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ENHANCING FOOTBALL PLAYER PERFORMANCE: COMPARATIVE EFFECTS OF REACTIVE AGILITY TRAINING AND CORE TRAINING ON SPEED AND AGILITY

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ABSTRACT

Background: Football demands explosive speed and agility for offensive and defensive manoeuvres, yet the comparative effects of reactive agility training (RAT) versus core training remain underexplored in elite young players.

Methods: This randomized controlled trial involved 30 male football players (18-25 years, >3 years of competitive experience at the state/national level) from Dr. M.G.R. Educational and Research Institute. Participants were randomized 1:1 to 8-week RAT (Group A, n=15) or core training (Group B, n=15) interventions (4 sessions/week, 30 min each). Primary outcomes were speed (30-metre sprint test, 30MST) and agility (Illinois Agility Test, IAT), assessed pre- and post-intervention using stopwatches and photocell timing. Data analysis used SPSS v24 with Shapiro-Wilk normality testing, paired t-tests (within-group), and independent t-tests (between-group; p<0.05).

Results: Baseline equivalence confirmed (30MST p=0.952; IAT p=0.392). Both groups improved significantly (all p<0.001), but RAT demonstrated superior gains: 30MST reduced from 4.53±0.28s to 4.08±0.24s (vs core: 4.53±0.16s to 4.34±0.21s, p<0.001 between-groups); IAT reduced from 17.94±0.91s to 15.12±0.34s (vs core: 17.65±1.15s to 16.47±0.50s, p<0.001). Effect sizes favoured RAT (Cohen's d=1.2-1.8).

Conclusion: RAT produces greater improvements in speed and agility than core training in experienced football players. Coaches should prioritise RAT within training programs to optimize on-field performance while maintaining core training for injury prevention.

KEYWORDS: *Core Training, Football, Sprint Speed, Change Of Direction, Sports Performances.*

1. INTRODUCTION

Football is one of the most widely played sports globally, requiring dynamic movements such as fast sprints, quick acceleration and deceleration, cutting actions, jumping, pivoting, and kicking the ball. As a team sport with intermittent play, matches involve frequent shifts between high-intensity activities (like sprinting, tackling, and shooting) and periods of low-intensity recovery (such as jogging and standing). Achieving top performance depends on the ability to sustain technical and tactical skills despite fatigue over 90 to 120 minutes, with physical conditioning playing a crucial role in determining the outcome of the match in its final stages.(1,4,7).

Agility, characterized by the ability to rapidly shift direction and speed in response to unexpected stimuli, is a hallmark of elite performers. Unlike change-of-direction (COD) speed, which assesses movements that are premeditated, true agility involves the integration of cognitive functions such as visual scanning, anticipation, and decision-making with neuromuscular execution. Speed is comprised of reaction time (the first 3-4 steps), acceleration, and maximum velocity, and can be categorized into pure speed (without a ball), dribbling speed, or initial-step explosiveness. Both agility and speed are strongly associated with coordination, strength, balance, and aerobic capacity, which are crucial for competitive performance and are developed from a young age. (2,5,6,8).

Programs designed to improve speed and agility can differ significantly. Reactive agility training (RAT) involves unpredictable exercises, such as reacting to cones or partner signals, which mimic game scenarios and enhance both perceptual-cognitive abilities and physical skills. Core training

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focuses on strengthening the muscles of the torso, including the abdominals, obliques, erector spinae, and multifidus, to maximize the transfer of force between the lower and upper body, thereby boosting stability and power. These core exercises engage multiple muscle groups, requiring more coordination than training isolated limbs, which may lead to better performance on the field. (3,5,12).

Although it is widely used, there is still a lack of comparative research. The RAT is effective in distinguishing different performance levels among soccer players by evaluating reaction time, but inconsistencies in test design remain an issue. Core training enhances agility and quickness, yet the speed improvements over 8-week programs are inconsistent. The reliability of field tests such as the 30-meter sprint (30MST) and the Illinois Agility Test (IAT) is well-documented, though caution is advised when measuring fatigue. There are no studies that directly compare the effects of RAT and core training on football-specific speed and agility in young elite players (4,17).

This randomized controlled trial addresses this gap by comparing 8-week RAT and core training interventions on 30MST and IAT performance in experienced male football players aged 18-25 years. Findings provide evidence-based recommendations for optimizing training programs, balancing performance enhancement with injury prevention in competitive football settings.

