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Comparative Analysis of Athletes: An Anthropometric Profiles in Different Sports

Sanjay Kumar Prajapati [1,*], Lamlun Buhril [1], Tanushree Yadav [2], Shafeeq S.N [3], Aswathy P.K [3]

[1] SAI LNCPE, Thiruvananthapuram, Kerala-695581, India
[2] Amity University, Utter Pradesh-221002, India
[3] SAI LNCPE, University of Kerala, Thiruvananthapuram, Kerala-695581, India
* Corresponding author email: sanjay.hockey88@gmail.com
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Abstract

Introduction: An athlete's capacity to succeed in their chosen sport is greatly influenced by their anthropometric traits, which are essential to sports performance. This cross-sectional study investigates how the anthropometric characteristics of athletes who play football, cycling, and athletics compare. This study looks into the distinct physical aspects of football, cycling, and sports to identify patterns and linkages that provide light on the relationship between specific body measures and athletic aptitude. **Method:** The present study used precise anthropometric measurements, such as height, weight, BMI, waist circumference, hip circumference, WHR, arm span, and various skinfold measurements (biceps, triceps, supraspinal, and subscapular), along with 60 male participants, ages 18 to 25 yr , who were selected from the athletics, football, and cycling demographics. **Results:** The football, cycling, and athletics athletes were compared morphologically using ANOVA tests and post hoc comparisons. The findings showed notable variations in the athletes' triceps skinfold, supraspinal skinfold, sitting height, fat mass, fat-free mass, and fat percentage. Compared to their counterparts in football and athletics, cyclists showed notably larger biceps skinfold, supraspinal skinfold, and fat percentages. This is probably because cycling is an endurance sport. Conversely, the athletes' group had higher sitting heights and football players had more body fat. Athletes also have greater fat-free mass than their counterparts in cycling and football. **Conclusions:** Findings of the present study demonstrate how an athlete's performance is influenced by anthropometric characteristics that are specific to a given sport. These variations may impact training regimens, methods for identifying talent, and customized treatments depending on the physical attributes of athletes in football, cycling, and athletics. Sports science will benefit from this study's filling in gaps in the literature and laying the groundwork for future research on enhancing athletic performance.

Keywords: Body fat percentage, Fat mass, Height, Weight, Athletes

Resumen

Introducción: La capacidad de un atleta para tener éxito en su deporte elegido está muy influenciada por sus rasgos antropométricos, que son esenciales para el rendimiento deportivo. Este estudio transversal investiga cómo se comparan las características antropométricas de los atletas que juegan fútbol, ciclismo y atletismo. Este estudio analiza los distintos aspectos físicos del fútbol, el ciclismo y los deportes para identificar patrones y vínculos que arrojan luz sobre la relación entre medidas corporales específicas y la aptitud atlética. **Métodos:** El presente estudio utilizó mediciones antropométricas precisas, como altura, peso, IMC, circunferencia de la cintura, circunferencia de la cadera, WHR, extensión del brazo y varias mediciones de pliegues cutáneos (bíceps, tríceps, supraespinal y subescapular), junto con 60 participantes masculinos, de 18 a 25 años, que fueron seleccionados de los grupos demográficos de atletismo, fútbol y ciclismo. **Resultados:** Los atletas de fútbol, ciclismo y atletismo se compararon morfológicamente utilizando pruebas ANOVA y comparaciones post hoc. Los resultados mostraron variaciones notables en el pliegue cutáneo tricipital, el pliegue cutáneo supraespinal, la altura sentada, la masa grasa, la masa

libre de grasa y el porcentaje de grasa de los atletas. En comparación con sus homólogos en fútbol y atletismo, los ciclistas mostraron un pliegue cutáneo bicipital, un pliegue cutáneo supraespinal y porcentajes de grasa notablemente mayores. Esto probablemente se debe a que el ciclismo es un deporte de resistencia. Por el contrario, el grupo de atletas tenía una altura sentada más alta y los jugadores de fútbol tenían más grasa corporal. Los atletas también tienen una mayor masa libre de grasa que sus homólogos en ciclismo y fútbol. **Conclusiones:** Los hallazgos del presente estudio demuestran cómo el rendimiento de un atleta se ve influenciado por las características antropométricas específicas de un deporte determinado. Estas variaciones pueden afectar los regímenes de entrenamiento, los métodos para identificar talentos y los tratamientos personalizados según los atributos físicos de los atletas de fútbol, ciclismo y atletismo. La ciencia del deporte se beneficiará de este estudio que llena los vacíos en la literatura y sienta las bases para futuras investigaciones sobre la mejora del rendimiento atlético.

