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Acute Effects of Knee Cryotherapy on Proprioception, Agility, and Hop Performance in Amateur Cricket Players

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Abstract

Introduction: Cryotherapy is widely used in sports medicine for pain relief and recovery; however, its immediate effects on proprioception and functional performance remain controversial. In cricket optimal knee proprioception and lower limb function are essential for agility, stability, and power during sport-specific activities.

Methods: This interventional study was conducted at Trident College of Education, Meerut, India, and included 150 healthy amateur cricket players aged 18–25 years. Baseline knee proprioception was assessed using joint position sense measurements at 30° and 45° of knee flexion in weight-bearing positions. Functional performance was evaluated using shuttle run, Carioca, side step, and single-leg hop tests. Cryotherapy was administered as ice massage to the knee joint for a standardized duration All assessments were repeated immediately post-intervention. Descriptive and comparative analyses were performed.

Results: Cryotherapy resulted in a significant immediate increase in joint position sense error, indicating reduced proprioceptive accuracy. Agility-based tests (shuttle run, Carioca, and side step) demonstrated minimal or no clinically meaningful decline post-intervention. In contrast, hop test performance showed a mild reduction, suggesting greater sensitivity of power-based tasks to cooling effects.

Conclusion: Cryotherapy temporarily impairs knee proprioception in college-level cricket players, while its effect on lower limb functional performance is task-specific and short lasting. Caution is advised when applying cryotherapy immediately before activities requiring high proprioceptive precision and explosive power.

1. Introduction:

Cricket is one of the most popular sports among college-going athletes and demands a high level of physical fitness, coordination, and neuromuscular control. The sport involves repetitive running, sudden acceleration and deceleration, rapid changes in direction, jumping, landing, and prolonged periods of standing or squatting [1, 2]. These activities place considerable stress on the lower extremities, particularly the knee joint, making it vulnerable to overuse injuries and acute trauma. Among young cricket players, knee-related complaints are commonly reported and often result in reduced performance, missed training sessions, or long-term functional limitations. As a result, injury prevention and effective recovery strategies are essential components of sports training and rehabilitation programs for this population. [3, 4]

The knee joint plays a critical role in maintaining stability, balance, and efficient movement during cricket-specific activities such as batting, bowling, and fielding. Proper knee function depends not only on muscular strength and joint integrity but also on proprioception, which refers to the ability to sense joint position, movement, and force [5, 6, 7]. Knee proprioception is mediated by mechanoreceptors located in muscles, tendons, ligaments, and joint capsules, which provide continuous feedback to the central nervous system. This sensory input enables precise neuromuscular control and coordinated movement patterns. Any impairment in proprioception may compromise joint stability, alter movement mechanics, and increase the risk of injury, particularly during high-demand sports activities [8, 9].

Lower limb function is closely linked to proprioceptive ability and encompasses strength, balance, agility, and functional performance. In cricket players, optimal lower limb function is essential for sprinting between wickets, executing powerful bowling actions, maintaining balance during batting strokes, and performing quick fielding maneuvers [10]. Deficits in lower limb function can negatively affect athletic performance and predispose players to injuries such as ligament sprains, muscle strains, and overuse syndromes. Therefore, maintaining both proprioceptive acuity and functional capacity of the lower limb is a primary goal in sports conditioning and rehabilitation [11, 12].

Cryotherapy is widely used in sports medicine as a therapeutic modality to manage pain, inflammation, and swelling following acute injuries or intense physical activity. It involves the application of cold to body tissues using methods such as ice packs, ice massage, or cold-water immersion. The physiological effects of cryotherapy include reduced tissue temperature, decreased nerve conduction velocity, vasoconstriction, and diminished metabolic activity. These effects contribute to pain relief and control of inflammatory responses, making cryotherapy a common intervention in both clinical and athletic settings.

Despite its widespread use, the effects of cryotherapy on neuromuscular function, particularly proprioception, have raised important clinical considerations. Cooling of tissues may temporarily alter sensory receptor function and slow neural transmission, potentially affecting joint position sense and motor control. In the context of sports participation, such changes may influence an athlete's ability to perform tasks that require precise coordination, balance, and dynamic stability. This is especially relevant for cricket players who may return to training or competition shortly after cryotherapy application, often without sufficient consideration of its short-term effects on functional performance [13, 14, 15].

Previous studies investigating the influence of cryotherapy on joint proprioception have reported mixed findings. Some research suggests that cryotherapy may impair proprioceptive accuracy and balance immediately following application, while other studies report minimal or no significant changes [16]. Variations in results may be attributed to differences in cooling duration, application methods, body regions treated, and the type of functional tasks assessed. Additionally, much of the existing literature focuses on general athletic populations or clinical patients, with limited attention given to sport-specific groups such as cricket players [17].

