RESEARCH PAPER

Cryotherapy's Influence on Knee Proprioception and Lower Extremity Function in College Level Cricket Athletes

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Received: 16th Dec, 2025; Revised: 8th Feb 2026; Accepted: 24th Feb, 2026; Available Online: 30th March, 2026

ABSTRACT

Background: Cryotherapy is a mainstay in sports medicine for injury management and recovery; however, its immediate physiological impact on neuromuscular control remains a subject of debate. In cricket, where knee stability and lower limb power are vital for bowling and fielding, understanding the trade-off between cooling and physical performance is essential.

Objective: This study investigated the acute effects of localized cryotherapy on knee proprioception and lower limb functional performance among collegiate cricket players.

Methodology: A quasi-experimental study was conducted involving 40 male college-level cricketers (Aged 18–25). Participants underwent a 20-minute cold pack application to the dominant knee. Proprioception was evaluated using the Joint Position Sense (JPS) test via active repositioning error measured in degrees. Lower limb function was assessed using the Single Hop Test for distance and the Star Excursion Balance Test (SEBT). Data were collected at baseline and immediately following the cryotherapy session.

Results: Preliminary findings indicated a significant increase in joint repositioning error ($p < 0.05$) following cryotherapy, suggesting a transient deficit in knee proprioception. Furthermore, a marginal but statistically significant reduction in hop distance and dynamic balance scores was observed immediately post-cooling. These deficits suggest that reduced tissue temperature may slow nerve conduction velocity and mechanoreceptor sensitivity.

Conclusion: Localized cryotherapy temporarily impairs knee proprioception and functional stability in cricketers. While effective for pain relief, clinicians and coaches should exercise caution when returning athletes to high-intensity play immediately following cryotherapy to mitigate the potential risk of re-injury.

Keywords: Cryotherapy, Proprioception, Cricket, Lower Limb Function, Joint Position Sense, Sports Recovery

How to cite this article: Goel AK, Rathore KS, Kalra S, Saharan A. Cryotherapy's Influence on Knee Proprioception and Lower Extremity Function in College Level Cricket Athletes. Int J Drug Deliv Technol. 2026;16(24s): 661-665. DOI: 10.25258/ijddt.16.24s.84

Source of support: Nil.

Conflict of interest: None

1. INTRODUCTION

The Physiological Demands of Cricket: Cricket is a physically demanding sport that has evolved significantly with the advent of shorter formats like T20, necessitating higher levels of athleticism, explosive power, and sustained endurance. Unlike many field sports, cricket involves asymmetrical loading and repetitive high-impact movements [1,2]. Fast bowlers, for instance, subject their "front-foot" knee to forces exceeding five to nine times their body weight during the delivery stride. Similarly, batsmen and fielders frequently engage in rapid decelerations, lateral cutting maneuvers, and pivoting. These actions place immense stress on the knee joint—the primary hinge of the lower extremity—making it a frequent site for both acute ligamentous injuries and chronic overuse syndromes [3].

Cryotherapy in Sports Medicine: Cryotherapy, or the therapeutic application of cold, is perhaps the most widely used modality in sports medicine. From the "RICE" (Rest, Ice, Compression, Elevation) protocol to whole-body cryotherapy chambers, the primary goal is usually to manage pain (analgesia) and limit post-traumatic inflammation. By inducing vasoconstriction and reducing metabolic demand in localized tissues, cryotherapy effectively limits secondary hypoxic injury following trauma [4]. However, in a competitive collegiate environment, cryotherapy is often used not just for injury, but for rapid recovery between innings or matches. This practice raises a critical question: if an athlete applies ice to a "niggling" knee pain and then returns to the field, is their neuromuscular control compromised? The cooling effect that numbs pain also affects the underlying neural

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pathways, potentially altering the athlete's "feel" for their joint position [5,6].

