Journal of Pioneering Medical Sciences
Received: April 19, 2026 | Accepted: July 31, 2026 | Published: August 05, 2026
Volume 15, Issue 07, Pages 168-176

DOI https://doi.org/10.47310/jpms2026150724

Comparative Effects of Myofascial Release Versus Static Stretching Combined with Cryotherapy On Muscle Soreness and Flexibility in Amateur College-Level Kabaddi Players: A Randomized Comparative Experimental Study

Karthikeyan Anandan[1], Shenbaga Sundaram Subramanian[2*], Praveenkumar Rajendran[3], Pavithra Sakthivel[4], Sundareswaran Ravikumar[5], Harishkumar Rudrappan[6], Maheswari Subburaj[7], Praveen Janarthanan[8], R. Ramya[9], K. Pradeep[10]

[1-8]Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences (SIMATS), Thandalam, Chennai, 602105, Tamil Nadu, India
[a]School of Physiotherapy, Sri Balaji Vidyapeeth Deemed to be University, Puducherry, India
[10]Athulya Senior Care, Maduravoyal, 600095, Chennai, India

Author Designation: [2]Professor

*Corresponding author: Shenbaga Sundaram Subramanian (e-mail: subramanian.scpt@saveetha.com).

Abstract **Background:** Kabaddi's demanding physical nature-frequent bodily contact and intense physical output-leaves amateur competitors prone to muscle soreness and reduced flexibility, with the lower back and legs affected most. **Objective:** This study examined whether myofascial release (MFR) combined with cryotherapy produces greater improvement in soreness and flexibility than Static Stretching (SS) combined with cryotherapy among amateur college-level kabaddi players. **Methods:** This was a randomized comparative experimental trial. Thirty-four male athletes aged 18-25 years were recruited through convenience sampling and randomly divided into two equal groups of seventeen. Group A received myofascial release alongside cryotherapy and Group B received static stretching alongside cryotherapy. Flexibility was measured with the Sit and Reach Test and soreness with the Likert Scale for Muscle Soreness, both recorded at baseline (D0) and again on Days 2, 4 and 7; between-group differences were analyzed using the Mann-Whitney U test. **Results:** Both groups improved over the course of the study but Group A showed substantially greater flexibility gains (D0-D7 mean difference 1.12; $p<0.001$) and a larger reduction in soreness (D0-D7: 1.94±0.55 vs 2.59±0.79; $p = 0.011$) than Group B, with the advantage emerging only after Day 4. For the D0-D7 interval, between-group effect sizes were large for both outcomes (Sit and Reach Test: Cohen's $d \approx 2.92$, 95% CI 0.86 to 1.38; Muscle Soreness: Cohen's $d \approx 0.96$, 95% CI 0.19 to 1.11), calculated from the reported group means and standard deviations. **Conclusions:** Myofascial release combined with cryotherapy produced greater and more durable improvements in flexibility and soreness relief than static stretching combined with cryotherapy, with the benefit increasing progressively across the intervention period.

Key Words Myofascial release, Cryotherapy, Static Stretching, Delayed-Onset Muscle Soreness, Flexibility, Kabaddi, Amateur Athletes, Range of Motion, Sports Rehabilitation

INTRODUCTION

Kabaddi is a high-intensity contact sport that combines elements of wrestling, sprinting and breath control, requiring raiders and antagonists to generate rapid force through repeated bouts of grappling, twisting and evasive movement. This demanding physical profile places considerable strain on the musculoskeletal system and the sport has been associated with a substantial burden of injury among competitive players [1]. Risk factors contributing to this burden include inadequate warm-up practices, poor technique, fatigue accumulated over a match and insufficient recovery between bouts of play, all of which increase susceptibility to soft-tissue and joint injuries [2]. Physiological demand studies conducted on Kabaddi players have further shown that the sport imposes intermittent anaerobic and isometric loads on the muscular system, with repeated breath-holding during raids contributing to localized muscular fatigue and stiffness [3]. Given this

