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RESEARCH ARTICLE

Comparison of concurrent training versus high intensity interval training on speed and performance in collegiate football players

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Abstract

Background: Football is a physically demanding sport with a unique combination of strength, speed, endurance, agility and technical expertise. To meet these demands, training programmes should be carefully designed to optimise players' performance. This study explored the comparison of concurrent training (CT) and high-intensity interval training (HIIT) on speed and overall performance in collegiate football players.

Methods: A comparative experimental study was carried out between 30 September and 23 November 2024, involving forty purposively selected male university-level players. Participants were randomly designated to either a CT or HIIT group using a simple lottery, with 20 players in each group. Both groups completed an eight-week programme comprising three sessions per week. Speed and agility were evaluated before and after the intervention using the Illinois agility test and the repeated sprint ability test.

Results: Both training approaches significantly improved agility and sprint performance (P <0.001). The CT group reduced Illinois agility test times from 16.0 to 14.2 seconds and sprint times from 42.4 to 40.8 seconds. The HIIT group demonstrated greater improvements with agility times dropping from 16.4 to 12.4 seconds and sprint times from 42.7 to 38.5 seconds.

Conclusion: The study displayed improvement in speed and agility performance after the training interventions. Both methods enhanced speed and agility, however HIIT proved to be more effective than CT in improving performance.

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Key messages

This study among 40 male collegiate football players emphasises that high-intensity interval training is effective in boosting agility and sprint ability compared to concurrent training.

Introduction

Football is an intermittent, high-intensity team sport requiring players to repeatedly execute rapid movements such as sprinting, accelerating, decelerating, jumping, and changing direction, combined with lower-intensity activity. These demands place considerable physiological and neuromuscular stress on players, necessitating well-developed strength, speed, endurance, agility and repeated sprint ability; especially for collegiate athletes facing growing competitive pressures [1].

Sprinting and rapid directional changes are critical to football performance and often influence match outcomes. However, performing these actions under fatigue significantly increases mechanical strain on the musculoskeletal system, particularly the hamstrings and ankle structures, contributing to a high incidence of non-contact injuries [2]. Subsequently, training programmes must be carefully designed to enhance performance-related qualities while reducing fatigue-related risks.

Resistance training is widely recognised for improving maximal strength, power output, and neuromuscular efficiency which translates into effective sprinting, jumping and change-of-direction ability [3]. Conversely, endurance training enhances aerobic capacity and fatigue resistance, enabling players to sustain high-intensity efforts throughout a match [4]. Considering the limited time available during collegiate seasons, integrating these components effectively remains a practical challenge.

Concurrent training (CT), which combines resistance and endurance work within the same programme, is commonly used in football conditioning to develop multiple physical qualities simultaneously. While CT can be effective, research recommends that poor organisation may lead to an interference effect, where endurance training diminishes strength and power gains [5]. High-intensity interval training (HIIT) has emerged as a time-efficient alternative, improving aerobic capacity, anaerobic performance and sprint ability. HIIT involves repeated bouts of near-maximal effort interspersed with short recovery periods, closely mirroring the intermittent demands of football match play [6].

Despite the widespread use of CT and HIIT, direct comparisons of their effects on speed, agility and repeated sprint performance in collegiate football players remain scarce. Furthermore, there is a need for studies employing valid, field-based assessments to provide evidence-based training prescriptions. This study therefore aimed to compare the effects of CT and HIIT on speed, agility and sprint performance in collegiate football players using practical, field-based tests.

Methods

Study design

This study employed a comparative experimental design to investigate the effects of CT and HIIT on speed and performance in collegiate football players. The study was conducted from 30 September 2024 to 23 November 2024. A pre-test–post-test design was used to evaluate changes in performance variables following an eight-week training intervention.

Study population

Forty male collegiate football players aged between 18 and 25 years were recruited from various universities in Chennai using purposive sampling technique. All participants were actively engaged in college-level or club football training. Players with a history of cardiovascular conditions, musculoskeletal disorders or any injury within the previous six months were excluded from the study.

Sample size and randomization

The sample size was determined based on feasibility and the need to achieve sufficient statistical power for between-group comparisons. Participants were randomly assigned to two equal groups (n=20 each) using a simple lottery method. The groups were designated as the CT group and the HIIT group.

Training intervention

Both groups completed supervised training over eight weeks, with three sessions per week scheduled on non-consecutive days. Training intensity and progression were standardised across the intervention. Each session comprised multiple sets with controlled rest intervals, which were progressively increased throughout the programme to ensure adaptation and maintain safety.

