Scholars Academic Journal of Biosciences
Abbreviated Key Title: Sch Acad J Biosci
ISSN 2347-9515 (Print) | ISSN 2321-6883 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Optometry

The Relationship between Body Mass Index, Body Fat Percentage and Athletic Performance of Male and Female Student-Athletes

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DOI: https://doi.org/10.36347/sajb.2025.v13i04.004 | **Received:** 17.02.2025 | **Accepted:** 22.03.2025 | **Published:** 10.04.2025

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Abstract | **Original Research Article**

Background*:** The present study examined some relationship between anthropometric parameters; including height, weight, and body mass index (BMI) and athletic performance of male and female student-athletes. ***Methods*:** The descriptive statistics measured parameters between male and female athletes and illustrated the mean values and standard deviations for these parameters in both groups of student-athletes. Using T-tests, the statistical comparisons were height between male and female athletes, weight between male and female athletes and BMI between male and female student-athletes. The results showed a statistically significant difference in height between male and female athletes (t = 11.786; p < 0.00001). However, there was no statistical significance in weight (t = 0.835; p = 0.416) or BMI (t = 0.549; p = 0.549) between the two groups. ***Results*:** These findings suggest that while male and female athletes may differ significantly in height, there is no significant disparity in weight or BMI. These results may provide a better understanding of the physical characteristics of male and female athletes and may have implications for training and performance considerations. Further research in this area could provide valuable insights into optimizing athletic performance across gender groups. ***Conclusion: The present study may expand our knowledge of height, weight and BMI differences between male and female athletes. These findings challenge stereotypes, advocate for personalized approaches in sports science, and emphasize the need for gender-specific assessments to enhance athlete performance and well-being. This research provides valuable insights for sports professionals and coaches working with male and female athletes.

Keywords: Anthropometry, Statistics, Body Mass Index (BMI), Athletes, Performance.

1. INTRODUCTION

Athletics, whether in professional sports or recreational activities, are characterized by the relentless pursuit of physical excellence and performance improvement (Knutzen, 2013; Salter, 1999). Athletes continually strive to reach their peak performance levels, pushing the boundaries of human capabilities (Siddarth,2011) Within this realm, the role of anthropometric measurements has gained prominence as a crucial factor that may influence an athlete's performance (Ademola & Ilochi, 2024; Liu, *et al*., 2011). This study delves into the intriguing world of the relationship between anthropometric measurements and physical performance in athletes, setting the stage for a comprehensive exploration of this multidimensional connection. Anthropometry, the science of measuring human body dimensions (Scheker & Babb, 2010; Krishan, 2007), has long been recognized as a valuable tool for understanding physical variations among individuals (Ademola & Ilochi, 2024; Goldstein & Mcquiston, 2001). It encompasses a wide array of measurements, including height, weight (Nath & Krishan, 1990), body composition (such as muscle and fat percentages), limb lengths (Gulati, 2011), and various circumferences (Elhassan & Assenmacher, 2018; Camron, 2012). These measurements provide valuable insights into an individual's physical makeup, allowing for the assessment of body proportions and the identification of unique characteristics (Ilochi, *et al*., 2019; Knutzen, 2013). The realm of physical performance in athletes encompasses diverse sports disciplines, each with its unique demands. Performance may be evaluated through parameters such as speed, strength, endurance, agility, flexibility, and skill proficiency (Leonard, 1999; Hiernaux, 1989). Achieving excellence in these areas is the hallmark of a successful athlete, making it imperative to uncover the factors that contribute to superior performance (Bergman, 2018). The performance of athletes is influenced by a multitude

of factors, including their anthropometric measurements such as height, weight, body composition, limb lengths (Harcourt, 2014; Moore, Persaud & Torchia, 2012), and other physical attributes. However, a comprehensive understanding of how these anthropometric measurements specifically correlate with and impact the physical performance of athlete's remains limited (Ilayperuma, 2010; Halpern, 2014). This study aims to investigate the relationships between various anthropometric measurements and different aspects of physical performance in athletes across various sports disciplines. By addressing this gap in knowledge, we seek to provide valuable insights that can inform athlete training, selection, and performance optimization strategies. The aim of this study is to determine if there is a correlation or relationship between various anthropometric measurements and the physical performance of athletes.

2. MATERIALS AND METHODS

2.1 Ethical Consideration

This study was approved by Madonna University Research Ethics Committee with reference MUN/MUREC/CM/2024/017. The following ethical issues were considered while carrying out the research work.

