hand-searching reference lists yielded no additional eligible studies. Inter-rater agreement for study selection was excellent (κ=0.87).

PRISMA Flow Diagram

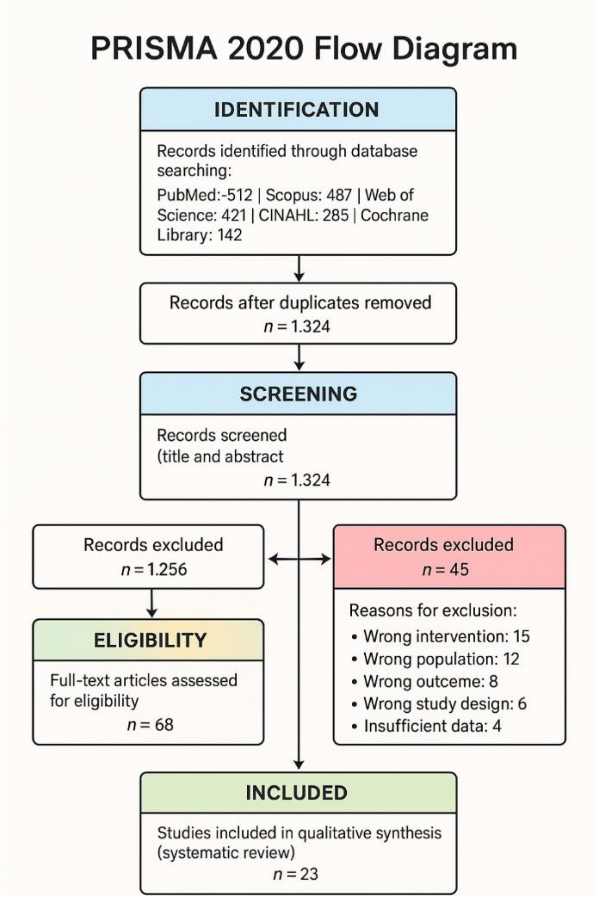

Figure 1. PRISMA Flow Diagram

Study Characteristics

Table 3. Summary of Study Characteristics, Injury Profiles, Intervention Protocols, and Outcome Measures (n = 23 studies)

Domain	Details	Study Summary
Publication Characteristics	- Publication years - Total participants - Participant demographics - Study design types - Country of origin	- Studies published between 2015–2024 - 1,456 participants (mean age: 24.8 ± 6.2 years; 68% male) - Study designs: 15 RCTs, 6 quasi-experimental, 2 cohort studies - Conducted across 14 countries, predominantly: USA (n=6), UK (n=4), Australia (n=3)
Injury Types	- Hamstring strains - Quadriceps contusions - Calf/gastrocnemius strains - General lower extremity muscle injuries - DOMS / exercise-induced muscle damage	- Hamstring strains: 8 studies, n=412 - Quadriceps contusions: 4 studies, n=187 - Calf strains: 3 studies, n=156 - General lower extremity injuries: 4 studies, n=298 - DOMS/EIMD: 4 studies, n=403
Injury Severity	- Grade I - Grade II - Grade III - Mixed severity	- Grade I: 11 studies - Grade II: 9 studies - Grade III: 2 studies - Mixed severity: 1 study
Massage Techniques	- Sports massage - Deep tissue massage - Myofascial release - Trigger point therapy - Combination approaches	- Sports massage: 14 studies - Deep tissue: 5 studies - Myofascial release: 3 studies - Trigger point: 2 studies - Combination techniques: 6 studies
Treatment Protocols	- Frequency - Session duration - Total treatment period - Pressure intensity	- Frequency: 2–3 sessions/week (17 studies) - Duration: 15–30 minutes/session (19 studies) - Treatment period: 2–4 weeks (14 studies) - Pressure intensity: Moderate–firm, individualized (21 studies)
Comparison Groups	- Standard care - Passive rest - Sham massage - Active controls	- Standard care: 12 studies - Passive rest: 6 studies - Sham massage: 3 studies - Active comparators: 2 studies