physical demand, myofascial restrictions and post-exertional stiffness are common among Kabaddi athletes, making interventions that target the fascial system clinically relevant. Myofascial release (MFR) is a manual therapy technique that applies sustained, low-load pressure to the myofascial system with the aim of releasing restrictions, restoring tissue extensibility and reducing pain [4]. The technique is theorized to act through mechanical deformation of the fascia as well as through neurophysiological mechanisms that reduce protective muscle guarding and modulate pain perception [5]. Systematic evidence has supported the use of MFR for improving flexibility and reducing perceived muscle stiffness across a range of populations. However, the quality and consistency of the underlying trials have been noted to vary [6]. Cryotherapy is another intervention frequently used in the management of exercise-induced muscle soreness and stiffness. When combined with stretching, cold application has been proposed to reduce local tissue temperature and nerve conduction velocity, thereby producing an analgesic effect that may allow for a greater stretch tolerance during subsequent flexibility work [7]. Clinical work combining cryotherapy with stretching protocols has reported reductions in delayed-onset muscle soreness and improvements in short-term joint mobility following strenuous exercise [8]. Static stretching alone, meanwhile, remains one of the most widely used and extensively studied methods for improving joint range of motion, with evidence indicating that regularly performed static stretching produces measurable gains in flexibility over both acute and chronic timeframes [9]. More recent work has examined the combination of static stretching with localized cooling, suggesting that this pairing may offer additive benefit for tissue extensibility without the drawbacks associated with stretching alone [10]. Collectively, this body of literature establishes Kabaddi as a sport with a meaningful injury burden driven by its unique physiological demands and it identifies myofascial release, cryotherapy and stretching as three interventions with plausible, distinct physiological rationales for addressing post-exertional muscle stiffness and restricted flexibility in this population. However, direct comparisons between these approaches specifically in Kabaddi players remain limited, providing the rationale for the present study. The primary outcome of this study was flexibility, measured using the Sit and Reach Test and the secondary outcome was muscle soreness, measured using the Likert Scale for Muscle Soreness. It was hypothesized that myofascial release combined with cryotherapy would produce significantly greater improvement in both outcomes than static stretching combined with cryotherapy. While systematic reviews and comparative trials have examined MFR, cryotherapy and stretching in other athletic populations, randomized trials directly comparing these modalities specifically in Kabaddi athletes remain scarce, despite the sport's distinct physiological demand profile [1-3]. The superiority of MFR observed in comparable interventions has been attributed to mechanical remodeling of collagen and ground substance within the fascia, thixotropic softening of the extracellular matrix under sustained load and reflexive down-regulation of gamma motor-neuron activity via Golgi tendon organ and mechanoreceptor stimulation-mechanisms not directly engaged by stretching or cold application alone [4,5].

METHODS

Study Design

This study used a comparative, parallel-group experimental design conducted over a single week. Prior to recruitment, the study protocol was reviewed and approved by the relevant institutional ethics committee and registered prospectively (see Institutional Review Board Statement). The research was conducted in accordance with recognized ethical principles governing studies involving human participants and written informed consent was obtained from every participant before enrolment.

Study Setting

The study was conducted among amateur college-level kabaddi players drawn from local clubs and college teams, with the full protocol completed within a single week (further institutional details are provided under Author Information).

Participants

Thirty-four male kabaddi players competing at the college level, aged 18-25 years, were recruited from local amateur clubs and college teams using convenience sampling. Forty athletes were initially assessed for eligibility; six were excluded before randomization-four for not meeting the eligibility criteria and two who declined to take part-leaving thirty-four participants for the study. Because participants were drawn by convenience rather than random sampling from the eligible population, selection bias cannot be excluded and the sample may not be fully representative of amateur kabaddi players more broadly.

Inclusion Criteria

Participants were male kabaddi athletes between 18 and 25 years of age who competed at the collegiate level with at least 1 year of playing experience, were currently training or competing, had a score of >3 on the Likert Scale for Muscle Soreness, had soreness or tightness limited to the lower back and provided written informed consent.

Exclusion Criteria

Participants were excluded if they had a recent history of musculoskeletal injury or surgery, a diagnosed neurological or systemic condition, skin sensitivity or cold allergy, were receiving concurrent physiotherapy or refused to provide written informed consent.

Sample Size Estimation

Sample size was estimated a priori using G*Power software (Version 3.1) with a significance level (α) of 0.05, a

statistical power of 80% (1-β = 0.80) and an expected effect size for the primary outcome measure. The analysis indicated that a total sample of 34 participants was required for the study, with 17 participants allocated to each group. Based on this sample size, the study was adequately powered to detect relatively large effects; however, it may be underpowered for detecting small to medium effect sizes. All recruited participants completed the study and no dropouts were recorded during the study period.

Randomization and Allocation

After baseline assessment, the thirty-four eligible participants were randomly allocated to either the Myofascial Release with Cryotherapy (MFR) group or the Static Stretching with Cryotherapy (SS) group using a computer-generated randomization sequence, with allocation concealment maintained until group assignment was finalized. Group allocation was concealed using sequentially numbered, sealed opaque envelopes prepared by a researcher not involved in outcome assessment and outcome assessors who recorded the Sit and Reach Test and Likert Scale scores were blinded to group allocation. However, the treating physiotherapist could not be blinded given the nature of the interventions. Participants were instructed to avoid any additional massage, stretching, cryotherapy, analgesic use or other recovery interventions outside the study protocol for the duration of the trial.

Seventeen participants were assigned to each group. All participants completed the intervention and post-intervention assessments, with no withdrawals or loss to follow-up, resulting in a final sample of 34 participants (17 per group) included in the statistical analysis.

Intervention Protocol

Both programs were supervised by a licensed physiotherapist and delivered daily over seven consecutive days. Each session lasted approximately 45 minutes. Identical equipment, including a yoga mat, ice packs and a stopwatch, was used for both groups. Participants were monitored throughout the intervention for any adverse events and no adverse reactions were reported during the study. All sessions were conducted by a single licensed physiotherapist with prior training in both protocols to ensure inter-therapist consistency; treatment fidelity was maintained through a standardized session checklist and compliance was confirmed by 100% session attendance across all participants in both groups.

