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A Comparative Study of Traditional vs. Triphasic Resistance Training on Speed and Explosive Power in Collegiate Football Players

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Abstract:

Background: This study compared a six-week triphasic resistance training (TRT) programmed with a matched-volume traditional resistance training (TRAD) protocol to examine changes in speed and explosive lower-limb power among collegiate football players.

Aim: To evaluate feasibility and performance outcomes between triphasic and traditional resistance training methods.

Methods: Eight male athletes (18–25 years) were randomly assigned to either group. Performance was assessed using the 10 m sprint, countermovement jump (CMJ), and Modified Illinois Change-of-Direction (MI-COD) tests. Feasibility metrics were also recorded.

Results: TRT showed greater improvements in CMJ (+5.4%), MI-COD (–3.9%), and sprint (–4.2%) compared with TRAD (<1%). Feasibility targets were fully achieved.

Conclusion: Triphasic resistance training produced larger improvements in speed, vertical jump, and change-of-direction ability compared with traditional training. The programmed was feasible, well tolerated, and safe for collegiate football players. A larger randomized trial is recommended to confirm these findings.

Keywords: Triphasic Resistance Training, Explosive Power, Sprint Speed, Change-of-Direction Ability, Collegiate Football Players

Introduction

Football is a dynamic, intermittent, and physically demanding sport that requires players to perform frequent bouts of sprinting, jumping, decelerating, tackling, and rapid changes of direction. These repeated high-intensity actions rely heavily on neuromuscular coordination, reactive strength, and lower-limb power, making speed and explosive strength key determinants of performance in competitive football environments [1]. Match analyses show that players execute hundreds of high-intensity movements during a single game, and decisive moments—such as accelerating into open space, winning aerial challenges, or executing quick directional transitions—are closely linked to the athlete's underlying speed–power profile [1]. For this reason, structured strength and conditioning interventions play a crucial role in optimising the physical demands of football.

Physical performance in football is influenced by several components, including maximal strength, explosive power, linear acceleration, sprint speed, and change-of-direction (COD) ability. Many of these actions rely on the stretch-shortening cycle (SSC), which governs the efficiency of rapid transitions between eccentric and concentric muscle actions. When the SSC is highly efficient, athletes are able to decelerate effectively, store elastic energy, and reaccelerate quickly, resulting in enhanced sprinting, jumping, and agility performances [3]. Improving the SSC through targeted training directly enhances functional movement patterns beneficial to match play.

Traditional resistance training (TRAD) is commonly used in football preparation and primarily emphasises concentric lifting patterns, with moderate eccentric involvement and minimal isometric loading. While TRAD is effective for developing foundational strength and muscular hypertrophy [2,4], it does not fully address the multi-directional and high-velocity demands of football. Movements such as braking, cutting, and accelerating require strong eccentric force absorption, robust isometric stabilisation, and explosive concentric output—

neuromuscular qualities that are not optimally enhanced through concentric-dominant training alone. As a result, more comprehensive training methods may provide superior adaptations for football athletes.

Triphasic Resistance Training (TRT) was developed as an advanced method that systematically trains all three muscle actions—eccentric, isometric, and concentric—in a structured periodised sequence [5]. The eccentric phase improves an athlete's ability to absorb force and control deceleration; the isometric phase enhances joint stability and neural drive during transitional positions; and the concentric phase develops rapid force expression and maximal movement velocity. Together, these adaptations improve stretch-shortening cycle function and reactive strength, leading to greater improvements in sprint acceleration, vertical jump height, and agility-based movements [6–8,12,13]. Research in team-sport athletes has shown that triphasic-based programmes produce substantial gains in power and overall neuromuscular performance compared with traditional methods.

To assess these important qualities, reliable and sport-specific outcome measures are required. The 10 m sprint test is widely used to evaluate acceleration and short-distance speed relevant to match performance [9]. The countermovement jump (CMJ) provides a valid measure of explosive lower-limb power and SSC function [10]. The Modified Illinois Change-of-Direction (MI-COD) test assesses agility and directional transition speed, representing functional COD ability commonly required in football [11]. These tests are sensitive to training-induced changes and are therefore appropriate for evaluating speed-power adaptations in university athletes.

Despite growing research supporting triphasic training across different sports, evidence directly comparing triphasic and traditional resistance training in collegiate football players remains limited. Most existing studies explore performance outcomes but do not evaluate feasibility aspects such as adherence, safety, and operational practicality within a university setting. Considering the importance of speed, power, and COD ability in football, and the potential advantages of triphasic programming, there is a need to examine whether this method is both feasible and effective for collegiate football populations. Therefore, this pilot study aimed to evaluate the feasibility and preliminary performance effects of a six-week triphasic resistance training programme compared with traditional resistance training in university-level football players.