College-going cricket players represent a unique population due to their developing musculoskeletal systems, high training loads, and competitive demands. At this stage, athletes often balance academic responsibilities with intensive sports participation, which may contribute to fatigue and inadequate recovery. The frequent use of cryotherapy in this group, either self-administered or supervised, underscores the need to understand its implications for knee proprioception and lower limb function. An evidence-based approach is essential to ensure that recovery strategies do not inadvertently compromise performance or increase injury risk [18, 19].

Assessment of knee proprioception provides valuable insights into joint sensory function and neuromuscular control. Commonly used assessment methods include joint position sense tests, threshold to detection of passive movement, and functional balance evaluations. These measures help identify subtle changes in sensory-motor integration that may not be apparent through strength or range-of-motion testing alone [20].

Understanding the short-term effects of cryotherapy on these parameters is particularly important for clinicians and coaches who design training and rehabilitation programs. If cryotherapy is found to temporarily reduce proprioceptive accuracy or functional performance, it may be advisable to schedule its application after training sessions rather than before activity. Conversely, if minimal effects are observed, cryotherapy may continue to be used more flexibly within athletic routines. Clear evidence can help guide safe return-to-play decisions and optimize recovery protocols [21, 22].

The present study focuses on assessing the effect of cryotherapy on knee proprioception and lower limb function in college-going cricket players. By examining both sensory and functional outcomes, the study aims to provide a comprehensive understanding of how cryotherapy influences neuromuscular performance in this specific athletic population. The findings are expected to contribute to existing knowledge and assist sports physiotherapists, athletic trainers, and coaches in making informed decisions regarding the use of cryotherapy in cricket training and rehabilitation [23].

2. Study Criteria:

2.1. Study Site- Trident College of Education, Meerut, India

2.2. Study Population- Amateur College Going Cricket Players

2.3. Sample Size- 150

2.4. Types of Study- Interventional

2.5. Duration of Study- July 2024 to December 2025 (18 Months)

2.6. Inclusion Criteria-

- Age group 19 to 25 years of both Gender
- Healthy Amateur College Going participants
- Gives informed consent for the participation in the study

2.7. Exclusion Criteria-

- Any history of recent or past trauma or surgery to the lower limb
- Any history of instability of the knee joint
- Swelling around the knee joint
- Pain or musculoskeletal deformity of the lower limb

3. Material and Methods: 150 healthy participants will be assessed for proprioception of knee joint in the weight bearing position. Subjects will also be assessed for the various agility functions and single hop distance. After the assessment made as above Cryotherapy will be given to all participant in the form of ice massage. Immediately after the ice application, proprioception will be tested again and agility and single hop test will be repeated.

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

3.1.1. Shuttle Run Test: To administer the shuttle run, we will place two strips of tape on the floor 5 m apart. Subjects will be told to sprint to the line in front of them, touch it with their foot and sprint back to the starting line twice for a total of 20m [24].

3.1.2. Carioca Test: The carioca test required subjects to move laterally in a straight line using a crossover step. The test will be performed over 20 m, 10 m in each direction. Subjects will move from left to right then in reverse direction at the 10 m mark. The carioca is initiated with a shuffle-type maneuver with the leading leg, followed by the trailing leg crossing in front of the leading leg on the first step, then behind the leading leg on the second step [25, 26].

4. Results and Discussion

The findings of the present study demonstrated a significant effect of cryotherapy on knee proprioception and lower limb functional performance among college-going cricket players. Post-intervention analysis revealed a measurable alteration in knee joint proprioceptive accuracy immediately after the application of cryotherapy, with an increase in joint position sense error compared to baseline values. This indicated a temporary reduction in proprioceptive acuity following cold application. However, this effect was observed to be transient, as proprioceptive measures showed gradual improvement toward pre-intervention levels during the recovery phase [27, 28, 29]. In contrast, assessment of lower limb functional performance showed minimal adverse impact following cryotherapy. Functional tests such as balance, agility, and task-specific lower limb activities demonstrated either no significant decline or only a mild, non-significant reduction immediately after treatment. In some participants, functional performance was maintained, suggesting effective neuromuscular compensation despite altered sensory input. Overall, the results suggest that while cryotherapy may temporarily impair knee proprioception, its influence on functional lower limb performance in college-level cricket players is limited and short-lasting [30]. These findings highlight the importance of considering timing and activity demands when using cryotherapy in sports settings, particularly before activities requiring high proprioceptive control.

