

Integrating Artificial Intelligence in Sports Training: A Comparative Analysis of Expert, AI-Driven and Hybrid Regimens among Female Basketball Players

M. Pavithra¹, Dr. S. Kamalakannan²

¹PhD Research Scholar, Department of Physical Education, Kumaraguru College of Liberal Arts and Science, Coimbatore, Tamilnadu.

²Associate Head, Department of Physical Education, Kumaraguru College of Liberal Arts and Science, Coimbatore, Tamilnadu.

Abstract

This study assessed the impact of expert-designed, AI-driven and hybrid strength and skill training programs on female basketball players' physical fitness and performance. Expert (ETG), AI (AITG), Hybrid (HTG) and Control (CG) groups were randomly allocated to sixty intercollegiate athletes (18–21 years old). After a pilot study for load standardization, the experimental groups finished a 12-week program (5 days per week, 60–75 minutes per session). Performance (passing, shooting) and physical fitness (speed, agility, leg strength, core strength) were evaluated. ANCOVA, Scheffé's post-hoc test and paired t-tests were used to analyze the data. All experimental groups demonstrated significant improvements ($p < 0.05$), however the control group did not exhibit any meaningful changes. Out of all the factors, the HTG showed the biggest improvements. Post-hoc analysis verified the hybrid approach's superiority over expert and AI methods and ANCOVA revealed substantial between-group differences. These results imply that the best way to improve female basketball players' performance and fitness is to combine expert supervision with AI-based customisation. Further research should examine long-term effects and broader applicability.

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

1. Introduction

Modern sports training has significantly changed as a result of the fusion of scientific concepts and technological innovations. While recent developments in artificial intelligence (AI) have made it possible to create data-driven and personalized training systems, traditional training programs mostly concentrate on professional coaching [4]. By evaluating performance data, monitoring fatigue and maximizing training loads, AI-based solutions can increase productivity and athlete development [23]. Despite these advancements, little research has been done to compare expert-designed methods and hybrid models with AI-generated training [16].

Strength, speed, agility and technical skills like dribbling, passing and shooting are required in basketball, a high-intensity, intermittent sport [18]. It thus provides the ideal framework for evaluating the effectiveness of training. Additionally, research on female athletes is still lacking. Artificial intelligence (AI) is transforming sports training with personalized programs [4]. However, there aren't many studies that contrast AI with expert training [16]. This study fills these gaps.

2. Methodology

2.1 Design

A randomized controlled design was used for the investigation. There were four groups of participants, each with fifteen members:

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

2.2 Participants

Sixty Coimbatore-based female intercollegiate basketball players, ranging in age from eighteen to twenty-one, were selected. Each participant was physically active and in good health.

2.3 Training Protocol

A pilot study was first conducted to standardize the training load and assess the feasibility of the research strategy. During this phase, participants finished a pre-test, a 4-week training course and a post-test on the selected variables. The training load was carefully modified and finalized based on the responses and performance of the subjects to ensure appropriate intensity and effectiveness. The main investigation, which was carried out on 60 people according to the approved training regimens, did not include the pilot study participants in order to maintain the integrity of the results. The AI, Expert and Hybrid groups underwent a 12-week training program consisting of five sessions each week, each lasting 60 to 75 minutes.

AI Group received a training regimen created by AI chatbot. Expert Training Group trained on a training schedule created by specialists. Hybrid Group used to further modify AI-generated designs. Control Group No specific guidance.

2.4 Variables

Physical fitness variables included Speed, Agility, Explosive Power, Leg Strength, Core Strength, Lower Back Strength, Lower Body Strength Endurance

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 $p < 0.05$.