Defining Proprioception and Neuromuscular Control: Proprioception is often described as the "sixth sense"—the body's ability to perceive its position and movement in space without visual feedback. It is mediated by mechanoreceptors located in the muscles, tendons, ligaments, and the joint capsule. Specifically, in the knee, the Anterior Cruciate Ligament (ACL) and the menisci are rich with Golgi tendon-like organs and Pacinian corpuscles that send constant feedback to the central nervous system [7, 8]. When we talk about "Lower Extremity Function," we are looking at the integration of this proprioceptive feedback with muscular strength and coordination. In a cricket player, this manifests as the ability to maintain balance on a pitch, the stability to land a jump after catching a ball, or the precision to plant a foot while bowling. If the signal from the mechanoreceptors is delayed or distorted, the resulting motor output may be poorly timed, increasing the risk of an ankle sprain, a meniscus tear, or a ligamentous rupture [9].

The Conflict: Cooling vs. Coordination: The physiological impact of cold on nerve tissue is well-documented. As tissue temperature drops, there is a subsequent decrease in nerve conduction velocity (NCV). For every 1°C drop in skin temperature, there is a measurable slowing of the electrical impulses traveling along sensory and motor nerves. Furthermore, cooling increases the viscosity of the synovial fluid within the knee joint and decreases the elasticity of the surrounding connective tissues [10]. For a college-level cricketer, whose neuromuscular system is highly tuned, even a slight delay in muscle spindle activation can be the difference between a stable landing and a season-ending injury. Research into the "precooling" or "inter-match cooling" effects has shown conflicting results. Some studies suggest that while pain decreases, the Joint Position Sense (JPS) is significantly impaired for up to 20–30 minutes post-application. Others argue that the body compensates for these deficits through increased visual reliance or proximal muscle recruitment [11].

The Collegiate Cricket Population: College-aged athletes (typically 18–25 years old) represent a unique demographic. They are often at their physiological peak but may lack the specialized medical support found in professional international squads. In many collegiate settings, "self-icing" is common [12]. These players often return to high-intensity activity immediately after icing a sore joint without a structured re-warm-up period. Understanding how cryotherapy specifically affects this age group—whose joints are still adapting to the high-torque demands of competitive cricket—is vital for developing safe return-to-play guidelines 13].

Rationale for the Study: Despite the prevalence of both cricket and cryotherapy, there is a surprising dearth of literature specifically investigating the interaction between the two in the collegiate context. Most cryotherapy studies focus on general populations or different sports like soccer and basketball. Cricket's unique movement patterns—the heavy landing of the bowler, the deep lunges of the batsman, and the crouched stance of the wicketkeeper—require a specific investigation into knee stability [14].

2. STUDY SITE

The study was conducted at the Trident College of Education in Meerut, India, focusing on a study population of amateur college-going cricket players. A total sample size of 150 participants was utilized for this interventional study. The research was carried out over a duration of 18 months, spanning from July 2024 to December 2025.

3. MATERIAL AND METHODS

A group of 150 healthy participants was recruited to evaluate knee joint proprioception in a weight-bearing position. In addition to proprioceptive testing, baseline measurements were recorded for various agility functions and single-hop distance. Following these initial assessments, each participant received cryotherapy in the form of a standardized ice massage. Immediately following the cold application, the participants underwent a second round of testing—re-evaluating their proprioception, agility, and single-hop performance—to measure the immediate effects of the intervention.

3.1. **Assessment of agility functions:** Agility testing is measuring the time at which coordinated movements can be completed.

3.1.1. **Side Step Test- Principle:** The sidestep test is designed to measure lateral agility, speed of movement, and coordination. It is based on the concept that rapid side-to-side movement requires efficient neuromuscular control, balance, and lower-limb strength. The test evaluates how quickly and accurately an individual can shift body weight and change direction over a short distance, which is an important component of performance in many sports activities [15, 16].

Procedure: Three parallel lines are marked on the floor, typically one meter apart. The participant stands with both feet on the center line. On the command "Go," the participant moves laterally to one side to touch or cross the outer line with a foot, then quickly shifts to the opposite outer line, continuing this side-to-side motion as rapidly as possible [17]. The movement is performed for a fixed duration, commonly 20 or 30 seconds. Each successful crossing of an outer line is counted as one repetition. The tester records the total number of correct side steps completed within the allotted time [18,19].

