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A Comparative Analysis of Body Composition Between Female Athletes and Non-Athlete College Students

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ABSTRACT

Introduction: Body composition is a key determinant of physical fitness, metabolic health, and athletic performance. Female college athletes typically demonstrate more favourable body composition profiles—lower body fat percentage and higher lean muscle mass—compared to their non-athlete counterparts. This study aimed to compare body composition parameters between female college athletes and non-athlete female students, thereby highlighting the physiological impact of sports participation in young adult females.

Methodology: A comparative cross-sectional study was conducted involving 50 female college students aged 18–25 years, equally divided into two groups: athletes (n=25) and non-athletes (n=25). Body composition was assessed using the Omron Body Composition Monitor (HBF-702T), measuring parameters such as BMI, body fat percentage, skeletal muscle percentage, subcutaneous fat, resting metabolic rate, and body age. Statistical analysis was performed using independent samples t-tests to compare group means.

Results: Statistically significant differences were found in BMI (p=0.0001), body age (p=0.0009), and trunk skeletal muscle percentage (p=0.0083), with athletes showing lower BMI, younger body age, and higher trunk muscle mass than non-athletes. No significant differences were observed in overall body fat, visceral fat, RMR, total skeletal muscle percentage, or subcutaneous fat across limbs and trunk (p>0.05). These results suggest that while certain central body composition metrics benefit from athletic training, others—such as limb fat and muscle distribution—show minimal variation between the groups.

Conclusion: The findings indicate that consistent athletic training in female college students positively influences specific physiological parameters, particularly central muscle development and metabolic age.

However, not all body composition metrics differ significantly, highlighting the complex interaction of lifestyle, genetics, and physical activity. These insights can inform gender-sensitive health and fitness programs on college campuses to promote lifelong wellness among young women, both athletes and non-athletes.

Keywords: Body composition, female college students, athletes vs. non-athletes, skeletal muscle percentage, body mass index (BMI), subcutaneous fat, resting metabolic rate, physical activity, body age, health promotion.

INTRODUCTION

Body composition, defined as the proportion of fat mass and fat-free mass (including muscle, bone, and body water), is a critical determinant of physical fitness, athletic performance, and metabolic health (Heymsfield et al., 2015). Accurate assessment of body composition provides valuable insights into health status and physical preparedness, particularly in young adult populations such as college students.

Female athletes often exhibit more favourable body composition profiles, characterized by lower body fat percentage and higher lean body mass, primarily due to consistent training regimens, structured diets, and lifestyle factors associated with sports participation (Ackland et al., 2012; Sundgot-Borgen & Garthe, 2011). These physiological adaptations contribute significantly to enhanced performance and reduced risk of injury and chronic disease. Conversely, non-athlete female students, who may lead more sedentary lifestyles and have varied dietary patterns, tend to show higher adiposity and lower muscle mass, potentially increasing their susceptibility to metabolic disorders, cardiovascular issues, and musculoskeletal imbalances (Hills et al., 2014; Nelson et al., 2007).

The college years are a pivotal period for developing lifelong health behaviours, and the contrast between athletic and non-athletic student populations provides a unique opportunity to explore how lifestyle choices influence body composition. Despite the well-documented benefits of physical activity, limited research has systematically compared the body composition profiles of female athletes and their non-athlete counterparts within a college environment, especially in diverse academic and cultural settings.

This study aims to conduct a comparative analysis of body composition parameters—including body mass index (BMI), fat mass (FM), fat-free mass (FFM), and body fat percentage—between female college athletes and non-athlete female students. Through this analysis, the research seeks to underscore the physiological distinctions between these groups and to provide evidence-based recommendations for health promotion among female college populations.

NEED FOR THE STUDY

In recent years, there has been growing concern over sedentary lifestyles, poor dietary habits, and rising obesity rates among college students, particularly among females (Nelson et al., 2007). While the benefits of physical activity and athletic involvement are widely recognized, limited empirical research has specifically examined how regular sports participation impacts body composition among female college students in contrast to their non-athlete peers.

Understanding these differences is vital for several reasons. First, body composition is not only a key indicator of physical fitness but also a predictor of long-term health outcomes, including the risk of metabolic syndrome, cardiovascular disease, and musculoskeletal disorders (Heymsfield et al., 2015).