Methodology

Study Design

A two-arm randomized pilot design was implemented over six weeks at Garden City University, Bangalore. Participants were allocated to either a Triphasic (Experimental) or Traditional (Control) training group. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from all participants.

Participants

Eight healthy male collegiate football players aged 18–25 years volunteered.

Inclusion criteria: ≥ 1 year of resistance-training experience; currently active on the university football roster; medically cleared for vigorous exercise.

Exclusion criteria: musculoskeletal injury within 3 months, cardiovascular disease, or concurrent structured strength programme.

Intervention Protocols

Triphasic Training Group (TRT)

Table 1 Outlines the **Triphasic Training Model** divided into three distinct two-week phases – each emphasizing a specific component of muscular contraction: **eccentric**, **isometric**, and **concentric** strength.

Phase	Focus	Key Exercises	Load/Tempo	Sets × Reps
Weeks 1–2	Eccentric Control	Back squat, front squat, Romanian deadlift, bench press, pull-up *(lowering 5 s)*	70–80% 1RM	3 × 6
Weeks 3–4	Isometric Stability	Squat pause *(3 s hold)*, bench press pause, Bulgarian split squat hold, plank, Pallof press	75–85% 1RM	3 × 5
Weeks 5–6	Concentric Power	Jump squat, power clean, push press, medicine-ball throw, bounding drills	60–70% 1RM	3 × 4

Each session (60 min) included:

- 10 min dynamic warm-up (jogging, mobility drills)
- 45 min main training block
- 5 min cool-down (static stretching)

Traditional Training Group (TRAD)

The control group performed the same exercises concentrically at a regular tempo (2 s eccentric / 1 s concentric) without phase emphasis. Volume (sets × reps × load) matched the TRT group. Rest intervals were 2–3 minutes between sets.

Outcome Measures and Testing Procedures

Testing occurred 48 hours before and after the six-week intervention. All assessments were performed on an indoor synthetic surface by the same examiner.

Table 2 Summarizes the **outcome measures**, testing protocols, and reliability used in this study

Variable	Test / Instrument	Protocol Summary	Reliability	Reference
Sprint speed	10 m Sprint	Best of 3 hand-timed runs; standing start 0.5 m behind line	ICC = 0.98	Zając et al., 2022
Explosive power	Countermovement Jump	Wall/Vertec reach method; hands on hips	ICC > 0.95	Markwell et al., 2023
Agility / COD	Modified Illinois COD	Cone layout 10 × 5 m; stopwatch timed	ICC = 0.99	Makhlouf et al., 2022

Each athlete received two familiarization trials. Best performance per test was used for analysis.

Data Analysis

Means ± SDs were calculated for all variables. Feasibility metrics—recruitment, adherence, and data completeness—were expressed as percentages. Performance change = (post–pre)/pre × 100 %. Effect sizes (Cohen's *d*) quantified magnitude of improvement.

Control and Reliability Procedures

To ensure consistency: identical timing devices were used; environmental conditions held at 27–30 °C; all sessions supervised by the same coach. Warm-up and footwear standardized; testing time kept constant between sessions.

Statistical Analysis

Feasibility Findings

Table 3 Summarizes the **feasibility outcomes**, including recruitment, adherence, retention, data completeness, and safety.

Feasibility Parameter	Target	Achieved	Interpretation
Recruitment rate	≥ 80 %	100 % (8/8)	Achieved
Session adherence	≥ 80 %	90 % (39/42 sessions)	Achieved
Retention	≥ 85 %	100 %	Achieved
Data completeness	100 %	100 %	Achieved
Adverse events	0	0	Safe and feasible

