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Body Composition Analysis Junior Basketball Players

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Abstract

Background: Athletes must maintain top physical condition to compete, with body composition a crucial indicator. Skeletal muscle mass and body fat are related to performance, with a lower fat percentage increasing physical ability. Nutritional needs also play a role, where athletes consume carbohydrates for 60-70% of their energy. These factors are essential for optimal performance and overall health.

Objectives: This study aimed to investigate the body composition of junior basketball athletes regarding gender.

Methods: This study employed a rigorous cross-sectional research design to analyze the body composition measurements of elite athletes and junior basketball players. The participants were carefully selected based on age, injury history, national-level achievements, and recent injury training. A total of 24 junior basketball athletes, evenly split between elite junior male and female athletes, participated in the test. The data was meticulously analyzed using Minitab software and the T-test to determine gender differences, ensuring the validity and reliability of the results.

Results: The athletes were aged 16-17, weighing 50-65 kg to 95-108 kg. They had BMI characteristics of 8.3% underweight, 79.2% normal, 12.5% overweight, and 0% obese. Significant differences were found in body composition characteristics for each gender. The T-test results show significant differences between the variables with a P value <0.05.

Conclusion: They indicate that female basketball athletes tend to have a higher fat percentage, while male athletes typically possess significantly greater muscle mass. These insights can be instrumental in developing gender-specific training and nutrition programs, thereby enhancing the performance and health of junior basketball athletes.

Keywords: body composition, basketball athletes, fat free mass, body fat mass.

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INTRODUCTION

The athlete is required to have the ability to be in prime physical condition to support the competition, so there are other indicators to support the athlete's physical condition, namely the athlete's body composition (Farhana et al., 2023). Assessment of athlete health, especially body composition analysis, has become a fundamental and essential component in optimizing athlete performance (Toselli, 2021). Body composition is a significant health and performance variable for athletes (Ackland et al., 2012). Athletes and coaches realize that skeletal muscle mass and body fat are related to performance when competing (Lukaski & Raymond-Pope, 2021).

Body composition is crucial for athletes as it directly influences performance, injury recovery, and overall health. Understanding the balance of fat and lean mass can help optimize training regimens and enhance athletic success across various sports. This synthesis highlights the significance of body composition in athletic performance, injury prevention, and tailored training strategies. Body composition metrics, such as fat mass (FM) and fat-free mass (FFM), are essential for evaluating athletic performance. For instance, in Kabaddi, specific body composition profiles correlate with player success (Kumar, Nara, & Dhull, 2023). This dramatically influences an athlete's performance because the lower the fat percentage level and the higher the muscle percentage level, the more physical abilities will increase (Kusumawati, 2016). Apart from that, an athlete must also meet nutritional needs. Athletes have different daily nutritional needs depending on the intensity of training. Athletes must consume carbohydrates for 60-70% of their total energy. Most of the carbohydrates in food are complex carbohydrates, while only a tiny portion (<10%) is simple carbohydrates (Williams, 2004).

An athlete is advised to consume protein and micronutrients because they affect performance, namely muscle strength, preventing muscle fatigue, oxidative stress, and athlete's cardiorespiratory (Putri & Dhanny, 2021). For all athletes involved in highly professional competitive sports, their bodies are required to perform as biomechanically as possible (Zaccagni, 2012). In other words, athletes must have specific body composition characteristics appropriate to their sport. Therefore, understanding an athlete's ideal body composition is essential to the overall management process (Arifi et al., 2017).

In previous studies of body composition analysis of paralympic athletes (Lemos et al., 2016), samples consisted of several sports with average results and standard deviations.

In the swimming branch, the number of athletes was 15 men, the results showed age (22.47 ± 7.75), height (1.69 ± 0.08), weight (63.60 ± 10.56), BMI (22.14 ± 2.70), Fat by SF (13.00 ± 7.02), Fat by ADP (19.15 ± 8.44), Body Density according to SF (1.06 ± 0.01), Body Density according to ADP (1.05 ± 0.01). Our study showed a difference in the results of more variables using the sophisticated and accurate Inbody 270 tool.