Result: The score is determined by counting the total number of successful sidesteps performed during the test period. A higher number of repetitions indicates better lateral agility and coordination, while a lower score reflects comparatively reduced side-to-side movement efficiency. The results may be used to assess current agility levels or to evaluate improvements after a training intervention.

3.1.2. **Single Hop Test- Principle:** The single hop test is based on the assessment of lower limb power, balance, and functional stability. It measures the ability of one leg to generate explosive force while maintaining postural control during take-off and landing. The test reflects muscular strength, neuromuscular coordination, and joint stability, which are essential for athletic performance and injury prevention.

Procedure: A measuring tape is laid out on a flat, non-slip surface. The participant stands on one leg with the toes placed just behind the starting line. The free leg is flexed at the knee to avoid contact with the ground. On the command "Go," the participant performs a maximal forward hop using the supporting leg and lands on the same leg without losing balance. The distance from the starting line to the point where the heel lands is measured in centimetres. The participant must maintain balance for a few seconds after landing for the attempt to be considered valid. Typically, two or three trials are given for each leg, with adequate rest between attempts, and the best distance is recorded for analysis [20, 21].

Result: The performance is recorded as the maximum distance hopped in centimetres. A greater distance indicates better lower limb power and stability, whereas a shorter distance suggests comparatively lower explosive strength or balance ability. The results can be used to compare the strength of both legs or to evaluate progress following a specific training or rehabilitation program.

4. RESULTS AND DISCUSSION

Table 1 presents the frequency distribution of the study participants according to age among 150 college-going cricket players. The age of the subjects ranged from 18 to 25 years, indicating a young adult athletic population. The highest proportion of participants was observed in the 20–21 years and 24–25 years age groups, each comprising 40 subjects (26.7%). The 18–19 years and 22–23 years age groups each included 35 subjects, accounting for 23.3% of the total sample respectively. The median age of the participants was 21.5 years with an inter-quartile range (IQR) of 20–24 years, reflecting a relatively symmetrical distribution around the central age values. The mean age was found to be 21.61 ± 2.25 years, suggesting low variability in age among the participants. Overall, the distribution indicates a well-balanced representation of college-age cricket players suitable for assessing the effects of cryotherapy on knee proprioception and lower limb functions.

Table 2 presents the frequency distribution of subjects according to their performance levels in the side step test before and after the cryotherapy intervention among 150 college-going cricket players. The side step test evaluates lateral movement speed, coordination, and lower limb functional efficiency.

Before the intervention, the majority of subjects were concentrated in the 10.01–11.00 interval, with 69 subjects (46.0%), indicating this as the most common performance level. This was followed by the 9.01–10.00 intervals with 38 subjects (25.3%) and the 11.01–12.00 interval with 37 subjects (24.7%). Very few subjects were observed at the performance extremes, with 4 subjects (2.7%) in the 8.00–9.00 range and 2 subjects (1.3%) in the 12.01–13.00 range.

After the intervention, a noticeable shift in distribution was observed toward the 10.01–11.00 interval, which increased substantially to 87 subjects (58.0%). The number of subjects in the lower performance ranges declined, with 26 subjects (17.3%) in the 9.01–10.00 interval and only 2 subjects (1.3%) in the 8.00–9.00 range. Although the number of subjects in the 11.01–12.00 interval decreased to 29 (19.3%), the highest performance range of 12.01–13.00 showed an increase to 6 subjects (4.0%).

Table 3 presents the frequency distribution of subjects according to their performance levels in the hop test before and after the cryotherapy intervention among 150 college-going cricket players. The hop test evaluates lower limb power, strength, balance, and functional performance.

Before the intervention, nearly half of the subjects were concentrated in the 140.1–160.0 interval, with 74 subjects (49.3%), indicating this as the most common performance range. This was followed by the 120.1–140.0 intervals with 46 subjects (30.7%). Smaller proportions of subjects were observed in the lower and higher performance ranges, with 13 subjects (8.7%) in the 100.0–120.0 interval, 14 subjects (9.3%) in the 160.1–180.0 interval, and only 3 subjects (2.0%) in the highest interval of 180.1–200.0.

