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EVALUATING THE EFFECTIVENESS OF CUPPING THERAPY IN ENHANCING MUSCULOSKELETAL RECOVERY IN ATHLETES

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Abstract

Background: Delayed onset muscle soreness (DOMS) impairs athletic performance by causing pain, stiffness, and reduced joint mobility. Cupping therapy, a traditional technique increasingly used in sports recovery, is claimed to mitigate DOMS, but robust evidence is scarce.

Objective: To compare the efficacy of cupping therapy versus standard recovery methods (static stretching and ice application) in alleviating DOMS, improving joint range of motion (ROM), and enhancing athlete satisfaction.

Methods: In a randomized controlled trial, 50 athletes (56% male, mean age 24.98 ± 2.48 years) with DOMS (baseline VAS ≥4) were assigned to either a cupping therapy group (10-minute dry cupping sessions, three times weekly) or a control group (15-minute static stretching and ice sessions, three times weekly) for 6 weeks. Outcomes included DOMS intensity (Visual Analog Scale, VAS), knee ROM (goniometer), and satisfaction (5-point Likert scale), assessed at baseline, week 3, and week 6. Data were analyzed using paired and independent t-tests.

Results: At week 6, the cupping group showed significantly lower VAS scores ($M = 3.08$, $SD = 1.55$) than the control group ($M = 5.56$, $SD = 1.04$; $t = -6.63$, $p < 0.001$, Cohen's $d = -1.88$). ROM improved significantly overall ($p = 0.001$, Cohen's $d = -0.50$), but group differences were not assessed. Satisfaction averaged 2.86 ($SD = 1.33$) without group-specific analysis.

Conclusion: Cupping therapy effectively reduces DOMS intensity, supporting its role in sports recovery. Larger studies with group-specific ROM and satisfaction comparisons are warranted.

Keywords: Cupping therapy, delayed onset muscle soreness, range of motion, athlete satisfaction, sports physiotherapy, pain relief, recovery intervention

INTRODUCTION

Delayed onset muscle soreness (DOMS) is a common condition characterized by muscle pain, stiffness, reduced strength, and limited joint range of motion (ROM) that typically emerges 24–72 hours after intense or unaccustomed exercise, particularly activities involving eccentric muscle contractions [1]. Symptoms peak around 48 hours post-exercise and generally resolve within 5–7

days, affecting approximately 25–35% of athletes annually across various sports, including running, weightlifting, and team sports [2]. DOMS disrupts athletic performance by impairing mobility, decreasing muscle power, and increasing injury risk due to compensatory movement patterns. Cupping therapy, an ancient therapeutic practice originating over 3,000 years ago in Chinese, Egyptian, and Middle Eastern medical traditions, involves applying suction cups to the skin to promote healing and recovery [3]. Its proposed mechanisms include enhanced blood circulation, myofascial decompression, neural modulation, and anti-inflammatory effects, which may address the multifaceted symptoms of DOMS [4].

The management of DOMS has been a focus of sports science, with various recovery modalities explored to mitigate its impact on athletic performance. Conventional approaches, such as cryotherapy, massage therapy, and compression garments, are widely used but demonstrate variable efficacy. Cryotherapy, for instance, reduces tissue temperature and swelling but may delay the inflammatory processes essential for muscle repair [5]. Massage therapy can alleviate soreness and improve flexibility, yet its outcomes depend heavily on the practitioner's expertise and technique consistency [6]. Compression garments enhance venous return and reduce edema, but their benefits are primarily limited to circulatory improvements [7]. These limitations highlight the need for alternative interventions that can consistently address DOMS symptoms while supporting adaptive muscle recovery.

Cupping therapy has gained significant attention in sports physiotherapy, particularly following its high-profile use by athletes like Michael Phelps during the 2016 Rio Olympics, which brought global visibility to the technique [2]. Athletes and clinicians report that cupping reduces muscle soreness, enhances joint mobility, and accelerates recovery, with anecdotal evidence suggesting improvements in sleep quality and overall well-being [4]. Scientific studies propose several physiological mechanisms underlying these benefits. Cupping's suction creates negative pressure, increasing local blood flow by up to 400%, as measured by laser Doppler imaging, which facilitates the clearance of metabolic byproducts like lactate and hydrogen ions accumulated during exercise [8]. This enhanced circulation, driven by nitric oxide production and capillary recruitment, may alleviate hypoxia and support muscle repair [9]. Additionally, cupping promotes myofascial decompression, reducing tissue adhesions and intramuscular pressure, which can enhance ROM and decrease pain by relieving nociceptor compression [10]. Neural mechanisms, such as the gate control theory of pain and the release of endogenous opioids (e.g., β-endorphins), further contribute to pain relief, while parasympathetic activation may reduce muscle tension [11]. Cupping also modulates inflammation by downregulating pro-inflammatory cytokines (e.g., IL-6, TNF-α) and upregulating anti-inflammatory markers (e.g., IL-10), potentially attenuating DOMS-related inflammation without hindering muscle adaptation [12].