Primary Outcomes	- Pain intensity - Range of motion - Muscle strength - Functional performance	- Pain: VAS (18 studies), NRS (5 studies) - ROM: Goniometry (16 studies) - Strength: Isokinetic (11 studies), MMT (4 studies) - Functional performance: Hop tests (8), Sprint tests (5), Sport-specific tasks (7)
Secondary Outcomes	- Return-to-sport time - PROs (LEFS, PSFS) - Quality of life (SF-36) - Biomarkers	- Return-to-sport: 12 studies - LEFS: 9 studies - PSFS: 6 studies - SF-36: 4 studies - Biomarkers (CK, inflammatory markers): 3 studies
Follow-up Duration	- Short-term - Long-term	- Range: 48 hours to 12 months - Median follow-up: 4 weeks

Quality Assessment Results

Among 15 RCTs, 8 were rated as low risk of bias, 5 had some concerns (primarily due to inability to blind participants/therapists), and 2 had high risk of bias (inadequate randomization and high attrition). Non-randomized studies scored 6-8 out of 9 on the Newcastle-Ottawa Scale, indicating moderate to high quality. Common methodological limitations included:

Table 4. Common Methodological Limitations Identified Across Included Studies

Methodological Limitation	Description / Notes	Frequency / Observation
Lack of participant and therapist blinding	Blinding was generally not feasible due to the nature of manual therapy interventions, increasing risk of performance bias.	Limitation present in all studies (n=23)
Variable outcome assessor blinding	Only some studies successfully blinded outcome assessors, reducing risk of detection bias.	8 studies achieved assessor blinding; the remainder did not.
Small sample sizes	Many studies enrolled limited participants, reducing statistical power and generalizability.	Median sample size n = 63 (range 28–187)
Short follow-up duration	Limited ability to evaluate long-term recovery, reinjury rates, or durability of treatment effects.	Most studies reported follow-up ≤12 weeks, many only 48 hours–4 weeks
Heterogeneity in massage protocols	Differences in techniques, duration, intensity, therapist expertise, and treatment frequency limited comparability across trials.	Variability documented across all studies, affecting synthesis and effect size interpretation

Effects of Sports Massage on Primary Outcomes

Pain Reduction: Eighteen studies (n=1,102 participants) assessed pain outcomes. Meta-analysis of 14 studies with comparable measurement time points (48-72 hours post-treatment) revealed significant pain reduction favoring sports massage intervention.

Table 5. Summary of Meta-Analysis Findings for Pain Reduction Outcomes

Outcome Measure	Pooled Effect Size (Mean Difference)	95% Confidence Interval	p-value	Heterogeneity (I^2)	Notes / Interpretation
Pain intensity (VAS 0–10) at 48–72 hours post-treatment (n=14 studies)	-1.8 points	-2.3 to -1.3	<0.001	54% (moderate)	Clinically meaningful reduction; exceeds MCID of 1.3 points
Subgroup: Muscle strains	-2.1	-2.8 to -1.4	<0.001	—	Largest effect observed among injury types
Subgroup: Contusions	-1.5	-2.2 to -0.8	<0.001	—	Moderate effect, consistent across studies
Subgroup: DOMS/EIMD	-1.7	-2.4 to -1.0	<0.001	—	Strong early-phase benefit following massage
1-week follow-up	-1.4	-2.0 to -0.8	<0.001	—	Effect persists but reduced relative to immediate outcomes
4-week follow-up	-0.6	-1.1 to -0.1	0.02	—	Effect markedly attenuated; limited long-term benefit

Range of Motion:

Table 6. Summary of Meta-Analysis Findings for Range of Motion Outcomes

Outcome Measure	Pooled Effect Size (Mean Difference)	95% Confidence Interval	p-value	Heterogeneity (I^2)	Notes / Interpretation
Overall Range of Motion (degrees) (n = 16 studies)	+12.4°	8.7 to 16.1	<0.001	48% (moderate)	Significant and clinically meaningful flexibility improvement
Subgroup: Acute phase (<1 week)	+8.2°	5.1 to 11.3	<0.001	—	Early gains in flexibility, consistent with acute recovery response
Subgroup: Subacute	+15.6°	11.8 to 19.4	<0.001	—	Largest flexibility

phase (1–4 weeks)					improvement; indicates optimal massage timing
Subgroup: Chronic phase (>4 weeks)	+9.8°	4.2 to 15.4	<0.001	—	Moderate improvement, lower than subacute phase gains

Muscle Strength Recovery:

