Evaluating the Combination of Strength and Specific Skill Training through Expert-Designed, AI-Driven and Hybrid Regimens on Physical Fitness and Performance Variables among Female Basketball Players

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***Abstract*—Objective: This study aimed to evaluate and compare the effectiveness of expert-designed, AI-driven and hybrid strength and specific skill training regimens on selected physical fitness and basketball performance variables among female basketball players.**
Design: A randomized controlled experimental design was adopted.
Participants: A total of 60 intercollegiate female basketball players aged 18–21 years from Coimbatore district, Tamil Nadu, were randomly assigned into four groups: Expert Training Group (ETG), AI Training Group (AITG), Hybrid Training Group (HTG) and Control Group (CG).
Intervention: All experimental groups underwent a structured 12-week training programme. A pilot study was conducted prior to the main study to standardize training load and ensure feasibility. The AI group received AI-generated training schedules, the expert group followed coach-designed programmes and the hybrid group combined AI-generated plans with expert modifications. Training was conducted five days per week for 60–75 minutes per session.
Outcome Measures: Physical fitness variables included speed, agility, leg strength and core strength, while performance variables included passing and shooting ability. Data were analysed using paired t-tests, ANCOVA and Scheffé's post-hoc test.
Results: All experimental groups showed statistically significant improvements ($p < 0.05$) in both physical fitness and performance variables, whereas the control group showed no significant changes. Among the groups, the hybrid training group demonstrated the greatest improvements across all variables. ANCOVA results indicated significant differences between groups and Scheffé's post-hoc test confirmed the superiority of the hybrid group over the expert and AI groups.
Conclusions: The findings indicate that while both expert-designed and AI-driven training methods are effective, the hybrid training approach is the most efficient in enhancing physical fitness and basketball performance among female athletes. The integration of AI-based personalization with expert supervision provides a superior training model. Further research is recommended to examine long-term adaptations and applicability across different sports and populations.

***Index Terms*—Artificial Intelligence, Hybrid Training, Strength Training, Basketball Performance, Female Athletes.**

I. INTRODUCTION

The merger of scientific ideas and technology breakthroughs has led to a substantial evolution in modern sports training. While data-driven and customized training systems are now possible thanks to recent advancements in artificial intelligence (AI), traditional training programs are mainly focused on professional coaching [4]. AI-based solutions can improve efficiency and athlete development by analyzing performance data, tracking tiredness and optimizing training loads [23]. Despite these developments, limited study has been done to compare AI-generated training with expert-designed techniques and hybrid models [16].

Basketball is a high-intensity, sporadic sport that calls for strength, speed, agility and technical abilities including dribbling, passing and shooting [18]. As a result, it offers the perfect platform for assessing the efficacy of training. Furthermore, there is still little research on female athletes. Through customized programs, artificial intelligence (AI) is revolutionizing sports training [4]. There aren't many research comparing AI with expert training, though [16]. These holes are filled in this study.

II. METHODOLOGY

2.1 Design

The investigation was conducted using a randomized controlled design. Four groups of participants (n = 15 each) were formed:

- AI-Driven Training Group (AI)
- Expert Training Group (ET)
- Hybrid Training Group (HT)
- Control Group (CG)

2.2 Participants

Sixty female intercollegiate basketball players from Coimbatore, ages eighteen to twenty-one, were chosen. Every participant was medically fit and engaged in physical activity.

2.3 Training Protocol

In order to standardize the training load and evaluate the viability of the research design, a pilot study was first carried out. Participants completed a pre-test, a 4-week training course and a post-test on the chosen variables during this phase. To guarantee proper intensity and efficacy, the training load was carefully adjusted and finalized based on the subjects' answers and performance. In order to preserve the integrity of the findings, the pilot study participants were not included in the main investigation, which was conducted on 60 subjects following the approved training regimens.

A 12-week training regimen (five sessions each week, lasting 60 to 75 minutes each) was administered to the AI, Expert and Hybrid groups.

- AI Group: Received AI-generated training schedule on combination of strength and specific skill training.
- Expert Training Group: Trained under Experts experts designed training schedule.
- Hybrid Group: Received AI-generated plans further modified by expert combination of strength and specific skill training.
- Control Group: No particular instruction.

2.4 Variables

Physical fitness variables included speed, agility, explosive power and strength-related components.