Despite these promising mechanisms, the evidence base for cupping therapy remains limited. Many studies suffer from methodological flaws, including small sample sizes, inconsistent treatment protocols, and potential placebo effects, which undermine their reliability [2]. For example, while some trials report a 15–20% improvement in ROM and reduced pain scores on the Visual Analog Scale (VAS) within 48 hours post-cupping, others fail to demonstrate significant differences compared to controls [13]. The lack of large-scale, randomized controlled trials (RCTs) evaluating cupping's efficacy in sports recovery represents a critical gap in the literature. Furthermore, comparisons with conventional methods are sparse, with few studies directly assessing cupping against cryotherapy or massage in terms of pain relief, functional recovery, or athlete satisfaction [14]. This paucity of robust data restricts cupping's integration into evidence-based sports physiotherapy protocols.

Rationale for Study

DOMS affects a substantial proportion of athletes, with an estimated 25–35% prevalence across sports disciplines, leading to significant performance impairments, including reduced joint mobility, diminished muscle strength (up to 50% in severe cases), and heightened injury risk due to altered biomechanics [2]. The limitations of traditional recovery methods underscore the need for innovative, non-invasive interventions. Cryotherapy, while effective for acute swelling, may delay tissue healing

by suppressing inflammation, and massage therapy's variability limits its reliability in standardized settings [5, 6]. Compression garments, though beneficial for circulation, lack the multifaceted effects of cupping, such as fascial decompression and neural modulation [7]. Cupping therapy's growing popularity in sports, driven by anecdotal reports of reduced soreness and improved flexibility, suggests its potential as a recovery tool. However, the absence of rigorous, controlled studies evaluating its impact on DOMS severity, joint mobility, and athlete perceptions hinders its adoption in clinical practice. This study aims to address this gap by systematically investigating cupping therapy's efficacy through a controlled experimental design, providing evidence to inform its use in sports physiotherapy. Establishing a scientific basis for cupping could optimize recovery strategies, enhance athletic performance, and guide clinicians in developing standardized protocols for DOMS management.

Hypothesis and Objectives

Null Hypothesis (H_0):

There is no significant effect of cupping therapy on musculoskeletal recovery among athletes suffering from delayed onset muscle soreness (DOMS).

Alternative Hypothesis (H_1):

There is a significant effect of cupping therapy on musculoskeletal recovery among athletes suffering from delayed onset muscle soreness (DOMS).

The objectives are:

- To assess the effectiveness of cupping therapy in reducing DOMS intensity compared to conventional recovery methods in athletes following intense exercise.
- To quantify improvements in joint range of motion (ROM) in athletes experiencing DOMS after cupping intervention.
- To evaluate athletes' satisfaction and perceived effectiveness of cupping therapy as a recovery modality using a standardized assessment scale.

By addressing these objectives through a rigorous experimental approach, this study seeks to provide evidence-based insights into cupping's role in sports recovery, ultimately contributing to improved athletic performance and clinical practice.

MATERIALS AND METHODS

Participants

This study targets competitive and recreational athletes aged 18–35 years experiencing delayed onset muscle soreness (DOMS) following intense exercise, recruited from the Limra Sports Physiotherapy Clinic in Okhla, New Delhi, India. The sample includes athletes engaged in sports such as running, football, basketball, and weightlifting, where DOMS is prevalent due to eccentric muscle contractions. A total of 50 participants (25 per group) are enrolled, with the sample size calculated using G*Power software (version 3.1) to achieve 80% power, a medium effect size of 0.5 (Cohen's d), and a significance level of $\alpha = 0.05$ (two-tailed) for independent t-tests. This yields a minimum of 22 participants per group, increased to 25 to account for a 10–15% dropout rate due to potential non-compliance or scheduling conflicts.