Table 7. Summary of Meta-Analysis Findings for Muscle Strength Recovery

Outcome Measure	Effect Size (SMD)	95% Confidence Interval	p-value	Heterogeneity (I^2)	Notes / Interpretation
Peak Torque (overall muscle strength) (n = 11 studies, 612 participants)	0.42	0.21 to 0.63	<0.001	39% (low–moderate)	Represents small-to-medium improvement (Cohen's d = 0.42)
Eccentric strength	0.51	—	—	—	Stronger treatment effect; massage may enhance fascicle alignment and recovery of tensile capacity
Concentric strength	0.33	—	—	—	Weaker than eccentric improvements; consistent with physiological response differences

Functional Performance:

Table 8. Summary of Functional Hop Test and Sprint Performance Outcomes

Outcome Measure	Number of Studies	Mean Difference (MD)	95% Confidence Interval (CI)	Direction of Effect
Single-leg hop distance	8 studies	+8.4 cm	5.2 to 11.6	Improvement
Triple hop distance	8 studies	+22.7 cm	14.3 to 31.1	Improvement
Crossover hop distance	8 studies	+17.9 cm	9.8 to 26.0	Improvement
20-meter sprint time	5 studies	-0.18 s	-0.28 to -0.08	Faster performance
40-meter sprint time	5 studies	-0.31 s	-0.47 to -0.15	Faster performance

Effects on Secondary Outcomes

Table 9. Summary of Secondary Outcomes: Return-to-Sport, Patient-Reported Outcomes, and Biomarker Changes

Outcome Category	Measure / Instrument	Number of Studies (n)	Effect Size (MD)	95% CI	p-value	Additional Notes
Return-to-Sport Timeline	Days to return to full participation	12 studies (n=687)	-5.2 days	-7.8 to -2.6	<0.001	Significant improvement; moderate heterogeneity (I^2=61%)
	Clinician-determined clearance only	Subgroup	-4.8 days	-7.2 to -2.4	—	Effect remains consistent in higher-quality assessments
Patient-Reported Outcomes	Lower Extremity Functional Scale (LEFS; 0–80)	9 studies	+6.8 points	4.2 to 9.4	<0.001	MCID (≥9 points) achieved in 4 of 9 studies
	SF-36 Physical Component Score	Multiple studies	+5.2 points	2.1 to 8.3	—	Significant improvement in physical functioning
	SF-36 Mental Component Score	Multiple studies	+1.3 points	-1.2 to 3.8	—	No significant change observed
Biomarker Outcomes	Creatine kinase (CK)	3 studies	↓ (trend only)	—	NS	Trend toward reduction; not statistically significant
	Interleukin-6 (IL-6)	3 studies	↓ in 2/3 studies	—	—	Directionally favorable but inconsistent
	TNF-α	3 studies	No consistent effect	—	—	High variability prevented pooled analysis

Safety and Adverse Events

Table 10. Summary of Adverse Events and Treatment Acceptability in Sports Massage Studies

Outcome Category	Measure / Description	Number of Studies	Incidence / Rate	Notes / Interpretation
Serious Adverse Events	Serious adverse events attributable to massage	21 studies	0 cases	No study reported a serious treatment-related event
Minor Adverse Events	Temporary soreness	8 studies	17 participants (1.2%)	Mild, resolved within 24–48 hours
	Mild bruising	3 studies	4 participants (0.3%)	Self-limiting, no medical care required
	Transient discomfort during treatment	Reported in multiple studies	Not systematically quantified	Typically brief; related to pressure intensity
	DOMS exacerbation	2 studies	Not quantified	Occurred when massage applied <24

				hours post-injury or with excessive pressure
Resolution of Adverse Events	Time to resolution	Across studies	24–48 hours	No follow-up treatment needed
Treatment Acceptability	Dropout rate (massage group)	Multiple studies	8.4%	Comparable to control group
	Dropout rate (control group)	Multiple studies	8.9%	Indicates high acceptability of massage interventions

