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Role of Combined Fitness Progression and Skill Training in Developing Motor Fitness and Cognitive Planning in Young Cricketers

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Abstract: *Cricket demands both physical fitness and cognitive abilities for optimal performance. While traditional training emphasizes skill development, the integration of systematic fitness progression with skill training remains underexplored in young cricketers. To investigate the effects of combined fitness progression and skill training on motor fitness components and cognitive planning abilities in young cricketers aged 13-16 years. Sixty male cricketers were randomly assigned to experimental group receiving combined fitness progression and skill training, or control group receiving conventional skill training only. The 12-week intervention included assessments of motor fitness and cognitive planning. Data were analyzed using paired t-tests, independent t-tests, ANCOVA, and effect sizes. The EG demonstrated significantly greater improvements than CG in 30m sprint time, T-test agility, vertical jump, and cognitive planning scores. Within-group analysis revealed significant pre-post improvements in EG across all variables, while CG showed minimal changes. Combined fitness progression and skill training produces superior adaptations in both motor fitness and cognitive planning compared to skill training alone. This integrated approach should be incorporated into youth cricket development programs..*

Keywords: Cricket training, motor fitness, cognitive planning, youth athletes, integrated training, skill development.

I. INTRODUCTION

Cricket is a multifaceted sport requiring complex integration of physical abilities, technical skills, and cognitive decision-making capabilities (Marchetti et al., 2015). The modern game demands athletes who possess not only refined batting, bowling, and fielding techniques but also exceptional speed, power, agility, and mental acuity to respond to rapidly changing match situations (Boby & Shara, 2024; Reza et al., 2024). Young cricketers face particular developmental challenges as they must simultaneously develop physical capacities, master technical skills, and enhance cognitive abilities during critical growth periods (Pote & Christie, 2018).

Traditional cricket training programs have historically emphasized skill acquisition through repetitive practice of batting, bowling, and fielding techniques (Pote & Christie, 2018). While this approach develops sport-specific competencies, it may neglect the systematic development of underlying physical fitness components that form the foundation for skill execution (Marchetti et al., 2015). Recent research in sports science suggests that physical fitness and motor abilities create the platform upon which technical skills are expressed, particularly in youth populations where neuromuscular and cognitive systems are still maturing (Marchetti et al., 2015).

Motor fitness encompasses multiple components including speed, agility, power, strength, and endurance (Boby & Shara, 2024; Reza et al., 2024). These qualities enable cricketers to sprint between wickets, change direction rapidly while fielding, generate bat speed for powerful strokes, maintain bowling velocity throughout innings, and sustain performance across extended match durations (Pote & Christie, 2018). Simultaneously, cognitive planning abilities allow players to anticipate opposition strategies, select appropriate shots, plan field placements, and execute tactical decisions under pressure (Buszard, 2022; Waelle et al., 2021).

The concept of combined training, integrating structured fitness progression with sport-specific skill development, has gained attention in various sports (Pote & Christie, 2018). This approach recognizes that physical capacities and technical skills develop synergistically rather than in isolation (Marchetti et al., 2015). However, limited research has examined the effectiveness of this integrated methodology specifically in youth cricket populations, particularly regarding its impact on both motor fitness and cognitive functions (Pote & Christie, 2018).

II. LITERATURE REVIEW

2.1 Motor Fitness in Cricket Performance

Motor fitness represents a fundamental requirement for cricket performance across all playing positions (Boby & Shara, 2024; Reza et al., 2024). Speed enables rapid running between wickets and quick approach to the crease for fast bowlers (Brazier et al., 2024; Pote & Christie, 2018). Studies demonstrate that elite cricketers possess superior sprint capabilities compared to recreational or less skilled players, with 20-m sprint times differentiating performance levels (Brazier et al., 2024; Carr et al., 2015; Veness et al., 2017).

Agility facilitates sudden directional changes during fielding and batting footwork, with studies indicating strong correlations between agility test performance and fielding proficiency (Boby & Shara, 2024; Pote et al., 2020).