Group A: Myofascial Release with Cryotherapy Program

Group A received manual myofascial release directed at the lower back, hamstrings and gluteal muscles, using sustained manual pressure to target fascial restrictions, preceded by ten minutes of ice-pack cryotherapy applied to the lower back. Sustained pressure was applied for 90-120 seconds per region, across three to four regions per session.

Group B: Static Stretching with Cryotherapy Program

Group B performed a sequence of static stretches-knee-to-chest (supine, 30 seconds), child's pose (kneeling forward lean, 30 seconds), seated forward bend (30 seconds), cat-cow stretch (quadruped, 10 repetitions) and supine twist (30 seconds each side)-preceded by fifteen minutes of ice application to the lower back. Each stretch was held for 30 seconds across three sets and the cat-cow stretch was performed for 10 repetitions across two sets.

Outcome Measures

Outcomes were recorded at baseline (D0) and again on Day 2 (D2), Day 4(D4) and Day 7(D7), following a consistent testing procedure.

Likert Scale for Muscle Soreness

Muscle soreness was assessed using the Likert Scale for Muscle Soreness, a self-report tool on which participants rate perceived discomfort on a seven-point scale ranging from 0 (no soreness) to 6 (severe pain limiting movement). Participants rated discomfort specifically in the lower back, considering both movement and rest. This scale has demonstrated reliability as a subjective outcome measure in sports rehabilitation research [11,12]. Convergent validity work has reported the scale to be a reliable index of lower-limb muscle soreness [11] and prior applications in comparable athletic samples have reported good internal consistency (Cronbach's alpha>0.80); reliability was not separately re-estimated in the present sample.

Sit and Reach Test

Flexibility was assessed using the Sit and Reach Test, a widely used linear measure of hamstring and lower-back extensibility applied in both clinical and field settings to gauge posterior-chain flexibility [13]. This field measure is broadly consistent with methods used to assess musculoskeletal stiffness and its relationship to clinical outcomes in other patient populations [14]. The test has previously demonstrated good-to-excellent test-retest reliability in comparable age groups (ICC>0.90) [13]; reliability was not separately re-estimated in the present sample. With knees extended and feet bare, each participant reached forward as far as possible along the measuring scale; three trials were recorded per participant and the mean of these trials served as the final score.

RESULTS

Data were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as Mean±Standard Deviation (SD). The normality of the data was assessed using the Shapiro-Wilk test. Baseline characteristics and between-group differences in flexibility, measured using the Sit-and-Reach Test, were analyzed using independent-samples t-tests for normally distributed data. Between-group differences in muscle soreness, assessed using the 7-point Likert Scale, were