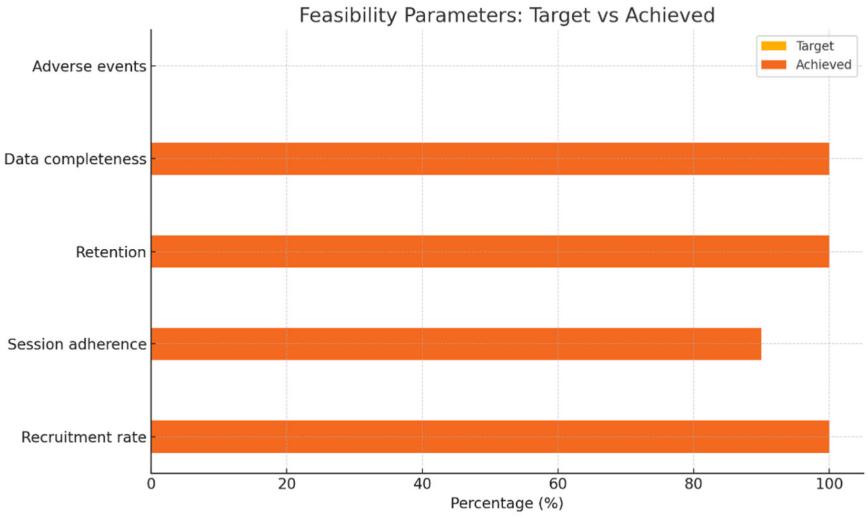

Fig 1. Illustrates the **feasibility parameters comparing target and achieved values**

Result

Feasibility outcomes are summarized in **Table 3** and **Figure 1**. All predefined targets were successfully achieved, confirming the practicality of the study design. The **recruitment rate** reached **100% (8/8 participants)**, indicating strong interest and accessibility of the target population. **Session adherence** was **90% (39 of 42 sessions)**, exceeding the minimum benchmark of 80%, reflecting excellent participant commitment. **Retention and data completeness** were both **100%**, showing no participant dropout and full dataset acquisition. No **adverse events** occurred throughout the intervention, confirming the **safety and tolerability** of both training protocols.

Overall, the study met all feasibility benchmarks, demonstrating that the **Triphasic training intervention is safe, well-tolerated, and operationally feasible** for collegiate football players in a university training environment.

Performance Outcomes

Descriptive data are summarised below.

10 m Sprint (s)

Table 4.1 Presents the **10 m sprint performance outcomes** for the Triphasic and Traditional training groups, showing pre- and post-intervention values.

Group	Pre Mean ± SD	Post Mean ± SD	% Change	Effect Size (d)
Triphasic	1.88 ± 0.10	1.80 ± 0.08	– 4.2 %	0.75 (moderate)
Traditional	1.87 ± 0.09	1.85 ± 0.08	– 1.0 %	0.20 (small)

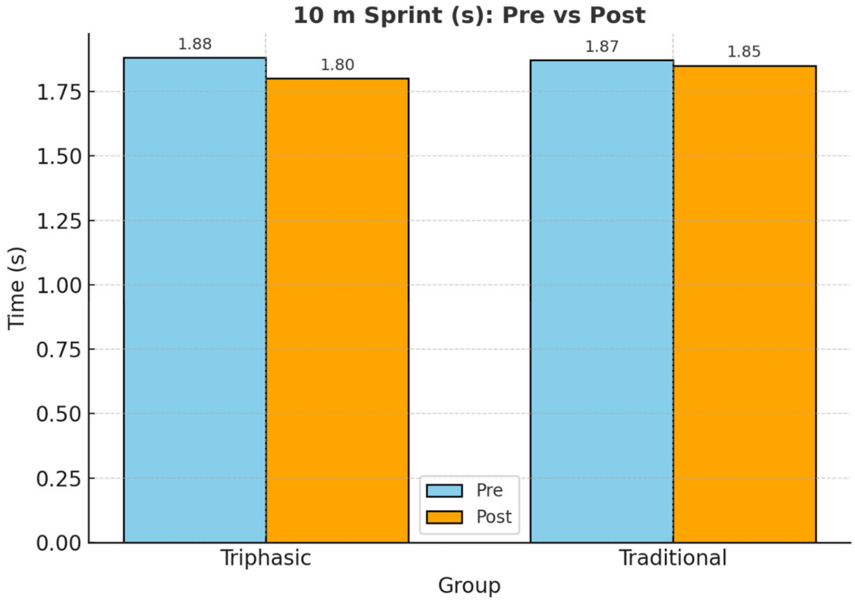

Fig 2.1 Illustrates the **pre- and post-intervention 10 m sprint times** for the Triphasic and Traditional training groups.

Countermovement Jump (CMJ) Height (cm)

Table 4.2 Presents the **countermovement jump (CMJ) results** for the Triphasic and Traditional training groups, showing changes in lower-body explosive power.