Palabras Clave: Porcentaje de grasa corporal, Masa grasa, Altura, Peso, Atletas

Introduction

Sports performance is influenced by a myriad of factors, among which anthropometric characteristics play a pivotal role. The unique combination of body size, composition, and proportionality significantly contributes to an athlete's ability to excel in their chosen sport. This cross-sectional study aims to delve into the comparative analysis of anthropometric characteristics among athletes participating in diverse sports disciplines. The importance of such research lies in its potential to uncover patterns, correlations, and distinctions that can elucidate the impact of specific body dimensions on athletic prowess within distinct sporting domains.

Investigating the anthropometric traits among athletes across various sports indicates that athletes in distinct sporting disciplines possess unique and sport-specific physical characteristics (Singh et al., 2010). An athlete's association with a particular sport signifies their "biotype," granting them a competitive edge in that specific sport rather than in others. (Masanovic, 2008; Krzykaa & Leszczynski, 2015).

Anthropometric assessments provide a quantitative lens through which we can explore variations in body morphology across sports, shedding light on the intricate interplay between physique and performance outcomes. In certain sports disciplines (such as basketball), possessing a tall stature, in conjunction with other essential attributes, provides a notable advantage in attaining success within that specific discipline (Popovic et al., 2014). Similarly, individuals with lower body weight, shorter stature, or average height possess an advantage in achieving greater success in long-distance running compared to those with higher body weight (Jeukendrup & Gleeson, 2009).

Anthropometric measurements have shown associations with performance outcomes in elite sports. (Shephard, 2009). Anthropometric assessments and measurements serve as a crucial tool for identifying talent in sports, monitoring developmental changes during adolescence, and investigating the impact of athletic training on growth. (Roy et al., 2015; Jeyapal et al., 2017)

In the subsequent sections of this paper, we will delve into the methodology employed for data collection, the specific anthropometric measurements considered, and the statistical analyses applied to draw meaningful insights. Our objective is to provide a nuanced understanding of the complex interrelationships between anthropometric traits and sports performance, ultimately contributing to the collective knowledge base in sports science.

This study not only addresses the existing gap in literature but also provides a foundation for future research endeavours aimed at refining training protocols and personalizing interventions based on individual athletes' physical profiles. As we embark on this exploration, the comparative analysis of anthropometric characteristics among athletes promises to unveil valuable insights that have the potential to shape the future landscape of sports science.

Material and Methods

Participants

In this study, 60 male participants within the age range of 18 to 25 years were involved, comprising 20 individuals from each of the following sports categories: Football, Athletics, and Cycling. Noteworthy is that all athletes, who are national players representing Kerala, shared similar socioeconomic backgrounds and academic levels. The acquisition of data was conducted ethically, with the informed consent of both parents and/or coaches of the participants. This homogeneity in demographics and the consent-based approach ensures a consistent and ethically sound foundation for the study, promoting reliability and relevance across the diverse athletic backgrounds represented.

Anthropometric Measurements

Anthropometric data, encompassing measurements of height, weight, and BMI, was acquired utilizing a precision electronic scale from Seca Instruments Ltd. (Hamburg, Germany) with an accuracy of up to .001 m. Additionally, metrics such as Waist Circumference, Hip Circumference, WHR, and arm span were determined using a Cescorf Steel tape. Skinfold measurements, including Biceps, Triceps, Subscapular, and Supraspinal, were obtained with a Harpenden Skinfold Caliper and recorded in millimetres. The utilization of standardized instruments ensures meticulousness in data collection, enhancing the reliability and accuracy of the anthropometric information crucial for the comprehensive analysis undertaken in this study.

Statistical Analysis

After ensuring normal distribution, the collected data underwent descriptive statistical analysis. Group distinctions were examined through ANOVA (Analysis of Variance) testing, with statistical significance set at $p<0.05$. IBM SPSS software version 21 facilitated these analyses. These methodologies serve to delineate morphological characteristics specific to Football, Athletics, and Cycling, aiding coaches in talent selection. The rigorous statistical approach applied in this study enhances the precision and applicability of the findings to inform talent identification strategies in the respective sports (Gulati, A., 2021).