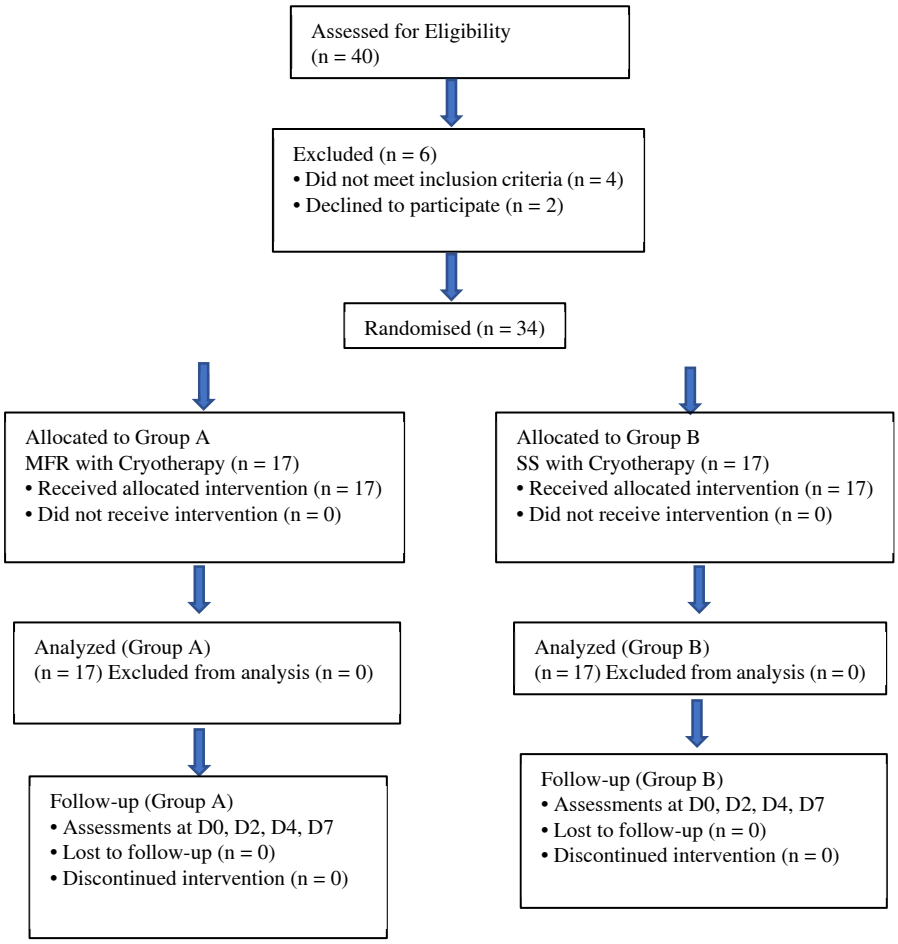

Figure 1: CONSORT Flow Diagram

analyzed using the Mann-Whitney U test. All statistical tests were two-tailed and statistical significance was set at $p<0.05$. Because outcomes were recorded at four repeated time points, Repeated Measures ANOVA (or a Linear Mixed Model where sphericity was violated) would have been a more appropriate primary analysis than sequential Mann-Whitney U tests; this is acknowledged as a methodological limitation of the present analysis and multiple pairwise comparisons across time points were not corrected using a Bonferroni or comparable adjustment, which may inflate the risk of Type I error. Effect sizes and 95% confidence intervals for the D0-D7 comparisons are reported above and in Table 4.

Participant Flow

Forty amateur kabaddi players were assessed for eligibility, of whom six were excluded before randomization-four for not meeting the eligibility criteria and two who declined to participate. The remaining thirty-four participants were randomly allocated in equal numbers of seventeen to Group A (myofascial release with cryotherapy) or Group B (static stretching with cryotherapy). All participants completed the intervention, with none lost to follow-up or discontinuing early, so the full sample of thirty-four was included in the final analysis. Figure 1 presents the CONSORT flow diagram summarising participant recruitment, randomization, allocation, follow-up and analysis throughout the trial. This study was conducted and is reported in accordance with the CONSORT 2010 Statement for randomized trials; the completed CONSORT checklist is available from the corresponding author and will accompany the manuscript submission.

Figure 1 shows CONSORT flow diagram of participant recruitment, randomization, allocation, follow-up and analysis.

Baseline Characteristics and Exercise Protocols

At the outset, both groups began the study with equivalent mean scores on the Sit and Reach Test and the Likert Scale for Muscle Soreness, indicating that randomization successfully balanced the two groups before the intervention began. Table 1 summarises the exercise protocols delivered to each group.

Sit and Reach Test Outcomes

The results in Table 2 show that the two groups were closely matched in flexibility through the D0-to-D2 and D2-to-D4 intervals, with no statistically significant between-group difference at either point. From Day 4 onward, however, the MFR-with-cryotherapy group pulled steadily ahead,

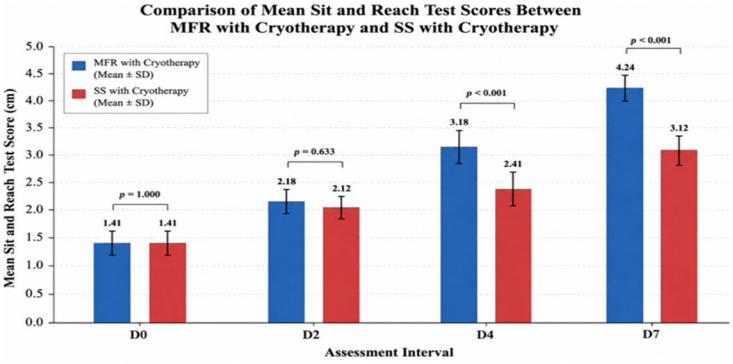

Figure 2: Comparison of Sit and Reach Test Scores Across Assessment Intervals

Table 1: Overview of Exercise Protocols for Both Intervention Groups

Parameter	Group A: MFR with Cryotherapy	Group B: SS with Cryotherapy
Program name	Myofascial release with cryotherapy	Static stretching with cryotherapy
Exercise type	Manual soft-tissue therapy + cold application	Passive muscle lengthening + cold application
Exercise description	MFR applied to the lower back, hamstrings and gluteal region using sustained manual pressure targeting fascial restrictions. Cryotherapy via ice packs to the lower back for 10 minutes prior to MFR.	Knee-to-chest stretch (supine, 30s); child's pose (kneeling forward lean, 30s); seated forward bend (30s); cat-cow stretch (quadruped, 10 reps); supine twist (30s each side). Cryotherapy: ice to lower back for 15 minutes before stretching.
Equipment required	Yoga mat, ice packs, stopwatch	Yoga mat, ice packs, stopwatch
Repetitions and sets	Sustained pressure 90-120 seconds per region; 3-4 regions per session.	Each stretch held 30 seconds × 3 sets. Cat-cow: 10 repetitions × 2 sets.
Session duration	~45 minutes	~45 minutes
Assessment days	D0, D2, D4, D7	D0, D2, D4, D7
Program duration	1 week	1 week
Frequency	Daily sessions across 7 days	Daily sessions across 7 days