CT group

The CT programme combined resistance training, plyometrics, sprint drills, and aerobic conditioning to develop the key physical attributes required for football performance. Training was structured across three weekly sessions. Day one directed on lower-body strength and aerobic conditioning, including exercises such as back squats, Romanian deadlifts, walking lunges, core stability work, and aerobic interval running. Day two aimed upper-body strength and speed development, incorporating bench press, pull-ups, push-ups, shoulder press, short-distance sprint drills, and resistance-band–assisted sprint starts. Day three concentrated on neuromuscular power and game-specific fitness through plyometric exercises (depth jumps, bounding, lateral hops, and single-leg box jumps) alongside 4v4 small-sided games. This integrated approach aimed to enhance muscular strength, power, endurance, and football-specific conditioning.

HIIT group

The HIIT programme was designed to improve speed, agility, repeated sprint ability, and cardiorespiratory fitness through short bursts of maximal or near-maximal effort. Training was conducted three times per week. On day one, sprint interval training, including 20–40 m linear sprints, acceleration sprints, and combined broad jump–sprint drills were performed. On day two, agility and change-of-direction drills using zig-zag cone runs, ladder drills, reactive shuttle runs, and T—test agility protocols were followed. Day three engaged on repeated sprint

capacity and explosive power through repeated sprints, shuttle runs, countermovement jumps, lateral skater jumps, and progressive box jumps. This coordinated HIIT approach aimed to enhance neuromuscular performance and high-intensity football-specific fitness.

Outcome measures

Speed and performance following the training interventions were assessed using validated field-based tests. Agility and change-of-direction speed were measured with the Illinois agility test, while repeated sprint performance was evaluated using the repeated sprint ability test. The outcome of the performance for both tests was recorded in seconds, with lower times indicating superior performance.

Statistical analysis

Descriptive statistics for all variables were calculated and expressed as mean (standard deviation). Normality of the data was assumed before analysis. Assessment of pre- and post-test changes in Illinois agility and repeated sprint ability in both the CT and HIIT groups (within-group) was analysed using a two-way repeated-measures analysis of variance. Comparisons of Illinois agility and repeated sprint ability scores between the CT and HIIT groups (between-group) were analysed using a two-way analysis of variance to determine speed and performance differences at post-intervention. Statistical analyses were performed using the SPSS, version 25. Results were presented as mean differences (95% confidence interval), calculated from pre minus post test. All statistical tests were two-tailed, and the level of significance was set at $P<0.05$.

Results

Participant characteristics

Forty collegiate football players completed the eight weeks training intervention in this study. Baseline characteristics were comparable between groups. The mean (standard deviation) age was 21.3 (1.9) years, height 172.4 (6.1) cm, body weight 68.7 (5.6) kg, and body mass index 23.1 (1.8) kg/m^2. No statistically significant differences were observed between groups at baseline.

Within-group changes

Both training interventions resulted in significant improvements in agility and repeated sprint performance. In the CT group, Illinois agility test times decreased from 16.0 (0.2) seconds to 14.2 (1.2) seconds (P <0.001). Repeated sprint ability performance also improved, with mean times reducing from 42.4 (0.5) seconds to 40.8 (0.5) seconds (P <0.001). The HIIT group demonstrated greater improvements. Illinois agility test times decreased from 16.4 (0.7) seconds to 12.4 (1.5) seconds (P <0.001). Repeated sprint ability test times improved from 42.7 (0.5) seconds to 38.5 (1.9) seconds (P <0.001) (Table 1).

Table 1 Pre- and post-test comparison in the concurrent training and high-intensity interval training groups (n=40)

Outcome measure	Pre-test	Post-test	Mean difference (95% CI)
Concurrent training group			
Illinois agility test (sec.)	16.0 (0.2)	14.2 (1.2)	−1.8 (−2.3 to −1.4)
Repeated sprint ability (sec.)	42.4 (0.5)	40.8 (0.5)	−1.6 (−2.0 to −1.1)
High-intensity interval training groups			
Illinois agility test (sec.)	16.4 (0.7)	12.4 (1.5)	−4.0 (−4.7 to −3.3)
Repeated sprint ability (sec.)	42.7 (0.5)	38.5 (1.9)	−4.3 (−5.1 to −3.4)

Results are mean (standard deviation); CI indicates confidence intervals
All changes are statistically significant at 1% level, two-way analysis of variances with repeated measures

Between-group comparison

Post-intervention comparisons demonstrated that the HIIT group performed better than the CT group in both tests. HIIT participants recorded significantly lower post-test times in the Illinois agility test [12.4 (1.5) seconds versus 14.2 (1.2) seconds] and the repeated sprint ability test [38.5 (1.9) seconds versus 40.8 (0.5) seconds] (P <0.001) (Table 2).