- ✓ The identity of subjects was not made known
- ✓ Respect for persons
- ✓ Non-maleficence
- ✓ Information sought from the subjects were not disclosed
- ✓ The obligation to do well and put the best interests of the other participants into consideration.

2.2 Awareness, Recruitment and Screening

Awareness and recruitment were strictly within the College of Medicine, Madonna University, Elele, Rivers State, Nigeria and AZ Sporting complex, Owerri, Imo State. This was done through some medium such as advertisements, social media and faculty referrals. Participants were screened using medical history, physical examinations and laboratory tests.

2.3 Informed Consent

Before inclusion as a participant in this study, the voluntary informed consent was received and properly documented. A sample of the document is attached to this study.

2.4 Confidentiality

This study's confidentiality measures ensures the protection of participants personal and medical information. All data will be anonymized using unique identifiers instead of names, data transmitted electronically will be encrypted and stored in strong password-protected computers.

2.5 Participants Right to Withdrawal

Participants have the right to withdraw at any given period during the course of this study without penalty or loss of benefits. Withdrawal will not affect the medical care and/or relationship with healthcare providers and the data of the participant will be completely removed from the study.

2.6 Sample Size

A total of 100 male and female student athletes were recruited for this cross sectional study. Anthropometric measurements were taken in a standard manner, including height, weight, body composition. This study was carried out with a total number of 100 subjects (50 males & 50 females) who were between the ages 18 years to 27 years of the selected athletes.

2.6.1 Sample Size Determination

The sample size was determined using Fischer's formula for populations infinite or large population > 10,000 (Cochran 1963).

SS $\frac{Z\text{^}2\times n\times q}{a\text{^}2}$

Where SS= Sample size

Z= Z score =1.96

N=estimated population proportion

Q= $1-n$

a= margin of error usually expressed as 5% or 0.05

For Female Students:

n= $\frac{target\ population}{total\ population}$ =$\frac{50}{5000}$ = 0.01

q=1- 0.01 = 0.09

SS= $\frac{1.96^2\times 0.01\times 0.09}{0.05\text{^}2}$ = 15.2

10% attrition rate of sample size = 0.1 × 15.2+ 1.52 =16.72

Total working sample for female students = 15.2 + 1.52 = 16.72

For Male Students:

n= $\frac{target\ population}{total\ population}$ =$\frac{50}{5000}$ = 0.01

q=1- 0.01 = 0.09

SS= $\frac{1.96^2\times 0.01\times 0.09}{0.05\text{^}2}$ = 15.2

10% attrition rate of sample size = 0.1 × 15.2+ 1.52 =16.72

Total working sample for male students = 15.2 + 1.52 = 16.72

Individuals who met the inclusive criteria were randomly selected using Simple random sampling technique

2.7 Subject Selection

Individuals who met the inclusive criteria were randomly selected using multisage simple random sampling technique.

2.7.1 Inclusion Criteria

- ✓ Age between 18-27 years
- ✓ Physically fit
- ✓ Student athletes

2.7.2 Exclusion Criteria

- ✓ Subjects below 18 or above 27 years old.
- ✓ Deformed subjects
- ✓ Athletes on medications
- ✓ Athletes on the use of enhancing drugs or hard drugs
- ✓ Pregnant athletes

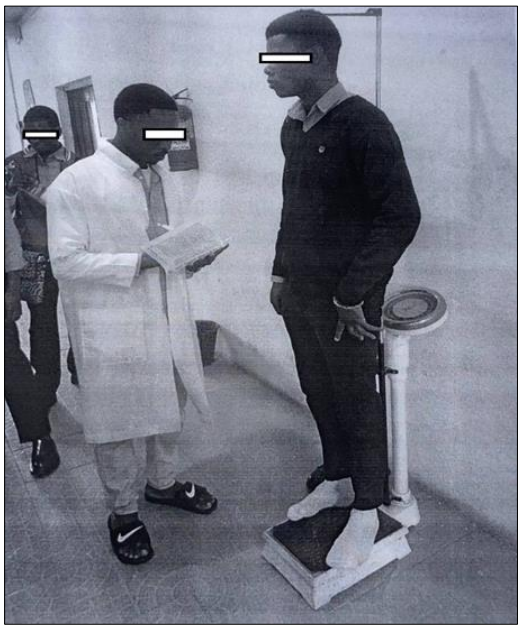

Figure (a)

