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Sport-specific morphological profiles and somatotypes: a comparative analysis of state-level Kabaddi and football Players

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ABSTRACT

This cross-sectional study aimed to compare the anthropometric characteristics and somatotype profiles of state-level Kabaddi and football players, with the goal of identifying sport-specific morphological adaptations. A cross-sectional study was conducted on 24 male athletes (12 Kabaddi, 12 Football; age: 18–25 years) from Rajasthan, India. Standardized ISAK protocols were used to assess anthropometric parameters, and somatotypes were computed via the Heath–Carter method. Group comparisons were performed using independent t-tests, with Bonferroni correction applied for multiple comparisons ($\alpha = .0033$ for anthropometric variables, $\alpha = .01$ for somatotype/body composition). Significant between-group differences were observed in endomorphy ($p = .001$, $d = 1.18$) and ectomorphy ($p = .006$, $d = 1.24$), with football players exhibiting higher values in both components. Kabaddi athletes displayed a more mesomorphic–endomorphic profile, whereas footballers were predominantly mesomorphic–ectomorphic. Additionally, humerus ($p = .002$, $d = 1.59$) and femur breadths ($p = .002$, $d = 1.52$) were significantly larger in football players. While differences in height, fat-free mass, and triceps skinfold did not reach statistical significance, large effect sizes (d ≥ 0.74) suggest practically meaningful distinctions in physique and body composition. This study reveals distinct somatotype and structural differences between Kabaddi and Football players, underscoring the influence of sport-specific demands on body morphology. These findings support the use of anthropometric profiling in talent identification, performance optimization, and tailored training strategies for athletes in high-intensity sports.

KEYWORDS

Anthropometry; Somatotype; Kabaddi; Football; Morphological Adaptation

1. INTRODUCTION

Athletes across various sports disciplines exhibit distinct physical and physiological characteristics, which are influenced by the specific demands of their sport (Konopka et al., 2024; Gusic et al., 2017). Understanding these differences through morphological analysis provides critical insights into the interplay between physical attributes and athletic performance (Kabir et al., 2024). Such research is crucial for optimizing training regimens, identifying talent, and preventing injuries (Alneama et al., 2023; Katanic et al., 2023; Ram et al., 2022; Giudicelli et al., 2021; Toselli et al., 2021; Hermassi et al., 2021).

Kabaddi and football represent two distinct yet highly popular sports in India, each embodying unique aspects of the country's sports culture. Kabaddi, deeply rooted in Indian tradition, demands agility, muscular strength, and tactical intelligence, reflecting indigenous athleticism. Conversely, football, a globally recognized sport, requires endurance, speed, and strategic decision-making. These contrasting physiological demands shape the morphological characteristics of athletes in each sport. Kolena et al. (2024) emphasize that the ideal body characteristics for football players encompass a combination of anthropometric and physiological factors, aligning with the sport's inherent physical and strategic requirements. A state-level comparative analysis is essential to understand these differences and their implications for performance.

Several studies have explored the anthropometric and physiological profiles of athletes across various sports, highlighting sport-specific adaptations. For instance, volleyball players tend to be taller and leaner, attributes that are advantageous for movements requiring height and agility (Kutseryb et al., 2023; Horička et al., 2023; Pocek et al., 2021; Albaladejo-Saura et al., 2022). In contrast, football players typically exhibit greater muscle mass and lower body fat percentages than both volleyball players and sedentary individuals, as these characteristics enhance endurance and physical intensity on the field (Popovic et al., 2014; Aksoy et al., 2024; Ghosh et al., 2023). Studies on kabaddi players indicate a predominantly mesomorphic-endomorphic physique with relatively higher body fat levels, traits that contribute to their strength and agility in dynamic play (Dey et al., 1993; Shelke et al., 2024; Kalpana et al., 2023). Yallappa (2020) further emphasized the relevance of anthropometric and physiological parameters, highlighting their strong correlation with competitive performance in university-level Kabaddi athletes. Similarly, Ram & Singh (2021); Ram (2019) identified significant associations between selected anthropometric and kinematic variables and the effectiveness of key Kabaddi skills, such as the toe-touch and running hand touch, underscoring the biomechanical foundations of sport-specific performance. Additionally, research on Kho-Kho players highlights distinctive morphological attributes, particularly in terms of body composition and limb proportions, differentiating them from football players (Lokesh & Reddy, 2018; Muniraju et al., 2019; Deepak et al., 2022).

