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A Cross-Sectional Study on the Relationship between Body Composition and Basketball Playing Ability of School-Going Children

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Abstract: During adolescence, school-going children often contend with demanding schedules, which may impact their athletic performance. Among the various factors influencing performance, body fat percentage is critical. This study aims to investigate the relationship between various body composition metrics— including skinfold measurements, fat mass, fat percentage, and lean body mass (LBM)—with basketball playing ability among children aged 13 to 16. A sample of 70 basketball players aged 14.36±1.34 from various schools in Faridabad, who had participated in intradistrict tournaments, was selected using purposive sampling. The skinfold measurements were evaluated, including bicep skinfold, tricep skinfold, subscapular skinfold, and suprailiac skinfold. Basketball playing ability was assessed using standardized skill tests. The results revealed a negative correlation between all four skinfold measurements and basketball playing ability. However, no significant relationship was found between lean body mass and playing ability. The findings indicate that a higher body fat percentage negatively affects basketball performance, while lean body mass does not significantly contribute to the playing abilities of school-going children.

Keywords: Body Composition, Lean Body Mass, Fat Percentage.

INTRODUCTION

"It is far better to shoot an airball than not to shoot at all for fear of missing." —Tony Alfonso

Basketball is a physically demanding sport that requires a combination of basic fitness factors, namely strength, agility, endurance, and skill. If not maintained, these factors can lead to injuries. Health-related fitness factors include body composition, which might be a barrier to physical performance. However, in relation to basketball, there aren't ample studies. As school-going children engage in this sport, their athletic performance can be significantly influenced by body composition. Adolescence is a crucial developmental stage characterized by substantial physical and physiological changes. Children aged 13 to 16 often undergo changes in body fat, muscle mass, and overall physical stature, which can directly affect their sports capabilities (Pringle, J. et al., 2016).

One of the key factors associated with athletic performance in basketball is body fat percentage. High body fat can impede a player's speed and agility while decreasing overall endurance on the court (Bouley, K. J. et al., 2009). Therefore, knowledge of body composition is important to understand how these variables correlate with performance-related skills. Body composition assessments often employ skinfold measurements to derive estimates of fat mass and lean body mass.

Previous research has shown that excessive body fat negatively correlates with an athlete's performance in various games and sports, including basketball (Singh, Jasbir, 2019). However, the relationship between lean body mass and playing ability is less clear, raising questions about its significance in contributing to athletic prowess. Assessment of these relationships can enhance our understanding of how physical fitness aspects interplay with skillful performance in sports during adolescence.

This study focuses on school-going children who have participated in intradistrict tournaments, analyzing their body composition metrics—skinfold thickness at multiple sites, fat percentage, and lean body mass—in conjunction with their basketball playing abilities. By doing so, we aim to identify whether changes in these metrics are associated with improved performance on the basketball court. The findings from this research may contribute valuable insights into sports training and physical education curricula, helping to foster better athletic potential among young players.

METHODOLOGY

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Participants: For this study, a total of 70 male basketball players aged 13-16 years were chosen from various schools in Faridabad District, Haryana. All subjects had participated in intra-district basketball tournaments. Purposive sampling was utilized for the selection of subjects. Written informed consent was obtained from the parents before the study commenced, ensuring ethical standards were upheld.

Anthropometric Measures: In this study, anthropometric measurements like body weight and skinfold thickness (4 sites) were measured. The 4 sites were bicep skinfold, tricep skinfold, subscapular skinfold, and suprailiac skinfold. Further, by adding all skinfold measurements, the sum of all 4 sites was assessed. For evaluating fat percentage, Durnin & Womersely (1974) formula was used, which gave the body density of individuals. The Siri equation was used to assess fat percentage.

