RESEARCH ARTICLE

INTERNATIONAL JOURNAL OF KINANTHROPOMETRY

DOI: 10.34256/ijk2328

Demographic Insights Into College-Going Students in India: A Morphological Analysis

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DOI: https://doi.org/10.34256/ijk2328

Received: 21-08-2023; Revised: 04-12-2023; Accepted: 17-12-2023; Published: 30-12-2023

Resumen

Introducción: En el contexto de la cultura diversa de la India y el cambiante sistema educativo, es crucial comprender las características morfológicas de los estudiantes universitarios, especialmente ahora que el gobierno apoya activamente los deportes a través de iniciativas como el programa "Khelo India" para ayudar a los atletas jóvenes. El propósito del estudio fue investigar las características morfológicas de los atletas y no atletas de nivel universitario en la India. **Métodos:** Se seleccionaron aleatoriamente 287 estudiantes universitarios para adquirir un conjunto completo de datos demográficos y antropométricos. **Resultados:** El estudio reveló diferencias significativas en el índice de masa corporal (p=0,004), endomorfia (p=0,001), ectomorfia (p=0,02) y porcentaje de grasa corporal (p=0,001). Sin embargo, no se identificaron diferencias significativas en la mesomorfia (p=0,09) y sólo se observaron diferencias mínimas en la masa magra (p=0,57). Los atletas de nivel universitario exhiben un físico ectomórfico-mesomórfico (2,9-3,9-3,0), caracterizado por una combinación distintiva de musculatura y delgadez. Los no deportistas son endomorfos mesomórficos (5,0-4,3-2,4) y exhiben mayor contenido de grasa corporal y musculatura. Los deportistas presentaban un porcentaje de grasa corporal significativamente menor, destacando la influencia positiva del entrenamiento deportivo y el ejercicio físico regular en la reducción de la adiposidad. El análisis de las clasificaciones percentiles proporciona información integral sobre la distribución de métricas antropométricas entre atletas y no atletas, lo que ayuda a personalizar los regímenes de entrenamiento, identificar áreas de posible mejora y mejorar una evaluación integral de las características físicas de los individuos. **Conclusión:** El estudio arroja luz sobre el papel crucial de los rasgos morfológicos a la hora de discernir las diferencias entre los atletas de nivel universitario y los no atletas dentro del contexto más amplio del "Movimiento Fit India". El estudio ayudará a diseñar un módulo de formación eficaz para mejorar la salud general de los estudiantes universitarios.

Palabras Clave: Antropometría, Somatotipo, Composición corporal, Morfología, Masa corporal magra.

Abstract

Introduction: In the context of India's diverse culture and changing education system, it is crucial to understand the morphological characteristics of college students, especially with the government actively supporting sports through initiatives like the "Khelo India" program to aid young athletes. The purpose of the study was to investigate the morphological characteristics of college-level athletes and non-athletes in India. **Methods:** 287 college students have been randomly selected to acquire a comprehensive set of demographic and anthropometric data. **Results:** The study revealed significant differences in body mass index (p=0.004), endomorphy (p=0.001), ectomorphy (p=0.02), and body fat percentage (p=0.001). However, no significant difference in mesomorphy (p=0.09) was identified, and only minimal differences in fat-free mass (p=0.57) were observed. College-level athletes exhibit an ectomorphic-mesomorphic physique (2.9-3.9-3.0), characterized by a distinct blend of muscularity and leanness. Non-athletes are mesomorphic-endomorphs (5.0-4.3-2.4), exhibiting higher body fat content and muscularity. Athletes had a significantly lower body fat percentage, highlighting the positive influence of sports training and regular physical exercise on reducing adiposity. The analysis of percentile rankings provides comprehensive insights into the

distribution of anthropometric metrics among athletes and non-athletes, assisting in customizing training regimens, identifying areas for potential improvement, and enhancing a comprehensive assessment of individuals' physical characteristics. **Conclusion:** The study sheds light on the crucial role of morphological traits in discerning differences between college-level athletes and non-athletes within the broader context of the "Fit India Movement." The study will help design an effective training module to improve the overall health of college students.