Results

Table 1. Descriptive Analysis of Selected Anthropometric Variables of Athletics, Football and Cycling Players

Descriptives Statistics				
Anthropometric Variables	**Game**	**N**	**Mean**	**Std. Deviation**
Biceps	Athletics	20	4.2800	.93223
	Football	20	4.6000	.91306
	Cycling	20	4.9600	1.80945
	Total	60	4.6133	1.29660
Triceps	Athletics	20	7.2600	1.28489
	Football	20	8.0900	2.30192
	Cycling	20	9.4400	3.52650
	Total	60	8.2633	2.65777
Subscapular	Athletics	20	8.9100	1.47181
	Football	20	9.3000	1.23714
	Cycling	20	9.9700	2.50160
	Total	60	9.3933	1.84408
Supraspinale	Athletics	20	6.4800	1.70251
	Football	20	5.9300	1.26370
	Cycling	20	8.8200	3.52429
	Total	60	7.0767	2.65409
Height	Athletics	20	176.8000	8.03676
	Football	20	172.2800	5.76702
	Cycling	20	175.8500	5.51815
	Total	60	174.9767	6.72063

Weight	Athletics	20	66.3150	8.58058
	Football	20	63.6950	6.26309
	Cycling	20	64.0275	6.44153
	Total	60	64.6792	7.14731
BMI	Athletics	20	21.1520	1.66024
	Football	20	21.4445	1.58181
	Cycling	20	20.6750	1.76740
	Total	60	21.0905	1.67381
Sitting Height	Athletics	20	89.1150	4.11138
	Football	20	86.2500	2.54258
	Cycling	20	88.2950	2.70642
	Total	60	87.8867	3.37048
Arm Span	Athletics	20	182.2800	7.87411
	Football	20	178.6200	9.05135
	Cycling	20	181.9200	5.48794
	Total	60	180.9400	7.66861
Weist	Athletics	20	70.1250	4.89596
	Football	20	71.0600	4.10358
	Cycling	20	68.4250	4.31727
	Total	60	69.8700	4.51158
Hip	Athletics	20	89.3950	4.12380
	Football	20	89.4750	4.57290
	Cycling	20	88.5700	5.06932
	Total	60	89.1467	4.54493
WHR	Athletics	20	.7843	.03930
	Football	20	.7948	.03894
	Cycling	20	.7729	.03041
	Total	60	.7840	.03695
Fat Mass	Athletics	20	12.1135	2.28387
	Football	20	18.9861	3.29120
	Cycling	20	16.1390	3.70441
	Total	60	15.7462	4.20370
Fat-Free Mass	Athletics	20	87.8865	2.28387
	Football	20	81.0169	3.28281
	Cycling	20	83.8615	3.70426
	Total	60	84.2550	4.20075

Fat Percentage	Athletics	20	12.8750	1.78351
	Football	20	13.6500	2.05260
	cycling	20	15.3000	3.28233
	Total	60	13.9417	2.62500

Table 1 shows the Mean with Standard Deviation (SD) values of the anthropometric variables among Athletics, Football and Cycling players about Biceps (4.28 ± 0.93, 4.60 ± 0.91±1.80), Triceps(7.26 ± 1.28, 8.09 ± 2.30, 9.44 ± 3.52) Subscapular (1.8.91 ± 1.47, 9.30 ± 1.23, 9.97 ± 2.50), Supra Spinale (6.48± 1.70, 5.93 ± 1.26, 8.82 ± 3.52), Height (176.80 ± 8.03, 172.28 ± 5.76, 175.85 ± 5.51), Weight(66.31 ± 8.58, 63.69 ± 6.26, 64.02 ± 6.44). BMI(21.15 ± 1.66, 21.44 ± 1.58, 20.67 ± 1.76), Sitting Height(89.11 ± 4.11, 86.25 ± 2.54, 88.29 ± 2.70), Arm Span(182.28 ± 7.87, 178.62 ± 9.05, 181.92 ± 5.48), Weist(70.12 ± 4.89, 71.06 ± 4.10, 68.42 ± 4.31), Hip (89.39 ± 4.12, 89.47 ± 4.57, 88.57 ± 5.06), and WHR(0.78 ± 0.03, 0.79 ± 0.03, 0.78 ± 0.03) , Fat Mass(12.11 ± 2.28, 18.98 ± 3.29, 16.13 ± 3.70), Fat Free Mass(87.88 ± 2.28, 81.01 ± 3.28, 83.86 ± 3.70) and Fat Percentage(12.87 ± 1.78, 13.65 ± 2.05, 15.30 ± 3.28).