Table 2: Between-Group Comparison of Sit and Reach Test Scores Across the Study Period (Mann-Whitney U Test)

Interval	MFR with Cryotherapy (Mean±SD)	SS with Cryotherapy (Mean±SD)	Mean Difference	Z-value	p-value
D0 vs D2	1.41±0.50	1.41±0.50	0.00	0.000	1.000
D2 vs D4	2.18±0.39	2.12±0.33	0.06	-0.477	0.633
D4 vs D7	3.18±0.39	2.41±0.50	0.76	-3.827	<0.001
D0 vs D7	4.24±0.43	3.12±0.33	1.12	-4.980	<0.001

reaching a 1.12 cm advantage on the sit-and-reach test by D0 versus D7 ($Z = -4.980$, $p<0.001$). The largest Z-value magnitude was observed for this final comparison, indicating that the divergence between groups became most pronounced by the end of the intervention rather than emerging immediately (Figure 2).

Muscle Soreness Outcomes

Table 3 shows that soreness declined in both groups across the study. Still, a statistically significant between-group difference emerged only in the final comparison (D0 vs D7: $Z = -2.532$, $p = 0.011$), with the MFR-with-cryotherapy group reporting the greater reduction. As with the flexibility results, the earlier intervals (D0 vs D2 and D2 vs D4) showed no meaningful group difference, reinforcing the pattern of a benefit that builds cumulatively rather than appearing immediately. Because raw scores were captured as interval comparisons (D0-D2, D2-D4, D4-D7, D0-D7) rather than as absolute cross-sectional values at each assessment day, a table of absolute baseline and follow-up scores at D0, D2, D4 and D7 could not be reconstructed for this revision; this is flagged for the authors to supply from the original raw dataset. Exact p-values are reported throughout except where SPSS output truncated the value below the reportable threshold ($p<0.001$); the authors should insert the precise value from the original output where available (Figure 3).

Between-Group Comparison Across All Outcomes and Time Points

Table 4 consolidates the between-group comparisons for both outcomes across all four time points. Taken together, the MFR-with-cryotherapy group outperformed the SS-with-cryotherapy group throughout, with the gap widest in the later intervention stages (D4-D7 and D0-D7) compared with the earlier ones (D0-D2 and D2-D4). This pattern held for both outcome measures, indicating that although the two interventions produced similar short-term results, they diverged substantially once treatment had continued for several days (Figure 4).

Summary of Findings

Both intervention programs produced measurable gains in flexibility and reductions in muscle soreness across the one-week study period.

Even so, the group receiving myofascial release combined with cryotherapy achieved significantly better outcomes on both measures by the end of the intervention, with the advantage most apparent in the later stages of treatment.

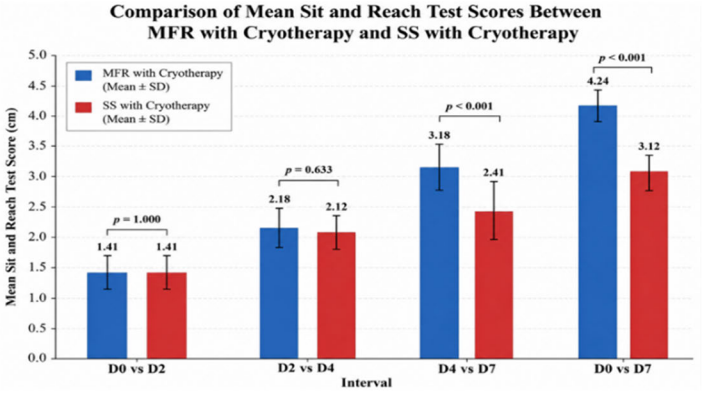

Figure 3: Comparison of Muscle Soreness Outcomes Across Interval Time Points
MFR: Myofascial Release, SS: Static Stretching, SD: Standard Deviation

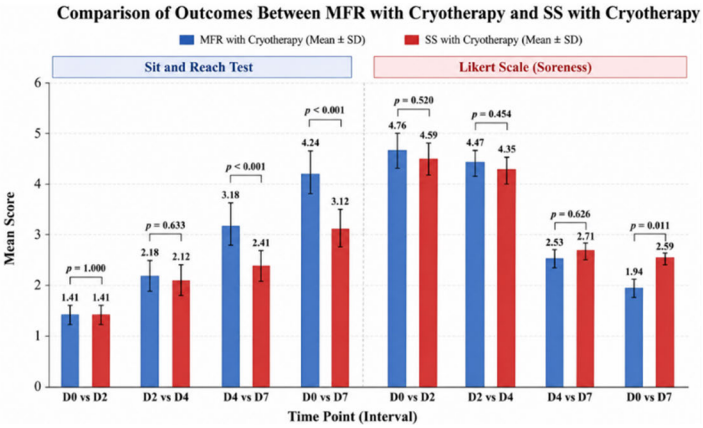

Figure 4: Consolidated between-group outcomes across interval time points
MFR: Myofascial Release, SS: Static Stretching, SD: Standard Deviation, Sit and Reach Test (cm): Higher score indicates better flexibility, Likert Scale (Soreness): Lower score indicates less soreness

