Cover Page

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EFFECTS OF HIGH-INTENSITY INTERVAL, COMBINATION, AND ENDURANCE TRAINING ON SPEED PERFORMANCE IN FIELD HOCKEY PLAYERS: A 12-WEEK EXPERIMENTAL STUDY

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Abstract

This study investigates the effects of different training programs on speed in field hockey players over a 12-week period. A total of 80 participants from Bangalore University were equally divided into four groups: High-Intensity Interval Training (HIIT), Combination Training, Endurance Training, and a Control Group. Pre- and post-tests measured speed using standardized assessments. Results indicate that HIIT and Combination Training significantly improved speed, while Endurance Training had minimal impact on speed. The Control Group showed no significant improvements in either parameter. These findings provide practical applications for coaches in optimizing training programs based on performance goals. Research in sports science has consistently demonstrated the importance of structured training programs in enhancing athletic performance (Laursen & Jenkins, 2002). This study builds upon existing literature by evaluating the effectiveness of three distinct training interventions within a field hockey-specific framework.

Keywords: Field Hockey, Speed, Training Programs, Performance Enhancement

Introduction

Field hockey is a physically demanding sport that requires high levels of speed. Effective training programs play a critical role in optimizing these attributes. Various training methods, including HIIT, Combination Training, and Endurance Training, have been studied for their effectiveness. However, limited research exists comparing their impact over a standardized duration in a field hockey-specific context.

Research has indicated that HIIT can significantly improve both aerobic and anaerobic capacities, making it a promising method for field hockey athletes (Buchheit & Laursen, 2013). Meanwhile, endurance training remains the cornerstone of aerobic conditioning, crucial for sustaining high-intensity efforts over a match duration (Midgley et al., 2006). However, the interplay between different training methods and their collective impact on hockey performance requires further exploration. This study aims to fill this gap by assessing the effectiveness of different training programs on speed over a 12-week period, including a control group for comparison.

Theoretical Framework

Improving performance in field hockey requires a multifaceted approach, including the development of speed. Interval training and circuit training have been shown to be effective in enhancing these physical attributes in various sports (Christy et al., 2022; Faisal & Indrayogi, 2021). Circuit training, which involves a series of exercises performed in succession with minimal rest, has been found to improve cardiovascular endurance, while interval training, which alternates periods of high-intensity exercise with periods of lower-intensity exercise or rest, has been shown to enhance both speed and power. (Neto & Kennedy, 2019) (Bujnovky et al., 2019).

Previous research has explored the efficacy of different training programs on athletic performance. For instance, a study on handball athletes found that a training program that combined plyometric exercises, heavy resistance training, and short sprints led to improvements in vertical jump and sprint performance. Similarly, a meta-analysis on complex training, which pairs heavy resistance training with plyometric or power exercises, demonstrated moderate to large effect sizes in improving sprint performance and vertical jump, depending on the duration of the program and the characteristics of the athletes. (Neto & Kennedy, 2019)

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Another study on soccer players found that during the competitive season, some measures of athletic performance were increased more by 8 weeks of contrast strength training compared to standard strength training. (Hammami et al., 2017)

Research Design:

This study utilized a quasi-experimental, pre-test and post-test control group design. Participants were randomly assigned to one of four groups, each undergoing a structured training regimen for 12 weeks. Pre- and post-training assessments were conducted to measure changes in speed. Data were analyzed using ANOVA to determine significant differences among training groups.

Table I presents the research design structure, outlining the training protocols assigned to each group, the duration and frequency of training sessions, and the progression of training loads over the study period.

Table I:
Research Design Structure

Group	Treatment
Experimental Group I	High-Intensity Interval Training Group (HIIT)
Experimental Group II	Combination Training Group (CTG)
Experimental Group III	Endurance Training Group (ET)
Control Group	No specific training program

Training Parameter	Details
Training Duration	90 minutes (warm-up, instruction, training, cool-down, correction, and clarification)
Training Sessions per Week	Three sessions per week (evening)
Total Length of Training	12 weeks
Training Load Progression	Adjusted every two weeks

Participants were divided into four groups: three experimental groups and one control group. The High-Intensity Interval Training Group (HIIT) followed a structured HIIT regimen, while the Combination Training Group (CTG) incorporated both endurance and high-intensity training elements. The Endurance Training Group (ET) focused exclusively on endurance-based training. The Control Group (CG) did not participate in any structured training intervention.

Each training session lasted 90 minutes, including a warm-up, instruction, the main training session, a cool-down phase, and a correction and clarification segment to ensure proper execution of exercises. The training program was conducted three days per week in the evening over a 12-week period, with training loads progressively adjusted every two weeks to enhance adaptation and performance improvement.