Keywords: Anthropometry, Somatotype, Body composition, Morphology, Lean Body Mass

Introduction

In light of India's distinctive cultural diversity and the swiftly evolving educational scenario, it is crucial to gain insights into the nuanced demographic features of college-going students. Recently Indian government has proactively promoted a robust national sports culture through key initiatives. The "Khelo India" program stands out for identifying and nurturing grassroots sporting talents, emphasizing infrastructure, talent identification, and athlete support. Concurrently, the "Fit India Movement" encourages a healthy lifestyle, with financial assistance programs, including stipends and scholarships, addressing athletes' financial challenges. The "Target Olympic Podium Scheme (TOPS)" provides elite athletes with top-tier training, international exposure, and specialized coaching, emphasizing the government's commitment to fostering a vibrant sports culture, nurturing talent, and positioning India as a formidable presence in global sports. In accordance with recent trends, this study aims to investigate the anthropometric characteristics of college-going students, focusing on their sporting preferences. Those students who engage regularly in specific sports at the college level will be categorized as athletes, while others who do not partake in such activities will be classified as non-athletes. This study is dedicated to a thorough exploration, delving into the morphological intricacies that intricately shape the educational trajectories of students across the expansive landscape of India.

The exploration of morphological characteristics is crucial in understanding the complex relationships between physical health and athletic performance (Hermassi et. al., 2021). This study focuses on the specific context of college-level athletes and non-athletes in India, where the pursuit of academic excellence often goes hand in hand with a burgeoning interest in sports and physical activities. Athletes, regardless of their age or level of expertise, engage in regular physical training and participate in both national and international competitions. Due to their demanding physical pursuits, athletes exhibit a higher propensity for certain characteristics compared to the general population or non-athletes (Campa et. al., 2021). To determine an athlete's ideal physical structure and tailor it to their individual sports, understanding their body composition is essential (Biswas and Biswas, 2021). Conversely, non-athletes are individuals who do not regularly participate in organized sports or competitive physical activities. Understanding the anthropometric profile, somatotype, and body composition of non-athletes holds significance for various reasons. Investigating morphological characteristics of non-athletes helps to understand the impact of sedentary behaviors on body structure and composition (Júdice et. al., 2022). Given the prevalence of sedentary lifestyles due to modern technology and urbanization, comprehending the physical traits of non-athletes contributes to addressing public health issues linked to inactivity and obesity (Hermassi et. al., 2021). This knowledge aids in evaluating one's state of health, a pivotal measure for both athletes and non-athletes (Ortansa & Ileana 2006).

Morphological characteristics encompass a range of observable traits, including body composition, somatotype, and anthropometry, which contribute significantly to an individual's overall physical makeup (Shakhanova et. al., 2016). Athletes, by nature, have long been recognized for their distinct physical attributes that align with the requirements of their chosen sports. Non-athletes, on the other hand, exhibit a diverse range of morphological features shaped by varying lifestyles and activities.

India, with its rich cultural diversity and a burgeoning interest in sports, offers a fertile ground for investigating the morphological characteristics of college-level individuals. The interaction between morphological characteristics, academic commitments, physical activities, and the cultural backdrop shapes a distinctive landscape in which athletes and non-athletes alike navigate their physical development (Shakhanova et. al., 2016). So, by examining the morphological variations one can gain valuable insights into the potential impact of various lifestyles on physical health and performance.

This study aims to explore the morphological characteristics of college-level athletes and non-athletes in India. Ultimately, this investigation seeks to enhance the understanding of how morphological attributes influence the lives of college students, shaping their journey towards holistic well-being. From this point of view, the research not only holds significance within the sports community but also has broader implications for public health and wellness. Understanding the physical distinctions between athletes and non-athletes promotes active lifestyles and encourages individuals to regularly engage in physical activity to enhance their overall health and well-being.