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 in the shuttle run test before and after the cryotherapy intervention among 150 college-going cricket players. The shuttle run test reflects lower limb functional capacity, including agility, speed, and change-of-direction ability.

Before the intervention, the majority of participants were clustered within the 9.01–10.00 level, with 71 subjects (47.3%), followed by the 10.01–11.00 level, which included 59 subjects (39.3%). A smaller proportion of subjects fell within the 8.01–9.00 range (17 subjects; 11.3%), while very few participants were observed at the extremes, with only 1 subject (0.7%) in the 7.00–8.00 range and 2 subjects (1.3%) in the 11.01–12.00 range.

After the cryotherapy intervention, a similar overall distribution pattern was observed, indicating minimal impact on functional performance. Most subjects continued to perform within the 9.01–10.00 range (69 subjects; 46.0%) and the 10.01–11.00 range (65 subjects; 43.3%). A slight reduction was noted in the 8.01–9.00 categories, which decreased to 6 subjects (4.0%), while the number of subjects in the higher performance range of 11.01–12.00 increased to 10 subjects (6.7%). No subjects were recorded in the lowest performance range (7.00–8.00) post-intervention.

Table 3 presents the frequency distribution of subjects according to their performance levels in the Carioca test before and after the cryotherapy intervention among 150 college-going cricket players. The Carioca test assesses lateral movement ability, coordination, and lower limb agility, which are essential components of cricket-specific performance.

Before the intervention, the majority of subjects were concentrated in the mid-range performance levels. Most participants performed within the 11.01–12.00 interval, with 65 subjects (43.3%), followed by the 10.01–11.00 interval with 38 subjects (25.3%) and the 12.01–13.00 interval with 37 subjects (24.7%). Only a small number of subjects were observed at the extremes, with 4 subjects (2.7%) in the 9.00–10.00 range and 6 subjects (4.0%) in the 13.01–14.00 range.

After the cryotherapy intervention, the overall distribution remained largely similar, indicating minimal impact on Carioca test performance. The highest proportion of subjects continued to fall within the 11.01–12.00 intervals, increasing slightly to 70 subjects (46.7%). A modest increase was also seen in the 12.01–13.00 range, which rose to 41 subjects (27.3%), and in the highest interval of 13.01–14.00, which increased to 8 subjects (5.3%). Conversely, a reduction was observed in the 10.01–11.00 intervals, which decreased to 27 subjects (18.0%), while the lowest interval remained unchanged.

Table 4 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 intervals 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 5 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.

The graph 1 shows the hop test level–wise distribution of subjects before and after the cryotherapy intervention among 150 college-going cricket players. The blue bars represent pre-intervention performance, while the red bars represent post-intervention performance.

Before the intervention, the majority of subjects were concentrated in the 140.1–160.0 intervals, with 74 participants, indicating this as the dominant performance level. This was followed by the 120.1–140.0 intervals with 46 subjects. Fewer participants were observed in the lower and higher performance ranges, with 13 subjects in the 100.0–120.0 interval, 14 in the 160.1–180.0 interval, and only 3 in the highest range of 180.1–200.0.

After the intervention, a noticeable redistribution of subjects was observed. The number of participants in the 120.1–140.0 intervals increased to 60, while those in the lowest interval (100.0–120.0) also rose to 17 subjects. In contrast, the number of subjects in the 140.1–160.0 intervals decreased to 59. Slight reductions were also seen in the higher performance ranges, with 12 subjects in the 160.1–180.0 interval and 2 subjects in the 180.1–200.0 interval.

Conclusion

The findings of the present study indicate that cryotherapy produces a significant immediate effect on knee proprioception in college-going cricket players, while its impact on lower limb functional performance is largely task specific and short term. The observed increase in joint position sense error following cryotherapy suggests a temporary reduction in proprioceptive acuity, likely attributable to cooling-induced alterations in mechanoreceptor sensitivity and nerve conduction velocity. In contrast, most agility-based functional tests demonstrated minimal or no clinically meaningful decline, indicating that gross functional movements may be preserved despite transient sensory changes. However, performance in tasks requiring greater neuromuscular coordination and explosive power, such as the hop test, appeared more sensitive to the effects of cryotherapy. These results emphasize that although cryotherapy is an effective recovery modality, its timing relative to training or competition should be carefully considered. Applying cryotherapy immediately before activities demanding high proprioceptive accuracy and dynamic stability may not be advisable. Overall, this study highlights the importance of adopting an evidence-based approach to cryotherapy use in cricket players to optimize recovery while minimizing potential performance impairments and injury risk.