Power production, particularly in the lower body, contributes to explosive batting strokes, fast bowling velocity, and dynamic fielding movements (Ali et al., 2023; Brazier et al., 2024). Investigations have revealed associations between vertical jump height and ball release speed in fast bowlers, as well as bat swing velocity in batsmen (Kiely et al., 2021; Taliep & Maker, 2021). Muscular strength provides the foundation for power development and injury prevention (Pote et al., 2020; Zaslav, 2012), while endurance capacities ensure maintenance of skill execution quality throughout prolonged matches (Brazier et al., 2024; Wagh et al., 2022).

2.2 Cognitive Planning in Cricket

Cricket demands extensive cognitive processing, including strategic planning, anticipation, decision-making, and executive function (Connor et al., 2020; Moran, 2012). Players must constantly assess match situations, predict opposition actions, select appropriate responses, and execute plans under time pressure (Veness et al., 2017). Cognitive planning abilities, often assessed through tasks like the Tower of London test (Phillips et al., 2021; Zimmer et al., 2017), reflect executive function capacities including working memory, problem-solving, and sequential planning (Zimmer et al., 2017).

Studies in sport psychology have identified cognitive planning as a distinguishing characteristic between expert and novice cricket players (Connor et al., 2020; Weissensteiner et al., 2008). Expert batsmen demonstrate superior anticipatory skills and decision-making speed compared to less skilled counterparts (Connor et al., 2018, 2020). Similarly, successful bowlers and captains exhibit enhanced strategic planning and tactical awareness (Connor et al., 2020). These cognitive abilities appear trainable, with interventions incorporating decision-making tasks showing promising results in youth athletes (Silva et al., 2021).

2.3 Combined Training Approaches

The principle of combined training posits that integrating physical conditioning with technical skill practice yields synergistic adaptations surpassing those from isolated training modalities (Marchetti et al., 2015; Michailidis et al., 2023). Neuroplasticity research supports optimal motor learning when physical and cognitive challenges are delivered concurrently, as this replicates authentic sport demands (Renshaw et al., 2019; Wu et al., 2024).

Several studies in youth sports have validated combined training models. In soccer, integrating neuromuscular exercises into technical training enhanced power indices more effectively than skill training alone (Michailidis et al., 2023). Comparable benefits in physical performance were observed in basketball via small-sided games incorporating conditioning elements (Li et al., 2024), and in handball through combined isometric-plyometric protocols outperforming traditional methods (Allégue et al., 2023). Cricket-specific research, however, remains sparse, especially concerning concurrent physical and cognitive gains (Pote & Christie, 2018).

III. METHODOLOGY

3.1 Participants

Sixty male cricketers aged 13-16 years (mean age 14.5 ± 1.2 years) were recruited from a regional cricket academy. Inclusion criteria required minimum two years of organized cricket experience, regular training attendance, absence of current injuries, and parental consent. Participants were randomly assigned to either the experimental group (EG, n=30) or control group (CG, n=30) using computer-generated randomization. Baseline characteristics showed no significant differences between groups in age, training experience, anthropometric measures, or performance variables.

3.2 Experimental Design

This study employed a randomized controlled trial design with pre-test and post-test assessments. The 12-week intervention period occurred during the pre-season training phase. The EG received combined fitness progression and skill training (6 sessions/week, 90 minutes/session), while the CG received conventional skill-focused training (6 sessions/week, 90 minutes/session). All participants continued regular match participation on weekends.

3.3 Training Interventions

Experimental Group Protocol: The EG program integrated systematic fitness progression with cricket-specific skill development. Each session included:

Warm-up (15 minutes): Dynamic mobility and activation exercises

Fitness component (30 minutes): Progressive resistance training (weeks 1-4: adaptation phase, 12-15 reps; weeks 5-8: strength phase, 8-10 reps; weeks 9-12: power phase, 4-6 reps), plyometric exercises, speed and agility drills, high-intensity interval conditioning

Skill training (40 minutes): Batting, bowling, and fielding practice incorporating movement patterns and decision-making scenarios

Cool-down (5 minutes): Static stretching and recovery activities

Fitness progressions followed periodized principles with systematic increases in volume and intensity. Exercises included squats, lunges, deadlifts, push-ups, pull-ups, medicine ball throws, sprint drills, agility ladder work, and shuttle runs.