Materials and Methods

The participants

A total of 287 male participants from various parts of India were randomly selected from different departments at the National Institute of Medical Science (NIMS), Rajasthan. Participants completed a brief questionnaire covering personal information and training history before measurements, and provided written consent after being informed about the study's purpose, procedures. The study excluded three individuals due to missing data. Participants under the age of 18 had parental consent obtained. Data were collected in simulated environmental circumstances during morning (9:30 a.m. to 12:30 p.m.) and afternoon (5:00 p.m. to 7:30 p.m.) sessions. The ethical council of the National Institute of Medical Science (NIMS), Rajasthan, granted approval for the study (Ref. No.: NIMSUR/IEC/2023/699 of 01.09.2023), adhering to the principles outlined in the Helsinki Declaration.

Procedure of data collection

A certified anthropometrist, recognized by the International Society for the Advancement of Kinanthropometry (ISAK), following ISAK guidelines, measured all the body measurements listed in Table 1, (Carter, 2002). The Technical Errors of Measurement (TEM) Scores were within 5% for skinfolds and 1% for other variables.

Table 1. Measuring parameters of college level athletes and non-athletes

Variables	Parameters	Test/procedure	Equipment
Personal	Age (years)	Age proof certificate	-
Demographic	Height (cm)	Standing Height	Anthropometric rod (Hopkins Road Rod Portable Stadiometer)
	Body Mass (kg)	Body mass wearing minimum cloths	Digital Weighing Scale (Dual frequency body composition monitor, RD-545-SV Smart Bluetooth, Wireless)
Anthropometric	Biceps skin fold (mm)	According to ISAK manual	Harpenden Skinfold Caliper
	Triceps skin fold (mm)		
	Subscapular skin fold (mm)		
	Supraspinal skin fold (mm)		
	Bi-epicondyle humerus (cm)		Sliding Caliper
	Bi-epicondile femur (cm)		
	Arm girth (cm)		Anthropometric tape (CESCORF)
	Calf girth (cm)		

Statistical analysis

The Anderson-Darling test was used to examine the distribution pattern of the data. Parametric analysis was chosen due to the predominant normal distribution observed in the dataset. Descriptive statistics were employed to characterize the data, while inferential statistics were utilized for comparing and correlating the dataset. A significance level of $p \leq 0.05$ was considered in this study. Statistical analysis and graphical representation were carried out using the Gnumeric spreadsheet (Ver: 1.12.48), Microsoft Excel, and SPSS software (Ver: 20).

Results

Table 2 presents a comparison of various anthropometric parameters between college athletes and non-athletes. The p-values signify the statistical importance of the detected distinctions between these two groups.

Table 2. Basic and anthropometric characteristics of college level athletes and non-athletes

Parameters	**Athletes**(n=134)	**Non-athletes**(n=153)	**p-value**
Age (year)	20.6±1.8 (20.2-21.1)	22.6±2.2 (22.0-23.1)	1.03 e-06
Height (cm)	169.0±5.8 (167.4-170.6)	169.1±7.1 (167.3-170.9)	0.94
Body mass (kg)	61.0±8.2 (58.7-63.2)	65.1±10.8 (62.4-67.8)	0.02
BMI (kg/m^2)	21.3±2.1 (20.7-21.9)	22.7±3.2 (21.9-23.6)	0.004
Biceps skinfold (mm)	5.2±2.1 (4.6-5.8)	7.9±4.2 (6.8-8.9)	2.18 e-05
Triceps skinfolds (mm)	8.5±3.3 (7.6-9.4)	13.4±5.0 (12.2-14.7)	6.59 e-09
Subscapular skinfolds (mm)	10.8±3.4 (9.9-11.7)	15.5±4.7 (14.3-16.7)	8.92 e-09
Supraspinal skinfolds (mm)	9.8±4.0 (8.7-10.9)	22.3±10.1 (19.7-24.8)	4.85 e-14
Medial calf skinfolds (mm)	9.7±4.1 (8.6-10.9)	11.6±4.5 (10.5-12.7)	0.02
Bi-epicondyle humerus (cm)	6.7±0.7 (6.5-6.9)	7.0±0.5 (6.9-7.1)	0.01
Bi-epicondyle femur (cm)	9.3±0.5 (9.1-9.4)	9.4±1.3 (9.1-9.7)	0.56
Arm girth flex (cm)	28.7±2.9 (27.9-29.5)	30.6±3.6 (29.6-31.5)	0.002
Max. calf girth (cm)	34.1±3.4 (33.2-35.0)	32.9±3.1 (32.1-33.7)	0.05