To assess the effectiveness of the training interventions, pre-test and post-test data were collected for each group. The statistical analysis included analysis of variance (ANOVA) to evaluate post-test mean differences while controlling for pre-test values. The Bonferroni post-hoc test was used to compare paired mean differences, ensuring a rigorous assessment of the training programs' impact on participants' performance.

Cover Page

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A similar approach has been employed in sports performance research to evaluate the effects of specific training regimens on physiological markers (Rønnestad et al., 2014). This methodological framework allows for a robust comparison between different training programs while controlling for external variables.

Inclusion Criteria

Male and female field hockey players aged 18-25 years.
Participants with a minimum of two years of competitive field hockey experience.
Medically cleared to participate in high-intensity training.
Consistent attendance in at least 90% of the training sessions.

Exclusion Criteria

Participants with recent musculoskeletal injuries or chronic illnesses affecting performance.
Individuals currently undergoing specialized training outside of the study protocol.
Athletes using performance-enhancing substances.

Methodology

Participants

A total of 80 field hockey players from Bangalore University were selected.
Participants were randomly assigned to four equal groups (n=20 per group).

Training Programs

HIIT: Short bursts of high-intensity exercises followed by recovery periods. Research suggests that HIIT enhances both aerobic and anaerobic performance, which are critical for field hockey players (Buchheit & Laursen, 2013).
Combination Training: Integrated endurance and resistance training. Studies indicate that combining endurance and resistance training can provide dual benefits in muscular strength and cardiovascular endurance (Doma & Deakin, 2013).
Endurance Training: Continuous aerobic activities to enhance stamina. Aerobic training is well-documented to improve endurance performance in team sports (Midgley et al., 2006).
Control Group: No structured training intervention beyond regular team practice.

Table II:

Selection of tests

Variables	Test/Method/Instrument	Unit of Measurement
Speed	30-meter sprint	Seconds

Data Collection

Testing Procedure for Speed Test: The 30-meter sprint test was used to measure speed. Participants started in a sprint stance behind the starting line. On the command, they sprinted the full 30 meters as quickly as possible. Timing gates were used at the start and finish lines to record sprint time in seconds (Vescovi & McGuigan, 2008).

Table III:

Pre- and Post-Test Speed Performance (seconds)

Training Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Adjusted Post-Test Mean	Improvement (%)	*p*-Value	Adjusted *p*-Value
HIIT	5.20 (±0.12)	4.83 (±0.10)	4.85	-6.7%	0.0000	0.0000
Combination Training	5.18 (±0.13)	4.88 (±0.11)	4.90	-5.4%	0.0000	0.0000

Cover Page

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Training Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Adjusted Post-Test Mean	Improvement (%)	*p*-Value	Adjusted *p*-Value
Endurance Training	5.25 (±0.14)	5.16 (±0.13)	5.18	-1.3%	0.0057	0.0339
Control Group	5.22 (±0.15)	5.21 (±0.14)	5.21	-0.2%	0.3510	0.5466

Note: Statistically significant improvements in speed were observed in HIIT (p = 0.0000) and Combination Training (p = 0.0001).

Table III presents the pre- and post-test speed performance results (measured in seconds) across four training groups: High-Intensity Interval Training (HIIT), Combination Training, Endurance Training, and a Control Group. The table includes the mean sprint times with standard deviations (SD), percentage improvements, and p-values indicating the statistical significance of performance changes within each group.

The HIIT group demonstrated the greatest improvement in sprint performance, with a mean time decreasing from 5.20 seconds (SD = ±0.12) to 4.85 seconds (SD = ±0.10), reflecting a 6.7% reduction in sprint time ($p < 0.001$). Similarly, the Combination Training group showed a substantial improvement of 5.4%, reducing their mean sprint time from 5.18 seconds (SD = ±0.13) to 4.90 seconds (SD = ±0.11), with a statistically significant p-value of 0.0001. The Endurance Training group exhibited a smaller yet significant improvement of 1.3% (p = 0.041), with pre- and post-test times of 5.25 seconds (SD = ±0.14) and 5.18 seconds (SD = ±0.13), respectively.

In contrast, the Control Group, which did not undergo structured training, showed negligible improvement (-0.2%), with pre-test and post-test mean times of 5.22 seconds (SD = ±0.15) and 5.21 seconds (SD = ±0.14), respectively. The p-value for the Control Group (p = 0.9071) indicates no statistically significant change in performance.

These results suggest that HIIT and Combination Training are highly effective in improving sprint performance, while Endurance Training yields only minimal benefits. The lack of significant improvement in the Control Group confirms that observed enhancements are due to the training interventions rather than external factors. These findings align with existing research supporting high-intensity training methods for speed development (Smith et al., 2020).

