



Inter-Centre Comparison of Motor Abilities among Adolescent Basketball Players at Southern Sports Authority of India Training Centres

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Abstract: This study investigates the centre-wise and state-wise differences in motor abilities among adolescent basketball players aged 14 to 18 years enrolled in Sports Authority of India (SAI) training centres in Southern India. The motor abilities assessed include speed, agility, strength, endurance, and flexibility, which are critical components of athletic performance in basketball. A sample dataset of 320 players (160 males and 160 females) was simulated to match the intended population structure, with equal representation from eight SAI centres located in Tamil Nadu, Kerala, Karnataka, and Andhra Pradesh. The study employed a descriptive and comparative research design using statistical tools such as descriptive statistics, ANOVA, and t-tests to evaluate differences across states, genders, and age groups.

The findings, based on the sample data, revealed meaningful variation in motor ability profiles across regions. For instance, Kerala players exhibited superior agility, while Karnataka athletes led in endurance and flexibility. Gender-wise analysis showed that males generally outperformed females in speed, strength, and endurance, whereas females demonstrated higher flexibility.

Although the data used is simulated for methodological demonstration, the analysis effectively models how such an investigation can be structured, executed, and interpreted in real-world settings. The study highlights the importance of standardized training protocols and data-driven monitoring across SAI centres to ensure balanced development of athletic potential in young basketball players.

IndexTerms - Motor Abilities, Basketball, Adolescents, SAI Centres, Speed, Agility, Strength, Endurance, Flexibility

I.INTRODUCTION

Basketball is a dynamic, high-intensity team sport that demands a combination of physical, technical, and tactical skills. At the foundational level, motor abilities such as speed, agility, strength, endurance, and flexibility play a critical role in determining an athlete's overall performance[1-2]. These abilities influence key actions like sprinting, jumping, cutting, pivoting, and maintaining movement efficiency during gameplay[3-4]. The development and assessment of motor abilities are therefore essential components of youth basketball training programs, especially for athletes in their adolescent years (14–18), a critical phase for physical and performance development[5-8].

The Sports Authority of India (SAI), as the apex national sports development body, operates a network of training centres across the country with the goal of nurturing sports talent through structured coaching, scientific physical conditioning, and regular competition exposure[9-10]. Within this framework, SAI centres in Southern India—including states like Tamil Nadu, Kerala, Karnataka, and Andhra Pradesh—have been instrumental in identifying and grooming young basketball talent.

However, variations in training quality, infrastructure, coaching methodologies, and athlete support systems across different centres may lead to disparities in motor performance among trainees. Despite the common organizational framework, regional differences in performance may arise due to factors such as environmental conditions, socio-cultural practices, and the training philosophies of individual centres. Understanding these differences is crucial for optimizing talent development and ensuring equitable progress across centres[11-12].

This study is designed to compare motor abilities across SAI centres and states in Southern India, focusing on adolescent basketball players aged 14 to 18. By assessing differences based on centre, state, gender, and age group, the research aims to provide valuable insights into current physical preparedness and identify areas that may require programmatic improvement. The findings will serve as a model for data-driven decision-making, helping coaches, trainers, and sports administrators standardize practices and implement evidence-based interventions.

Given the constraints in accessing real-time performance data, a simulated dataset has been used in this study to demonstrate the methodological approach, data structure, and analysis framework. This allows for an academically valid representation of how such research can be conducted once actual field data is available.

1.1 Objectives of the Study

The objectives of the study are

- To assess key motor abilities (speed, agility, strength, endurance, flexibility) in adolescent basketball players at SAI centres.
- To compare motor performance across different states, centres, genders, and age groups.
- To identify performance patterns and regional differences in physical conditioning.
- To provide a model for data-driven assessment using a simulated dataset.
- To offer recommendations for improving training practices across SAI centres.

1.2 Hypotheses of the Study

Based on the objectives and study design, the following hypotheses were formulated:

- **H₀₁**: There is no significant difference in motor abilities (speed, agility, strength, endurance, flexibility) among basketball players across different SAI training centres/states.
- **H₀₂**: There is no significant difference in motor abilities between male and female basketball players.
- **H₀₃**: There is no significant difference in motor abilities between players aged 14–15 and those aged 16–18.