Young athletes are transitioning between adolescence and adulthood. It is estimated that approximately 975,000 American students participated in secondary school basketball during the 2015– 2016 academic year (National Federation of State High School Associations, 2022). High School Athletics Participation Survey., 2015). Results for adolescent basketball players revealed that the injury incidence varied considerably from 7.8 – 49.0 per 100 participants for girls and 5.6 – 36.8 per 100 participants for boys (Harmer, 2005). Basketball is a physically demanding intermittent sport requiring players to repeat intense actions such as running, dragging, and jumping (Chen et al., 2018). Excess fat mass becomes dead weight during activities where the body must be lifted repeatedly when exercising and jumping (Masanovic, 2019).

In contrast, musculoskeletal mass indicates sports performance (Trajkovic et al., 2018). It aids energy production during high-intensity activities and gives athletes absolute power (Aslan et al., 2019). Therefore, modern athletes need to be fast, explosive, and powerful. The average training intensity for playing basketball is more than 85% of the maximum heart rate and more than 80% of the maximum oxygen uptake (Ozen et al., 2020). They must have more muscle mass and less fat tissue to support performance in training and competition. Thus, this study aims to describe the characteristics of body composition profiles in elite junior basketball athletes to provide a brief overview of body composition analysis methods in junior basketball athletes and to show and compare the latest data on their usefulness and reliability in order to find the best solution for athletes in a practical way. Understanding body composition is crucial for athletes as it directly influences their performance, health, and injury management. Athletes can optimize their training regimens, monitor nutritional status, and enhance recovery strategies by analyzing body composition.

METHOD

Study Design and Participants

This research uses cross-sectional research. Participants were asked to take body composition measurements to see Body Mass Index (BMI), fat mass, and skeletal muscle. Subjects were observations on male and female elite athletes and junior basketball players (n=24). Selection is based on inclusion criteria: (1) junior athletes with a maximum age of 19 years, (2) junior athletes who have no injuries, and (3) athletes who have minimum achievements at the national level; moreover, with exclusion criteria (1) junior basketball athletes who have not participated in systematic injury training in the last 1 month. After the selection, 12 elite junior male athletes and 12 elite junior female athletes who would participate in the body composition test were obtained.

Research Instruments

Participants were asked to fill in initial selection data. Then, participants who passed the selection were asked to take a body composition measurement test using BIA Inbody 270 Seoul, South Korea.

Data Analysis

After the data is collected, the data will be analyzed to determine the characteristics of body composition and will be analyzed using Minitab software version 21 with the T-test to determine the differences between each gender.

RESULTS AND DISCUSSION

Results

The characteristics of the respondents in this study were a total of 24 junior basketball athletes, divided into 12 male athletes and 12 female athletes. Where the characteristics of the respondents can be seen in Table 1. (1) The age range of athletes is 16-17 years (62.5%) and 18-19 years (37.5%). (2) Body weight 50-65 kg (41.7%), 66-79 (37.5%), 80-94 (8.3%), and 95-108 (12.5%). (3) Height 166-176 cm (50.0%), 177-186 cm (20.8%), 187-196 cm (20.8%), 197-206 (8.3%). (4) With BMI (Body Mass Index) characteristics, namely 8.3% underweight, 79.2% normal, 12.5% overweight, and 0% obese. The differences in body composition characteristics of each gender are known in this study, and there are significant differences shown in Table 2. That the significance is below <0.05. The differences in Segmental Fat-Free Mass and Segmental Body Fat Mass for each gender were also found to be different in this study, which shows that there are

significant differences. Segmental Fat-Free Mass can be seen in Table 3. and Segmental Body Fat Mass can be seen in Table 4.

Table 1. Respondent Characteristics

Respondent Characteristics	N=24	
	N	%
Gender		
Man	12	50.0
Woman	12	50.0
Age (years)		
16-17	15	62.5
18-19	9	37.5
Weight (kg)		
50-65	10	41.7
66-79	9	37.5
80-94	2	8.3
95-108	3	12.5
Height		
166-176	12	50.0
177-186	5	20.8
187-196	5	20.8
197-206	2	8.3
BMI		
Underweight	2	8.3
Normal	19	79.2
Overweight	3	12.5
Obese	0	0

Characteristics of respondents in Table 1. It shows 24 junior basketball athletes, with 12 men and 12 women. With an average age of 17.3 years, body weight of 71.3 kg, and height of 180.1, most athletes have a normal BMI.