- Durnin & Womersely Formula:
Bd = 1.1631 – 0.0632 (log sum of 4 sites)

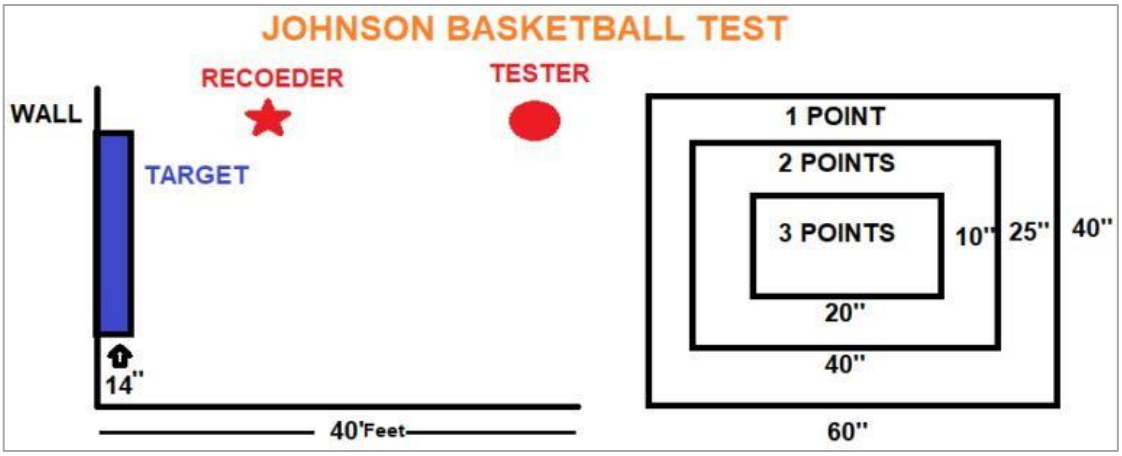
- Siri Equation:
Fat % = (4.95 / Bd – 4.50) × 100

Table 1: Tools and Units Used for Anthropometric Measures and Body Composition

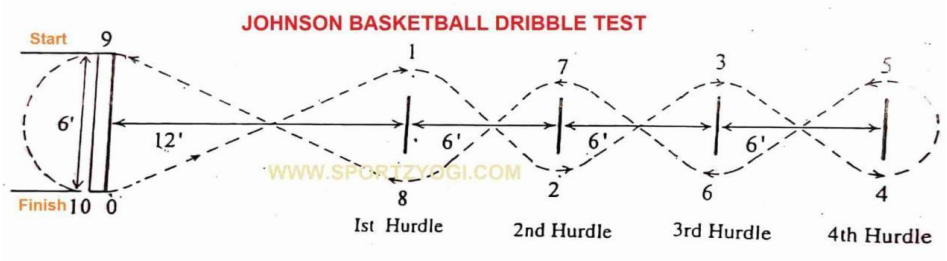
Variable	Instrument	Unit of Measurement	Measured to the Nearest
Body Weight	Digital Scale (Bold Fit)	kg	0.1 kg
Skinfold Thickness	Galaxy body fat caliper	mm	1 mm
Fat Percentage	Durnin Womersley Method / Siri Equation	%	0.1%
Lean Body Mass	Calculation	kg	0.01 kg
Fat Mass	Calculation	kg	0.01 kg

Playing Ability Test Battery:
Basketball playing ability was assessed using the Johnson Basketball Test, which consists of the following components: Field Goal Speed Test, Basketball Throw, and Dribble Test. After recording the results of all 3 tests, scores of all 3 tests were added to create a Total Test Battery Score.

- Field Goals Speed Test: Measures the ability of a player to consistently score baskets as quickly as possible under a time pressure of 30 seconds.
- Basketball Throw for Accuracy (Passing Skill): Measures the ability to consistently and accurately throw the basketball towards a target from varying distances. Total points in 10 throws were recorded.



- Dribble Test: Measures the ability to control the ball and agility of the player while moving in a zig-zag pattern through a series of cones in the shortest time possible. Number of cones crossed in 30 seconds was recorded.



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Statistical Analysis

Data were analyzed using SPSS 16.0. Descriptive statistics of anthropometric measures, body composition, and playing ability were evaluated with mean and standard deviation. The relationship between body composition and playing abilities was assessed using Pearson's correlation coefficient. The significance level was set at 0.05.