Table 3 illustrates the morphological characteristics of students attending college. The examination specifically focuses on key parameters from the Somatochart, including Endomorphy (body roundness), Mesomorphy (muscularity), Ectomorphy (slenderness), as well as the percentage of body fat and fat-free mass. The results underscore notable differences between athletes and non-athletes in terms of Endomorphy, Ectomorphy, Body fat percentage, and a slight difference in Mesomorphy ($p < 0.05$). However, there is no substantial distinction in Fat-free mass between the two groups. As a result of the physical demands associated with sports participation, these results indicate that athletes frequently exhibit lower body fat percentages and distinct morphological profiles in comparison to non-athletes.

Table 3. Morphological characteristics of college level athletes and non-athletes

Parameters	Athletes (n=134)	Non-athletes (n=153)	p-value
Endomorphy	2.9±1.0 (2.7-3.2)	5.0±1.5 (4.6-5.4)	5.32 e-14
Mesomorphy	3.9±0.9 (3.7-4.2)	4.3±1.6 (3.9-4.7)	0.09
Ectomorphy	3.0±1.0 (2.7-3.3)	2.4±1.4 (2.1-2.8)	0.02
Body fat (%)	13.9±3.7 (12.9-14.9)	20.1±4.7 (18.9-21.3)	1.16 e-12
Fat free mass (kg)	52.3±6.1 (50.7-54.0)	51.7±6.8 (50.0-53.4)	0.57

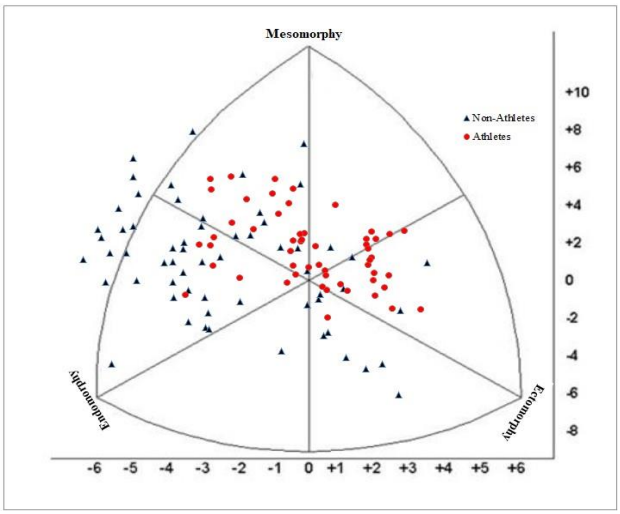

Figure 1. Somato-chart of college level athletes and non-athletes

A visual depiction of the students is presented in the Somatochart (Figure 1). According to somatochart, college-level athletes are Ectomorphic mesomorphs (2.9-3.9-3.0), whereas non-athletes are Mesomorphic endomorphs (5.0-4.3-2.4).