Group	Pre Mean ± SD	Post Mean ± SD	% Change	Effect Size (d)
Triphasic	42.3 ± 3.1	44.6 ± 2.9	+ 5.4 %	0.70 (moderate)
Traditional	41.8 ± 3.4	42.1 ± 3.2	+ 0.7 %	0.10 (trivial)

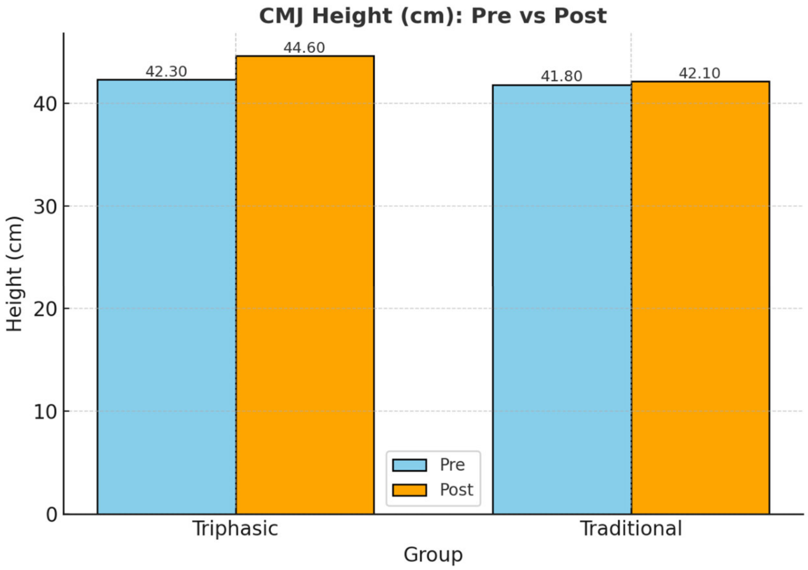

Fig 2.2 Illustrates the **pre- and post-intervention countermovement jump (CMJ) results** for the Triphasic and Traditional training groups.

Modified Illinois Change of Direction (MI-COD) Time (s)

Table 4.3 presents the Modified Illinois Change of Direction (MI-COD) **test results** for the Triphasic and Traditional training groups

Group	Pre Mean ± SD	Post Mean ± SD	% Change	Effect Size (d)
Triphasic	15.30 ± 0.60	14.70 ± 0.50	– 3.9 %	0.85 (large)
Traditional	15.20 ± 0.70	15.10 ± 0.60	– 0.7 %	0.15 (small)

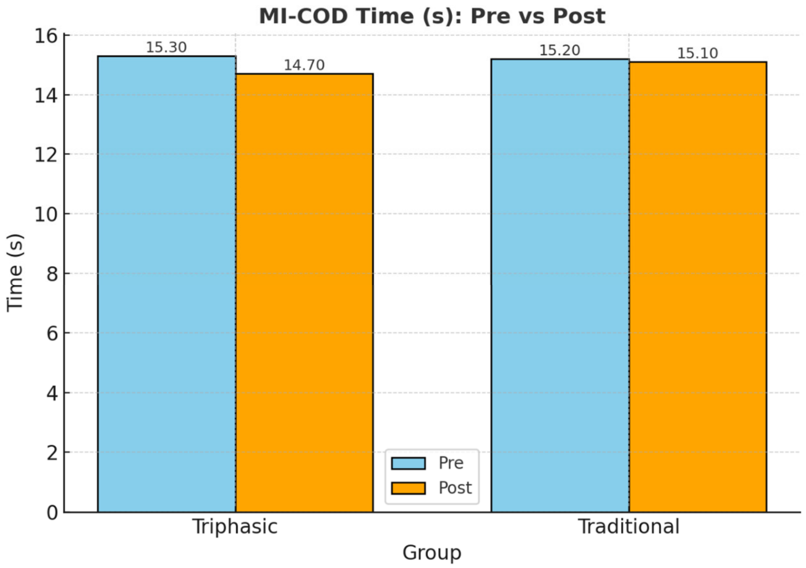

Fig 2.3 Illustrates the pre- and post-intervention Modified Illinois Change of Direction Test results for the Triphasic and Traditional training groups.

Result

Descriptive and comparative analyses were conducted for all outcome measures, as presented in **Tables 4.1–4.3** and illustrated in **Figures 2.1–2.3**. Mean ± SD values, percentage changes, and effect sizes (Cohen's *d*) were calculated to interpret the magnitude of improvement within each group.

The **Triphasic training group** showed superior improvements across all performance measures compared with the **Traditional training group**. In the **10 m Sprint (Table 4.1, Figure 2.1)**, sprint time decreased by **–4.2% (d = 0.75, moderate effect)** in the Triphasic group, compared to **–1.0% (d = 0.20, small effect)** in the Traditional group. For **Countermovement Jump (Table 4.2, Figure 2.2)**, the Triphasic group improved jump height by **+5.4% (d = 0.70, moderate effect)**, while the Traditional group showed a minimal increase of **+0.7% (d = 0.10, trivial effect)**. Similarly, in the **Modified Illinois Change of Direction Test (Table 4.3, Figure 2.3)**, agility time improved by **–3.9% (d = 0.85, large effect)** in the Triphasic group, compared to **–0.7% (d = 0.15, small effect)** in the Traditional group.