Table 2 Comparison of post-intervention outcomes between the training groups (n=40)

Outcome measure	Concurrent training	High-intensity interval training	P[a]
Illinois agility test (sec.)	14.2 (1.2)	12.4 (1.5)	<0.001
Repeated sprint ability (sec.)	40.8 (0.5)	38.5 (1.9)	<0.001

[a]Two-way analysis of variance

Discussion

This study compared the effects of CT and HIIT on agility and repeated sprint ability in collegiate football players over an eight-week intervention. The key findings indicate that both training methods produced significant improvements in agility and repeated sprint performance; however, HIIT resulted in markedly greater gains across both measures. These outcomes suggested that, integrated strength–endurance approaches are beneficial, while HIIT may offer superior adaptations for speed and sprint-related performance in this population.

The greater improvements observed in the HIIT group can largely be supported by the principle of training specificity. Football match play is characterised by repeated high-intensity efforts interspersed with short recovery periods, closely reflecting the work-to-rest structure of HIIT. Training of this kind has been shown to enhance anaerobic capacity, phosphocreatine resynthesis, sprint economy and neuromuscular efficiency, which are essential for rapid accelerations, decelerations and repeated sprint actions [7,8]. The substantial reductions in Illinois agility test and repeated sprint ability times recorded in the HIIT group in this study support these physiological adaptations [9].

Although the CT group demonstrated significant improvements, the level of change was smaller compared with HIIT. This understanding aligns with an earlier study suggesting a potential interference effect when resistance and endurance training are performed within the same cycle in combination [10]. Residual neuromuscular fatigue and competing molecular signaling pathways may limit maximal speed and power adaptations, particularly when training duration and recovery are constrained [11]. Nevertheless, the improvements observed in the CT group highlight their value in developing multiple

physical qualities simultaneously, which may be advantageous during extended preparatory phases. Evidence also suggests that the organisation and sequencing of CT that includes intensity distribution and recovery critically influence the extent of these adaptations in team sport athletes [12]. In this study, CT was shown to improved agility and repeated sprint ability, probably due to the inclusion of sport-specific strength and power exercises within the programme.

The significant improvements in repeated sprint ability following HIIT are consistent with previous studies reporting enhanced fatigue resistance and sprint maintenance in football players after HIIT [13]. Considering that, repeated sprint ability is strongly associated with match running performance and decisive game actions, these findings have important practical implications for football conditioning [14]. Moreover, the time-efficient nature of HIIT makes it particularly suitable during congested competitive schedules where training volume must be carefully managed [15]. Both groups exhibited meaningful improvements in agility, highlighting the role of high-intensity, football-specific training in enhancing neuromuscular coordination and change-of-direction performance. However, the superior agility gains in the HIIT group further support the use of movement-specific, high-velocity drills to optimise performance adaptations [16].

The strengths of this study include randomised group allocation, supervised training, and the use of validated field-based performance measures. The eight-week intervention reflects realistic training durations applicable to collegiate football settings. Despite having strengths in this research, it has some limitations. These include the relatively small sample size, short intervention period, and the inclusion of only male collegiate players, which may limit generalisability. Additionally, real game-play performance and long-term adaptations assessment were beyond the scope of this study.

Conclusion

In this study, both CT and HIIT significantly improved speed, agility and repeated sprint performance in collegiate football players. However, HIIT was more effective in enhancing these performance outcomes. These findings encourage the use of HIIT as an efficient and sport-specific conditioning strategy for football players. Future research should be done on larger samples, longer intervention periods, and match -based performance analysis to further validate these findings.

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Author contributions

Concept or design of the work; or the acquisition, analysis, or interpretation of data for the work: SPS. *Drafting the work or reviewing it critically for important intellectual content:* VNK. *Final approval of the version to be published:* SPS, RK, BA, VNK, PK. *Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* BA.

Conflict of interest

We do not have any conflict of interest.

Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

Supplementary file

None

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