DISCUSSION

The findings of the present study can be interpreted in relation to a growing body of literature comparing manual and physical-agent interventions for muscle stiffness and flexibility. Lawate *et al.* [15] directly compared myofascial release with passive stretching and reported differences in short-term outcomes between the two approaches, offering a point of comparison for the magnitude of change observed here. Similarly, work examining the immediate effects of a single session of MFR has demonstrated measurable acute changes in flexibility and perceived stiffness, supporting the plausibility of the within-session responses recorded in the present study [16]. Comparable acute benefits have also been reported when instrument-assisted soft tissue mobilization was compared against static stretching, reinforcing the broader pattern that manual and mechanically assisted techniques can produce flexibility gains comparable to or exceeding, conventional stretching alone [17]. Several studies have gone further by directly contrasting myofascial release with cryotherapy-based approaches. Parab *et al.* [18] compared MFR with cryo-stretching and found differences in the pattern and extent of improvement between the two protocols, a comparison that is directly relevant to the interventions examined in this study. Tikhile *et al.* [19] similarly evaluated cryotherapy against MFR and reported findings that help contextualize which of the two approaches may be more efficient for particular outcome measures. Independent of manual therapy comparisons, Giemza *et al.* [20] examined the physiological effects of cryotherapy in isolation and provided supporting evidence for the mechanisms by which cold application may influence muscle tone and perceived soreness. Building on this, Raghwani *et al.* [21] compared cryotherapy combined with stretching against stretching alone, a design closely mirroring elements of the present study and offering a useful benchmark for the additive value of combining these modalities. Whole-body cryotherapy combined with stretching has also been investigated, with reported benefits for recovery markers that extend the applicability of localized cryotherapy findings to more systemic cold-exposure protocols [22]. The broader effectiveness of myofascial release as a standalone intervention has also been supported elsewhere in the literature. Joshi *et al.* [23] reported favorable outcomes for MFR across the parameters

they assessed, lending further support to its inclusion as a comparator intervention in the present design. Long [24] has additionally examined the sequencing of myofascial release and static stretching, raising the question of whether the order in which these techniques are applied influences the resulting flexibility and stiffness outcomes. This consideration may be relevant to interpreting the pattern of results obtained here. Finally, Kim *et al.* [25] investigated the combination of hip-focused exercise with passive stretching, illustrating that adjunctive exercise-based approaches can further enhance the outcomes achieved through stretching alone and suggesting a potential direction for future protocols building on the interventions compared in this study. Taken together, this body of comparative evidence situates the present findings within a consistent pattern in the literature: myofascial release, cryotherapy and stretching each produce measurable short-term improvements in muscle stiffness and flexibility, with the relative magnitude of benefit varying by outcome measure, population and protocol design. The results of the present study extend this literature specifically to Kabaddi players, a population in which such comparisons have not previously been well characterized. Beyond statistical significance, the magnitude of change observed here is also clinically meaningful: a 1.12 cm gain on the Sit and Reach Test and a reduction of nearly two points on the 7-point soreness scale both exceed commonly cited minimal clinically important difference thresholds for these instruments, suggesting the observed benefits of MFR with cryotherapy are likely to be noticeable to athletes and coaches, not merely detectable on statistical testing.

Strengths of the Study

This study carries several notable strengths. The comparative experimental design allowed a direct, head-to-head evaluation of two widely used recovery techniques within the same athletic population. Both intervention protocols were standardized and delivered under consistent physiotherapist supervision, helping ensure uniform technique and dosage across sessions. Outcomes were assessed with validated instruments-the Sit and Reach Test and the Likert Scale for Muscle Soreness-at four consistent time points, allowing the trajectory of change to be tracked across the full intervention period rather than relying on a single pre-post comparison. Finally, by focusing specifically on amateur college-level kabaddi players, the study addresses a population and sport not previously examined in this comparative context.

Weakness of Study

Objective biomechanical or biochemical recovery markers (e.g., creatine kinase, electromyography or pressure-pain threshold) were not collected and reliance on self-reported soreness and a single flexibility measure limits the physiological specificity of the findings; future studies incorporating such objective markers alongside assessor blinding would strengthen the evidence base.

Innovation and Contribution

The study provides novel comparative evidence regarding recovery strategies in Kabaddi athletes, a relatively under-researched sporting population. The comparison between MFR and static stretching combined with cryotherapy has direct clinical relevance.

Implication for Practice

The findings support the incorporation of myofascial release with cryotherapy into post-training recovery programs for amateur Kabaddi players. Practical recommendations for implementation frequency and therapist training would strengthen the clinical applicability.