Female athletes may develop healthier body composition profiles through sustained training, but without direct comparison to non-athletes, the extent of these physiological advantages remains unclear.

Second, college years represent a transitional phase marked by increased autonomy, lifestyle experimentation, and heightened academic stress—all of which influence physical health behaviours (Nelson et al., 2007; Keating et al., 2005). This period often sees a decline in physical activity, particularly among women, making it crucial to identify protective factors such as sports participation that may counteract this trend.

Third, by focusing on female populations—who are underrepresented in sports science literature—this study addresses an important gender gap in body composition research. Women face unique physiological and societal challenges regarding body image, weight management, and sports participation, and targeted research can support the development of gender-sensitive health interventions (Sundgot-Borgen & Garthe, 2011).

Finally, insights gained from this study can aid universities, health professionals, and policy makers in designing and promoting physical activity programs, nutritional education, and wellness initiatives tailored to the needs of female students, whether or not they are engaged in athletics. Establishing a scientific basis for these interventions supports the broader goal of fostering a healthier campus environment.

OBJECTIVES OF THE STUDY

1. To assess and compare the body composition parameters—including body mass index (BMI), subcutaneous fat percentage, skeletal muscle percentage, body age, resting metabolism—between female college athletes and non-athlete female students.
2. To identify significant differences in body composition trends that may be attributed to variations in physical activity levels, training intensity, and lifestyle behaviours.
3. To contribute to the limited literature on gender-specific body composition analysis in young adult populations, particularly within the context of higher education institutions.

METHODOLOGY

1. Research Design

This study adopts a comparative cross-sectional research design to analyse differences in body composition between two groups: female college athletes and non-athlete female students.

2. Participants

Sample Size: Approximately 50 female college students were recruited, divided equally into two groups:

- Group A: Female athletes (actively participating in collegiate-level or competitive sports for at least 6 months)
- Group B: Non-athlete female students (not involved in any structured sports or regular physical training)

Inclusion Criteria:

- Female students aged 18–25 years
- Enrolled in undergraduate or postgraduate programs
- Willing to provide informed consent

Exclusion Criteria:

- Individuals with known metabolic, cardiovascular, or endocrine disorders

- Pregnant women or those with recent injuries affecting body composition

1. Data Collection Tools and Measurements

Data collection involved the evaluation of various anthropometric and body composition parameters. Height and weight measurements were recorded, and body mass index (BMI) was calculated. The Omron Body Composition Monitor HBF-702T was used to analyse body composition analysis. The parameters assessed included:

1. Body Fat Percentage: Classified into four levels (Low, Normal, High, Very High) based on gender-specific cutoffs (Lohman et al., 1988; Nagamine, 1972).
2. Visceral Fat Level: Categorized as Normal, High, or Very High (OMRON Healthcare figures).
3. Resting Metabolic Rate (RMR): Evaluated according to age and gender-based reference values (Sasaki, 2017).
4. Total Skeletal Muscle Percentage: Interpreted based on standard classification criteria.
5. Segmental Body Composition: Including skeletal muscle percentage and subcutaneous fat percentage for arms, trunk, and legs.
6. Body Age: Estimated based on body composition parameters.

4. Data Analysis

Statistical analysis was performed using software such as SPSS.

Descriptive Statistics: Mean, standard deviation, and range for each variable

Inferential Statistics: Independent Samples t-test: To compare mean values of BMI, FM, FFM, and body fat % between female athletes and non-athletes

5. Ethical Considerations

Informed consent will be obtained from all participants

Participant data was kept confidential and used strictly for academic purposes

RESULTS AND DISCUSSION

In the present study, various parameters including body fat, body mass index, body age, resting metabolism, skeletal muscle percentage and subcutaneous fat percentage were compared between female athletic and non-athletic population. The results are as follows:

1. COMPARISON OF BODY FAT

		MEAN	STANDARD DEVIATION	T VALUE	P VALUE
OVERALL BODY FAT	ATHLETES	28.67	5.32	-0.793	0.432
	NON-ATHLETES	27.42	5.57		
VISCERAL FAT	ATHLETES	3.36	2.42	-1.01	0.320
	NON-ATHLETES	4.33	3.29		

When the overall body fat percentages were compared, we found no significance difference between the two groups ($p > 0.05$). The small difference in means was likely due to random variation rather than a meaningful effect. Also, there was no statistically significant difference in visceral fat between athletes and non-athletes ($p > 0.05$).