Existing literature further underscores the strong association between body composition, somatotype, and sport-specific performance demands. For instance, Khanna & Koley (2020) reported that inter-university volleyball players demonstrated superior anthropometric profiles and handgrip strength compared to sedentary individuals, which directly influenced their performance. Similarly, Pradhan (2017) observed significant differences in height, weight, and body fat percentages between inter-university volleyball and football players. However, not all studies report major distinctions. Singh and Pathania (2020) found no statistically significant anthropometric differences between football and volleyball players, suggesting an overlap in some physical attributes across these sports.

While previous studies (e.g., Dey et al., 1993; Shelke et al., 2024) have provided insights into the somatotype and morphological characteristics of elite Kabaddi players, these investigations have largely focused on athletes at the national or professional level, often in isolation. Moreover, they rarely included cross-sport comparisons or accounted for confounding variables such as age, training history, or competitive experience. To date, there is a lack of state-level research comparing Kabaddi athletes with their counterparts in other sports under controlled conditions.

The present study addresses this gap by conducting a comparative analysis of the anthropometric profiles and body composition of state-level Kabaddi and football players. By examining sport-specific morphological adaptations, this research aims to enhance our understanding of how physical traits influence performance, inform tailored training approaches, support talent identification, and reduce injury risk among student-athletes.

2. METHODS

2.1. Study Design and Participants

This comparative cross-sectional study evaluated and contrasted the anthropometric profiles and somatotypes of state-level Kabaddi and Football players. Employing standardized measurement protocols, the study aimed to uncover sport-specific morphological adaptations and their potential impact on performance.

This study initially screened 40 male state-level athletes aged between 18 and 25 years from eight sports academies across Rajasthan, India. Based on consistent performance over the past competitive season, as assessed through training attendance and competitive results, a total of 24 athletes were selected for final inclusion. The final sample comprised 12 Kabaddi players and 12 Football players, with equal group sizes to ensure balanced comparison.

Inclusion criteria required participants to be aged between 18 and 25 years, actively competing at the state level in either Kabaddi or Football, and engaged in consistent training for at least two consecutive years with a frequency of five or more sessions per week. Athletes were excluded if they had any diagnosed physical disability, chronic illness, recent injury within the past six months, or irregular training patterns that could interfere with performance or study outcomes.

To minimize selection bias and ensure comparability, participant recruitment applied stratification based on academy affiliation and recent performance metrics. Random selection was not employed, as homogeneity in training exposure and sport-specific experience was necessary to support the validity of between-group comparisons.

All participants provided written informed consent after receiving a detailed explanation of the study's objectives, procedures, potential risks, and benefits.

This study adhered to strict ethical protocols, ensuring participant rights and data confidentiality. Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of NIMS University (Approval No: NIMSUR/IEC/2023/699). Written informed consent was obtained from all participants before enrolment, with the assurance that they could withdraw at any stage without repercussions.

2.2. Anthropometric Measurements

Anthropometric assessments encompassed height, weight, limb breadths, girths, and skinfold thicknesses, performed by ISAK guidelines. All measurements were conducted in triplicate, and the mean value was recorded to minimize errors. Instruments were calibrated before each session to ensure accuracy. Details of the equipment used, and the procedures employed are outlined in Table 1

Table 1. Anthropometric parameters and measuring procedures

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 clothes	Digital Weighing Scale (Dual frequency body composition monitor, RD-545-SV Smart Bluetooth, Wireless)
Anthropometric	Biceps skin fold (mm)	According to the ISAK manual	Slim 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)		

2.3. Somatotype Assessment

Somatotypes were assessed using the Heath-Carter method, a well-established technique for categorizing physical composition into three components: endomorphy (relative fatness), mesomorphy (musculoskeletal robustness), and ectomorphy (linearity or leanness). This method was chosen for its precision and widespread application in sports science, allowing for comprehensive morphological comparisons between athletes."

Calculations were based on anthropometric measurements using the following formulas:

Endomorphy: Endomorphy = $-0.7182 + 0.1451(X) - 0.00068(X^2) + 0.0000014(X^3)$, where X is the sum of triceps, subscapular, and supraspinal skinfolds adjusted for height.