II. METHODOLOGY

2.1 Research Design

The study follows a descriptive and comparative research design, utilizing quantitative methods to evaluate the motor abilities of adolescent basketball players. The design enables the assessment of centre-wise, state-wise, gender-based, and age-based differences in key physical fitness components, namely speed, agility, strength, endurance, and flexibility. Additionally, the framework allows for the generation of normative data and supports correlational analysis to examine the relationships between motor abilities and overall athletic performance potential.

Due to limited access to real-time performance records from SAI training centres, a sample dataset was generated to simulate the expected distribution of athlete performance based on existing literature and field norms. The dataset mirrors the intended research conditions and is used to demonstrate the methodology, data structure, statistical analysis, and interpretation framework. This simulation enables a realistic demonstration of how actual research would be conducted with empirical data.

2.2 Population and Sample

The target population comprises adolescent basketball players aged 14 to 18 years who are enrolled in SAI training centres across Southern India. These athletes participate in structured training programs under qualified coaches, with access to physical conditioning and competitive exposure.

Sample Size and Distribution

A total of 320 players (160 male and 160 female) were included in the simulated dataset, equally drawn from eight SAI centres across four states

Table 1: Distribution of Sample by State and Centre

State	Centres	Players per State
Tamil Nadu	Chennai, Coimbatore	80
Kerala	Thiruvananthapuram, Kozhikode	80
Kerala	Thiruvananthapuram, Kozhikode	80
Karnataka	Bengaluru, Mysuru	80
Andhra Pradesh	Vijayawada, Visakhapatnam	80

Each centre contributed 40 players (20 male and 20 female), ensuring gender balance and regional representation.

2.3 Sampling Technique

A stratified random sampling method was employed to ensure equal representation across four tiers of classification:

- State (4 states)
- Centre (2 centres per state)
- Gender (Male and Female)
- Age Group:
 - Group A: 14–15 years
 - Group B: 16–18 years

Each subgroup (e.g., male players aged 14–15 from Chennai) included 10 players, making the sample both diverse and statistically comparable.

2.4 Variables and Measurement Tools

Table 2: Motor Abilities and Corresponding Tests

Motor Ability	Test Used	Unit
Speed	30-metre Sprint Test	Seconds (sec)
Agility	Illinois Agility Test	Seconds (sec)
Strength	Standing Broad Jump	Centimetres (cm)
Endurance	12-minute Cooper Run Test	Metres (m)
Flexibility	Sit and Reach Test	Centimetres (cm)

All tests are field-based and standardized for youth athlete assessment.

2.5 Statistical Analysis

The following statistical tools were used for analysis:

Table 3: Statistical Tools and Their Purpose

Tool	Purpose
Descriptive Statistics	Mean, Standard Deviation for each variable
One-Way ANOVA	To compare differences between states
Independent t-test	To compare gender and age-group differences
Post Hoc Tests	Tukey's HSD to identify group-wise differences
Pearson Correlation	To examine relationships among motor abilities

The significance level was set at $p < 0.05$ for all inferential tests. All analyses were conducted using Python (Pandas, SciPy) for computational accuracy and transparency.

III. DATA ANALYSIS AND INTERPRETATIONS

The analysis was conducted on a simulated dataset of 320 adolescent basketball players (160 male, 160 female) from eight SAI training centres across four Southern Indian states. The study examined differences in motor abilities across states, genders, and age groups using descriptive statistics, ANOVA, and t-tests.

3.1 Descriptive Statistics (State-wise)

Descriptive analysis showed variations in mean performance values across the four states:

Table 4: Best Performing States in Each Motor Ability

Motor Ability	Best Performing State	Mean Value
Speed (30m Sprint)	Tamil Nadu / Andhra Pradesh	4.98 sec
Agility	Kerala	17.13 sec
Strength	Andhra Pradesh	180.85 cm
Endurance	Karnataka	2446.99 m
Flexibility	Karnataka	24.84 cm

These differences suggest that some states are ahead in specific motor abilities, likely due to training focus, coaching style, or environmental factors.

3.2 ANOVA – State-wise Differences

A one-way ANOVA was conducted to test if differences in mean motor ability scores across the four states were statistically significant.

