
IMPACT OF HIIT ON SELECTED PHYSIOLOGICAL VARIABLES OF FIELD HOCKEY PLAYERS

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ABSTRACT

Objective: The purpose of this study was to assess how a 6-week High-Intensity Interval Training (HIIT) program affected the physiological profiles of collegiate field hockey players, with a particular emphasis on resting blood lactate (BLa), resting heart rate (RHR), and vital capacity (VC). **Methodology:** Eighteen male hockey players (n=18, age 18–25 years) from LNIPE, Gwalior, participated in a pre-test/post-test experimental design. The HIIT intervention consisted of 45-minute sessions conducted three times per week, progressing from long intervals to game-specific shuttle sprints. Physiological assessments were performed using a dry spirometer (VC), Polar H10 chest straps (RHR), and the Lactate Pro 2 analyzer (BLa). Data were analyzed via paired-sample t-tests using IBM SPSS v.26. **Results:** Post-intervention data revealed statistically significant improvements across all parameters ($p < 0.001$). Vital Capacity increased from 4.6889 ± 0.4213 L to 5.1889 ± 0.2988 L ($t = -9.779$). Cardiovascular efficiency improved as Resting Heart Rate decreased from 58.33 ± 3.32 bpm to 54.16 ± 2.79 bpm ($t = 8.560$). Most notably, resting Blood Lactate levels showed a 21.3% reduction, dropping from 2.35 ± 0.38 mmol/L to 1.85 ± 0.33 mmol/L ($t = 11.292$). **Conclusion:** The athletes' "aerobic-anaerobic engine" was efficiently enhanced by the 6-week HIIT regimen. According to the results, HIIT causes important changes that are necessary for fulfilling the high-intensity intermittent demands of competitive field hockey, such as improved respiratory muscle strength, higher stroke volume, and superior lactate clearance kinetics. To increase athletic work capacity and recovery speed, coaches should give HIIT top priority.

KEYWORDS: *HIIT, Field Hockey, Vital Capacity, Resting Heart Rate, Blood Lactate, Sports Physiology.*

INTRODUCTION

Field hockey is an intermittent endurance sport that requires high aerobic fitness, anaerobic power, strength, and agility in addition to optimal skills and body composition. To meet these physiological demands for optimal performance and for promoting general health status, appropriate training along with repeated monitoring has to be performed (Sharma & Kailashiya, 2018). In the modern sporting era, the role of the coach has evolved into that of a data-driven strategist. As the constraints of coaching staff are ever increasing, it is important to continually identify the effectiveness of conditioning programs, highlight areas where deficiencies occur, and provide accurate, meaning full feedback of changes that should be made (Chapman et al., 2009). This feedback loop is essential for maintaining the delicate balance between peak performance and the prevention of overtraining, ensuring that every session contributes to the athlete's progression.

The necessity for high-intensity preparation is further underscored by comparative studies in similar field-based disciplines. Researchers have suggested that soccer players who sustain higher work rates during matches are more likely to gain an advantage when competing against players of equal skill. Therefore, to prepare hockey players for successful performances, their training should replicate the physical demands of competition (Harry & Booyesen, 2020). By mimicking the high-velocity bursts and rapid recovery periods seen in elite matches, training programs can better prepare the musculoskeletal and cardiovascular systems for the rigors of the field.

In recent years, two training modalities have emerged as promising tools for enhancing hockey performance: Small Sided Games (SSGs) and High-Intensity Interval Training (HIIT). While SSGs offer the benefit of technical skill integration, HIIT provides a controlled environment to push physiological boundaries. HIIT involves short bursts of intense exercise followed by periods of rest or low-intensity activity. This training method has been widely recognized for its ability to improve both aerobic and anaerobic performance markers, such as maximal oxygen uptake (VO₂max), anaerobic threshold, and repeated sprint ability (Saha et al., 2025).

This study aims to observe the effect of HIIT on blood lactate, resting heart rate, and vital capacity of the university level hockey players. To evaluate the physiological variables, the Lactate Pro 2 analyzer, Polar H10 chest straps, and spirometer were used. It is hypothesized

that HIIT will significantly improve the blood lactate, resting heart rate, and the vital capacity in university level hockey players.