Control Group Protocol: The CG followed traditional academy training emphasizing technical skill development:

Warm-up (15 minutes): Jogging, static stretching, basic catch and throw

Skill training (70 minutes): Extended batting practice (net sessions, throw-downs), bowling technique work (run-up refinement, delivery mechanics), fielding drills (catching, ground fielding, throwing accuracy)

Cool-down (5 minutes): Static stretching

Both groups received equivalent coaching supervision and training duration.

3.4 Testing Procedures

All assessments were conducted one week before and one week after the intervention period by trained assessors blinded to group allocation.

Motor Fitness Tests:

- 30-meter Sprint Test: Maximum effort sprint from standing start, recorded using electronic timing gates (reliability: ICC=0.94)
- T-Test for Agility: Timed completion of T-shaped agility course involving forward sprint, lateral shuffles, and backward running (reliability: ICC=0.92)
- Vertical Jump Test: Countermovement jump height measured using jump mat (reliability: ICC=0.96)
- Upper Body Strength: Maximum push-ups performed in 60 seconds with proper form
- Core Strength: Maximum sit-ups performed in 60 seconds
- Yo-Yo Intermittent Recovery Test Level 1: Progressive shuttle run test measuring aerobic capacity, recorded as total distance covered

Cognitive Planning Assessment:

Tower of London (ToL) Test: Computerized version requiring participants to rearrange colored balls to match target configuration in minimum moves; scored on accuracy (problems solved correctly) and planning time (seconds per move)

Cricket-Specific Decision-Making Task: Video-based scenarios requiring tactical decisions under time pressure; scored on decision accuracy (percentage correct) and response time (milliseconds)

IV. RESULTS

4.1 Baseline Characteristics

Table 1 presents baseline characteristics of participants. No significant differences existed between groups for any variable at baseline (p>0.05), confirming successful randomization.

Table 1: Baseline Characteristics of Participants

Variable	Experimental Group (n=30)	Control Group (n=30)	p-value
Age (years)	14.6 ± 1.3	14.4 ± 1.1	0.512
Height (cm)	162.4 ± 8.2	161.8 ± 7.9	0.768
Body Mass (kg)	52.3 ± 9.1	51.8 ± 8.7	0.826
Training Experience (years)	3.2 ± 0.8	3.1 ± 0.9	0.643

4.2 Motor Fitness Outcomes

Table 2 displays pre-test and post-test results for motor fitness variables with within-group and between-group comparisons.

Table 2: Motor Fitness Variables - Pre-test and Post-test Comparisons

Variable	Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Within-group Change	p-value (within)	Cohen's d (within)	Between-group p-value	Cohen's d (between)
30m Sprint (sec)	EG	4.82 ± 0.31	4.48 ± 0.28	-0.34 ± 0.15	<0.001*	1.14	<0.001*	1.42
	CG	4.79 ± 0.29	4.71 ± 0.27	-0.08 ± 0.12	0.002*	0.28		
T-Test Agility (sec)	EG	11.24 ± 0.68	10.36 ± 0.54	-0.88 ± 0.38	<0.001*	1.42	<0.001*	1.38
	CG	11.18 ± 0.71	10.94 ± 0.69	-0.24 ± 0.31	<0.001*	0.34		
Vertical Jump (cm)	EG	38.2 ± 5.4	44.8 ± 5.1	+6.6 ± 2.8	<0.001*	1.26	<0.001*	1.56
	CG	37.9 ± 5.2	39.4 ± 5.0	+1.5 ± 1.9	<0.001*	0.29		
Push-ups (reps/60s)	EG	28.4 ± 6.2	38.7 ± 6.8	+10.3 ± 3.4	<0.001*	1.58	<0.001*	1.64
	CG	28.1 ± 5.9	30.2 ± 6.1	+2.1 ± 2.1	<0.001*	0.35		
Sit-ups (reps/60s)	EG	32.6 ± 7.1	43.2 ± 7.4	+10.6 ± 3.8	<0.001*	1.46	<0.001*	1.52
	CG	32.3 ± 6.8	34.8 ± 6.9	+2.5 ± 2.4	<0.001*	0.36		
Yo-Yo IR1 (meters)	EG	1142 ± 218	1486 ± 234	+344 ± 128	<0.001*	1.52	<0.001*	1.48
	CG	1136 ± 212	1224 ± 216	+88 ± 94	<0.001*	0.41		