Table 2. Differences in Body Composition Characteristics

Variable	Woman (n=12)			Man (n=12)			P-Value
	Mean ± SD	Min	Max	Mean ± SD	Min	Max	
Age	16.8 ± 0.8	16.0	18.0	17.8 ± 0.8	17.0	19.0	0.001*
Height (cm)	172.8 ± 4.6	166.0	183.0	187.4 ± 8.7	172.0	200.0	0.003*
Weight (kg)	63.3 ± 8.0	50.0	76.0	80.0 ± 15.1	63.0	106.0	0.003*
FFM (kg)	50.5 ± 6.4	40.1	64.1	72.0 ± 12.6	58.0	97.5	0.001*
SMM (kg)	28.1 ± 3.9	22.0	36.1	41.5 ± 7.6	33.0	56.9	0.001*
BMI (kg/m^2)	21.2 ± 2.1	16.7	24.6	22.6 ± 3.1	16.0	28.2	0.001*
PBF (%)	20.1 ± 5.1	12.7	28.0	9.6 ± 3.3	6.9	18.6	0.023*

FFM (Fat Free Mass); SMM (Skeletal Muscle Mass); BMI (Body Mass Index); PBF (Percent Body Fat)

The results of measuring the body composition of junior basketball athletes followed by 12 boys and 12 girls using Inbody 270 are listed in Table 2. Which shows the average age of female athletes is 16.8 ± 0.8 while male athletes are 17.8 ± 0.8; the height of female athletes is 172.8 ± 4.6 while male athletes are 187.4 ± 8.7; the weight of female athletes shows an average of 63.3 ± 8.0 while male athletes 80.0 ± 15. 1, then the FFM variable shows the average female athlete 50.5 ± 6.4 while the male athlete 72.0 ± 12.6,

the SMM variable shows the average female athlete 28.1 ± 3.9, while the male athlete 41.5 ± 7.6, the BMI results show the average female athlete 21.2 ± 2.1. In contrast, the male athlete is 22.6 ± 3.1, and the PBF variable shows the average results of female athletes were 20.1 ± 5.1, while male athletes were 9.6 ± 3.3.

The independent t-test was conducted to further evaluate the differences in body composition characteristics, including weight, age, height, FFM, SMM, BMI, and PBF, as shown in Table 3. The results revealed significant differences in height (p-value = 0.003), weight (p-value = 0.003), FFM (p-value = 0.001), SMM (p-value = 0.001), BMI (p-value = 0.001), and PBF (p-value = 0.023). These findings have practical implications for the training and development of junior basketball athletes, as they provide a deeper understanding of the unique body compositions that contribute to their performance potential.

Table 3. Segmental Distribution *Fat Free Mass* 0n the Body

Variable	N=24		P-Value
	Man (n=12)	Woman (n=12)	
	Mean ± SD	Mean ± SD	
FFM Right Arm	2.4± 0.4	4.0 ± 0.8	0.001*
FFM Left Arm	2.4 ± 0.4	3.9 ± 0.8	0.001*
FFM Trunk	21.1 ± 2.2	30.7 ± 4.5	0.001*
FFM Right Leg	8.2 ± 1.1	11.8 ± 1.7	0.001*
FFM Left Leg	8.2 ± 1.1	11.7 ± 1.7	0.001*

FFM (Fat free mass)

The difference in fat-free mass body parts can be seen in detail from junior basketball athletes (Table 3). 5 body parts can provide information about the amount of fat-free muscle mass in the body. The average result of the distribution of fat-free mass of male athletes on the right arm is 2.4 ± 0.4, and 2.4 ± 0.4 for the left arm. At the same time, the distribution of fat-free mass of female athletes on the right arm is 4.0 ± 0.8 and 3.9 ± 0.8 for the left arm. There is also a fat-free mass in the trunk of male athletes 21.1 ± 2.2, while for female athletes 30.7 ± 4.5. For the lower extremities of male athletes on the right foot, 8.2 ± 1.1, and 8.2 ± 1.1 for the left foot. While for female athletes on the right foot, 11.8 ± 1.7, and 11.7 ± 1.7 for the left foot. When compared to the fat-free mass of male athletes and female athletes, it can be seen that there is a difference in the results of the average fat-free mass of female athletes greater than male athletes. From the results of the independent t-test, it can be seen that there is a difference between male and female athletes with a p-value of 0.001.