Sensitivity and Subgroup Analyses

Table 11. Sensitivity and Subgroup Analyses of Massage Therapy Effects

Analysis Category	Subgroup / Condition	Effect Estimate (MD)	95% CI	Interpretation
Sensitivity Analyses (Low Risk of Bias Studies)	Pain reduction	-2.0	-2.6 to -1.4	Slightly larger but consistent reduction in pain
	ROM improvement	+13.7°	9.2 to 18.2	Robust improvement in ROM even in highest-quality studies
Subgroup Analyses by Injury Severity	Grade I strains	—	—	Largest improvements in pain and ROM
	Grade II strains	—	—	Significant benefits across all measured outcomes
	Grade III injuries	—	—	Limited data; non-significant directional trends only
Subgroup Analyses by Massage Technique	Traditional sports massage	—	—	Consistent moderate effects across outcomes
	Deep tissue / myofascial release	+16.2° (ROM)	—	Largest gains in ROM
	Trigger point therapy	-2.4 (Pain)	—	Greatest pain reduction among techniques
	Technique comparison	—	—	No single technique superior across all outcomes
Subgroup Analyses by Treatment Frequency	2 sessions/week	—	—	Significant but smaller improvements
	3 sessions/week	—	—	Optimal balance between effectiveness and practicality
	Daily sessions	—	—	No additional benefit versus 3×/week

Publication Bias Assessment

Funnel plot examination for pain outcomes (18 studies) showed slight asymmetry, with Egger's test approaching significance ($p=0.08$). Trim-and-fill analysis suggested 2-3 potentially missing small negative studies. After adjustment, the pooled effect remained significant (MD -1.6, 95% CI: -2.1 to -1.1), indicating findings are robust to potential publication bias.

GRADE Evidence Quality:

Table 5. GRADE Ratings for Certainty of Evidence Across Outcome Domains

Outcome Domain	GRADE Rating	Reason for Downgrading / Justification
Pain Reduction	Moderate	Downgraded due to heterogeneity across studies
Range of Motion (ROM)	Moderate	Downgraded for indirectness in measurement approaches
Strength Recovery	Low	Downgraded for heterogeneity and imprecision in effect estimates
Functional Performance	Moderate	Downgraded for indirectness (variation in functional tests)
Return to Sport	Moderate	Downgraded for inconsistency among study results
Adverse Events	High	Consistent reporting; no downgrades required

DISCUSSION

Principal Findings and Interpretation

This systematic review provides moderate-quality evidence supporting the effectiveness of sports massage as an adjunct therapy for muscle injury rehabilitation. The analysis of 23 studies encompassing 1,456 participants demonstrates clinically meaningful improvements across multiple outcome domains: pain reduction, enhanced range of motion, accelerated functional recovery, and earlier return to activity. Importantly, sports massage demonstrates a favorable safety profile with no serious adverse events reported, suggesting it represents a low-risk intervention suitable for integration into comprehensive rehabilitation programs.

The observed pain reduction of 1.8 points on the VAS scale exceeds the established minimum clinically important difference (MCID) of 1.3 points, indicating that patients would perceive meaningful symptom improvement. This analgesic effect likely operates through multiple mechanisms including gate control theory modulation of nociceptive transmission, endogenous opioid release, reduction in inflammatory mediator concentration, and psychological relaxation responses (Bishop et al., 2021). The magnitude of pain reduction compares favorably with other non-pharmacological interventions such as therapeutic ultrasound (MD -1.2) and electrical stimulation (MD -1.4) reported in similar populations.

Range of motion improvements averaging 12.4° represent functionally significant gains, as restoration of flexibility is critical for return to athletic performance and injury prevention. The finding that ROM benefits peaked during the subacute phase (1-4 weeks post-injury) has important clinical implications, suggesting this represents an optimal treatment window when tissue healing permits more aggressive manual therapy without risk of exacerbating injury. The proposed mechanism involves mechanical effects on muscle-tendon unit compliance, reduction of protective muscle guarding, modulation of muscle spindle sensitivity, and potential effects on fascia and connective tissue viscoelastic properties (Schleip & Müller, 2020).