Inclusion Criteria:

- Athletes aged 18–35, male or female, participating in competitive or recreational sports.
- Confirmed DOMS within 24–72 hours post-exercise, with a Visual Analog Scale (VAS) score ≥4.
- Willingness to commit to a 6-week intervention and attend all assessments.

Exclusion Criteria:

- Chronic musculoskeletal conditions (e.g., arthritis, tendonitis) that may confound DOMS evaluation.

- Skin conditions (e.g., eczema, open wounds) or anticoagulant use (e.g., hemophilia) increasing risks from cupping.
- Recent (within 4 weeks) use of other recovery modalities (e.g., acupuncture, electrical stimulation).
- Inability to perform the standardized exercise protocol due to injury or limitations.

Participants are selected via simple random sampling, with randomization to the cupping therapy or control group performed using a computer-generated list (Random.org), stratified by sport type to ensure balanced representation. An independent researcher oversees randomization to maintain blinding of the intervention administrator.

Interventions

The experimental group receives dry cupping therapy, administered three times weekly for 6 weeks. Each 10-minute session involves placing four plastic cups (5 cm diameter) on the quadriceps (two per thigh, targeting rectus femoris and vastus lateralis) at a standardized suction pressure, performed by a certified physiotherapist in a private treatment room. The control group undergoes a standard recovery protocol, consisting of 10-minute static stretching sessions (e.g., standing quadriceps stretch, 30 seconds per leg) followed by 15-minute ice pack application (wrapped to prevent frostbite), also administered three times weekly for 6 weeks. Both interventions are conducted at the Limra Sports Physiotherapy Clinic, equipped with modern tools to ensure consistency.

Study Design

This study employs a randomized controlled trial (RCT) with a parallel-group design to compare the efficacy of cupping therapy versus standard recovery methods in managing DOMS. Participants are randomly assigned to either the cupping therapy or control group, with assessments conducted at baseline, week 3, and week 6 to track changes in outcomes over the 6-week intervention period. A standardized exercise protocol (30-minute sprint intervals: 10 sets of 30-second sprints at 80% maximum effort, 1-minute rest intervals) is used to induce DOMS in the quadriceps, ensuring consistency across groups. The RCT design minimizes bias through randomization and blinding, enabling causal inferences about the interventions' effects on DOMS intensity, range of motion (ROM), and athlete satisfaction.

Procedures

The study follows a structured protocol to ensure reliable data collection:

- Recruitment and Screening: Athletes are recruited via clinic advertisements and local sports clubs. Eligible participants undergo a health screening to confirm DOMS (VAS ≥4) and rule out contraindications.
- Informed Consent: Participants receive a detailed explanation of study procedures, risks (e.g., minor bruising from cupping), and benefits.
- DOMS Induction: A treadmill-based exercise protocol (30-minute sprint intervals) induces quadriceps DOMS, standardized across participants.
- Randomization: Participants are assigned to groups using a concealed, computer-generated randomization list, stratified by sport type.
- Intervention Delivery:
- Cupping Group: Receives 10-minute dry cupping sessions (four cups, quadriceps-focused) three times weekly.
- Control Group: Receives 10-minute static stretching and 15-minute ice application three times weekly.
- Assessments:
- Baseline: DOMS intensity (VAS, 0–10 scale), knee flexion ROM (goniometer), and demographic data (age, gender, sport type) are recorded.
- Week 3: Midpoint assessment of DOMS and ROM to monitor progress.

- Week 6: Final assessment includes DOMS, ROM, and athlete satisfaction (5-point Likert scale: 1 = very dissatisfied, 5 = very satisfied).
- Data Security: Data are anonymized using unique identifiers and stored in a password-protected database, accessible only to the research team.

Data Analysis

Statistical analyses are conducted using SPSS software (version 26). Primary outcomes (DOMS intensity, ROM) are compared between groups using independent t-tests for continuous data at each time point (baseline, week 3, week 6). Repeated-measures ANOVA assesses changes within groups over time, with post-hoc tests (Bonferroni correction) for significant findings. Athlete satisfaction (Likert scale) is analyzed using Mann-Whitney U tests due to its ordinal nature. Effect sizes (Cohen's d) are calculated to quantify intervention effects. Control variables (age, gender, sport type) are included as covariates in ANCOVA models to adjust for potential confounding. Statistical significance is set at $p < 0.05$ (two-tailed). Missing data due to dropouts are handled using intention-to-treat analysis with last-observation-carried-forward imputation. Results are reported as means ± standard deviations for DOMS and ROM, with median scores for satisfaction.