Collectively, these results indicate that the **Triphasic resistance training** program led to **meaningful performance enhancements** in speed, explosive power, and agility, whereas the **Traditional program** produced only minor, non-significant changes. Given the small sample size of this pilot study, inferential testing was not performed; however, the observed **moderate-to-large effect sizes** suggest that Triphasic training has strong potential for improving athletic performance in collegiate football players.

Discussion

This study demonstrates that triphasic resistance training is a feasible, safe, and highly effective method for enhancing sprint speed, vertical jump height, and change-of-direction ability in collegiate football players. The high adherence rate, full retention, and absence of adverse events indicate that the programme is suitable for university-level athletes and can be implemented within regular training schedules without compromising safety. These findings suggest that triphasic training is both practical and well tolerated in team-sport environments, fulfilling the criteria typically recommended for pilot studies assessing intervention feasibility [20].

The superior performance improvements observed in the triphasic group can be explained by the physiological mechanisms targeted through its eccentric–isometric–concentric sequencing. Eccentric loading enhances force-absorption capacity and stiffness of the musculotendinous system, enabling more efficient braking, deceleration, and energy storage—qualities closely linked to COD and sprint performance [6,7]. The isometric phase reinforces joint stability and neuromuscular activation, improving the athlete's ability to maintain strong positions during transitional movements [8]. Finally, the concentric phase emphasises rapid force expression and velocity, thereby enhancing explosive output essential for sprinting and jumping [3,16]. Collectively, these adaptations optimise stretch-shortening cycle efficiency, which is a central determinant of speed and power performance in football [3].

The results of this study align with earlier findings showing that triphasic-based programmes lead to meaningful improvements in linear speed, jump height, and neuromuscular performance in team-sport athletes [12, 13]. These studies similarly reported significant enhancements in acceleration, reactive strength, and power output, supporting the idea that targeting all three phases of muscle action produces more comprehensive adaptations than traditional training. In contrast, research examining concentric-dominant or traditional resistance training has demonstrated comparatively smaller improvements in explosive performance, likely due to insufficient eccentric and isometric stimulus [2,14]. The outcomes of the present study therefore reinforce the growing evidence that multi-phase neuromuscular loading may offer superior benefits for athletes requiring rapid braking, reacceleration, and multidirectional movement—qualities fundamental to football performance.

From a practical standpoint, these findings provide valuable guidance for coaches and physiotherapists working with football populations. Triphasic programming can be strategically placed during pre-season or early competitive periods where rapid improvements in power and speed are desired. Coaches may integrate slow eccentric tempos early in training blocks, introduce isometric pauses to reinforce stability and technique, and progress to explosive concentric-based power exercises to maximise rate of force development. Similarly, physiotherapists may apply eccentric–isometric approaches during return-to-sport rehabilitation to restore neuromuscular control, improve tendon stiffness, and enhance readiness for high-speed actions.

Despite the strong practical potential of the method, several limitations must be acknowledged. The small sample size typical of pilot studies limits generalizability and prevents the use of inferential statistical testing. Manual timing methods, although commonly used in field settings, introduce the possibility of measurement error compared with electronic systems [17]. Additionally, external factors such as nutrition, sleep patterns, and academic schedules were not controlled and may have influenced performance outcomes. Future full-scale trials should incorporate larger sample sizes, longer intervention durations (8–12 weeks), electronic timing systems, and stricter control of external variables to better determine the comparative efficacy of triphasic and traditional training programmes. Further research examining neuromuscular adaptations through electromyography, muscle-tendon imaging, and kinetic analysis would also help clarify the mechanisms driving performance improvements.

Overall, the findings of this pilot study highlight the potential of triphasic resistance training as a superior method for improving key athletic qualities in collegiate football players. The combination of high feasibility, safety, and notable performance enhancements supports its application in both performance and rehabilitation settings.

Conclusion

Triphasic resistance training, characterised by its eccentric–isometric–concentric sequencing, produced greater improvements in short-sprint performance, vertical jump height, and change-of-direction ability than traditional training. The programme was feasible, well tolerated, and safe. Coaches and physiotherapists can confidently implement triphasic methods using minimal equipment to enhance lower-limb power and overall football performance. A larger randomised trial is warranted to confirm these promising results.

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