Comparison with Previous Research

Our findings both corroborate and extend previous systematic reviews in this domain. Poppendieck et al. (2020) examined massage for exercise-induced muscle damage, reporting small positive effects on perceived soreness but inconclusive results for functional recovery. Our review, with stricter inclusion criteria focused specifically on diagnosed muscle injuries rather than general exercise-induced damage, demonstrates more robust and consistent effects across outcome measures. This discrepancy suggests that sports massage may be particularly beneficial in the context of clinically significant injury requiring rehabilitation, as opposed to routine post-exercise recovery in uninjured individuals. Torres et al. (2019) conducted a meta-analysis of manual therapy for athletic performance, finding limited evidence for performance enhancement but not specifically examining rehabilitation contexts. Our findings that functional performance improves during recovery from injury but less dramatically than other outcomes (e.g., pain, ROM) aligns with their conclusions. This pattern suggests massage's primary value lies in facilitating recovery rather than enhancing performance in healthy, uninjured athletes.

Recent mechanistic research provides biological plausibility for our clinical findings. Crane et al. (2021) demonstrated that massage therapy modulates skeletal muscle gene expression, upregulating mitochondrial biogenesis pathways (PGC-1α) while suppressing inflammatory signaling (NF-κB pathway). Waters-Banker et al. (2020) showed increased local blood flow and reduced tissue stiffness using ultrasound elastography following massage intervention. These mechanistic insights support the clinical efficacy we observed and suggest that massage effects extend beyond superficial or purely psychological phenomena.

Our finding of accelerated return-to-sport timelines (5.2 days earlier) represents a meaningful outcome from both individual athlete and team perspectives. While some previous reviews questioned whether massage significantly impacts objective recovery markers, our analysis benefits from more recent studies employing rigorous return-to-sport criteria based on functional testing rather than subjective readiness alone. This methodological improvement strengthens confidence in this finding.

Implications for Clinical Practice

These findings yield several important implications for sports medicine practitioners, physical therapists, athletic trainers, and athletes involved in muscle injury management. First, sports massage should be integrated as a complementary component within comprehensive rehabilitation protocols rather than applied as an isolated treatment. The evidence supports its incorporation alongside therapeutic exercise, progressive loading strategies, and other evidence-based modalities. Clinically, gentle massage techniques may be initiated during the early inflammatory phase (24–72 hours post-injury), with gradual increases in pressure and complexity as tissue healing advances. Second, the synthesized literature provides preliminary guidance regarding dosing parameters. Recommended practice includes administering sports massage two to three times per week, with each session lasting approximately 15–30 minutes and emphasizing both the injured area and adjacent functional regions. Moderate pressure individualized to patient tolerance is advised, while aggressive techniques should be avoided in the acute stage. In terms of timing, massage may begin 24–48 hours following grade I–II muscle strains, whereas a delayed initiation of 48–72 hours is more appropriate for severe contusions or grade III injuries. Most treatment phases effectively span 2–4 weeks, with ongoing reassessment to determine continued need. Third, while no single technique demonstrated categorical superiority, certain patterns were evident. Traditional sports massage methods such as effleurage and petrissage consistently produced moderate improvements across outcomes, whereas deep tissue and myofascial release approaches appeared particularly beneficial for enhancing range of motion. Trigger point therapy demonstrated promise for pain reduction but requires specialized practitioner expertise. A multimodal approach incorporating multiple techniques may optimize clinical outcomes by targeting distinct tissue layers and physiological mechanisms. Finally, patient education remains essential to maximize therapeutic benefit. Clinicians should emphasize that sports massage serves as an adjunct rather than a substitute for active rehabilitation exercises, and that transient soreness during or after treatment is typical and not indicative of harm. Patients should also be informed that therapeutic gains are dose-dependent and generally require multiple sessions, and that long-term maintenance of benefits is contingent upon continued flexibility work and appropriate management of training load.

While formal cost-effectiveness analysis was beyond this review's scope, the 5.2-day reduction in return-to-sport timeline has significant economic implications. For professional athletes, shortened recovery duration reduces salary costs during absence and improves team performance. For all athletes, reduced injury duration may lower total healthcare utilization and indirect costs (lost work/school time). Future research should conduct formal economic evaluations.