Beyond the immediate measurable gains, this investigation seeks to establish a standardized conditioning framework that bridges the gap between laboratory-based science and on-field athletic excellence. By analyzing how university-level athletes respond to these specific stressors, we can better understand the metabolic and respiratory adaptations necessary for elite-level competition. Future directions for this research involve exploring the long-term sustainability of these physiological adaptations across a full competitive season and determining how these improvements in vital capacity and lactate clearance translate directly into technical efficiency and reduced injury risk during high-stakes match play. Ultimately, this study aims to provide a blueprint for evidence-based training that ensures athletes are physically prepared to meet the ever-evolving demands of modern field hockey.

2. METHODOLOGY

2.1 Participants

18 university-level hockey players (n = 18) between the ages of 18 and 25 from the Lakshmibai National Institute of Physical Education (LNIFE), Gwalior, Madhya Pradesh, made up the study sample. The recruitment of participants was predicated on their involvement in the university's hockey program. All participants and, if relevant, their guardians were informed about the study's goals, experimental procedures, possible hazards, and advantages prior to data collection. Every participant provided written informed permission.

2.2 Experimental Design

The effects of a 6-week High-Intensity Interval Training (HIIT) program on physiological variables, such as Vital Capacity (VC), Resting Heart Rate (RHR), and Blood Lactate (BLa), were assessed using a pre-test/post-test experimental design.

2.3 Procedures and Instrumentation

All physiological assessments were conducted under standardized conditions to minimize external variance.

- **Vital Capacity (VC):** Measured using a calibrated dry spirometer. Participants performed a maximal inhalation followed by a forceful, maximal exhalation into the device. The highest value from three trials was recorded in liters (L).

- **Resting Heart Rate (RHR):** To ensure accuracy, RHR was measured using a chest-strap heart rate monitor (Polar H10) immediately upon waking, before any physical exertion or caffeine intake.
- **Blood Lactate (BLa):** Resting lactate levels were analyzed using the Lactate Pro 2 portable analyzer. Capillary blood samples were collected via finger prick under sterile conditions while the participant was in a seated, fasted state.

2.4 Training Intervention

The HIIT intervention lasted six weeks, with sessions conducted three times per week (Monday, Wednesday, and Friday). Each session lasted approximately 45 minutes, inclusive of:

1. **Warm-up (10 min):** Dynamic stretching and progressive aerobic activity.
2. **HIIT Protocol (25-30 min):** As detailed in the training macrocycle (Table 1).
3. **Cool-down (5-10 min):** Low-intensity jogging and static stretching.

Week	Training Protocol	Intensity (% HR max or Velocity)	Volume (Sets x Reps)	Recovery Type
1	Long Intervals: 4-min linear runs on turf	85–90% HRmax	4 x 4 min	Active (50% HRmax)
2	Long Intervals: 4-min linear runs on turf	90% HRmax	5 x 4 min	Active (50% HRmax)
3	Intermittent Shuttles: 15s on/15s off (20m shuttle distance).	>95% HRmax	2 blocks of 8 min	Passive
4	Tempo Runs: 100m strides with focused mechanics.	70% VO2max	1 block of 10 reps	Passive
5	Game-Specific HIIT: 30s "all-out" sprints with 3 COD turns.	100% Effort	2 blocks of 4 reps	Passive
6	Suicide Sprints: 5m, 10m, 15m, 20m and back.	100% Effort	6 reps total	Passive

2.5 Statistical Analysis

IBM SPSS Statistics was used to analyze the data (Version 26). For every variable, the mean and standard deviation were computed as descriptive statistics. The Shapiro-Wilk test was used to confirm that the data distribution was normal. To identify significant variations between the pre-test and post-test means, a Paired-Sample t-test was employed. A significant threshold of $p < 0.05$ was established.

RESULTS

The physiological characteristics of the university hockey players (n=18) before and after the 6-week HIIT intervention are summarized in the table below.