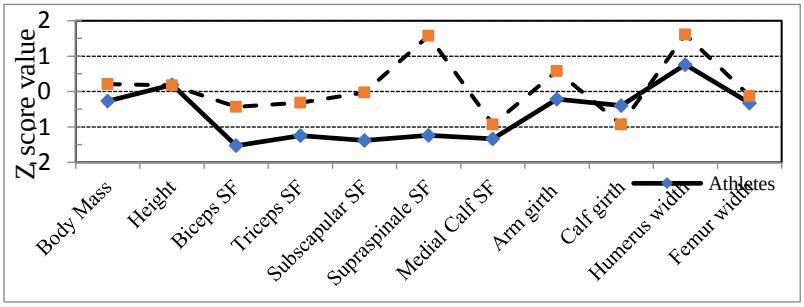

Figure 2. Segmental comparison with reference man (Phantom)

Figure 2 presents a comparative analysis utilizing Phantom Z Scores, depicting distinctions in physiological traits between the two groups. Negative Z scores in athletes indicate values below the mean, while positive Z scores for non-athletes signify values exceeding the mean. The metrics include body mass, height, skinfold thickness at specific sites (triceps, subscapular, biceps, supraspinale, and medial calf), flexed arm and calf girth, as well as humerus and femur widths. The aforementioned figure offers a succinct overview of the variations in these physical attributes between college-level athletes and their non-athlete counterparts.

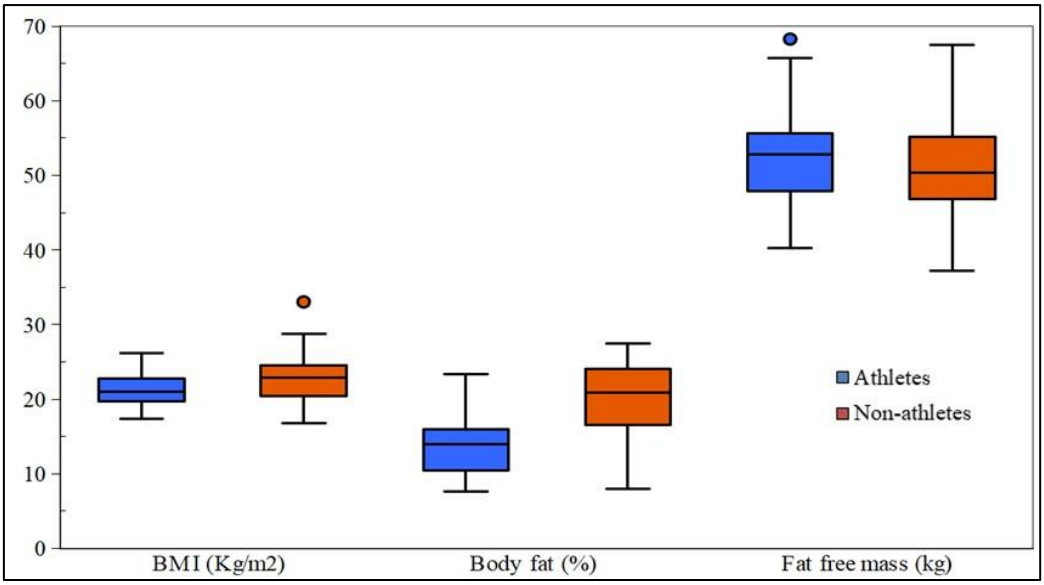

Figure 3. Box plot of BMI, % of body fat and fat free mass of college level athletes and non-athletes

Figure 3 illustrates the significance of body composition metrics in distinguishing between college-level athletes and non-athletes. The table displays the average values of BMI, body fat percentage, and fat-free mass for both groups. In general, athletes exhibited a lower BMI (21.3 Kg/m^2) compared to non-athletes (22.7 Kg/m^2). Athletes displayed a body fat percentage of 13.9%, whereas non-athletes had a higher percentage at 20.1%. Athletes possessed a slightly greater fat-free mass at 52.3 kg when compared to non-athletes. These findings indicate that athletes tend to have a leaner physique compared to non-athletes.

Tables 4 and 5 display percentile rankings for diverse anthropometric measures among college-level players and non-athletes, offering an understanding of how these metrics are distributed within the population. These tables offer specific measurements linked to the 10th to 90th percentiles, offering a thorough depiction of the scope and diversity of anthropometric characteristics in both athlete and non-athlete groups.