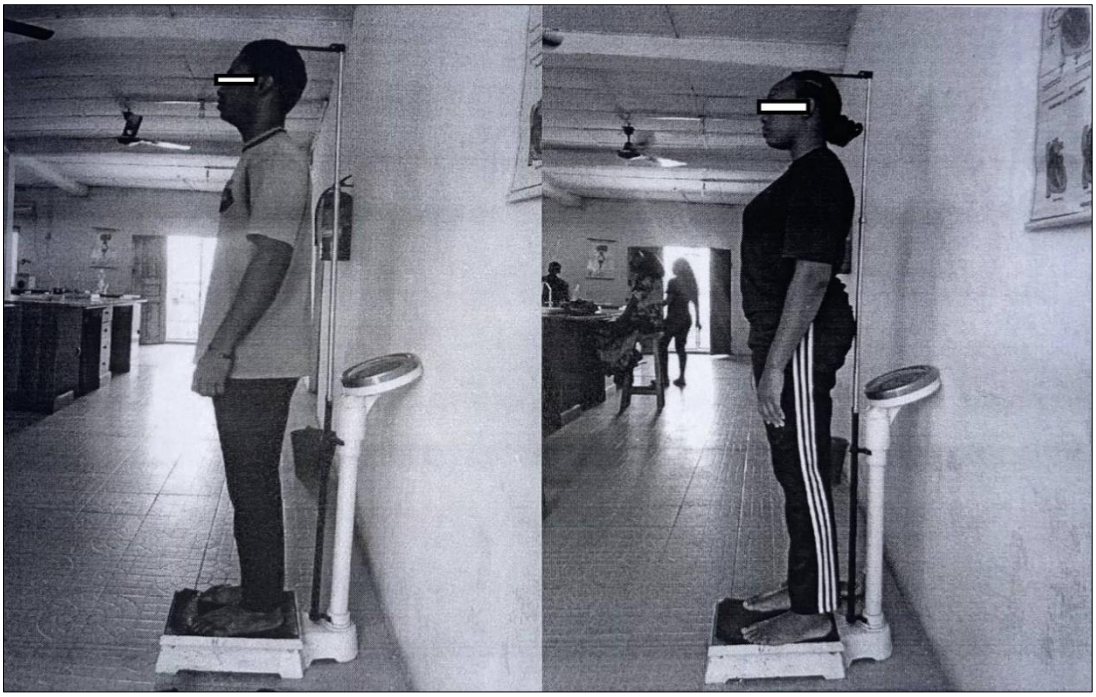

Figure (b)

Figure (a) and (b): Data collection from some samples in the study area.

2.8 Data Collection

A total of 100 samples were taken using simple random sampling method; 50 males and 50 female subjects above 18 years of age, from Rivers State (Madonna University) and Owerri (AZ sporting complex). In taking the measurements for the weight, subjects were asked to stand on a weighing scale in order to prevent errors. Heights in Elele were taken with Stadiometer, while those in Owerri were gotten through oral dialogue.

2.9 Statistical Analysis

The results were presented as Mean ± Standard Deviation (SD). Statistical Package for Social Sciences

(IBM®-SPSS) was used for all statistical tests. (Ilochi, *et al*., 2021; Ilochi, *et al*., 2014)

3. RESULTS

The following are the results from this study:

Table 1.0: Descriptive statistics of the measured parameters between male and female athletes

Parameters	Groups	Total [*n*=100]	Total [*n*=100]
Height (cm)	Male	94.26±13.89	82.28±16.96
	Female	78.29±20.03	
Weight (Kg)	Male	1.80±0.14	1.79±0.14
	Female	1.77±0.14	
Body Mass Index (Kg/M^2)	Male	29.77±6.65	27.61±7.15
	Female	25.45±7.65	

SD=Standard Deviation, *n*=Number of subjects

Table 2.0: Statistical comparison of height between male and female athletes

Gender	*n*	Mean	SD	T-test	*P*-value
Male	50	1.80	0.14		
				11.786	0.00001
Female	50	1.77	0.14		

Std. Deviation= Standard deviation, *n*=Number of subjects= insignificant at p≤0.05

Table 2.0 shows the T-test results for the height of the male and female athletes suggesting that there is a statistically significant difference in height between both male and female athletes (t=11.786; -0.050) at *p*≤0.05

Table 3.0: Statistical comparison of weight between male and female athletes

Gender	*n*	Mean	SD	T-test	*P*-value
Male	50	94.26	13.89		
				0.209	0.835
Female	50	78.29	20.3		

Std. Deviation= Standard deviation, *n*=Number of subjects= insignificant at *p*≤0.05

Table 3.0 shows the T-tests results for the weight of male and female athletes. The table above suggests that there is no statistically significant difference between the weight of the male and female athletes. (t=0.835; -0.416 at p≤0.05) respectively.