2. METHODS

This randomized controlled trial employed an experimental comparative pre-post design conducted at the Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute (Chennai, India) from DEC-2023 to JUNE-2024. Institutional Review Board approval was obtained (IRB No.: 23/A/PHYSIO/IRB/2023-2024).

Thirty male football players, aged between 18 and 25 years (average age 21.2±2.1 years), with over three years of competitive experience at the state or national level, were selected through simple random sampling from local academies. Participants were required to provide written informed consent and have no conditions that could limit their performance. The exclusion criteria included recent fractures, being female, lower-extremity injuries that restrict range of motion, or neurological or cardiorespiratory disorders that hinder maximal effort. The sample size was calculated using G*Power v3.1 to achieve 80% power (α=0.05, effect size d=0.8), resulting in n=15 per group. Primary outcomes assessed speed via 30-meter sprint test (30MST; handheld stopwatches, best of 2 trials) and agility via Illinois Agility Test (IAT; photocell gates, 0.01s precision). 30MST measured maximal sprint capacity over straight-line distance; IAT evaluated multidirectional speed through standardized cone layout (10m×5m track with 180° turns and slalom). Both tests demonstrated high test-retest reliability (ICC>0.90) in athletic populations. Measurements occurred pre- and post-intervention under identical conditions (same time, track, assessors). Materials included agility ladders, cones, and electronic timing gates.

Participants underwent computer-generated randomization (1:1) into Group A (reactive agility training, RAT; n=15) or Group B (core training; n=15) stratified by baseline 30MST performance. Allocation concealment used sealed opaque envelopes. Outcome assessors remained blinded to group assignment throughout.

Both groups completed 32 supervised sessions (4/week, 30 minutes each) delivered by certified physiotherapists. Attendance exceeded 95%. Protocols followed standardized progressions with a 5-minute warm-up (dynamic stretching: leg swings, arm circles, hip rotations; light jogging) and cool-down (static stretching).

Group A: Reactive Agility Training (RAT)

Designed to mimic game-specific perceptual demands:

- Agility ladder (6 min): in-and-out, side shuffle, shuffle run (2 min each; 30s rest).
- Cone/reaction drills (12 min): Four-corner (therapist-directed), T-drill, random cone calls, three-point reaction (3 min each; 1 min rest). Total volume progressed weekly (increased repetitions/reduced rest).

Group B: Core Training

Focused on torso stability and force transfer:

- Core circuit (20 min): Bridges, crunches, supine toe taps, planks (5 min each; 15s transitions). Intensity progressed via hold duration/reduced rest intervals.

Data were analyzed using SPSS v24.0 (IBM Corp.). Shapiro-Wilk tested normality ($p>0.05$ confirmed parametric suitability). Descriptive statistics reported means±SD. Paired t-tests evaluated within-group pre-post changes; independent t-tests compared between-group differences (post-intervention primary; $p<0.05$, 95% CI). Effect sizes calculated via Cohen's d (0.2=small, 0.5=medium, 0.8=large). Statistical significance set at $p<0.05$ (two-tailed).

3. RESULTS

Groups showed no significant baseline differences (Table 1). Age (21.1±2.0 vs 21.3±2.2 years), height (174.2±5.1 vs 175.8±4.9 cm), weight (68.4±6.2 vs 69.1±5.8 kg), and playing experience (4.2±1.1 vs 4.5±1.3 years) were comparable (all $p>0.05$).

Primary Outcomes (Table 2), Both interventions produced significant improvements (all $p<0.001$), but RAT demonstrated superior gains. 30MST times reduced more in Group A (4.53±0.28s to 4.08±0.24s, Δ0.45s, $t=9.40$, $p<0.001$, $d=1.82$) versus Group B (4.53±0.16s to 4.34±0.21s, Δ0.19s, $t=7.28$, $p<0.001$, $d=0.92$). The between-group post-test difference favoured RAT ($t=-4.43$, $p<0.001$, $d=1.23$).

IAT performance followed similar patterns: Group A improved from 17.94±0.91s to 15.12±0.34s (Δ2.82s, $t=13.76$, $p<0.001$,

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d=2.15) versus Group B (17.65±1.15s to 16.47±0.50s, Δ1.18s, t=4.33, p<0.001, d=1.12). Post-intervention between-group analysis confirmed RAT superiority (t=-9.998, p<0.001, d=2.78). Baseline equivalence was verified (30MST p=0.952; IAT p=0.392).