Table 4. Percentile score of various anthropometric parameters of athletes

Parameters	**10th**	**20th**	**30th**	**40th**	**50th**	**60th**	**70th**	**80th**	**90th**
Age (Years)	20.0	21.0	21.0	22.0	22.0	23.0	24.0	25.0	26.0
Body Mass (kg)	52.3	56.8	58.8	60.8	63.0	67.7	70.0	74.0	79.0

Stature (cm)	160.0	162.0	165.3	167.0	170.0	171.0	173.0	174.0	178.0
Biceps (mm)	3.0	4.0	5.0	6.0	7.0	8.0	9.4	11.0	14.0
Triceps Sf. (mm)	8.0	8.0	10.6	12.0	13.0	15.0	16.0	17.0	20.0
Subscapular Sf. (mm)	10.0	12.0	12.0	14.0	15.0	16.0	18.0	20.0	22.4
Supraspinale Sf. (mm)	10.1	13.4	15.0	17.0	20.0	25.0	28.8	31.6	36.3
Medial Calf Sf. (mm)	5.0	8.0	10.0	10.0	11.0	12.0	14.5	15.5	16.9
Bi-epicondylar Humerus (cm)	6.4	6.6	6.8	7.0	7.0	7.0	7.0	7.2	7.8
Bi-epicondylar Femur (cm)	8.6	8.9	9.0	9.5	9.6	9.8	9.9	10.0	10.2
Arm Girth Flex(cm)	27.0	27.0	28.6	30.0	31.0	31.0	32.4	33.0	35.8
Calf Gth (max.) (cm)	30.0	30.0	31.0	32.0	33.0	33.2	34.4	36.0	37.0
Endomorphy	3.1	3.7	3.9	4.6	5.2	5.7	6.1	6.4	6.8
Mesomorphy	1.9	3.1	3.7	4.1	4.5	5.0	5.1	5.5	6.1
Ectomorphy	0.7	1.1	1.7	1.9	2.2	2.6	3.0	3.7	4.4
BMI (kg/m2)	18.5	20.0	21.1	22.1	22.9	23.4	24.2	25.3	26.6
Body fat (%)	14.6	15.7	17.6	19.4	20.9	22.4	23.6	24.4	25.4
Fat free mass (kg)	43.9	46.2	48.1	49.5	50.4	52.5	54.1	57.6	61.1

Table 5. Percentile score of various anthropometric parameters of Non-athletes

Parameters	**10th**	**20th**	**30th**	**40th**	**50th**	**60th**	**70th**	**80th**	**90th**
Age (Years)	19.0	19.0	20.0	20.0	20.0	21.0	22.0	22.0	23.0
Body Mass (kg)	51.3	53.5	55.3	58.4	60.3	62.6	64.0	66.8	68.1
Stature (cm)	162.0	164.3	166.2	167.4	169.0	170.4	172.0	173.0	177.3
Biceps (mm)	3.3	3.8	4.0	4.2	4.4	4.8	5.2	6.2	8.7
Triceps SF. (mm)	5.2	5.4	6.1	7.1	7.6	8.4	10.3	11.1	12.7
Subscapular SF. (mm)	7.1	8.1	9.0	9.4	10.2	11.0	11.3	12.4	15.3
Supraspinale SF. (mm)	5.8	6.3	6.9	7.7	8.8	9.9	11.3	13.2	15.7
Medial Calf SF. (mm)	5.8	6.5	7.0	8.1	9.0	10.0	11.0	12.8	14.8
Bi-epicondyle Humerus (cm)	6.2	6.3	6.4	6.6	6.6	6.7	6.7	6.8	7.2
Bi-epicondyle Femur (cm)	8.7	8.9	9.0	9.1	9.2	9.4	9.5	9.8	10.0
Arm Girth Flex (cm)	25.3	26.0	26.8	27.5	28.4	29.1	29.9	31.0	32.0
Calf Girth (max.) (cm)	31.2	32.0	32.2	33.1	33.6	34.2	34.9	36.0	37.6
Endomorphy	1.8	2.0	2.2	2.7	2.9	3.0	3.2	3.6	4.4
Mesomorphy	2.7	3.2	3.6	3.7	3.9	4.0	4.2	4.5	5.4
Ectomorphy	1.6	2.0	2.4	2.7	3.1	3.4	3.6	3.8	4.1
BMI (kg/m^2)	18.9	19.6	19.8	20.5	21.0	21.5	22.3	23.2	23.8
Body fat (%)	9.6	10.2	11.3	12.7	13.9	14.5	15.5	16.5	19.2
Fat free mass (kg)	44.7	47.4	48.1	49.7	52.8	54.1	54.8	57.0	59.0