Table 4. Segmental Distribution *Body Fat Mass* on the Body

Variable	n=24		P-Value
	Man (n=12)	Woman (n=12)	
	Mean ± SD	Mean ± SD	
BFM Right Arm	0.8 ± 0.3	0,3 ± 0.3	0.001*
BFM Left Arm	0.8 ± 0.3	0,3 ± 0.3	0.001*
BFM Trunk	6.5 ± 2.2	3,8 ± 2.6	0.003*
BFM Right Leg	2.2 ± 0.6	1.3 ± 0.4	0.001*
BFM Left Leg	2.2 ± 0.6	1.3 ± 0.4	0.001*

BFM (Body Fat Mass)

The results of the average distribution of body fat mass (BFM) of junior basketball athletes are in Table 4. The average body fat mass in the upper extremities of male athletes is 0.8 ± 0.3 in the right arm and 0.8 ± 0.3 in the left arm. At the same time, female athletes are 0.3 ± 0.3 for the right arm and 0.3 ± 0.3 for the left arm. Male athletes have an average of 6.5 ± 2.2 for the trunk, while for female athletes, 3.8 ± 2.6. Then, for the upper extremities, male athletes on the right leg have an average of 2.2 ± 0.6 and 2.2 ± 0.6 for the left leg. At the same time, female athletes are 1.3 ± 0.4 for the right and left legs. There are differences in the average results of body fat mass in junior basketball athletes, with the results of male athletes having a more significant body fat mass than female athletes. So, it can be seen that the independent t-test results have a difference with a p-value <0.005.

DISCUSSION

This study aimed to examine and analyze the body composition characteristics of elite junior basketball athletes. So far, more specific research is still needed on the body composition characteristics of basketball athletes, especially in Indonesia, especially at young ages. Even though body composition data can support athlete performance based on their characteristics, the researchers found that athletes whom BMI categorized were underweight (8.3%), average (79%), overweight (12.5%), and overweight (12.5%). These findings reveal that female athletes have a higher percentage of body fat than male athletes, and the comparison of the composition of male and female athletes has a significant difference of <0.05. In general, basketball athletes in this study can be categorized as having good body composition.

Fat percentage in women is more significant due to biological factors (Karastergiou et al., 2012), which can cause a greater risk of injury. An overweight person with the highest activity level is more likely to sustain an injury (Ezzat et al., 2016), because a lower percentage of fat has benefits for neuromuscular actions such as jumping and changing

direction (Ribeiro et al., 2015; Spiteri et al., 2015), apart from that, this sport also requires defensive actions that are beneficial when competing, such as rebounding in pick and low post situations. So, in this action, a larger body mass will be more advantageous when competing, as previous research has revealed that players with a higher level have a larger body mass and have an advantage in competing to make it less likely to be expelled from their position (Stojanović et al., 2018). In this case, a person who is overweight and has the highest activity level will have a greater likelihood of injury (Ezzat et al., 2016).

Body composition is a physical factor that can also influence the movement ability of basketball athletes. Therefore, body composition must be considered to prepare an athlete's physical condition. It can be seen from the results of this study that the body composition variables FFM, SMM, BMI, and PBF reveal that there are differences in the body composition of male and female athletes. Moreover, a larger BMI does not determine a large percentage of fat, so BMI cannot be used as a reference in determining excess fat in athletes and non-athletes; in this case, BMI incorrectly classifies athletes who have normal fat as overweight athletes (Heymsfield et al., 2009).

Although BMI has several favorable characteristics as a screening tool for assessing obesity in each individual (Heymsfield et al., 2009), as we monitor obesity trends over time and among different populations, more effective obesity assessment methods can be obtained using surface anthropometry, such as measuring the neck or chest area in men and the upper back or arm area in women (Kruschitz et al., 2013). Given the level of popularity of basketball, there is a need for high-quality research on the sport of basketball. This study has limitations in that it only knows body composition in junior athletes, so further research is expected to add to and evaluate the incidence of injury with other variables.

CONCLUSION

Research shows that female basketball athletes have a greater percentage of fat than male athletes, while male athletes have much greater muscle mass than female athletes. To effectively control body fat percentage and maintain performance, coaches and athletes should focus on balanced dietary practices and sustainable weight management strategies. Emphasizing the quality of dietary fats, meal planning, and avoiding extreme dieting methods are crucial for optimizing athletic performance.

CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

AUTHOR'S CONTRIBUTION

Solikah, Wahyudi, Widodo, Firmansyah, and Muarif are essential contributions to the conception and design of the study protocol, acquisition, analysis, and interpretation of data, and involved in drafting the manuscript. Solikah and Muslim are critical revisions for important intellectual content. All authors read and approved the final manuscript.

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