RESULTS & FINDINGS

Descriptive statistics of age, anthropometric measurements, and body composition are given in Table 2. Descriptives of Johnson Basketball Playing Ability tests are in Table 3.

Table 2: Descriptives of Age, Anthropometric Measures, and Body Composition

Anthropometric Variable	Mean	Std. Deviation	Minimum	Maximum
Age	14.35	.90	13.00	16.00
Body Weight	71.45	10.23	49.00	95.00
Biceps Skinfold	9.72	4.19	1.00	18.00
Triceps Skinfold	13.91	5.21	4.00	26.00
Subscapular Skinfold	17.72	6.83	6.00	36.00
Suprailiac Skinfold	24.28	8.74	8.00	44.00
Sum of 4 Sites	65.81	22.63	21.00	120.00
Fat %	27.36	5.62	13.40	38.00
Fat Mass	19.80	6.76	6.65	36.10
Lean Body Mass	51.63	4.61	41.65	65.57

As shown in Table 2, the average age was 14.35 ± 0.90 years. The average body weight was 71.45 ± 10.23 kg, suggesting moderate variability in weight among participants. The mean bicep skinfold was 9.72 ± 4.19 mm, while the triceps skinfold averaged 13.91 ± 5.21 mm. The subscapular skinfold showed a higher mean of 17.72 ± 6.83 mm, and the suprailiac skinfold had an average of 24.28 ± 8.74 mm. The total sum of skinfolds across four sites averaged 65.81 ± 22.63 mm, indicating significant variability in total body fat distribution among participants. The average body fat percentage was 27.36 ± 5.62%, and the mean fat mass measured was 19.80 ± 6.76 kg. Lastly, the average lean body mass of the participants was 51.63 ± 4.61 kg.

Table 3: Descriptives of Johnson Basketball Playing Ability Test

Playing Ability	Mean	Std. Deviation	Minimum	Maximum
Field Goal Speed Test	8.18	1.56	5.00	12.00
Basketball Throw for Accuracy	17.11	3.07	11.00	23.00
Dribble Test	9.71	1.37	7.00	13.00
Total Test Battery Score	35.01	4.94	24	47

Participants were evaluated through various basketball performance tests. In Table 3, the field goal speed test yielded a mean score of 8.18 ± 1.56. The basketball throw for accuracy had a mean score of 17.11 ± 3.07, while the dribble test produced a mean score of 9.71 ± 1.37. The total test battery score averaged 35.01 ± 4.94.

Correlation Coefficients among Body Composition and Basketball Playing Ability of Johnson Basketball Test

Table 4: Correlation of Field Goal Speed Test with Body Composition

Variable	Field Goal Speed Test (r)
Body Weight	-0.274
Biceps Skinfold	-0.410
Triceps Skinfold	-0.350
Subscapular Skinfold	-0.437
Suprailiac Skinfold	-0.368
Sum of 4 Sites	-0.436
Fat Percentage	-0.401
Fat Mass	-0.349
Lean Body Mass (LBM)	-0.090

Significance Levels:

- *Correlation is significant at the 0.01 level (2-tailed).*
- *Correlation is significant at the 0.05 level (2-tailed).*

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The analysis of variables correlated with the Field Goal Speed Test is revealed in Table 4. Body weight shows a negative correlation of -0.274. More significant correlations include the biceps skinfold at -0.410 and the triceps skinfold at -0.350. The subscapular skinfold displays a stronger negative correlation of -0.437, while the suprailiac skinfold has a correlation of -0.368. The sum of the four skinfold sites also has a notable negative correlation at -0.436, and fat percentage correlates at -0.401, indicating that higher body fat metrics are associated with consistent shooting ability. Notably, lean body mass (LBM) shows no significant correlation at -0.090. These results emphasize the impact of body composition on field goal performance in basketball.