3. Results

Variable	Group	Pre Mean	Post Mean	t-value	F-value (ANCOVA)	Scheffe Results
Speed	ETG	8.62	8.46	4.60*	14.53*	HTG > ETG, AITG, CG
	AITG	8.56	8.46	2.52*		HTG > others
	HTG	8.33	8.03	5.92*		Best performer
	CG	8.58	8.69	1.33		No significant change
Agility	ETG	10.65	10.42	7.82*	35.42*	HTG > all groups
	AITG	10.58	10.44	7.65*		HTG > others
	HTG	10.55	10.22	9.49*		Best performer
	CG	10.68	10.72	1.06		No change
Explosive Power	ETG	2.12	2.16	4.38*	19.85*	HTG > all groups
	AITG	2.04	2.18	3.78*		HTG > others
	HTG	2.05	2.41	5.59*		Best performer
	CG	1.97	1.95	1.58		No change
Leg Strength	ETG	53.86	62.06	46.97*	349.24*	HTG > ETG, CG
	AITG	54.26	65.80	42.13*		≈ HTG
	HTG	53.86	65.98	48.67*		Best performer
	CG	54.06	54.40	0.89		No change
Core Strength	ETG	87.73	96.40	34.39*	404.45*	HTG >> others
	AITG	83.73	87.40	24.39*		
	HTG	88	101.26	64.32*		Best performer
	CG	87.33	87.60	0.50		No change
Lower Back Strength	ETG	10.33	11.66	10.58*	26.83*	HTG > all
	AITG	9.33	11.66	9.58*		
	HTG	10.53	12.86	11.06*		Best performer
	CG	10.40	10.80	1.46		No change
Lower Body Endurance	ETG	28	32.26	14*	102.22*	HTG > all
	AITG	26.33	28.33	12.10*		
	HTG	28.33	34.33	14.10*		Best performer
	CG	27.80	28.13	1.16		No change
Passing	ETG	23.20	27.46	11.49*	60.53*	HTG > ETG, CG
	AITG	23.13	27.73	11.85*		
	HTG	23	29.17	11.28*		Best performer
	CG	23.12	23.20	0.80		No change
Shooting	ETG	13	14.80	10.31*	28.44*	HTG > AITG, CG
	AITG	13.13	15.93	10.31*		

	HTG	13	16.80	10.36*		Best performer
	CG	13.06	13.46	1.70		No change
Dribbling	ETG	30.40	27.20	22.10*	54.24*	HTG > ETG, CG
	AITG	30.93	27	59*		
	HTG	30.86	26.93	59*		Best performer
	CG	26.93	26.60	0.50		No change

Significant at 0.05 level df 14 (2.13); Critical F value (0.05) \approx 2.77

The results demonstrated that each experimental group had made notable progress. The hybrid training group showed the most increase in both performance measurements and physical fitness. The ANCOVA results, which revealed significant differences across groups, indicated that training style had a measurable effect on performance outcomes. Scheffe's post hoc test showed that the hybrid group fared much better than the expert and AI groups.

4. Discussion

The study's findings demonstrate that organized training plans significantly improve the physical fitness and performance indicators of female basketball players. The gains observed in the Expert Training Group can be attributed to systematic training based on known notions of strength and conditioning [11, 19]. These findings are consistent with previous studies showing how resistance training can improve athletic performance [3, 8]. The AI Training Group also made significant progress, proving the effectiveness of data-driven training techniques. Results can be improved by continually monitoring and optimizing training elements thanks to AI-based systems [4, 23].

The most significant finding of the study is the higher performance of the Hybrid Training Group. This suggests that there will be a synergistic benefit from combining expert knowledge with AI-based adjustments. Similar findings have been found in recent studies emphasizing the complementary function of AI in sports training [22].

Basketball performance is also influenced by a number of factors, such as physiological, biomechanical and tactical considerations [17]. The gains found in this study align with previous studies on basketball performance measurements [14]. The observed changes were caused by the training treatments, as evidenced by the control group's lack of progress.

5. Conclusions

The study's findings unambiguously show that all structured training programs greatly enhanced some facets of female basketball players' physical performance and fitness. The efficiency of both AI-based and expert-designed training methods in enhancing performance results highlights the significance of systematic and data-driven approaches in modern sports training. However, the hybrid training approach—which combines the benefits of expert knowledge and AI-driven adaptations—produced the greatest results overall. The hypothesis that the training interventions were the actual cause of the observed gains is further supported by the fact that the control group did not exhibit any discernible changes. Therefore, it can be concluded that while individual training methods are helpful, the hybrid model is the most effective and comprehensive strategy for optimizing the physical fitness and performance.

6. Recommendations

- Future studies should examine the effects of hybrid training on skill retention and long-term adaptations.
- Further research including different age groups, competitive levels and athletic disciplines is recommended.
- Hybrid coaching models might be further enhanced by using real-time AI monitoring tools.

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