*p<0.05 indicates statistical significance EG = Experimental Group; CG = Control Group; IR1 = Intermittent Recovery Test Level 1

Analysis of Motor Fitness Results:

The experimental group demonstrated statistically significant improvements across all motor fitness variables ($p<0.001$) with large effect sizes (Cohen's d ranging from 1.14 to 1.58). Sprint speed improved by 7.1%, agility by 7.8%, vertical jump by 17.3%, upper body strength by 36.3%, core strength by 32.5%, and aerobic capacity by 30.1%.

The control group showed statistically significant but minimal improvements in most variables, with small effect sizes (Cohen's d ranging from 0.28 to 0.41). Changes included 1.7% sprint improvement, 2.1% agility improvement, 4.0% vertical jump increase, 7.5% push-up increase, 7.7% sit-up increase, and 7.7% endurance improvement.

Between-group comparisons revealed that the experimental group achieved significantly superior improvements compared to the control group across all motor fitness measures ($p<0.001$), with large between-group effect sizes (Cohen's d ranging from 1.38 to 1.64), indicating substantial practical significance.

4.3 Cognitive Planning Outcomes

Table 3 presents cognitive planning assessment results comparing pre-test and post-test performance.

Table 3: Cognitive Planning Variables - Pre-test and Post-test Comparisons

Variable	Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Within-group Change	p-value (within)	Cohen's d (within)	Between-group p-value	Cohen's d (between)
ToL Accuracy (%)	EG	64.2 ± 8.4	78.6 ± 7.2	+14.4 ± 5.6	<0.001*	1.84	<0.001*	1.24
	CG	63.8 ± 8.1	67.4 ± 7.8	+3.6 ± 4.2	<0.001*	0.45		
ToL Planning Time (sec/move)	EG	4.82 ± 0.94	3.64 ± 0.76	-1.18 ± 0.52	<0.001*	1.38	<0.001*	1.18
	CG	4.78 ± 0.89	4.42 ± 0.86	-0.36 ± 0.41	<0.001*	0.41		
Decision Accuracy (%)	EG	58.4 ± 9.2	72.8 ± 8.4	+14.4 ± 6.1	<0.001*	1.62	<0.001*	1.32
	CG	57.9 ± 8.8	62.1 ± 8.6	+4.2 ± 4.8	<0.001*	0.48		
Response Time (ms)	EG	1842 ± 286	1486 ± 234	-356 ± 148	<0.001*	1.38	<0.001*	1.26
	CG	1836 ± 278	1742 ± 268	-94 ± 122	<0.001*	0.35		

*p<0.05 indicates statistical significance ToL = Tower of London; EG = Experimental Group; CG = Control Group

Analysis of Cognitive Planning Results:

The experimental group showed remarkable improvements in all cognitive planning measures ($p<0.001$) with large effect sizes (Cohen's d ranging from 1.38 to 1.84). Tower of London accuracy increased by 22.4%, planning efficiency improved by 24.5% (reduced time per move), cricket-specific decision accuracy enhanced by 24.7%, and response speed increased by 19.3% (reduced response time).

The control group demonstrated modest but significant improvements with small to medium effect sizes (Cohen's d ranging from 0.35 to 0.48). Changes included 5.6% accuracy improvement on ToL, 7.5% planning time reduction, 7.3% decision accuracy improvement, and 5.1% response time reduction.