RESULTS

Demographic Data

The study included 50 athletes (28 male, 56%; 22 female, 44%) with a mean age of 24.98 years (SD = 2.48, range: 19–30). Runners comprised 66% (n = 33), with 34% (n = 17) participating in other sports (e.g., football, basketball). Participants were evenly randomized into cupping therapy (n = 25) and traditional therapy (n = 25) groups. Baseline measures showed comparable pain intensity (Visual Analog Scale [VAS], M = 6.42, SD = 1.39, range: 4–9) and knee flexion range of motion (ROM, M = 124.86°, SD = 6.43, range: 108–135) across groups, ensuring group equivalence (Table 1).

Quantitative Results

Paired samples t-tests revealed significant improvements in pain and ROM from baseline to week 6 across all participants. VAS scores decreased from 6.42 to 4.32 (mean difference = 2.10, $t = 7.78$, $p < 0.001$, Cohen's $d = 1.10$), indicating substantial pain reduction. ROM improved from 124.86° to 128.18° (mean difference = -3.32°, $t = -3.55$, $p = 0.001$, Cohen's $d = -0.50$), reflecting moderate mobility gains. Within-group analyses showed the cupping group had a larger VAS reduction (6.40 to 3.08, mean difference = 3.32, $t = 7.67$, $p < 0.001$, Cohen's $d = 2.22$) compared to the traditional therapy group (6.44 to 5.56, mean difference = 0.88, $t = 3.15$, $p = 0.004$, Cohen's $d = 0.75$). ROM improvements were significant in both groups (cupping: 124.56° to 128.44°, $p = 0.006$, Cohen's $d = -0.60$; traditional: 125.16° to 127.92°, $p = 0.010$, Cohen's $d = -0.66$), with slightly greater gains in the cupping group (3.88° vs. 2.76°).Between-group comparisons at week 6 showed a significant difference in VAS scores (cupping: M = 3.08, SD = 1.55; traditional: M = 5.56, SD = 1.04; $t = -6.63$, $p < 0.001$, Cohen's $d = -1.88$), confirming cupping's superior pain reduction. No significant difference was observed in ROM (cupping: M = 128.44°, SD = 5.22; traditional: M = 127.92°, SD = 4.10; $t = 0.36$, $p = 0.718$, Cohen's $d = 0.10$).

Table 1: Demographic and Outcome Measures

Variable	Category/Statistic	Frequency	Percent	Valid Percent	Cumulative Percent	Mean	SD	Min	Max
Gender	Male	28	54.9%	56.0%	56.0%	-	-	-	-
	Female	22	43.1%	44.0%	100.0%	-	-	-	-
Sport Type	Running	33	64.7%	66.0%	66.0%	-	-	-	-
	Other	17	33.3%	34.0%	100.0%	-	-	-	-
Group	Cupping	25	49.0%	50.0%	50.0%	-	-	-	-
	Traditional Therapy	25	49.0%	50.0%	100.0%	-	-	-	-

Age	-	-	-	-	-	24.98	2.475	19	30
Baseline VAS	-	-	-	-	-	6.42	1.386	4	9
Baseline ROM	-	-	-	-	-	124.86	6.427	108	135

Demographic characteristics and changes in VAS and ROM from baseline to week 6 for cupping (n = 25) and traditional therapy (n = 25) groups. Data include means, SDs, t-tests, p-values, and effect sizes.

DISCUSSION

This study evaluated cupping therapy's efficacy compared to traditional recovery methods (static stretching and ice application) in reducing delayed onset muscle soreness (DOMS), improving joint range of motion (ROM), and enhancing athlete satisfaction among 50 athletes. The findings, derived from t-tests and descriptive statistics, are interpreted within a framework positing that cupping promotes recovery through increased blood flow, myofascial decompression, neural modulation, and anti-inflammatory effects. This discussion integrates results with prior literature, explores clinical implications, and addresses limitations and future research directions.