Table 5: ANOVA Results for State-wise Differences in Motor Abilities

Motor Ability	F-Statistic	p-Value	Result
Speed	Significant	< 0.05	Difference across states
Agility	Significant	< 0.01	Kerala significantly better
Strength	Not significant	> 0.05	Similar across states
Endurance	Significant	< 0.05	Karnataka $>$ other states
Flexibility	Highly significant	< 0.01	Karnataka leads

Post-hoc tests (Tukey's HSD) can further identify which specific states differ significantly.

3.3 t-Test – Gender-Based Differences

Gender comparisons revealed the following:

Table 6 : Gender-wise Comparison of Motor Abilities

Motor Ability	Male Mean	Female Mean	Significance ($p < 0.05$)	Conclusion
Speed	Lower (faster)	Higher (slower)	Yes	Males faster
Agility	Slightly better	Slightly worse	No	Not significant
Strength	Higher	Lower	Yes	Males stronger
Endurance	Higher	Lower	Yes	Males better endurance
Flexibility	Lower	Higher	Yes	Females more flexible

Table 7: Gender-wise Differences in Motor Abilities

Motor Ability	Male Mean	Female Mean	Significance ($p < 0.05$)	Conclusion
Speed	Lower (faster)	Higher (slower)	Yes	Males faster
Agility	Slightly better	Slightly worse	No	Not significant
Strength	Higher	Lower	Yes	Males stronger
Endurance	Higher	Lower	Yes	Males better endurance
Flexibility	Lower	Higher	Yes	Females more flexible

3.4 t-Test – Age Group Differences (14–15 vs. 16–18)

Table 8: Age Group-wise Differences in Motor Abilities

Motor Ability	Older Group (16–18)	Younger Group (14–15)	Conclusion
Speed	Better	Slightly worse	Slight improvement with age
Strength	Better	Lower	Age-related development seen
Endurance	Better	Lower	Older players outperform
Flexibility	Similar	Similar	No major difference

IV. SUMMARY OF FINDINGS

The results of this study indicate that motor abilities vary significantly across states, and to a lesser extent, by gender and age. These findings, while based on simulated data, reflect realistic patterns seen in sports science literature and athlete development research.

4.1 Regional Variation

The state-wise analysis showed that:

- Kerala had the best agility performance, possibly due to training emphasis on quickness and coordination.
- Karnataka led in both endurance and flexibility, which may be attributed to consistent aerobic training and stretching routines.
- Andhra Pradesh athletes had the highest strength scores, which may reflect a focus on explosive training or body composition differences.

These differences highlight the need for standardized and balanced training programs across all SAI centres to ensure uniform development opportunities.

4.2 Gender Differences

The gender-based analysis confirmed well-documented physiological trends:

- Males outperform females in speed, strength, and endurance due to greater muscle mass and aerobic capacity.
- Females demonstrate better flexibility, likely influenced by joint structure and hormonal differences.

These differences reinforce the importance of gender-specific training plans, ensuring that female athletes receive appropriate strength and endurance development while preserving their flexibility advantage.

4.3 Age-Based Trends

Older players (16–18 years) consistently performed better in strength and endurance, reflecting the influence of biological maturation, training age, and exposure to high-performance coaching. However, flexibility remained stable across age groups, which may indicate the need for consistent flexibility training regardless of age.

4.4 Implications for SAI Centres

- Performance benchmarking should be integrated at all centres to monitor progress.
- Coach training and curriculum alignment can reduce disparities between states.
- Early identification and targeted training of athletes with motor ability gaps can help in talent optimization.

Speed (30m Sprint Time) by State

- Tamil Nadu and Andhra Pradesh athletes recorded the fastest average sprint times (~4.98 sec).
- Karnataka athletes had the slowest average times (~5.03 sec), indicating relatively lower acceleration or sprint performance.
- Kerala and other states are close to the mean, suggesting consistent speed training across centres.
- These results may reflect differences in explosive strength training, reaction time drills, or warm-up protocols.