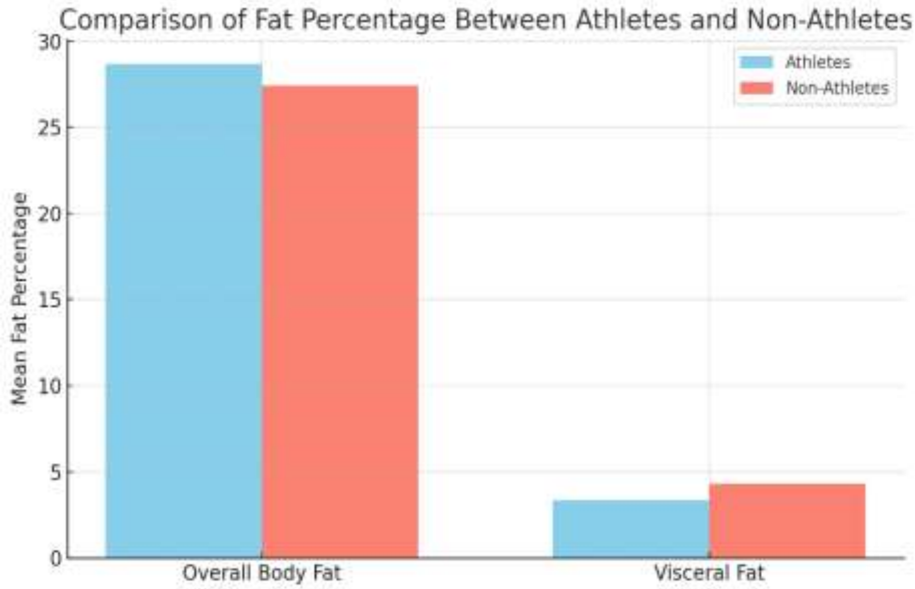

Figure.1 The bar chart comparing the mean fat percentage (overall body fat and visceral fat) between athletes and non-athletes. It visually illustrates that: Athletes have slightly higher overall body fat; non-athletes have higher visceral fat. However, statistical tests showed that these differences were not significant.

2. COMPARISON OF BMI

PARAMETER		MEAN	STANDARD DEVIATION	T VALUE	P VALUE
BMI	**ATHLETES**	21.19	2.32	-4.88	0.0001*
	NON-ATHLETES	24.84	3.65		
BODY AGE	**ATHLETES**	24.91	7.05	-3.68	0.0009*
	NON-ATHLETES	33.36	9.72		
RESTING METABOLISM (kcal)	**ATHLETES**	1200.50	134.22	-0.496	0.622
	NON-ATHLETES	1221.17	153.78		

Athletes have significantly lower BMI compared to non-athletes. The p-value was significantly below 0.05, indicating a statistically significant difference in BMI between athletes and non-athletes. When the body age was compared, the p-value (0.0009) was significantly less than 0.05, indicating a statistically significant difference in body age between athletes and non-athletes. On average, athletes have a significantly younger body age compared to non-athletes.

On a contrary, there was no statistically significant difference in resting metabolism between athletes and non-athletes ($p > 0.05$). The RMR of athletes was slightly lower on average than non-athletes, but not significantly different ($p = 0.622$). This might be due to: Similar body compositions between groups, small sample size or variation within groups, inclusion of female participants (who generally have lower RMR).

3. **COMPARISON OF SKELETAL MUSCLE (TOTAL, ARMS, TRUNK AND LEGS) PERCENTAGE**

PARAMETER		MEAN	STANDARD DEVIATION	T VALUE	P VALUE
TOTAL	ATHLETES	26.89	2.20	0.898	0.374
	NON-ATHLETES	26.35	1.94		
ARMS	ATHLETES	29.92	4.31	0.792	0.432
	NON-ATHLETES	28.93	4.37		
TRUNK	ATHLETES	23.58	2.85	2.76	0.0083*
	NON-ATHLETES	21.49	2.62		
LEGS	ATHLETES	38.83	1.81	0.83	0.408
	NON-ATHLETES	38.40	1.81		

The skeletal muscle percentage were compared among athletes and non-athletes, the difference in skeletal muscle percentage between Athletes and Non-Athletes was not statistically significant ($p > 0.05$). Also, there was no statistically significant difference in skeletal muscle percentage of the arms between athletes and non-athletes ($p > 0.05$). On contrary, we found a statistical difference between the trunk skeletal muscle percentage between the two groups. Since the p-value was less than 0.05, we reject the null hypothesis. Despite athletes having a slightly higher mean, the difference is not statistically significant ($p > 0.05$). The leg muscle percentages were very similar between groups in this sample.