Table 5: Correlation between Basketball Throw for Accuracy (Passing Skill) with Body Composition

Variable	Basketball Throw for Accuracy (r)
Body Weight	-0.439
Biceps Skinfold	-0.524
Triceps Skinfold	-0.478
Subscapular Skinfold	-0.527
Suprailiac Skinfold	-0.508
Sum of 4 Sites	-0.563
Fat Percentage	-0.497
Fat Mass	-0.497
Lean Body Mass (LBM)	-0.243

Significance Levels:

- *Correlation is significant at the 0.01 level (2-tailed).*
- *Correlation is significant at the 0.05 level (2-tailed).*

As shown in Table 5, body weight shows a moderate negative correlation of -0.439. Additionally, the biceps skinfold demonstrates a stronger negative correlation of - 0.524, suggesting that greater subcutaneous fat in the biceps adversely impacts passing skill. The subscapular skinfold and suprailiac skinfold also show substantial negative correlations, with values of -0.527 and -0.508, respectively. Notably, the sum of skinfold measurements across four sites displays the most significant negative correlation at -0.563. Furthermore, fat percentage and fat mass each exhibit notable negative correlations of -0.497. In contrast, lean body mass (LBM) has a weaker correlation of -0.243, indicating a less significant relationship with basketball throw for accuracy compared to the other variables.

Table 6: Correlation between Dribble Test with Body Composition

Variable	Dribble Test (r)
Body Weight	-0.328
Biceps Skinfold	-0.454
Triceps Skinfold	-0.379
Subscapular Skinfold	-0.446
Suprailiac Skinfold	-0.487
Sum of 4 Sites	-0.502
Fat Percentage	-0.507
Fat Mass	-0.439
Lean Body Mass (LBM)	-0.086

Significance Levels:

- *Correlation is significant at the 0.01 level (2-tailed).*
- *Correlation is significant at the 0.05 level (2-tailed).*

In Table 6, the correlation analysis of various physical parameters in relation to the Dribble Test reveals several notable relationships. Body weight shows a negative correlation of -0.328. The biceps skinfold demonstrates a stronger negative correlation of -0.454, suggesting that excess fat in the biceps negatively impacts dribble performance. Similarly, the subscapular skinfold and suprailiac skinfold reveal substantial negative correlations of -0.446 and -0.487, respectively. The sum of skinfold measurements across four sites shows a significant negative correlation of - 0.502. Additionally, both fat percentage and fat mass correlate negatively with performance, with values of -0.507 and -0.439. In contrast, lean body mass (LBM) shows a weak correlation of -0.086. Overall, these findings indicate that lower body fat levels are associated with better performance in dribbling tasks.

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Table 7: Correlation between Total Test Battery Score with Body Composition

Variable	Total Test Battery Score (r)
Body Weight	-0.451
Biceps Skinfold	-0.582
Triceps Skinfold	-0.513
Subscapular Skinfold	-0.590
Suprailiac Skinfold	-0.568
Sum of 4 Sites	-0.627
Fat Percentage	-0.576
Fat Mass	-0.542
Lean Body Mass (LBM)	-0.204

Significance Levels:

- *Correlation is significant at the 0.01 level (2-tailed).*
- *Correlation is significant at the 0.05 level (2-tailed).*

The correlation analysis between various physical parameters and the Total Test Battery Score of the Johnson Basketball Test is revealed in Table 7. Body weight shows a substantial negative correlation of -0.451. Notably, the subscapular skinfold exhibits a particularly strong negative correlation of -0.590. The suprailiac skinfold and sum of 4 sites also show strong negative correlations, with values of -0.568 and - 0.627, respectively. The biceps skinfold demonstrates a moderate negative correlation of -0.582. Similarly, fat percentage and fat mass show negative correlations of -0.576 and -0.542, respectively. In contrast, lean body mass (LBM) has a relatively weak correlation of -0.204, indicating a less significant relationship with overall basketball performance compared to the other measured variables.