Mesomorphy: $(0.858\ HB + 0.601\ FB + 0.188\ CAG + 0.161\ CCG) - (0.131\ H) + 4.5$, where HB is humerus breadth, FB is femur breadth, CAG is corrected arm girth, CCG is corrected calf girth, and H is height.

Ectomorphy:

- If HWR≥40.75HWR≥40.75, Ectomorphy = 0.732 HWR - 28.58
- If HWR<40.75HWR<40.75 and HWR>38.25HWR>38.25, Ectomorphy = 0.463 HWR - 17.63
- If HWR≤38.25HWR≤38.25, Ectomorphy = 0.1 (or recorded as ½), where HWR is the height-to-weight ratio. (Ross, Carr & Carter, 1999)

2.4. Statistical Analyses

Descriptive statistics (mean ± SD) were calculated for all variables. Normality was assessed using the Shapiro–Wilk test, and homogeneity of variances was checked with Levene's test. Independent samples t-tests were used for group comparisons given that parametric assumptions were sufficiently met. Bonferroni correction was applied to control for multiple comparisons, with an adjusted $\alpha = 0.0033$ for anthropometric variables and $\alpha = 0.01$ for somatotype and body composition variables. Effect sizes were reported using Cohen's d. A priori power analysis using G*Power 3.1 indicated a required sample size of 51 for detecting medium effects ($d = 0.5$) with 80% power; the current sample size ($n = 24$) reflects the exploratory nature of the study. Statistical significance was set at $p \leq .05$. Analyses were performed using SPSS (v20) and Gnumeric (v1.12.48).

The accuracy and consistency of anthropometric measurements were verified using the Technical Error of Measurement (TEM). Results showed that TEM values were within acceptable limits: ≤ 5% for skinfold thickness and ≤ 1% for all other variables. These findings confirm the high reliability and reproducibility of the data collection process.

3. RESULTS

Table 2 presents the differences in fundamental anthropometric and body measurement traits between state-level kabaddi and football players. It provides a comprehensive comparison across multiple parameters, illustrating the distinct morphological profiles associated with each sport. Football players exhibit significantly greater height (M = 172.9 cm, SD = 3.5) compared to kabaddi players (M = 169.1 cm, SD = 5.2), with respective height ranges of 168.5–179.2 cm and 157.0–176.0 cm. Similarly, football players demonstrate higher body mass (M = 65.7 kg, SD = 10.1) than kabaddi players (M = 59.1 kg, SD = 3.7), with broader variability (55.1–81.9 kg vs. 51.0–64.0 kg). The corresponding BMI values (football: M = 21.9, SD = 3.0; kabaddi: M = 20.8, SD = 1.9) indicate that both groups fall within the normal weight range, though Football players exhibit a slightly higher average.

Table 2. Comparison of anthropometric and body composition measurements between kabaddi and football players (Mean±SD)

Variables	Kabaddi (M±SD)	Football (M±SD)
Height (cm)	169.1±5.2 (157.0-176.0)	172.9±3.5 (168.5-179.2)
Body mass (kg)	59.1±3.7 (51.0-64.0)	65.7±10.1 (55.1-81.9)
BMI (kg/m2)	20.8±1.9 (17.8-23.6)	21.9±3.0 (18.6-27.1)
Biceps skinfold (mm)	5.5±2.5 (3.2-12.0)	5.8±2.7 (3.0-10.0)
Triceps skinfolds (mm)	7.1±3.1(4.2-14.0)	9.4±3.1 (5.0-13.0)
Subscapular skinfolds (mm)	9.9±2.2 (7.1-13.9)	11.8±3.5 (7.3-16.0)
Supraspinal skinfolds (mm)	7.6±2.7 (4.9-15.0)	10.0±5.1 (4.0-16.0)
Medial calf skinfolds (mm)	8.8±2.8 (5.9-14.0)	9.0±2.9 (4-14.1)
Bi-epicondyle humerus (cm)	6.5±0.3 (5.8-6.8)	7.5±0.9 (6.6-9.0)
Bi-epicondyle femur (cm)	9.0±0.7 (7.0-10.0)	9.8±0.4 (9.1-10.5)
Arm girth flex (cm)	28.4±2.8(24.0-33.0)	30.9±4.4 (21.0-38.0)
Max. calf girth (cm)	34.2±5.5 (26.0-49.0)	33.6±2.2 (31.0-38.0)

Regarding skinfold measurements, kabaddi players tend to have lower values. The biceps skinfold averages 5.5 mm (SD = 2.5) for kabaddi players and 5.8 mm (SD = 2.7) for football players. Similarly, triceps (7.1 mm vs. 9.4 mm), subscapular (9.9 mm vs. 11.8 mm), and supraspinal (7.6 mm vs. 10.0 mm) skinfolds follow this trend, with Football players consistently displaying higher values. The medial calf skinfold remains comparable between groups (kabaddi: M = 8.8 mm, SD = 2.8; football: M = 9.0 mm, SD = 2.9).