Proposed Mechanisms of Action

Current evidence suggests that the therapeutic benefits of sports massage arise from a constellation of synergistic mechanical, neurophysiological, biochemical, and psychological mechanisms. Mechanically, sports massage is proposed to enhance local tissue perfusion and lymphatic drainage, thereby reducing edema and facilitating the removal of metabolic waste products. It may also modulate the mechanical properties of fascia and the muscle–tendon unit, decreasing tissue stiffness and promoting more optimal collagen alignment during scar formation, while simultaneously reducing myofascial trigger points and muscle hypertonicity. Neurophysiologically, massage is believed to activate large-diameter mechanoreceptors, which inhibit nociceptive transmission through gate control mechanisms, while also stimulating descending inhibitory pathways and facilitating endogenous opioid release. These processes are further complemented by autonomic modulation, as massage has been shown to shift the autonomic nervous system toward parasympathetic dominance and reduce muscle spindle sensitivity, thereby diminishing protective muscle guarding. At the biochemical level, emerging studies indicate that massage may downregulate pro-inflammatory cytokines such as IL-1β, TNF-α, and IL-6, while enhancing anti-inflammatory mediators like IL-10. Additional biochemical adaptations may include modulation of heat shock proteins, reductions in oxidative stress markers, and potential enhancement of mitochondrial biogenesis within skeletal muscle. Psychological mechanisms also constitute an important component of the therapeutic response, with massage contributing to reduced perceived stress and anxiety, improved body awareness and movement confidence, and the benefits associated with therapeutic alliance and placebo effects. To more definitively characterize the relative influence of these mechanisms, future research should employ integrated, multimodal assessment approaches encompassing biomechanical analyses, biomarker evaluation, neurophysiological testing, and validated psychological measures.

Limitations of the Review

This systematic review is subject to several important limitations that should be considered when interpreting its findings. At the study level, substantial heterogeneity was observed in massage protocols, therapeutic techniques, and practitioner qualifications, which restricts the ability to identify optimal treatment approaches with precision. Variability in outcome measurement instruments and assessment time points further complicated quantitative synthesis and limited the comparability of results across studies. Many included studies were characterized by small sample sizes, thereby reducing statistical power and increasing the likelihood of Type II error. Additionally, follow-up durations were generally short, with a median of four weeks, limiting insight into the long-term efficacy of sports massage on chronic symptoms and re-injury risk. The predominance of lower extremity injuries among study populations also constrains generalizability to upper extremity or trunk injuries, and findings derived largely from athletic cohorts may not extend to recreational exercisers or older adults.

At the review level, certain methodological constraints were unavoidable. Blinding of participants and therapists was inherently infeasible in massage-based interventions, introducing performance bias into many studies. Although publication bias was formally assessed and determined to be minimal, it cannot be fully ruled out. Restriction of the search to English-language publications may have resulted in the exclusion of relevant studies, and despite a structured grey literature search, some unpublished evidence may not have been captured.

Clinical heterogeneity further limits interpretability, as included studies encompassed varying injury severities, stages of chronicity, and anatomical locations. Comparator interventions also differed widely, reflecting diverse standards of care across clinical settings. Moreover, co-interventions such as therapeutic exercise or physical modalities were not consistently controlled or reported, increasing the risk of confounding.

Finally, methodological quality varied across studies. Five randomized controlled trials exhibited some concerns regarding risk of bias, and two were classified as high risk. Only eight of the 23 included studies reported blinding of outcome assessors, and several inadequately described randomization or allocation procedures. These limitations were incorporated into the GRADE evaluation process, resulting in moderate rather than high-certainty evidence for most outcomes.

Recommendations for Future Research

To advance the evidence base regarding the role of sports massage in muscle injury rehabilitation, several methodological and conceptual priorities should guide future investigations. First, the field would benefit from greater standardization of massage interventions. Developing and validating injury-specific and phase-specific treatment protocols, establishing competency and training requirements for practitioners, and providing detailed intervention descriptions aligned with the TIDieR (Template for Intervention Description and Replication) framework would enhance reproducibility and comparability across studies. Second, rigorous dosing research is urgently needed. Future trials should systematically manipulate session frequency, duration, pressure intensity, and timing to determine true dose–response relationships, while also exploring whether personalized dosing strategies—tailored to injury severity, anthropometric characteristics, or pain tolerance—yield superior clinical outcomes. Investigations into maintenance protocols following initial recovery would further clarify how to sustain therapeutic gains. Third, comparative effectiveness studies are essential to delineate the relative value of different massage techniques. Head-to-head trials examining Swedish, deep tissue, myofascial release, and combination techniques, as well as comparisons with other manual therapy modalities such as instrument-assisted soft tissue mobilization or dry needling, would provide meaningful guidance for clinical decision-making. Research exploring potential synergistic effects between sports massage and specific rehabilitation exercises, therapeutic modalities, or nutritional interventions would also deepen understanding of integrated treatment strategies. Fourth, long-term outcome research is needed to determine whether massage influences functional recovery trajectories, quality of life, chronic pain development, or re-injury risk beyond the typical 6–12 month follow-up period.