Table2. Analysis of Variance (ANOVA) for the Selected Anthropometric Variables of Athletics, Football and Cycling Players

ANOVA						
Variables		Sum of Squares	df	Mean Square	F	Sig.
Biceps	Between Groups	4.629	2	2.315	1.395	.256
	Within Groups	94.560	57	1.659		
	Total	99.189	59			
Triceps	Between Groups	48.425	2	24.213	3.747	.030
	Within Groups	368.334	57	6.462		
	Total	416.759	59			
Subscapular	Between Groups	11.497	2	5.749	1.732	.186
	Within Groups	189.140	57	3.318		
	Total	200.637	59			
Supraspinal	Between Groups	94.201	2	47.101	8.353	.001
	Within Groups	321.406	57	5.639		
	Total	415.607	59			
Height	Between Groups	227.185	2	113.593	2.656	.079
	Within Groups	2437.662	57	42.766		
	Total	2664.847	59			
Weight	Between Groups	81.384	2	40.692	.791	.458
	Within Groups	2932.572	57	51.449		
	Total	3013.956	59			
Bmi	Between Groups	6.035	2	3.017	1.080	.346
	Within Groups	159.262	57	2.794		
	Total	165.297	59			
Sitting Height	Between Groups	87.084	2	43.542	4.256	.019
	Within Groups	583.165	57	10.231		

	Total	670.249	59			
Arm Span	Between Groups	162.768	2	81.384	1.403	.254
	Within Groups	3306.876	57	58.015		
	Total	3469.644	59			
Weist	Between Groups	71.383	2	35.692	1.801	.174
	Within Groups	1129.523	57	19.816		
	Total	1200.906	59			
Hip	Between Groups	10.040	2	5.020	.237	.790
	Within Groups	1208.689	57	21.205		
	Total	1218.729	59			
WHR	Between Groups	.005	2	.002	1.814	.172
	Within Groups	.076	57	.001		
	Total	.081	59			
Fat Mass	Between Groups	476.949	2	238.474	24.031	.000
	Within Groups	565.644	57	9.924		
	Total	1042.593	59			
Fat-Free Mass	Between Groups	476.556	2	238.278	24.057	.000
	Within Groups	564.575	57	9.905		
	Total	1041.131	59			
Fat Percentage	Between Groups	61.358	2	30.679	5.066	.009
	Within Groups	345.188	57	6.056		
	Total	406.546	59			

** Significant at 0.05 level.*

Table 2 indicates that a statistically significant difference was observed among Athletics, Football and Cycling players in Triceps, Sitting Height, Supra Spinale, Fat Mass, Fat-Free Mass and Fat Percentage as demonstrated by one-way ANOVA (F(2,57) = 3.74, 8.35, 4.25, 24.03, 24.05, 5.06, and p = .030, .001, .019, .000, .000, .009 which is less than the .05 (p < .05). An insignificant difference was observed among Athletics, Football and Cycling players about Biceps, Subscapular, Height, and Weight. BMI, Arm Span, Weist, Hip, and WHR as demonstrated by one-way ANOVA (F(2,57) = 1.39, 1.73, 2.65, .791, 1.08, 1.40, 1.80, .23, 1.84, and p = .256, .186, .079, .458, .346, .254, .174, .790, .172 which is more than the .05 (p < .05).

Table 3. Multiple Comparisons (LSD)

Dependent Variable	(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Triceps	Athletics	Football	-.83000	.80387	.306	-2.4397	.7797
		Cycling	-2.18000*	.80387	.009	-3.7897	-.5703
	Football	Athletics	.83000	.80387	.306	-.7797	2.4397
		Cycling	-1.35000	.80387	.099	-2.9597	.2597
	Cycling	Athletics	2.18000*	.80387	.009	.5703	3.7897

		Football	1.35000	.80387	.099	-.2597	2.9597
Supraspinale	Athletics	Football	.55000	.75091	.467	-.9537	2.0537
		Cycling	-2.34000*	.75091	.003	-3.8437	-.8363
	Football	Athletics	-.55000	.75091	.467	-2.0537	.9537
		Cycling	-2.89000*	.75091	.000	-4.3937	-1.3863
	Cycling	Athletics	2.34000*	.75091	.003	.8363	3.8437
		Football	2.89000*	.75091	.000	1.3863	4.3937
Sitting Height	Athletics	Football	2.86500*	1.01148	.006	.8395	4.8905
		Cycling	.82000	1.01148	.421	-1.2055	2.8455
	Football	Athletics	-2.86500*	1.01148	.006	-4.8905	-.8395
		Cycling	-2.04500*	1.01148	.048	-4.0705	-.0195
	Cycling	Athletics	-.82000	1.01148	.421	-2.8455	1.2055
		Football	2.04500*	1.01148	.048	.0195	4.0705
Fat Mass	Athletics	Football	-6.87255*	.99617	.000	-8.8674	-4.8778
		Cycling	-4.02550*	.99617	.000	-6.0203	-2.0307
	Football	Athletics	6.87255*	.99617	.000	4.8778	8.8674
		Cycling	2.84705*	.99617	.006	.8523	4.8419
	Cycling	Athletics	4.02550*	.99617	.000	2.0307	6.0203
		Football	-2.84705*	.99617	.006	-4.8419	-.8523
Fat-Free Mass	Athletics	Football	6.86958*	.99523	.000	4.8767	8.8625
		Cycling	4.02502*	.99523	.000	2.0321	6.0179
	Football	Athletics	-6.86958*	.99523	.000	-8.8625	-4.8767
		Cycling	-2.84455*	.99523	.006	-4.8375	-.8516
	Cycling	Athletics	-4.02502*	.99523	.000	-6.0179	-2.0321
		Football	2.84455*	.99523	.006	.8516	4.8375
Fat Percentage	Athletics	Football	-.77500	.77820	.324	-2.3333	.7833
		Cycling	-2.42500*	.77820	.003	-3.9833	-.8667
	Football	Athletics	.77500	.77820	.324	-.7833	2.3333
		Cycling	-1.65000*	.77820	.038	-3.2083	-.0917
	Cycling	Athletics	2.42500*	.77820	.003	.8667	3.9833
		Football	1.65000*	.77820	.038	.0917	3.2083