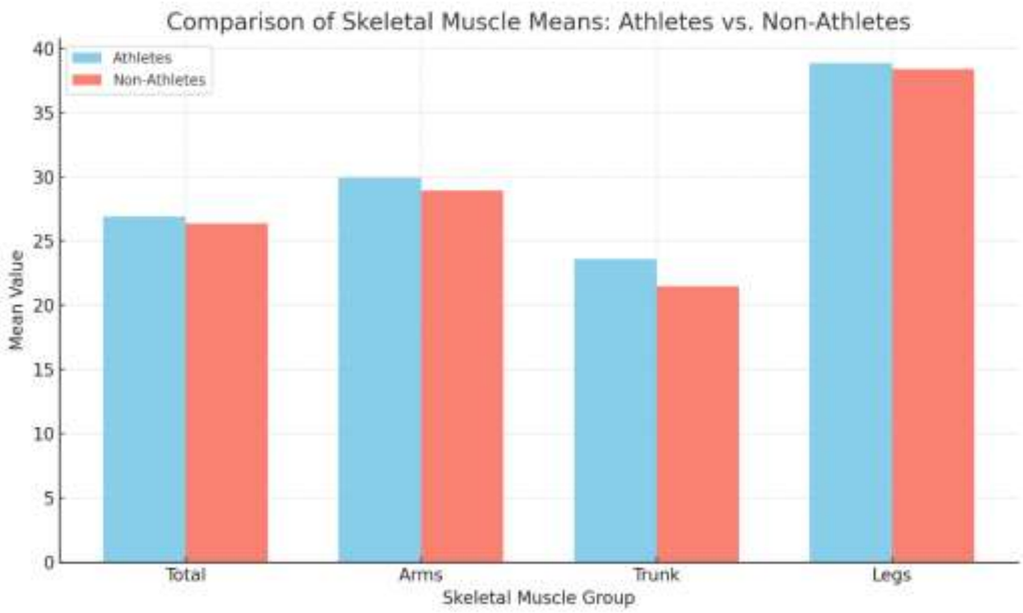

Figure.2 The bar chart comparing the mean skeletal muscle values between athletes and non-athletes across four muscle groups: Total, Arms, Trunk, and Legs. The most notable difference appeared in the Trunk region, where athletes have significantly higher mean values than non-athletes—corroborated by

the statistically significant p-value (0.0083) shown in table. Other regions show no statistically significant difference.

4. COMPARISON OF SUBCUTANEOUS FAT (TOTAL, ARMS, TRUNK AND LEGS) PERCENTAGE

PARAMETER		MEAN	STANDARD DEVIATION	T VALUE	P VALUE
TOTAL	ATHLETES	24.14	5.33	-0.81	0.424
	NON-ATHLETES	25.37	5.38		
ARMS	ATHLETES	40.35	6.31	0.02	0.983
	NON-ATHLETES	40.31	6.77		
TRUNK	ATHLETES	20.79	5.30	-0.53	0.598
	NON-ATHLETES	21.57	5.57		
LEGS	ATHLETES	36.36	6.42	-1.14	0.262
	NON-ATHLETES	38.65	8.26		

The p-value was found to be greater than 0.05, indicating no statistically significant difference in subcutaneous fat percentage between athletes and non-athletes. Although athletes appear to have slightly lower fat percentage on average, the difference was not enough to be considered significant with this data. The mean subcutaneous fat in arms was nearly identical between athletes and non-athletes. The p-value was 0.983, which was much greater than 0.05, indicating no statistically significant difference between the two groups. Despite being different populations, their arm fat percentages were practically the same statistically. Likewise, the average trunk subcutaneous fat was slightly lower for athletes, but not significant. P-value = 0.598 indicates no statistically significant difference between athletes and non-athletes. In addition, non-athletes have a slightly higher mean leg fat percentage, but the difference was not statistically significant. A p-value of 0.262 indicated we fail to reject the null hypothesis — the variation observed could be due to chance. Though we found difference between the mean among all the subcutaneous fat parameters, we could not prove it statistically.