Limb and girth measurements further reinforce these distinctions. Football players exhibit larger biepicondylar humerus (M = 7.5 cm, SD = 0.9) and femur (M = 9.8 cm, SD = 0.4) measurements compared to kabaddi players (M = 6.5 cm, SD = 0.3; M = 9.0 cm, SD = 0.7). Similarly, arm girth (football: M = 30.9 cm, SD = 4.4; kabaddi: M = 28.4 cm, SD = 2.8) follows the same pattern, while maximal calf girth remains relatively similar between groups (34.2 cm vs. 33.6 cm).

Overall, these findings align with the physiological demands of each sport. Football players, requiring greater physical endurance and strength, exhibit higher body mass, larger limb girths, and increased skinfold thickness. Conversely, kabaddi players, who rely on agility and rapid directional changes, demonstrate a leaner body composition with lower skinfold values.

To assess the normality of the data distribution, the Shapiro-Wilk test will be applied (Table 3 and 4). If the data meet normality assumptions, independent t-tests will be used to evaluate between-group differences. In cases where normality is violated, non-parametric alternatives such as the Mann-Whitney U test will be employed to ensure robust statistical comparisons

Table 3. Shapiro-Wilk test results for normality of anthropometric and body composition measurements in football players

Measurements	Statistic Shapiro-Wilk	df	Sig. Shapiro-Wilk	*p* value
Body Mass (kg)	.858	12	.046	< .05
Height (cm)	.907	12	.193	> .05
Biceps (mm)	.840	12	.028	> .05
Triceps Sf. (mm)	.860	12	.049	< .05
Subscapular Sf. (mm)	.927	12	.351	> .05
Supraspinale Sf. (mm)	.899	12	.155	> .05
Medial Calf Sf. (mm)	.936	12	.449	> .05
Biepicondylar Humerus (cm)	.876	12	.078	> .05
Biepicondylar Femur (cm)	.868	12	.061	> .05
Arm Girth Flex (cm)	.942	12	.519	> .05
Calf Gth (max.) (cm)	.896	12	.139	> .05
Crt. Arm Girth Flex (cm)	.937	12	.461	> .05
Crt. Calf Gth (max.) (cm)	.933	12	.417	> .05
Endomorphy	.933	12	.417	> .05
Mesomorphy	.916	12	.256	> .05
Ectomorphy	.936	12	.442	> .05
BMI (kg/m2)	.858	12	.046	< .05
Amount of fat (kg)	.923	12	.314	> .05
Fat-free mass (kg)	.887	12	.108	> .05

Table 4. Shapiro-Wilk test results for normality of anthropometric and body composition measurements in kabaddi players

Measurements	**Statistic Shapiro-Wilk**	**df**	**Sig. Shapiro-Wilk**	***p* value**
Body Mass (kg)	.937	12	.458	> .05
Height (cm)	.925	12	.334	> .05
Biceps (mm)	.794	12	.008	< .05
Triceps Sf. (mm)	.805	12	.011	< .05
Subscapular Sf. (mm)	.941	12	.509	> .05
Supraspinale Sf. (mm)	.807	12	.011	< .05
Medial Calf Sf. (mm)	.877	12	.081	> .05
Biepicondylar Humerus (cm)	.819	12	.016	< .05
Biepicondylar Femur (cm)	.825	12	.018	< .05
Arm Girth Flex (cm)	.969	12	.903	> .05
Calf Gth (max.) (cm)	.777	12	.005	< .05
Crt. Arm Girth Flex (cm)	.971	12	.918	> .05
Crt Calf Gth (max.) (cm)	.776	12	.005	< .05