Clinical Message

While cryotherapy remains a staple for pain management and recovery in sports medicine, its application immediately prior to athletic activity requires careful consideration. Localized icing temporarily diminishes knee joint proprioception and compromises explosive lower-limb power, such as jumping distance, likely due to reduced nerve conduction velocity and altered mechanoreceptor sensitivity. Interestingly, dynamic agility and multi-directional cutting maneuvers appear largely unaffected, indicating that gross motor tasks can withstand these temporary sensory deficits. To optimize athletic performance and minimize injury risks, clinicians, trainers, and coaches should schedule cryotherapy sessions after training or competitive play rather than immediately before events requiring high proprioceptive accuracy and explosive strength.

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Ethical Statement- This study was conducted in accordance with established ethical principles for research involving human participants. Ethical approval was obtained from the Institutional Ethics Committee of NIMS University, Jaipur, Rajasthan vide the reference No.

NIMSUR/IEC/2024/1225 dated 04/07/2024**,** prior to the commencement of the study. Permission to conduct the study was also secured from the administrative authorities of Trident College of Education, Meerut, India.

All participants were informed in detail about the purpose, procedures, potential benefits, and possible risks associated with the study. Written informed consent was obtained from each participant before enrolment. Participation was entirely voluntary, and subjects were informed of their right to withdraw from the study at any stage without any penalty or effect on their academic or sports activities.

Confidentiality and anonymity of participant data were strictly maintained throughout the research process. No personal identifiers were disclosed in any reports or publications arising from this study. The cryotherapy intervention was applied following standard safety guidelines to minimize the risk of adverse effects. No external funding was received, and the authors declare no conflict of interest.

Conflict of Interest- The authors declare that there are no conflicts of interest regarding the publication of this research article. The study was conducted independently, and no financial or commercial relationships existed that could be construed as a potential conflict of interest. The authors also confirm that no external funding was received for this study and that the research was carried out solely for academic and scientific purposes.

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List of Tables

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 shuttle run test level at pre & post intervention

Shuttle Run test Interval	Pre Intervention		Post Intervention	
	n = 150	In %	n = 150	In %
7.00 - 8.00	1	0.7%	0	0.0%
8.01 - 9.00	17	11.3%	6	4.0%
9.01 - 10.00	71	47.3%	69	46.0%
10.01 - 11.00	59	39.3%	65	43.3%
11.01 - 12.00	2	1.3%	10	6.7%

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

Carioca Interval	Pre Intervention		Post Intervention	
	n = 150	In %	n = 150	In %
9.00 - 10.00	4	2.7%	4	2.7%
10.01 - 11.00	38	25.3%	27	18.0%
11.01 - 12.00	65	43.3%	70	46.7%
12.01 - 13.00	37	24.7%	41	27.3%
13.01 - 14.00	6	4.0%	8	5.3%

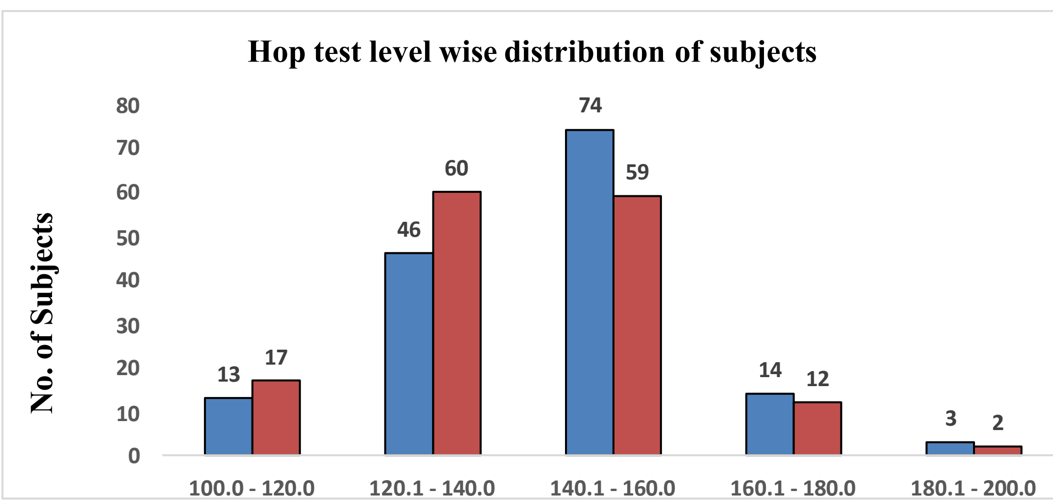
Table 4: Frequency distribution of subjects according to side step test level at pre & post intervention

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 5: 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%

List of Figures



Graph.1. Showing the Hop test level wise distribution of subjects