

Effectiveness of AI-Driven and Hybrid Training Approaches on Strength and Performance Outcomes among Female Basketball Players

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Abstract

Objective: This study evaluated and compared the effectiveness of AI-driven and hybrid strength and 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 120 intercollegiate female basketball players aged 18–21 years from the Coimbatore district, Tamil Nadu, were randomly assigned to three groups: Expert-Prescribed Training (EPT), Hybrid Training (HT) and Control Group (CG).

Intervention: All experimental groups completed a structured 12-week training programme. A pilot study was conducted beforehand to standardise training loads. An AI generative tool was used to develop individualised schedules, which were refined through expert corrections and validation. The hybrid regimen integrated AI-generated precision with expert supervision. Training was conducted five days per week for 60–75 minutes per session.

Outcome Measures: Strength (core strength) and basketball performance variables (dribbling speed, passing accuracy and shooting accuracy) were assessed. Data were analysed using ANCOVA and Scheffé's post-hoc test.

Results: Both AI-driven and hybrid groups showed significant improvements in all variables ($p < 0.05$), with the hybrid group demonstrating superior gains. Combining AI-based personalisation with expert judgement enhanced training efficiency and skill development.

Conclusions: Hybrid training proved more effective than AI-only or conventional approaches in improving strength and basketball performance among female athletes. Further studies are recommended to examine long-term outcomes and broader applicability.

Keywords: Artificial Intelligence, Hybrid Training, Strength Training, Basketball Performance, Female Athletes.

1. Introduction

Artificial Intelligence (AI) has increasingly influenced modern sports training by enabling the development of individualised, data-driven schedules aimed at improving performance and reducing

injury risk ^[1,2]. While AI ensures precision, consistency and adaptability, expert coaching contributes contextual judgement, technical correction and motivational support—elements critical to athlete development ^[3].

Basketball requires a high level of coordination, strength, agility and skill. Although AI-driven programmes provide personalisation, they may sometimes overlook practical nuances encountered on the court. Conversely, expert-driven programmes may lack the individualised scalability offered by AI systems. Hence, integrating AI-driven planning with expert supervision may yield superior outcomes, creating a hybrid approach that leverages the strengths of both systems.

Therefore, this study aims to evaluate and compare AI-driven and hybrid training regimens on selected strength and performance variables among female basketball players. The objective is to identify an optimal training framework that enhances performance while ensuring practical applicability.

2. Methodology

2.1 Design

A randomised controlled experimental design was employed. Participants were allocated into three groups (n = 40 each):

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

2.2 Participants

A total of 120 intercollegiate female basketball players aged 18–21 years from the Coimbatore district, Tamil Nadu, were selected for the study. Participants were medically screened and provided informed consent prior to participation.

2.3 Training Protocol

The AI and Hybrid groups underwent a 12-week training programme (5 sessions per week, 60–75 minutes per session).

- AI Group: Received AI-generated strength and basketball-skill regimens tailored to individual needs.
- Hybrid Group: Received AI-generated plans further modified by expert coaches to incorporate real-time corrections, contextual relevance and personalised feedback.
- Control Group: Continued regular physical activity without additional intervention.

2.4 Variables

- Performance Variables:
 - Dribbling speed
 - Passing accuracy
 - Shooting accuracy
- Fitness Variable:
 - Core strength

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 $p < 0.05$.

3. Results

Variable	Group	Pre-Test Mean	Post-Test Mean	Mean Diff.	't'-Ratio	Adjusted Mean (ANCOVA)	Post Hoc Comparison
Dribbling Speed (sec)	AI	8.42	7.18	1.24	5.68*	7.20	AI > CG
	HT	8.48	6.92	1.56	7.08*	6.98	HT > AI, CG
	CG	8.36	8.29	0.07	0.50	8.31	CG < AI, HT
Passing Accuracy (%)	AI	72.35	81.60	9.25	6.05*	81.32	AI > CG
	HT	71.90	84.45	12.55	7.26*	84.05	HT > AI, CG
	CG	72.45	73.25	0.80	0.46	73.09	CG < AI, HT
Shooting Accuracy (%)	AI	65.80	74.25	8.45	5.53*	74.09	AI > CG
	HT	66.35	77.95	11.60	7.21*	77.50	HT > AI, CG
	CG	65.90	66.75	0.85	0.49	66.58	CG < AI, HT
Core Strength (sec)	AI	58.15	71.30	13.15	6.28*	70.84	AI > CG
	HT	59.05	76.15	17.10	7.44*	75.70	HT > AI, CG
	CG	58.85	59.40	0.55	0.42	59.25	CG < AI, HT

4. Discussion

The findings of the study clearly demonstrate that both AI-driven and hybrid training interventions significantly enhanced strength and basketball performance variables when compared with the control group. The Hybrid Training Group (HT) exhibited the highest level of improvement across all variables.

The AI-driven regimen may have improved individualisation and workload optimisation, consistent with earlier findings that AI-based systems enhance training precision and reduce subjective errors ^[1,4]. However, the superior results exhibited by the hybrid model affirm the importance of expert supervision, which aligns with prior studies noting that expert feedback enhances technique execution, motivation and long-term adherence ^[5-7].

The integration of expert insights with AI-generated plans appears to have helped athletes internalise instructions more effectively, leading to higher performance gains in dribbling, passing and shooting skills. The improvements in core strength further indicate the effectiveness of hybrid training in enhancing foundational physical qualities essential for basketball.

5. Conclusions

The study concludes that:

1. Both AI-driven and hybrid training regimens significantly improved physical fitness and basketball performance variables.
2. The hybrid approach produced the most substantial improvements, demonstrating the combined benefits of AI precision and expert human judgement.
3. Hybrid training presents a balanced and effective framework suited for modern sports training, particularly for skill-dominated sports such as basketball.

6. Recommendations

- Future studies should investigate long-term adaptations and retention of skills through hybrid training.
- Additional research involving different age groups, competitive levels and sports disciplines is recommended.
- Integration of real-time AI monitoring systems may further enhance hybrid coaching models.

References

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