Discussion

The examination of physical characteristics in individuals, particularly comparing those involved in sports with those who are not at the college level, has garnered significant attention in Physical education and sports. This becomes particularly relevant within the Indian context, given the deep cultural roots of sports like cricket, field hockey, and kabaddi. Investigating the differences in physical attributes among college-level athletes and non-athletes becomes a pertinent endeavor, considering the diversified culture and evolving education system in India (Hermassi et. al., 2021). Government initiatives like "Khelo India" and the "Fit India Movement" further emphasize the importance of promoting sports and healthy lifestyle habits. The results of this study align with prior research suggesting that participation in athletic training and physical activities can bring about alterations in body composition. The reduced body mass, BMI, and skinfold measurements observed among athletes may be attributed to their consistent engagement in training and physical exercises. The observed younger age among athletes might mirror the typical age range of college-level individuals involved in competitive sports. The height estimates based on age for both college-level athletes and non-athletes closely resemble the recommendations outlined in the growth chart standards of the Indian Academy of Pediatrics (IAP) (Khadilkar et. al., 2015). However, the absence of a significant distinction in height between athletes and non-athletes could potentially be explained by the influence of genetic factors, early childhood nutrition, and socio-economic well-being. This discussion illuminates recent research findings on this subject and provides insights into the potential impact of athletic training on an individual's physical

characteristics. Numerous investigations have scrutinized the physical attributes of college-level athletes and non-athletes in India and overseas (Gudimov et. al., 2021). For instance, a study by Shyamal Koley (2011) focused on university cricket players aged 18-25 years. The study's outcomes revealed that cricket players displayed notably lower body fat percentages and higher proportions of lean body mass compared to their non-athlete counterparts, supporting the idea that consistent involvement in sports is associated with a leaner body composition (Koley, 2011). Similarly, a previous study by Toriola et al. (1985) found that field hockey players exhibited superior levels of cardiovascular fitness, muscle strength, and overall muscular development compared to non-athletes, suggesting that sports demanding dynamic movements and aerobic conditioning, such as field hockey, potentially contribute to elevated muscle development and cardiovascular well-being (Toriola et. al. 1985). The findings of this study suggest that college-level athletes exhibit distinct morphological characteristics compared to individuals who do not participate in sports. The lower values of endomorphy identified in athletes indicate a leaner body composition, aligning with the physical demands of numerous sports that require lower body fat levels for optimal performance. The higher mesomorphy values observed in athletes correspond with the concept that those with mesomorphic traits generally possess greater muscle development, potentially contributing to their athletic ability.

The observed differences in ectomorphy values may be linked to the particular sports and training programmes pursued by athletes, which could potentially facilitate the growth of lean body mass. The significant drop in body fat percentage observed in athletes provides further evidence that participating in sports training and regular physical exercise leads to a reduction in adiposity. The study's findings indicate that there is no notable disparity in fat-free mass between athletes and non-athletes. This suggests that both groups have comparable quantities of lean body mass, regardless of any variations in their levels of physical activity. Several factors, like as food choices, genetic inclination, and the intricacy of their exercise programmes, may affect this similarity.