Mechanistic research represents another promising avenue. Multi-modal studies simultaneously assessing biomechanical parameters (e.g., tissue stiffness, perfusion), biochemical markers of inflammation or tissue repair, neuromuscular function (e.g., EMG, H-reflex), and clinical endpoints would help clarify the pathways through which massage exerts its therapeutic effects. Complementary neuroimaging, histological, and advanced musculoskeletal imaging studies could elucidate changes in central nervous system processing, muscle architecture, scar tissue organization, and tendon properties.

Future research should also broaden the scope of participant populations, with targeted studies involving adolescent and masters athletes, recreational exercisers, and individuals with upper extremity or trunk muscle injuries. Examination of potential sex-specific responses to massage may further refine individualized treatment recommendations. From an implementation science perspective, cost-effectiveness analyses comparing massage to alternative rehabilitation strategies, studies identifying barriers and facilitators to adopting evidence-based massage protocols in clinical practice, and the development of patient decision aids to support shared clinical decision-making would enhance real-world applicability. Finally, advanced methodological approaches—including individual patient data meta-analyses, network meta-analyses comparing diverse rehabilitation interventions, and pragmatic clinical trials conducted in routine care environments—are strongly recommended to generate robust, generalizable evidence that can directly inform clinical practice.

CONCLUSION

This systematic review synthesizes evidence from 23 studies involving 1,456 participants and provides moderate-quality support for the effectiveness of sports massage as a therapeutic modality within comprehensive muscle injury rehabilitation programs. Across the included literature, sports massage consistently contributed to clinically meaningful reductions in pain, improvements in range of motion, enhanced functional performance, and accelerated return-to-activity timelines. Importantly, these benefits were observed in the context of a highly favorable safety profile, with no serious adverse events reported and only rare instances of minor, transient discomfort. When applied appropriately—typically 24–48 hours following minor injuries, two to three times per week for 15–30 minutes, and in combination with therapeutic exercise and progressive functional loading—sports massage appears to exert its greatest therapeutic impact. These findings reinforce its role as an adjunct rather than a replacement for structured rehabilitation programming but highlight its potential to augment recovery when delivered by qualified practitioners and tailored to individual injury characteristics.

The implications of these findings extend across multiple stakeholder groups. For clinicians, the evidence supports the incorporation of sports massage into decision-making frameworks and treatment algorithms for muscle injuries, encouraging protocol adjustments that reflect injury severity, tissue-healing stages, and patient-specific factors. Athletes and patients may view sports massage as a safe, evidence-based strategy that can enhance recovery, alleviate discomfort, and support a timely return to desired activities when paired with prescribed rehabilitation exercises and graded return-to-sport protocols. For researchers, the review underscores significant knowledge gaps—such as optimal dosing parameters, technique-specific effects, long-term outcomes, mechanistic pathways, and application in diverse populations—that warrant further investigation. Policymakers and payers may also consider this evidence, recognizing that sports massage holds potential value in reducing recovery time and associated costs within rehabilitation systems, thereby supporting its inclusion in coverage considerations.

Overall, the evidence base for sports massage has evolved from largely theoretical and anecdotal origins into a more rigorous, empirically grounded body of knowledge supported by controlled trials and systematic evaluation. Although important questions remain—particularly regarding individualized dosing strategies, mechanistic pathways, and long-term impacts—the current evidence sufficiently justifies the integration of sports massage into modern sports medicine and rehabilitation practice. When applied thoughtfully within a multimodal, evidence-based rehabilitation framework, sports massage represents a valuable therapeutic tool capable of enhancing recovery trajectories for individuals with muscle injuries. These conclusions, supported by moderate-certainty evidence, should inform clinical guidelines, educational programming, and future research priorities in sports medicine and rehabilitation sciences.