DISCUSSION

The current study sought to investigate the relationship between body composition and basketball playing abilities in school-going boys aged 12-17 years. The researchers evaluated the subjects using various anthropometric measures, body composition assessments, and the Johnson basketball playing ability test battery.

The findings revealed that the mean fat percentage of the samples exceeded 27%, far exceeding the recommended ideal range of 6-12% for basketball players, as suggested by the American Council on Exercise. This highlights the critical importance of nutrition and training in the development of these students. Moreover, the mean skinfold measurements of the suprailiac region was 24.28, significantly higher than the 14.48 reported by Singh (2019).

Correlational analysis was conducted to examine the relationship between body composition and anthropometric measures with basketball playing abilities. The results showed that as body weight, skinfold thickness, fat mass, and body fat percentage increased, playing ability decreased. Specifically, the study found that higher body fat levels were associated with reduced playing ability. Notably, greater subcutaneous fat, particularly in the biceps, was found to impair throwing accuracy.

The results of the Johnson basketball test also indicated that heavier body weight and higher skinfold measurements were linked to lower basketball performance scores across all three skill assessments: Field Goal Speed Test, Basketball Throw for Accuracy, and Dribble Test. This was consistent with the findings of Singh (2019), who reported that triceps and subscapular skinfolds were not significantly related to basketball playing ability.

Interestingly, lean body mass (LBM) showed a weak relationship with all three test items in the test battery, which may be attributed to the age of the participants. As noted by Marwaha et al. (2017), growth of LBM is relatively low during this age period. However, a previous study by Guimarães et al. (2019) found a significant positive correlation between LBM and playing ability in a sample of Portuguese under-14 team players. The discrepancy may be due to differences in training levels and experience between the two groups.

In line with previous literature, this study highlights the disadvantages of excess body fat in sports requiring explosive movements, agility, and coordination. According to Stone et al. (2007), children should ideally begin playing basketball at the age of 11-12, with specialization starting at 14-16. Moreover, the ideal age for achieving highest performance is 22-28. These findings underscore the importance of monitoring body composition and implementing targeted interventions to improve the playing abilities of school-going children.

Influence of Body Composition on Basketball Skills

As demonstrated in this study, higher levels of body fat correlate with decreased performance in critical skill assessments like the Field Goal Speed Test and Basketball Throw for Accuracy. Understanding these connections helps coaches and trainers design nutrition

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and training programs that optimize body composition for enhanced athletic performance.

Lean Body Mass and its Role

LBM is a critical factor in an athlete's ability to generate power and strength. Although the age group in this study may see slower growth in LBM, increased muscle mass is generally associated with improved performance. Previous literature suggests that a higher LBM can lead to enhanced athletic capacity as athletes advance through training and development stages. For instance, Guimarães et al. (2019) found a significant positive correlation between LBM and playing ability in a more trained group, indicating that with adequate training and development, increased LBM can support better performance outcomes.

Implications for Training and Development

The findings from this study have critical implications for the training and development of young basketball players. It is essential for coaches and trainers to monitor and manage body composition within their training programs. This can be achieved through targeted interventions focusing on nutrition and physical conditioning.

Limitations

The study's findings may be limited by several factors, including the sample size and diversity, which could affect the generalizability of the results to broader populations. Additionally, variations in growth and development among the 12-17 age group pose challenges in establishing clear conclusions. Differing levels of training among participants may also impact performance results, while the cross-sectional design restricts causal inferences about the relationship between body composition and basketball skills. Longitudinal studies are needed for more comprehensive insights.

CONCLUSION

In conclusion, this study highlights the significant influence of body composition on basketball skills among school-going children. The negative correlation between higher body fat percentages and basketball performance underscores the importance of addressing body composition through nutrition and training interventions. Although lean body mass did not show a significant relationship with playing ability in this sample but its potential role in enhancing athletic performance should not be overlooked. The findings suggest that monitoring and optimizing body composition can contribute to better athletic outcomes for young basketball players. Future research should aim to include more diverse populations, analyze longitudinal data, and explore the interactions between body composition and other factors that contribute to athletic performance.

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