Endomorphy	.904	12	.181	> .05
Mesomorphy	.886	12	.105	> .05
Ectomorphy	.986	12	.998	> .05
BMI (kg/m2)	.948	12	.611	> .05
Amount of fat (kg)	.869	12	.063	> .05
Fat-free mass (kg)	.892	12	.125	> .05

Tables 3 and 4 show that most of the variables for both groups (football and kabaddi) follow a normal distribution according to the Shapiro-Wilk test (p > .05). Although a few variables exhibit slight deviations from normality (p < .05), most of the data are normally distributed. Given the adequate sample size and the moderate nature of the deviations, parametric tests, specifically the independent t-test, were used for comparative analysis. Parametric tests are generally robust to minor deviations from normality, and this approach ensures that the experimental conditions for both research groups are met, enabling a reliable assessment of participants' baseline performances.

Table 5 presents the results of independent samples t-tests comparing somatotype components and body composition between kabaddi and football player

Table 5. Independent t-test comparison of somatotype and body composition between kabaddi and football players

	Kabaddi	Football	Independent *t*-test					
Variables	**M±SD**	**M±SD**	**Levene's *F, p***	***t***	**df**	***p***	**d**	**Mean difference**
Endomorphy	2.4±0.8	3.1±1.1	12.249, .002	-3.476	22	.001	- 0.81	- 0.81
Mesomorphy	3.6±1.1	4.8±1.2	.152, .701	1.128	22	.271	0.46	0.51
Ectomorphy	3.3±1.2	3.0±1.3	.014, .908	-3.035	22	.006	-1.24	-1.49
Body fat (%)	12.4±3.3	14.6±4.3	.844, .368	-1.395	22	.177	-0.57	-2.19
Fat-free mass (kg)	51.7±3.9	55.8±6.6	4.654, .042	-1.819	22	.083	- 0.74	-4.03

***Note**. Bonferroni-adjusted significance threshold:* p *< .01. Effect size (*d*): small = 0.2, medium = 0.5, large = 0.8.*

Significant differences were observed in endomorphy, where football players exhibited higher values compared to kabaddi players (t(22) = -3.476, p = .001, d = -0.81). Although the assumption of homogeneity of variance was violated (F(1,22) = 12.25, p = .002), the Welch correction confirmed statistical significance. The large effect size indicates a meaningful practical difference in fat distribution tendencies between groups.

Similarly, ectomorphy differed significantly (t(22) = -3.035, p = .006), with kabaddi players showing greater linearity. The effect size was very large (d = -1.24), indicating that this morphological characteristic sharply distinguishes between the two sports.

No statistically significant differences were found in mesomorphy, body fat percentage, or fat-free mass after Bonferroni correction. However, moderate to large effect sizes were observed for fat-free mass (d = -0.74) and mesomorphy (d = 0.46), suggesting potential practical differences that may warrant further exploration with larger samples. Table 6 presents the results of the independent t-test analysis of anthropometric measurements between kabaddi and football players.

Table 6. Independent t-test analysis of anthropometric measurements between kabaddi and football players

Measurements	Levene's *F*, *p*	*t*	df	*p*	d	Mean difference
Body Mass (kg)	8.417, .008	-2.132	22	.044	-0.84	-6.61
Height (cm)	1.217, .282	-2.082	22	.049	-0.73	-3.79
BMI (kg/m²)	2.047, .167	-1.165	22	.257	-0.42	-1.19
Biceps (mm)	1.288, .269	-0.291	22	.773	-0.11	-0.31
Fat Amount (kg)	6.168, .021	-1.965	22	.062	-0.74	-2.58
Triceps Skinfold (mm)	0.608, .444	-1.898	22	.071	-0.79	-2.39
Subscapular Sf. (mm)	2.856, .105	-1.585	22	.127	-0.57	-1.89
Supraspinale Sf. (mm)	7.143, .014	-1.451	22	.161	-0.60	-2.43
Medial Calf Sf. (mm)	.001, .998	-0.137	22	.892	-0.06	-0.16
Humerus Breadth (cm)	16.856, .001	-3.607	22	.002	-1.59	-1
Femur Breadth (cm)	.479, .496	-3.596	22	.002	- 1.52	-0.86
Arm Girth Flex (cm)	1.259, .274	-1.629	22	.118	-0.66	-2.45
Calf Girth (cm)	.972, .335	.344	22	.734	0.12	0.59
Crt. Arm Girth (cm)	1.189, .287	-1.572	22	.13	-0.64	-2.36
Crt. Calf Girth (cm)	1.106, .304	.355	22	.726	0.12	0.61