The findings of this study align with previous research that emphasises the association between participation in sports and significant physiological changes (Maffulli et. al., 2010). College-level athletes demonstrated significantly lower average body mass values, which is supported by the negative Phantom Z Scores associated with this measurement. This discovery suggests that athletes are more likely to exhibit a leaner body composition in comparison to their non-sporting counterparts. In addition, the negative Z scores for skinfold thickness measures among the group of athletes suggest that these individuals had reduced amounts of subcutaneous fat in key areas of their body, including the triceps, subscapular, biceps, supraspinale, and medial calf. This observation supports the widely held belief that regular physical activity leads to a decrease in overall body fat percentage, while also promoting increased muscle development (Maffulli et. al., 2010). In terms of girth measurements, the negative Z scores observed in athletes' flexed arm and calf girths indicate that their dimensions are below the average. This implies that athletes have a natural inclination to develop a more condensed yet clearly defined muscular structure in these specific regions.

The identified distinctions in morphological characteristics between college-level athletes and non-athletes align with established connections between endomorphy, mesomorphy, and ectomorphy and various physical traits. Athletes exhibit relatively lower endomorphy scores, indicating lower body fat and improved muscle definition due to regular engagement in physical activities. Those with higher mesomorphy scores display increased muscle development and more favorable body composition, reflective of physiological changes from sports participation. Athletes with somewhat elevated ectomorphy scores show a tendency toward slimness while maintaining well-proportioned muscularity, implying potential adjustments in their specialized training regimens. College-level athletes are categorized as ectomorphic mesomorphs (2.9-3.9-3.0), highlighting the amalgamation of slimness and muscularity. This classification resonates with the physique commonly observed in male athletes at the Bangladeshi national level (Anup et al., 2014). Conversely, non-athletes are classified as mesomorphic endomorphs (5.0-4.3-2.4), indicating significantly higher body fat and muscle content, with a lesser emphasis on leanness than athletes. A study by Chakrabarti et al. (2020) on somatotype traits of college students also aligns with our findings. According to their results, urban college students are essentially mesomorphic-endomorphs, a similarity observed in non-athletes among college students (Chakrabarti et al., 2020). The study included the evaluation of humeral and femoral breadths, serving as indicators of bone structure. Negative Z scores for athletes' humeral and femoral widths suggest limitations compared to non-athletes, attributed to sports-specific effects on bone mineral density and structural configuration.

Analyzing percentile rankings of anthropometric measurements among college-level athletes and non-athletes provides valuable insights into the distribution of these parameters. Percentile ranks comprehensively represent the range and diversity of anthropometric features, serving as crucial benchmarks for future inquiries. This understanding not only advances sports science and physiology but also aids in tailoring training regimens, identifying areas for potential improvement, and enhancing a comprehensive evaluation of individuals' physical attributes.

It is important to acknowledge that the study offers important insights into the physical disparities between college-level players and non-athletes in India, without taking into account the specific training load associated with each sport. The consensus is that different sports necessitate distinct physical characteristics, leading to variations when athletes from diverse disciplines are compared. Additionally, factors like genetic predisposition, dietary choices, and exercise intensity may contribute to the observed differences in physical characteristics.

Conclusion

This study highlights the relevance of morphological traits in differentiating college-level athletes and non-athletes, aligning with the goals of the "Fit India Movement." It confirms that rigorous training transforms athletes' body composition and establishes that athletes generally exhibit leaner and fitter physiques. These findings support national initiatives promoting an active lifestyle. The observed variations in body composition, reflected in endomorphy, mesomorphy, and ectomorphy, contribute to established connections between these traits and distinct physical characteristics. The study highlights sports-specific impacts on bone density, as evidenced by constrained humeral and femoral widths in athletes. The analysis of percentile rankings enhances our understanding of physiological differences between athletes and non-athletes, propelling advancements in sports science and tailored training protocols.

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Acknowledgement

The authors extend heartfelt gratitude to all NIMS students who voluntarily participated in this study. We would like to express our appreciation to the faculties of Humanities and Liberal Arts for their valuable support. Special thanks are due to the Chairman Sir and Vice-Chancellor of NIMS Rajasthan, Jaipur, for their continuous inspiration throughout this endeavor.

Funding

No funding was received for conducting this study.

Conflicts of Interest

The Authors declare no conflict of interest for this study