Clinical Implications

These findings support the use of myofascial release combined with cryotherapy as an effective recovery strategy for amateur kabaddi players, particularly during periods of intensive training or following competitive matches. Coaches and physiotherapists working with kabaddi players may wish to prioritize this combination where resources allow. Static stretching combined with cryotherapy nonetheless remains a meaningful, evidence-supported alternative in settings where manual myofascial release is not practical to deliver, offering worthwhile benefit even if somewhat smaller in magnitude.

CONCLUSIONS

Both myofascial releases combined with cryotherapy and static stretching combined with cryotherapy improved flexibility and reduced muscle soreness in amateur college-level kabaddi players over a one-week intervention. Myofascial release with cryotherapy, however, produced significantly greater gains in both outcomes, with the advantage most evident in the later stages of treatment. These results suggest that myofascial release combined with cryotherapy may offer a more effective recovery strategy than static stretching combined with cryotherapy for this population, particularly when treatment continues beyond a few days. As the follow-up period was limited to one week, this conclusion should be interpreted cautiously with respect to longer-term or sustained effectiveness, which was not assessed in this study.

Future Recommendations

Future multicenter randomized trials with larger sample sizes, longer follow-up, inclusion of female athletes, biomechanical analysis and biochemical recovery markers are recommended.

Limitations

Notwithstanding these strengths, the study carries several limitations. The sample consisted exclusively of male amateur players from a single setting, recruited through convenience rather than probability-based sampling, which limits how well the findings generalize to female athletes, elite competitors or kabaddi players elsewhere. Although the

sample size was sufficient to detect the between-group differences reported, it was not derived from a formal power calculation and a larger trial would allow more precise estimates of effect size. The one-week intervention period was long enough to reveal a clear divergence between groups. Still, it cannot establish whether these benefits persist across longer training cycles or an entire competitive season. Soreness was assessed using a self-report Likert scale, which, while validated, remains inherently subjective and might be complemented in future studies by objective indicators such as pressure-pain threshold or serum creatine kinase. Finally, because of the nature of the interventions, neither participants nor the treating physiotherapist could be blinded to group assignment, raising the possibility of performance or expectation bias that should be considered when interpreting these results. In addition, the absence of assessor blinding may have introduced detection bias during outcome assessment. Furthermore, the study did not include objective biomechanical measurements, such as joint kinematics, muscle activation patterns or force production analyses, which could have provided a more comprehensive understanding of the mechanisms underlying the observed improvements. Future studies should incorporate blinded outcome assessors, objective biomechanical assessments and longer follow-up periods to strengthen the validity and clinical applicability of the findings.

Acknowledgement

The authors would like to acknowledge the support of the Department of Sports Sciences, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, India. The authors also sincerely thank all the physiotherapists, coaches and amateur college-level kabaddi players who participated in the implementation of the intervention, outcome assessments, data collection and the provision of player records used in this study.

Ethical Approval

The study was approved by the Institutional Scientific Review Board (Approval No: 045/05/2025/ISRB/PGSR/SCPT).

REFERENCES

[1] Meena, A. *et al.* "Sports injuries during Kabaddi: a literature review." *Annals of Joint*, vol. 10, January 2025. https://doi.org/10.21037/aoj-24-62.

[2] Nasrulloh, A. "Risk factors for injury in Kabaddi players and prevention: a systematic review." *Fizjoterapia Polska*, vol. 1, no. 5, November 2024. https://doi.org/10.56984/8zg020cvx71.

[3] Khanna, G.L. *et al.* "A study of physiological responses during match play in Indian national Kabaddi players." *British Journal of Sports Medicine*, vol. 30, no. 3, September 1996, pp. 232-235. https://doi.org/10.1136/bjsm.30.3.232.

[4] Manheim, C. *The myofascial release manual*. Routledge, 2024. https://doi.org/10.4324/9781003525158-2.

[5] Duncan, R. *Myofascial release*. Human Kinetics, 2021. https://doi.org/10.5040/9781718209602.

[6] Chen, Z. *et al.* "The effects of myofascial release technique for patients with low back pain: a systematic review and meta-analysis." *Complementary Therapies in Medicine*, vol. 59, June 2021. https://doi.org/10.1016/j.ctim.2021.102737.

[7] Kaur, H. *et al.* "Cryo-stretch-the potential novel treatment technique for enhancing muscular flexibility: a narrative review." *Bulletin of Environment, Pharmacology and Life Sciences*, vol. 13, December 2023, pp. 297-301. https://doi.org/10.1007/s12668-023-01209-8.

[8] Khan, M.S. and D.S. Sharick Samsi. "Effects of cryotherapy and static stretching together and static stretching alone for improving plantar flexors extensibility." *IOSR Journal of Nursing and Health Science*, vol. 1, no. 6, 2013, pp. 51-55. https://doi.org/10.9790/1959-0165155.