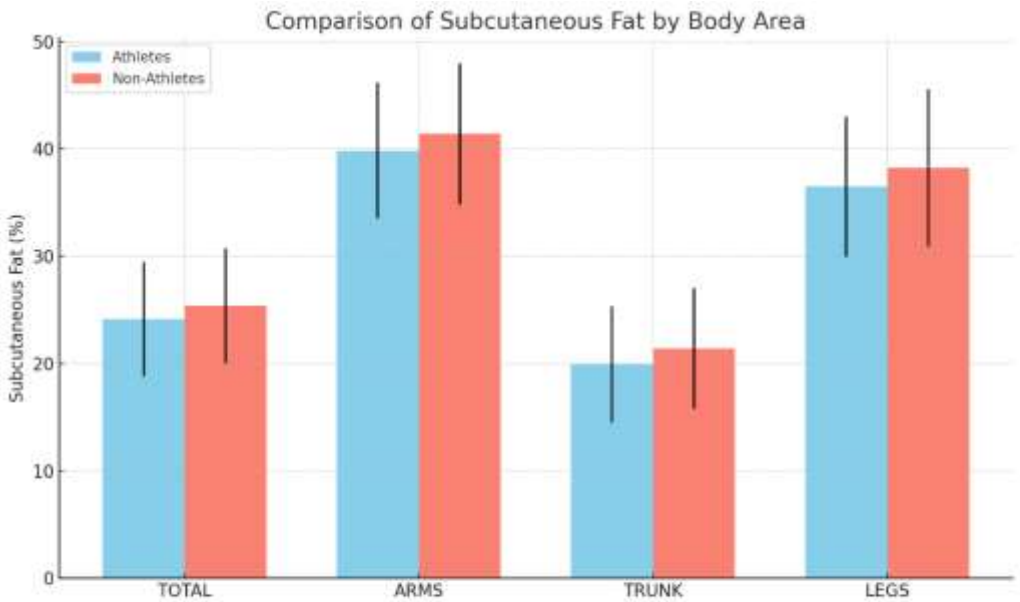

Figure.3 The bar chart comparing subcutaneous fat percentages across four body areas (TOTAL, ARMS, TRUNK, LEGS) between athletes and non-athletes. The bars showed the mean fat percentage, and the error bars represent the standard deviation for each group and area.

CONCLUSION

In the present study, the comparative analysis between female athletes and non-athletes reveals notable distinctions in specific physiological parameters that are closely linked to the impact of sustained physical training. A statistically significant difference was observed in Body Mass Index (BMI), Body Age, and Trunk Skeletal Muscle Percentage. These differences are consistent with prior findings that suggest regular athletic activity contributes to lower body fat, enhanced muscle mass, and a more favourable metabolic age profile in trained individuals (Aerenhouts & D'Hondt, 2020). Specifically, trunk skeletal muscle tends to respond significantly to core-strengthening and resistance exercises, which are common components of athletic training programs, leading to a marked development in this region (Kim et al., 2016).

Conversely, no statistically significant differences were found in overall subcutaneous fat percentage, resting metabolism, arm skeletal muscle percentage, and leg skeletal muscle percentage. These findings suggest that while athletes may demonstrate superior central muscle development, peripheral muscle and fat distribution, as well as basal metabolic rate, may not vary substantially from non-athletes in certain populations. Resting metabolic rate, for instance, is influenced not only by activity level but also by factors such as age, hormonal profile, and genetic predisposition (Speakman & Selman, 2003). Similarly, limb muscle mass and subcutaneous fat may be maintained through general daily movement and do not always reflect training specificity unless targeted explicitly.

Overall, the results reinforce the importance of consistent training in influencing central body composition and metabolic efficiency, while also highlighting areas where genetic or lifestyle factors may mitigate differences between athletic and non-athletic females. This nuanced outcome emphasizes that while training significantly alters some body metrics, its influence may not be uniformly distributed across all physiological systems.

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