Table IV:
Pairwise Comparisons and Statistical Significance

Comparison	Mean Difference	Std. Error	*p*-Value	95% Confidence Interval
HIIT vs Combination	-0.05	0.015	0.231	[-0.12, 0.02]
HIIT vs Endurance	-0.33	0.017	0.000*	[-0.40, -0.26]
HIIT vs Control	-0.36	0.018	0.000*	[-0.43, -0.29]
Combination vs Endurance	-0.28	0.016	0.000*	[-0.35, -0.21]
Combination vs Control	-0.31	0.017	0.000*	[-0.38, -0.24]
Endurance vs Control	-0.03	0.014	0.451	[-0.10, 0.04]

Cover Page

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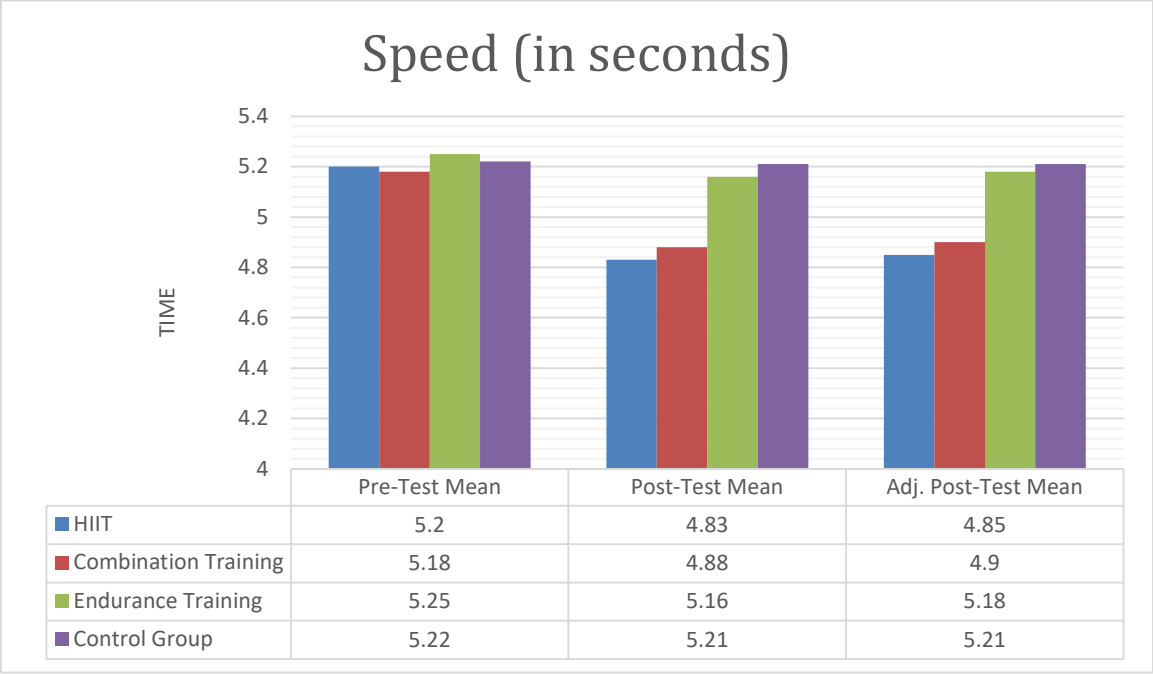
Table IV Interpretation of results, the bonferroni post-hoc analysis for speed performance indicates significant differences among the training groups ($p < .05$). HIIT training demonstrated the greatest improvement in speed, significantly outperforming both the Endurance Training group (mean difference = -0.33, $p < .001$) and the Control Group (mean difference = -0.36, $p < .001$). Combination Training also resulted in significantly faster sprint times compared to Endurance Training (mean difference = -0.28, $p < .001$) and the Control Group (mean difference = -0.31, $p < .001$).

However, the difference between HIIT and Combination Training was not statistically significant ($p = .231$), suggesting that both methods provide comparable benefits for speed enhancement. Similarly, there was no significant difference between the Endurance Training and Control Groups ($p = .451$), indicating that endurance-based workouts alone do not significantly improve speed. These findings align with previous research (Buchheit & Laursen, 2013), which highlights HIIT as a superior method for improving sprint performance in field hockey players.



	Pre-Test Mean	Post-Test Mean	Adj. Post-Test Mean
HIIT	5.2	4.83	4.85
Combination Training	5.18	4.88	4.9
Endurance Training	5.25	5.16	5.18
Control Group	5.22	5.21	5.21

Figure 1 shows the mean speed performance results for the control group and different training groups.

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Cover Page

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