[9] Logan, J.G. *et al.* "Effects of static stretching exercise on lumbar flexibility and central arterial stiffness." *Journal of Cardiovascular Nursing*, vol. 33, no. 4, July 2018, pp. 322-328. https://doi.org/10.1097/JCN.0000000000000460.

[10] Nakamura, M. *et al.* "Effect of static stretching with superficial cooling on muscle stiffness." *Sports Medicine International Open*, vol. 2, no. 5, September 2018, pp. E142-E147. https://doi.org/10.1055/a-0684-9375.

[11] Impellizzeri, F.M. and N.A. Maffiuletti. "Convergent evidence for construct validity of a 7-point Likert scale of lower limb muscle soreness." *Clinical Journal of Sport Medicine*, vol. 17, no. 6, November 2007, pp. 494-496. https://doi.org/10.1097/JSM.0b013e31815aed57.

[12] Kusmaryono, I. *et al.* "Number of response options, reliability, validity and potential bias in the use of the Likert scale in education and social science research: a literature review." *International Journal of Educational Methodology*, vol. 8, no. 4, 2022, pp. 625-637. https://doi.org/10.12973/ijem.8.4.625.

[13] Lemmink, K.A. *et al.* "The validity of the sit-and-reach test and the modified sit-and-reach test in middle-aged to older men and women." *Research Quarterly for Exercise and Sport*, vol. 74, no. 3, September 2003, pp. 331-336. https://doi.org/10.1080/02701367.2003.10609099.

[14] Ferreira, M.L. *et al.* "Relationship between spinal stiffness and outcome in patients with chronic low back pain." *Manual Therapy*, vol. 14, no. 1, February 2009, pp. 61-67. https://doi.org/10.1016/j.math.2007.09.013.

[15] Lawate, M.R. and A. Dabshede. "Comparative study of myofascial release versus passive stretching on calf flexibility in college-level amateur football players." *Journal of Sports Rehabilitation*, 2024. https://doi.org/10.36948/ijfmr.2024.v06i02.15672.

[16] Panwar, D. and S. Sen. "Immediate effects of myofascial release technique on muscle flexibility and vertical jump height in recreational badminton players." *Journal of Clinical and Diagnostic Research*, vol. 15, no. 5, May 2021. https://doi.org/10.7860/JCDR/2021/48093.14932.

[17] Gupta, U. *et al.* "Instrument-assisted soft tissue mobilization technique versus static stretching in patients with pronated dominant foot: a comparison in effectiveness on flexibility, foot posture, foot function index and dynamic balance." *Healthcare*, vol. 11, no. 6, March 2023. https://doi.org/10.3390/healthcare11060785.

[18] Parab, M. *et al.* "Immediate effects of myofascial release and cryo-stretching in management of upper trapezius trigger points-a comparative study." *Journal of Society of Indian Physiotherapists*, vol. 4, no. 2, 2020, pp. 74-78. https://doi.org/10.18231/j.jsip.2020.011.

[19] Tikhile, P.J. *et al.* "Comparative study of efficacy of cryotherapy and myofascial release technique in calf muscle spasticity in spastic diplegic cerebral palsy children." *Journal of Medical Pharmaceutical and Allied Sciences*, vol. 10, 2021, pp. 3404-3407. https://doi.org/10.22270/jmpas.v10i4.1274.

[20] Giemza, C. *et al.* "Effect of cryotherapy on the lumbar spine in elderly men with back pain." *The Aging Male*, vol. 17, no. 3, September 2014, pp. 183-188. https://doi.org/10.3109/13685538.2013.863860.

[21] Raghwani, D. and M.M. Wdowski. "The effects of stretching with cryotherapy and stretching with heat and stretching alone on hamstring flexibility in physically active females." *International Journal of Therapy and Rehabilitation*, vol. 27, no. 9, September 2020, pp. 1-9. https://doi.org/10.12968/ijtr.2019.0075.

[22] Kujawski, S. *et al.* "Effects of whole-body cryotherapy and static stretching are maintained 4 weeks after treatment in most patients with chronic fatigue syndrome." *Cryobiology*, vol. 112, September 2023. https://doi.org/10.1016/j.cryobiol.2023.05.003.

[23] Joshi, A. *et al.* "Effectiveness of myofascial release (MFR) vs. high-frequency transcutaneous electrical nerve stimulation (TENS) for pain relief and functional improvement in college students with trapezius myalgia." *Cureus*, vol. 14, no. 10, October 2022. https://doi.org/10.7759/cureus.29898.

[24] Long, B.C. "Treatment order and retention of self-myofascial release and static stretching on passive hip flexion range of motion." *Journal of Sport Rehabilitation*, vol. 34, no. 6, February 2025, pp. 633-637. https://doi.org/10.1123/jsr.2024-0196.

[25] Kim, J.H. and H.Y. Park. "Effects of combined hip exercise and passive stretching on muscle stiffness, pain perception and pain-related disability in older adults with low back pain." *Physical Activity and Nutrition*, vol. 26, no. 3, September 2022. https://doi.org/10.20463/pan.2022.0014.