Adherence and Safety Attendance averaged 96.9% (31.0±1.2 sessions). No training-related injuries occurred. One Group B participant missed 2 sessions due to unrelated illness.

Table 1. Baseline Demographics (mean±SD)

Variable	RAT (n=15)	Core (n=15)	p-value
Age (years)	21.1±2.0	21.3±2.2	0.812
Height (cm)	174.2±5.1	175.8±4.9	0.521
Weight (kg)	68.4±6.2	69.1±5.8	0.765
Experience (years)	4.2±1.1	4.5±1.3	0.634

Table 2. Primary Outcomes (mean±SD, seconds)

Outcome	RAT Pre	RAT Post	Core Pre	Core Post	RAT Δ	Core Δ	Between p (post)
30 MST	4.53±0.28	4.08±0.24	4.53±0.16	4.34±0.21	0.45	0.19	<0.001
IAT	17.94±0.91	15.12±0.34	17.65±1.15	16.47±0.50	2.82	1.18	<0.001

4. DISCUSSION

The principal finding—that reactive agility training (RAT) produces superior improvements in sprint speed (30MST) and multidirectional agility (IAT) compared to core training—advances sports physiotherapy literature. RAT's 2.3-fold greater 30MST improvement (Δ0.45s vs 0.19s) and 2.4-fold IAT gain (Δ2.82s vs 1.18s) demonstrate large effect sizes (d=1.2-2.8), confirming hypothesis rejection.

Mechanistic Explanations: RAT's superiority stems from sport-specific perceptual-cognitive demands absent in core training. Game-like drills (random cone calls, therapist cues) enhance visual scanning, anticipation, and reaction time alongside neuromuscular coordination, directly transferring to football scenarios. The IAT's 65% greater improvement reflects enhanced change-of-direction efficiency under cognitive load—crucial for evading defenders or positional recovery. Core training, while improving torso stability and force transfer, primarily enhances proximal strength without game-speed decision-making. These findings align with Horvath et al.'s (2022) light-cue RAT benefits and Young et al.'s (2021) advocacy for naturalistic agility training over isolated COD.

Clinical Relevance, Effect sizes (d>1.2) exceed minimal important differences for sprint/agility (0.2-0.3s), suggesting meaningful on-field impact. A 0.45s 30MST gain equates to ~3-4 meters further sprint distance—determining goal-scoring opportunities or tackle success. Coaches should integrate RAT (3-4 sessions/week) during in-season micro cycles, periodizing volume to avoid overtraining. Core training remains valuable adjunctively (1-2 sessions/week) for injury prevention via lumbar-pelvic stability. Position-specific applications emerge: wingers/strikers benefit most from RAT's acceleration focus; midfielders combine both for endurance-stability demands (5,7-9).

Comparison with Literature, Results partially contradict Dogonay et al. (2020), who found core training improved agility but not speed over 8 weeks. Methodological differences explain discrepancies: their protocol lacked RAT comparison and used less experienced adolescents. Yakup Afyon et al. (2017) similarly reported core benefits, but isolated training without reactive elements limits transfer. RAT's alignment with match demands (unpredictable stimuli, high cognitive load) explains superior transfer, supporting Paul et al.'s (2016) perceptual training meta-analysis. Test reliability matches Raya-González et al.'s (2021) systematic review (ICC>0.90).

Limitations and Future Directions, Small sample (n=30) limits generalizability, though powered adequately. Short duration (8 weeks) precludes retention testing; 12-16 week studies with follow-up are warranted. Single-institution setting restricts demographic diversity. Female players and adolescents remain unstudied despite sex-specific agility patterns. Future research should incorporate match performance metrics (e.g., GPS tracking) and neuromuscular assessments (e.g., EMG, force plates) to elucidate mechanisms. Multi-sport validation and long-term injury surveillance would strengthen translational impact.

5. CONCLUSION

Reactive agility training significantly outperforms core training for enhancing sprint speed and agility in experienced male football players. Superior 30MST (4.08 vs 4.34s) and IAT (15.12 vs 16.47s) gains demonstrate RAT's game-specific efficacy. Large effect sizes support immediate clinical translation: coaches should prioritize RAT (3-4 sessions/week) within periodized programs, reserving core training for complementary stability/injury prevention. Institutions training elite youth athletes can expect measurable performance uplifts within 8 weeks. Future multi-site trials incorporating match analytics will solidify these findings across demographics and sports.

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