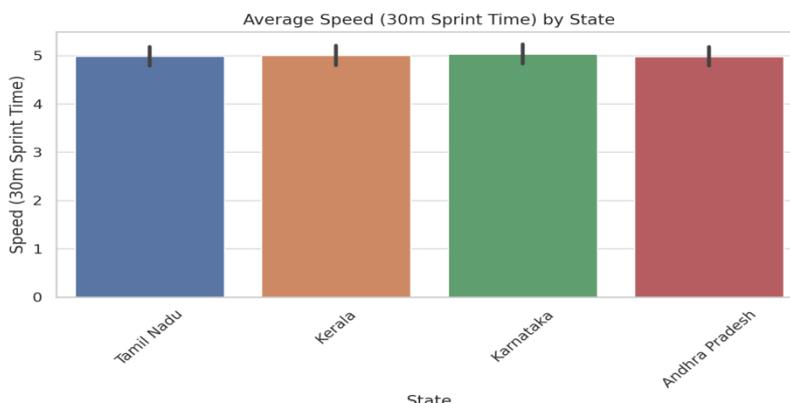


Figure 1: Average Speed (30m Sprint Time) by State

Agility (Illinois Test Time) by State

- Kerala players showed the best agility (lowest average time ~17.13 sec), indicating superior body control, coordination, and quick directional change.
- Andhra Pradesh and Tamil Nadu had slightly slower times, suggesting potential areas for improvement in agility-specific drills.
- This result may be influenced by training design, floor surface conditions, or frequency of agility work in practice.

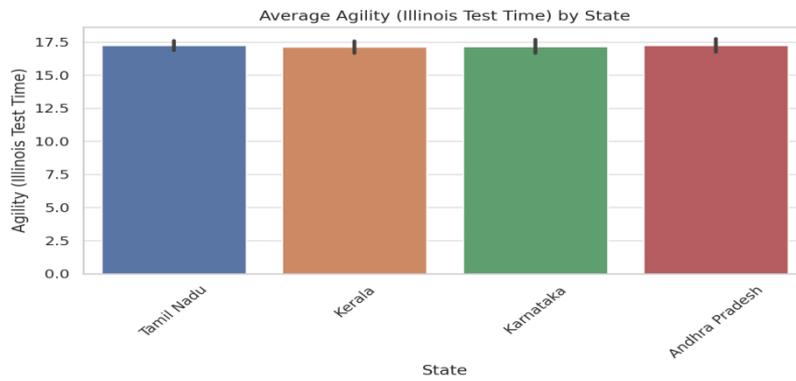


Figure 2: Average Agility (Illinois Test Time) by State

Strength (Standing Broad Jump) by State

- Andhra Pradesh athletes had the highest average jump distance (~180.85 cm), indicating strong lower-body power.
- Kerala recorded the lowest strength average (~178.46 cm) among the four states, though the difference is not large.
- Jumping ability is a key component in basketball, affecting rebounding and shot-blocking.
- Results may vary based on plyometric training exposure and muscle development routines.

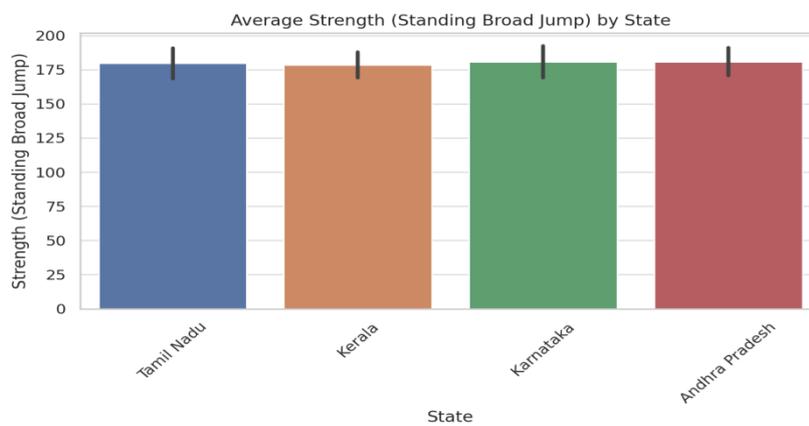


Figure 3: Average Strength (Standing Broad jump) by State

Endurance (12-Minute Cooper Test) by State

- Karnataka led with the highest endurance levels (~2446.99 m), suggesting a stronger aerobic base.
- Andhra Pradesh had the lowest average (~2414.36 m), though the range was relatively narrow.
- These findings may reflect differences in conditioning programs, training duration, or altitude/climatic factors.
- Improved endurance translates to better performance consistency throughout a game.