Table 4.0: Statistical comparison of BMI between male and female athletes

Gender	*n*	Mean	SD	T-test	P-value
Male	50	29.77	6.65		
				0.601	0.549
Female	50	25.45	7.65		

Table 4.0 Shows the t test results for the BMI of the male and female athletes suggesting that there is no statistical significance difference in BMI between both male and female athletes (t=0.549; -0.050) at p≤0.05.

4. DISCUSSION

Athletics, whether professional or recreational, embodies the relentless pursuit of physical excellence and performance enhancement, pushing the boundaries of human capabilities (Salter, 1999). Within this domain, anthropometric measurements have emerged as pivotal factors influencing an athlete's performance. This study investigated the intricate relationship between anthropometric measurements and athletic prowess, emphasizing the diverse parameters such as height, weight, body composition, limb lengths and circumferences that constitute anthropometry. Despite the recognition of the impact of anthropometric measurements, a comprehensive understanding of their specific correlation with athletic performance remains limited, thus forming the basis for this study. The study aims to bridge this knowledge gap by investigating the nuanced connections between various anthropometric measurements and diverse aspects of physical performance across sports disciplines. The scope of this study includes reviewing existing literature on anthropometric measurements and their influence on athlete performance, analyzing data from a diverse athlete pool, assessing correlations between specific measurements and performance metrics within individual sports, and identifying emerging trends or patterns. The results provide valuable insights into the physical characteristics of male and female athletes, specifically focusing on height, weight, and body mass index (BMI). Descriptive statistics of the measured parameters between male and female athletes revealed a significant difference in height between male and female athletes. On average, male athletes are notably taller than

their female counterparts. This finding is supported by the results of the t-test in Statistical comparison of height between male and female athletes, which shows a highly significant difference in height between the two groups ($t = 11.786$, $p < 0.00001$). Descriptive statistics of the measured parameters between male and female athletes displayed the mean weight for both male and female athletes, with males having a slightly higher average weight. However, the t-test results in Statistical comparison of weight between male and female athletes suggest that this difference is not statistically significant ($t = 0.835$, $p > 0.05$). Therefore, it can be concluded that there is no significant difference in weight between male and female athletes in this study. Statistical comparison of BMI between male and female athletes shows that, on average, male athletes have a higher BMI than female athletes. However, the t-test results in Statistical comparison of BMI between male and female athletes indicate that this difference is not provide evidence of a significant difference in BMI between male and female athletes. Also the body mass index of male is 29.77±16.65 while that of female is 25.45±7.65. This shows that the mean value of male is higher than that of female. However Descriptive statistics of the measured parameters between male and female athletes shows the descriptive statistics of the measured parameters between the male and female athlete. Statistical comparison of height between male and female athletes shows statistical comparison of height between male and female athletes. Also, the Statistical comparison of height between male and female athletes shows the t test result for the height of the male (1.80) and female (1.77) athletes, this shows that there is statistical significant difference in height between both male and female athletes ($t = 11.786$; -0.050) at a confidence interval of 0.05 consequently, the study does not provide evidence of a significant difference in BMI between male and female athletes. Also the body mass index of male is 29.77±16.65 while that of female is 25.45±7.65. This shows that the mean value of male is higher than that of female. However, descriptive statistics of the measured parameters between male and female athletes shows the descriptive statistics of the measured parameters between the male and female athlete. Statistical comparison of height between male and female athletes shows statistical comparison of height between male and female athletes. Also the Statistical comparison of height between male and female athletes shows the t test result for the height of the male (1.80) and female (1.77) athletes, this shows that there is statistical significant difference in height between both male and female athletes ($t = 11.786$; -0.050) at $p > 0.05$.

5. CONCLUSION

The present study may expand our knowledge of height, weight and BMI differences between male and female student-athletes. The findings of the present study may challenge stereotypes, advocate for personalized approaches in sports science, and emphasize the need for gender-specific assessments to enhance the performance and well-being of an athlete. This provides valuable insights for sports professionals and coaches working with male and female student-athletes.

Acknowledgments

No additional funding, grant or any other sources of funding were received for this study. We are however grateful to the management of Madonna University, Elele, Rivers State, University of Ilesa, Ilesa, Osun State and Federal University Otuoke, Bayelsa State.

Conflicts of Interest: None to report

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