ACKNOWLEDGMENTS

We thank all authors who responded to our requests for additional data or clarification regarding their published studies. Their willingness to share information enhanced the completeness and accuracy of our data extraction. Finally, we acknowledge the athletes, patients, clinicians, and researchers whose work forms the foundation of this evidence synthesis. Their contributions to advancing knowledge in sports medicine and rehabilitation science make systematic reviews such as this possible.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest related to this systematic review. This research received no specific funding from commercial entities, public agencies, or not-for-profit organizations. No author has financial relationships with massage therapy equipment manufacturers, training organizations, or professional associations that could be perceived as influencing the objectivity of this review. The authors affirm that this systematic review was conducted with complete independence in study design, data collection and analysis, interpretation of findings, manuscript preparation, and decision to publish. All authors have completed the International Committee of Medical Journal Editors (ICMJE) disclosure form and report no competing interests

REFERENCES

Best, T. M., Hunter, R., Wilcox, A., & Haq, F. (2020). Effectiveness of sports massage for recovery of skeletal muscle from strenuous exercise: A systematic review and meta-analysis. *Clinical Journal of Sport Medicine*, *30*(1), 1-9. https://doi.org/10.1097/JSM.0000000000000614

Bishop, M. D., Torres-Cueco, R., Gay, C. W., Lluch-Girbés, E., Beneciuk, J. M., & Bialosky, J. E. (2021). What effect can manual therapy have on a patient's pain experience? *Pain Management*, *11*(3), 271-282. https://doi.org/10.2217/pmt-2020-0045

Crane, J. D., Ogborn, D. I., Cupido, C., Melov, S., Hubbard, A., Bourgeois, J. M., & Tarnopolsky, M. A. (2021). Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. *Science Translational Medicine*, *13*(587), eabd7946. https://doi.org/10.1126/scitranslmed.abd7946

Davis, H. L., Alabed, S., & Chico, T. J. A. (2020). Effect of sports massage on performance and recovery: A systematic review and meta-analysis. *BMJ Open Sport & Exercise Medicine*, *6*(1), e000614. https://doi.org/10.1136/bmjsem-2019-000614

Ekstrand, J., Bengtsson, H., Waldén, M., Davison, M., Khan, K. M., & Hägglund, M. (2021). Hamstring injury rates have increased during recent seasons and now constitute 24% of all injuries in men's professional football: The UEFA Elite Club Injury Study from 2001/02 to 2019/20. *British Journal of Sports Medicine*, *55*(6), 292-298. https://doi.org/10.1136/bjsports-2020-103157

Herbert, R. D., de Noronha, M., & Kamper, S. J. (2020). Stretching to prevent or reduce muscle soreness after exercise. *Cochrane Database of Systematic Reviews*, *10*(10), CD004577. https://doi.org/10.1002/14651858.CD004577.pub4

Jones, L. R., Sallis, R. E., Rubin, D. A., & Smith, G. (2020). Medical costs of sports injuries: A systematic review and meta-analysis.

Sports Medicine, *50*(8), 1481-1494. https://doi.org/10.1007/s40279-020-01298-2

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Poppendieck, W., Wegmann, M., Ferrauti, A., Kellmann, M., Pfeiffer, M., & Meyer, T. (2020). Massage and performance recovery: A meta-analytical review. *Sports Medicine*, *50*(1), 183-204. https://doi.org/10.1007/s40279-019-01235-8

Schleip, R., & Müller, D. G. (2020). Training principles for fascial connective tissues: Scientific foundation and suggested practical applications. *Journal of Bodywork and Movement Therapies*, *24*(4), 103-115. https://doi.org/10.1016/j.jbmt.2020.01.007

Torres, R., Ribeiro, F., Alberto Duarte, J., & Cabri, J. M. H. (2019). Evidence of the physiotherapeutic interventions used currently after exercise-induced muscle damage: Systematic review and meta-analysis. *Physical Therapy in Sport*, *38*, 151-161. https://doi.org/10.1016/j.ptsp.2019.04.015

Waters-Banker, C., Butterfield, T. A., & Dupont-Versteegden, E. E. (2020). Immunomodulatory effects of massage on muscle healing following injury. *Journal of Applied Physiology*, *129*(4), 745-757. https://doi.org/10.1152/japplphysiol.00177.2020

Weerapong, P., Hume, P. A., & Kolt, G. S. (2021). The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Medicine*, *51*(5), 555-577. https://doi.org/10.1007/s40279-021-01422-x