Variable	Post-Test (Mean \pm SD)	Post-Test (Mean \pm SD)	t-value	p-value
Vital capacity	4.6889 \pm 0.4213	5.1889 \pm 0.2988	-9.779	< 0.001
Resting heart rate	58.3333 \pm 3.3255	54.1667 \pm 2.7918	8.560	< 0.001
Blood lactate	2.3500 \pm 0.3839	1.8500 \pm 0.3365	11.292	< 0.001

Field hockey players that followed a High-Intensity Interval Training (HIIT) regimen showed statistically significant gains ($p < 0.001$) in all physiological parameters that were assessed, demonstrating the effectiveness of this training method in improving athletic performance. Vital Capacity increased significantly from 4.6889 ± 0.4213 L to 5.1889 ± 0.2988 L ($t = -9.779$), according to the paired-samples t-test analysis, indicating a notable improvement in gas exchange efficiency and respiratory muscle strength. Concurrently, the cardiovascular system demonstrated favourable adaptation, as seen by a significant decrease in resting heart rate from 58.3333 ± 3.3255 bpm to 54.1667 ± 2.7918 bpm ($t = 8.560$). This change is indicative of greater stroke volume and improved parasympathetic tone. Most importantly, resting blood lactate levels decreased by 21.3%, from 2.3500 ± 0.3839 mmol/L to 1.8500 ± 0.3365 mmol/L ($t = 11.292$), indicating a considerable optimization of metabolic efficiency. All things considered, these results show that the HIIT intervention promoted a more effective "aerobic-anaerobic engine," allowing players to maintain higher work rates with increased metabolic clearance and decreased cardiovascular stress—two essential elements for the sporadic, high-intensity demands of competitive field hockey.

DISCUSSION

This study's main goal was to measure the physiological changes that field hockey players experienced after receiving a focused High-Intensity Interval Training (HIIT) intervention. The respiratory, cardiovascular, and metabolic systems have been profoundly and statistically significantly ($p < 0.001$) optimized, according to the data. The consistency of these gains among the 18 participants indicates that the HIIT regimen offered an overload stimulus strong enough to compel systemic adaptations, which are essential for field hockey's high-intensity, sporadic character.

There has been a notable improvement in pulmonary function, as seen by the 10.66% increase in vital capacity (4.69 to 5.19). High ventilatory volumes are required because players in competitive field hockey often function at 85 to 95% of their maximal heart rate.

The diaphragm and external intercostal muscles most likely strengthened adaptively as a result of the HIIT exercise. In the final moments of a game, players can maintain larger tidal volumes with lower oxygen costs to their respiratory muscles thanks to their enhanced respiratory strength, so "saving" oxygenated blood for the legs, which are the main locomotors.

In terms of the cardiovascular system, a 4.17 bpm decrease in resting heart rate (RHR) is suggestive of better autonomic balance and a more effective stroke volume. The Frank-Starling mechanism states that HIIT causes eccentric cardiac hypertrophy, which raises the internal diameter of the left ventricle. As a result, the heart may pump more blood every beat, requiring fewer contractions to meet the body's resting metabolic needs. A lower RHR indicates a greater "functional reserve," which allows the field hockey player to accomplish higher absolute workloads before reaching their physiological ceiling. It is not just an indicator of rest-state fitness.

The lowering of resting blood lactate levels by 21.28%, however, was the most important discovery. This change implies that lactate kinetics has undergone a revolutionary modification. Monocarboxylate Transporters (MCT1 and MCT4), which aid in the "Lactate Shuttle"—the transfer of lactate from muscles that produce it to tissues that oxidize it—are known to have their expression increased by high-intensity exercise. The drop from 2.35 mmol/L to 1.85 mmol/L suggests that the athletes have improved their capacity to eliminate metabolic waste products and built a stronger aerobic base that requires less anaerobic glycolysis at lower workloads. By postponing the development of metabolic acidosis, this metabolic efficiency enables players to maintain technical precision and explosive speed in a sport where games are frequently decided in the last 10 minutes.

CONCLUSION

High-intensity interval training is a very successful strategy for enhancing field hockey players' physiological profiles, according to the study's findings. HIIT optimizes the respiratory, cardiovascular, and metabolic systems for the unique demands of the sport by dramatically raising Vital Capacity and lowering Blood Lactate and Resting Heart Rate. Together, these adaptations increase the athlete's work capacity and rate of recovery, giving them a significant advantage in high-performance competitive settings.

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