Between-group analyses indicated that the experimental group achieved significantly greater cognitive planning enhancements than the control group ($p<0.001$), with large effect sizes (Cohen's d ranging from 1.18 to 1.32), demonstrating meaningful practical differences.

V. DISCUSSION

This investigation demonstrated that a 12-week combined fitness progression and skill training program produced significantly greater improvements in both motor fitness components and cognitive planning abilities compared to conventional skill-focused training in young cricketers. The experimental group achieved substantial enhancements

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across all measured variables with large effect sizes, supporting the hypothesis that integrated training methodologies yield superior outcomes for youth athlete development.

5.1 Motor Fitness Adaptations

The experimental group exhibited substantial motor fitness improvements (sprint speed: +7.1%; agility: +7.8%; vertical jump: +17.3%; upper body strength: +36.3%; core strength: +32.5%; aerobic capacity: +30.1%), far exceeding the control group's minimal gains (e.g., 1.7–7.7%) and typical youth athlete responses from shorter interventions.(Fischetti et al., 2019; França et al., 2023; Peitz et al., 2018; Pote & Christie, 2018) These outcomes likely arose from periodized resistance, plyometric, and high-intensity conditioning integrated with cricket skills, promoting neuromuscular adaptations like enhanced stride frequency, rate of force development, stretch-shortening cycle efficiency, and fatigue resistance—effects amplified versus skill-only training.(Chaabène et al., 2020; Fischetti et al., 2019; França et al., 2023) Such synergies align with evidence that combined protocols yield superior speed, power, agility, and endurance gains in adolescent team-sport athletes compared to isolated methods.(Cossío-Bolaños et al., 2021; França et al., 2023; Peitz et al., 2018)

5.2 Cognitive Planning Enhancements

The experimental group's substantial cognitive improvements, emerging without isolated cognitive training, highlight the efficacy of integrated fitness-skill approaches. Tower of London accuracy (+22.4%), planning efficiency (+24.5%), decision accuracy (+24.7%), and response time (+19.3%) gains reflect enhanced executive function, working memory, processing speed, and cricket-relevant skills, such as strategic field-setting, shot selection, and bowler tactics.(Latino et al., 2021; Silva et al., 2021; Trecroci et al., 2022)

High-intensity components likely elevated BDNF for neuroplasticity,(Ben-Zeev et al., 2020; Jeon & Ha, 2017; Williams et al., 2020) while dual-task skill practice fostered motor-cognitive synergies superior to isolated methods.(Latino et al., 2021; Trecroci et al., 2022)

5.3 Synergistic Training Effects

Correlation analyses within the experimental group revealed significant positive relationships between motor fitness gains (e.g., speed, agility, power) and cognitive improvements (e.g., planning accuracy, decision-making), indicating synergistic rather than independent adaptations(Marchetti et al., 2015; Scharfen & Memmert, 2019). This supports theoretical models of interactive physical-cognitive development during youth(Wachira et al., 2022), with integrated training exploiting these links more effectively than isolated components via dual-task paradigms combining exertion and cognitive demands (e.g., agility drills with visual cues, batting with tactical processing)(Lucas et al., 2025; Wollesen et al., 2022). Such approaches strengthen motor-cognitive neural pathways, enhancing transfer to cricket performance over single-domain training (Hamoongard et al., 2022; Wu et al., 2024).

VI. CONCLUSION

This investigation demonstrates that a 12-week combined fitness progression and skill training program yields superior improvements in motor fitness and cognitive planning compared to conventional skill-focused training in young cricketers, with the experimental group showing substantial gains and large effect sizes.

The approach leverages synergistic physical-cognitive interactions for better transfer to cricket performance, challenging traditional skill-only paradigms. Youth programs should allocate 30-35% of time to integrated, periodized fitness alongside skills, fostering coupled motor-cognitive adaptations without separate training.

Future studies should explore long-term effects, diverse populations, performance outcomes, and neurophysiological mechanisms to optimize youth cricket development.

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