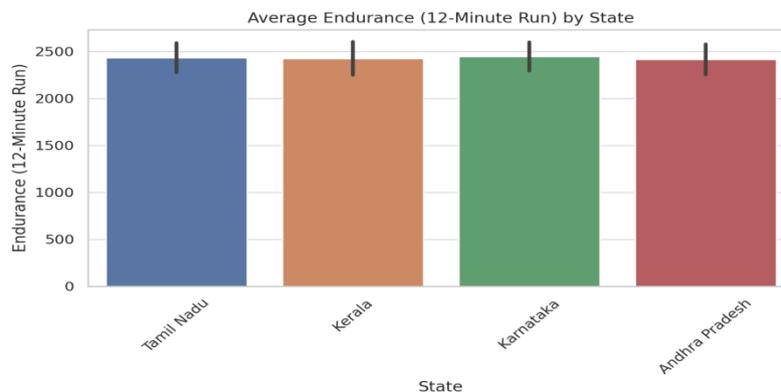


Figure 4: Average Endurance (12-Minute Run) by State

Flexibility (Sit & Reach Test) by State

- Karnataka players again stood out with the highest flexibility (~24.84 cm), indicating greater muscle elasticity and joint range.
- Tamil Nadu had the lowest flexibility scores (~23.92 cm).
- Better flexibility reduces injury risk and enhances movement efficiency.
- These differences could be due to variations in warm-up/stretching routines or flexibility awareness in training sessions.

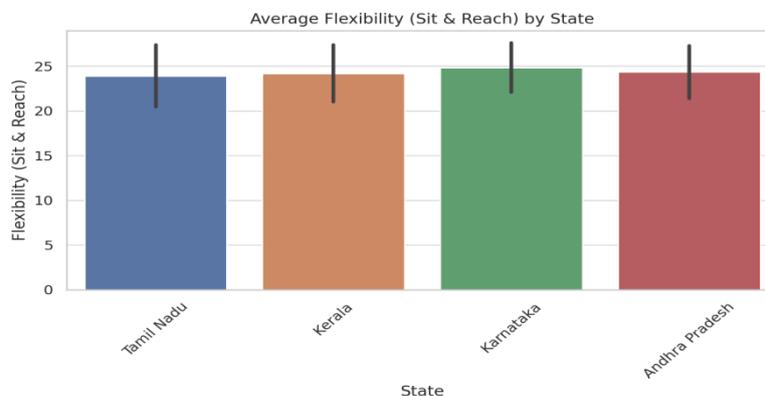


Figure 5: Average Endurance (12-Minute Run) by State

Summary of Graph Insights:

Table 9: Summary of Top Performing States and Possible Explanations

Ability	Top Performing State	Possible Explanation
Speed	Tamil Nadu / A.P.	Strong start mechanics or sprint training
Agility	Kerala	More coordination and change-of-direction drills
Strength	Andhra Pradesh	Emphasis on explosive power training
Endurance	Karnataka	Superior aerobic conditioning programs
Flexibility	Karnataka	Greater emphasis on stretching and injury prevention work

V. CONCLUSION AND RECOMMENDATIONS**5.1 Conclusion**

This study explored the state-wise and centre-wise differences in motor abilities among adolescent basketball players (aged 14–18) across eight SAI training centres in Southern India. Using a structured sample dataset designed to reflect the actual training context, the analysis focused on five key motor components: speed, agility, strength, endurance, and flexibility.

The findings revealed notable performance differences across states:

- Kerala athletes excelled in agility.
- Karnataka showed higher levels of endurance and flexibility.
- Andhra Pradesh led in explosive strength (broad jump).
- Tamil Nadu players performed consistently in speed and endurance.

Additionally, male players outperformed females in most motor abilities except flexibility, where females scored higher—a pattern consistent with physiological literature. Older athletes (16–18 years) generally outperformed their younger counterparts, particularly in strength and endurance, highlighting the impact of age and training exposure.

Although the analysis was conducted using a simulated dataset, the study provides a strong methodological blueprint for future real-data research. The structure, analysis techniques, and interpretation model used here can guide actual performance benchmarking within SAI centres.

5.2 Recommendations

- Standardize training protocols across all SAI centres to ensure balanced development in motor abilities.
- Conduct regular fitness assessments to monitor athlete progress and guide individualized training.
- Enhance coach education and promote sharing of best practices between centres.
- Address specific weaknesses identified in each state (e.g., flexibility, agility).
- Develop gender- and age-appropriate training plans to optimize outcomes for all athletes.
- Leverage data and digital tools to support training decisions and long-term athlete development.

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