Performance variables included passing, shooting and dribbling.

2.5 Statistical Techniques

Data were analysed using paired t-tests, ANCOVA and Scheffé's post hoc test. The level of significance was set at $p < 0.05$.

III. RESULTS

Variable	Group	Pre-Mean	Post Mean	t-value	F-value (ANCOVA)	Scheffe Summary
Speed (sec)	ETG	8.62	8.46	4.60*	14.53*	HTG > ETG, AITG, CG
	AITG	8.56	8.46	2.52*		
	HTG	8.33	8.03	5.92*		
	CG	8.58	8.69	1.33		
Agility (sec)	ETG	10.65	10.42	7.82*	35.42*	HTG > all groups
	AITG	10.58	10.44	7.65*		
	HTG	10.55	10.22	9.49*		
	CG	10.68	10.72	1.06		
Leg Strength (sec)	ETG	53.86	62.06	46.97*	349.24*	HTG > AITG > ETG > CG
	AITG	54.26	65.80	42.13*		
	HTG	53.93	65.98	48.10*		
	CG	54.06	54.53	1.12		
Core Strength (sec)	ETG	87.73	96.40	28.50*	404.45*	HTG highest
	AITG	83.73	87.40	18.22*		

	HTG	88.00	101.26	64.32*		
	CG	86.80	86.60	0.88		
Passing (score)	ETG	23.20	27.46	11.49*	60.53*	HTG > ETG & AITG
	AITG	23.13	27.73	10.80*		
	HTG	23.00	29.17	11.28*		
	CG	23.13	23.06	0.75		
Shooting (score)	ETG	13.00	14.80	8.60*	28.44*	HTG > all groups
	AITG	13.13	15.93	10.31*		
	HTG	13.06	16.80	12.45*		
	CG	13.20	13.26	0.64		

Significant at 0.05 level; Critical F value (0.05) ≈ 2.77

The findings showed that every experimental group had significantly improved. In terms of both physical fitness and performance metrics, the hybrid training group had the greatest degree of improvement. The style of training had a quantifiable impact on performance outcomes, according to the ANCOVA results, which showed significant variations between groups. The hybrid group outperformed the expert and AI groups by a large margin, according to Scheffe's post hoc test.

IV. DISCUSSION

The results of this study show that structured training regimens greatly enhance female basketball players' physical fitness and performance metrics. Systematic training based on well-established concepts of strength and conditioning is responsible for the benefits seen in the Expert Training Group [11, 19]. These results align with earlier research highlighting the contribution of resistance training to enhancing athletic performance [3, 8]. Additionally, the AI Training Group demonstrated notable advancements, demonstrating the efficacy of data-driven training methodologies. AI-based systems make it possible to continuously monitor and optimize training factors, which improves results [4, 23].

The Hybrid Training Group's superior performance is the study's most important finding. This implies that integrating expert knowledge with AI-based modifications will have a synergistic effect. Recent research highlighting the complementing role of AI in sports training has revealed similar results [22].

The hybrid model incorporates:

- Skilful judgment and contextual awareness.
- AI-driven accuracy and flexibility Performance outcomes are improved as a result of this combination.

Additionally, a variety of elements, including as physiological, biomechanical and tactical aspects, affect basketball performance [17]. This study's improvements are consistent with earlier research on basketball performance metrics [14]. The control group's lack of improvement demonstrates that the training interventions were the cause of the observed changes.

V. CONCLUSIONS

The results of this study unambiguously show that all organized training regimens significantly improved some aspects of female basketball players' physical fitness and performance. The effectiveness of both expert-designed and AI-based training techniques in improving performance outcomes shows the importance of methodical and data-driven approaches in contemporary sports training. But across all factors, the hybrid training approach—which combines the advantages of expert knowledge and AI-driven adaptations—produced the most gains. The fact that the control group showed no noticeable shifts further supports the idea that the training interventions were the direct cause of the observed improvements. Thus, it can be said that although separate training techniques are useful, the hybrid model is the most efficient and broad approach for maximizing female basketball players' physical fitness and performance.

VI. RECOMMENDATIONS

• Future research should look into how hybrid training affects long-term adaptations and skill retention.
• It is advised to conduct more study including various age groups, competitive levels and sports disciplines.
• Adding real-time AI monitoring technologies could improve hybrid coaching models even further.

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