*Significant at the 0.05 level.

An LSD post hoc test showed that the significant pairwise differences between Athletics and Cycling about triceps with an average difference of 2.18 (P<0.05) were statistically significant. There was no statistically significant difference in triceps between Football and Cycling (p=0.099) and between Athletics and Football (p= .306).

A significant pairwise difference was found between Athletics and Cycling about Supraspinale with an average difference of 2.34 (P<0.05) and between Football and Cycling with an average difference of 2.89 (P<0.05). There was no statistically significant difference in Supraspinale between Athletics and Football (p=.467).

A significant pairwise difference was found between Athletics and Football about Sitting Height with an average difference of 2.86 (P<0.05) and between Football and Cycling with an average difference of 2.04 (P<0.05). There was no statistically significant difference in Sitting Height between Athletics and Cycling (p=.421).

A significant pairwise difference was found between Athletics and Football about Fat Mass with an average difference of 6.87 (P<0.05) and between Athletics and Cycling at 4.02 (P<0.05) and between Football and Cycling with an average difference of 2.84 (P<0.05).

A significant pairwise difference was found between Athletics and Football about Fat-Free Mass with an average difference of 6.86 (P<0.05) and between Athletics and Cycling at 4.02 (P<0.05) and between Football and Cycling with an average difference of 2.84 (P<0.05).

A significant pairwise difference was found between Athletics and Cycling about Fat Percentage with an average difference of 2.42 (P<0.05) and between Football and Cycling with an average difference of 1.65 (P<0.05). There was no statistically significant difference in Fat Percentage between Athletics and Football (p=.324).

Discussion

The findings of the statistical analysis have shown a significant difference in Triceps, Supraspinale, Sitting Height, Fat Mass, Fat-Free Mass, and fat Percentage among Athletics, Football and Cycling Players and there is no significant difference among Athletics, Football and Cycling players about Biceps, Subscapular, Height, and Weight. BMI, Arm Span, Weist, Hip, and WHR. About triceps skinfold and Supraspinale skinfold and Fat Percentage cycling players have higher fat in comparison to football and athletics. This may be due to the physical demand and training regimen associated with sports. Cycling professionally involves prolonged endurance efforts and it may require higher body fat percentage in areas like the triceps and supraspinal due to their proximity to the shoulder and upper arm muscles as compared to football and athletics. Regarding sitting height, athletics players are taller as compared to cycling and football players. According to recent research, athletes who participate in sports like basketball and track and field tend to be taller and sit higher than athletes who play other sports like football and cycling (Singh & Jaiswal, 2016). (Monson et al., 2018) Researchers are now looking at the possible benefits of higher sitting heights for specific sports as a result of this observation. Regarding fat mass, football players have more fat mass as compared to athletic and cycling players. *Football players have a little more body fat mass because of the distinct physical demands of their activity.* Athletics often have a larger fat-free mass than cyclists and football players. This is because higher fat-free mass is essential for success in a variety of track and field competitions, where it significantly improves performance.

Conclusion

Cycling players show higher fat levels, as indicated by triceps and supraspinal skinfold thickness, compared to football and athletics players. Athletic players tend to have greater sitting height than those in cycling and football. Regarding fat mass, football players exhibit higher values than athletes and cycling players. In terms of fat-free mass, athletics players have a higher amount compared to their counterparts in football and cycling.

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Data availability

Full access to data on request.

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Conflicts of Interest

The Authors have no conflict of interest to declare.

Informed Consent Statement

All the athletes included in the study provided written informed consent.