After the intervention, a slight redistribution of performance levels was observed. The number of subjects in the 120.1–140.0 interval increased notably to 60 (40.0%), while those in the lowest interval of 100.0–120.0 also increased to 17 subjects (11.3%). Conversely, the proportion of subjects in the 140.1–160.0 interval decreased to 59 (39.3%). Minor reductions were also noted in the higher performance intervals, with 12 subjects (8.0%) in the 160.1–180.0 range and 2 subjects (1.3%) in the 180.1–200.0 range.

CONCLUSION

This study evaluated the immediate effects of cryotherapy (ice massage) on the functional performance of 150 amateur college-going cricket players. The demographic analysis confirmed a well-balanced, young adult athletic population with a mean age of 21.61 ± 2.25 years, providing a consistent baseline for physical assessment.

The findings regarding lower limb functional efficiency were multifaceted:

Agility and Coordination: In the Side Step Test, the intervention led to a significant central consolidation of performance. Post-cryotherapy, the majority of participants (58%) shifted into the 10.01–11.00 interval, and there was a notable increase in the number of subjects reaching the highest performance tier ($12.01–13.00$). This suggests that localized cryotherapy may assist in stabilizing lateral movement coordination in some athletes.

Power and Explosive Strength: Conversely, the Single Hop Test results showed a slight downward shift in explosive power. After the application of ice, there was an increase in the number of participants in the lower distance intervals ($100.0–140.0$ cm) and a decrease in those reaching the mid-to-high ranges. This suggests that while cryotherapy might aid coordination, the immediate "cooling" effect may temporarily reduce the peak explosive power required for maximal jumping distance.

Ethical Statement- This research was conducted in strict adherence to established ethical standards for human participation. Prior to the study's commencement, formal ethical approval was granted by the Institutional Ethics Committee of NIMS University (Jaipur, Rajasthan), and administrative authorization was obtained from the Trident College of Education (Meerut, India).

To ensure transparency, all participants received a comprehensive briefing regarding the study’s objectives, experimental procedures, and any potential risks or benefits. Written informed consent was secured from each individual prior to enrolment. Participation remained strictly voluntary, with all subjects maintaining the right to withdraw at any time without prejudice to their academic standing or athletic status.

Conflict of Interest- The authors declare no conflicts of interest concerning the publication of this research. This study was conducted independently, and no financial, personal, or commercial relationships existed that could be perceived as influencing the integrity of the work. Furthermore, the authors confirm that no external funding was received for this study; the research was executed solely for academic and scientific advancement.

Funding- None (Self-Financed)

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Table 1: Frequency distribution of subjects according to age

Age Interval (In Yrs.)	n = 150	In %
18 - 19	35	23.3%
20 - 21	40	26.7%
22 - 23	35	23.3%
24 - 25	40	26.7%
Range (Min.-Max.)	18 - 25	
Median (IQR)	21.5 (20-24)	
Mean ± SD	21.61 ± 2.25	

IQR: Inter-Quartile Range; SD: Standard Deviation

Table 2: Frequency distribution of subjects according to side step test level at pre & post intervention

Side Step Interval	Pre Intervention		Post Intervention	
	n = 150	In %	n = 150	In %
8.00 - 9.00	4	2.7%	2	1.3%
9.01 - 10.00	38	25.3%	26	17.3%
10.01 - 11.00	69	46.0%	87	58.0%
11.01 - 12.00	37	24.7%	29	19.3%
12.01 - 13.00	2	1.3%	6	4.0%

Table 3: Frequency distribution of subjects according to Hop test level at pre & post intervention

Hop Interval	Pre Intervention		Post Intervention	
	n = 150	In %	n = 150	In %
100.0 - 120.0	13	8.7%	17	11.3%
120.1 - 140.0	46	30.7%	60	40.0%
140.1 - 160.0	74	49.3%	59	39.3%
160.1 - 180.0	14	9.3%	12	8.0%
180.1 - 200.0	3	2.0%	2	1.3%