Objective 1: Reduction in DOMS Intensity

The cupping group exhibited significantly lower pain scores at week 6 (VAS: M = 3.08, SD = 1.55) compared to the traditional therapy group (M = 5.56, SD = 1.04; t = -6.63, $p < 0.001$, Cohen's d = -1.88), supporting the hypothesis that cupping reduces DOMS intensity more effectively. Within-group analyses confirmed substantial pain reduction in the cupping group (baseline: M = 6.40 to week 6: M = 3.08, $p < 0.001$, Cohen's d = 2.22) versus a modest reduction in the traditional group (baseline: M = 6.44 to week 6: M = 5.56, p = 0.004, Cohen's d = 0.75). These results align with the proposed mechanisms: cupping's suction enhances blood flow, clearing metabolic byproducts like lactate, while neural modulation via gate control theory and anti-inflammatory effects (e.g., reduced IL-6) mitigate pain [8, 11, 12]. A 2018 study reported similar pain relief with cupping (Cohen's d = 0.7), though our larger effect size may reflect the standardized protocol (10-minute sessions, three times weekly) [2]. Unlike a 2020 RCT that found no benefit over sham treatment due to small samples (n = 30), our robust design (n = 50, balanced groups) and baseline equivalence (p = 0.920) enhance reliability [3]. Clinically, cupping's superior pain reduction suggests its integration into sports physiotherapy to accelerate recovery, particularly for athletes like runners (66% of sample), who experience eccentric stress. Compared to cryotherapy, which may delay healing by limiting blood flow, cupping offers a non-invasive alternative [5].

Objective 2: Improvement in Joint Range of Motion

ROM improved significantly across all participants from baseline (M = 124.86°, SD = 6.43) to week 6 (M = 128.18°, SD = 4.66; t = -3.55, p = 0.001, Cohen's d = -0.50), with the cupping group showing a slightly larger gain (3.88°, p = 0.006) than the traditional group (2.76°, p = 0.010). However, no significant between-group difference was observed at week 6 (p = 0.718, Cohen's d = 0.10), limiting conclusions about cupping's superiority. The ROM gains support cupping's role in fascial decompression, reducing muscle stiffness caused by DOMS-related inflammation [10]. A 2019 study reported a 4° ROM increase with cupping, consistent with our 3.32° overall gain, suggesting practical benefits for mobility-dependent athletes [15]. The lack of group-specific differences may stem from baseline ROM variability in the cupping group (SD = 8.16 vs. 4.19), potentially masking effects. Clinically, cupping may complement stretching to enhance flexibility, but its modest effect size warrants cautious application until further evidence confirms its advantage over traditional methods.

Objective 3: Athlete Satisfaction

Satisfaction scores at week 6 (5-point Likert scale) showed a neutral mean (M = 2.86, SD = 1.33), with 34% neutral (n = 17), 22% very dissatisfied (n = 11), and 14% very satisfied (n = 7). The absence of group-specific comparisons limits insights into cupping's perceived effectiveness. The neutral

score contrasts with a 2019 study where 80% of athletes rated cupping highly, possibly due to our inclusion of both intervention groups or stricter evaluation criteria [15]. Satisfaction may be influenced by placebo effects from cupping's visible marks or unfamiliarity among younger athletes (mean age = 24.98). Clinically, educating athletes on cupping's evidence-based benefits (e.g., pain reduction) could improve acceptability and adherence, especially when combined with familiar modalities like stretching.

Limitations and Future Directions

Limitations include the lack of group-specific satisfaction and week 3 VAS comparisons, which restrict nuanced insights. The sample size (n = 50), while adequate, may not generalize to elite athletes or diverse sports. The 24-hour DOMS assessment window may miss peak soreness at 48 hours. Future studies should employ larger, multi-center designs, assess satisfaction by group, and explore long-term effects (e.g., beyond 6 weeks). Combining cupping with other modalities (e.g., dynamic stretching) could also be investigated to optimize recovery protocols.

CONCLUSION

This study of 50 athletes demonstrated that cupping therapy significantly reduced delayed onset muscle soreness (DOMS) intensity (VAS: $p < 0.001$, Cohen's $d = -1.88$) compared to traditional therapy (static stretching and ice application) and improved joint range of motion (ROM: $p = 0.001$, Cohen's $d = -0.50$) over 6 weeks, supporting its efficacy for pain relief. However, the lack of group-specific ROM and satisfaction comparisons limits conclusions about cupping's superiority in these areas. The findings suggest cupping's potential as a non-invasive intervention in sports physiotherapy, particularly for runners, by enhancing recovery through vasodilation and fascial decompression. Clinicians should integrate cupping with stretching to optimize outcomes and educate athletes to manage expectations. Future research should include larger samples, extended follow-ups, biomarker analyses, and group-specific comparisons to validate long-term benefits and mechanisms, ensuring broader applicability across sports and muscle groups.

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