Note. *Bonferroni-adjusted significance threshold:* p *< .0033. Effect size* (d)*: small = 0.2, medium = 0.5, large = 0.8.*

In table 6, after applying Bonferroni correction for multiple comparisons, humerus width (t(22) = -3.607, p = .002, d = -1.59) and femur width (t (22) = -3.596, p = .002, d = -1.52) were the only variables that showed statistically significant differences between groups. Football players exhibited larger bone breadths, with very large effect sizes, suggesting pronounced structural adaptations likely related to sport-specific demands.

Other variables, such as body mass (p = .044, d = -0.84) and height (p = .049, d = -0.73), did not reach statistical significance after adjustment, though effect sizes were large, indicating potentially meaningful differences in stature and build.

Skinfold measurements and fat mass values showed no statistically significant differences, but several variables (e.g., triceps skinfold d = -0.79; subscapular skinfold d = -0.57) demonstrated moderate to large effects. These results may reflect distinct fat distribution patterns, even in the absence of overall compositional differences.

Figure 1 illustrates the morphological distribution of body composition based on three key components: endomorphy (fatness), mesomorphy (musculoskeletal robustness), and ectomorphy (linearity or leanness) as depicted on the somatochart.

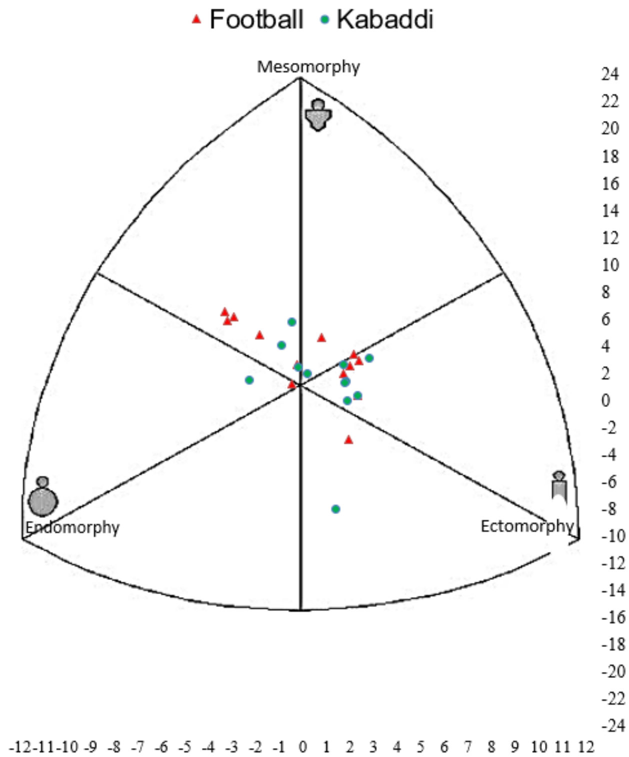


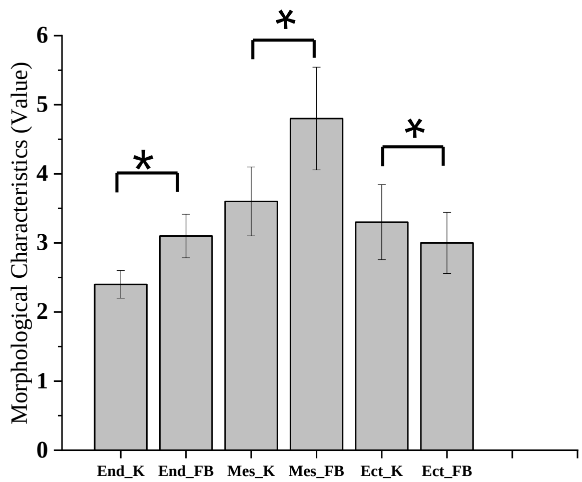
Figure 1. Somato-chart of state-level Kabaddi and Football player

The somatochart indicates that state-level Kabaddi players exhibit a Mesomorphic Endomorph body type (2.4–3.6–3.3), which is characterized by a balanced combination of muscular development (mesomorphy) and moderate adiposity (endomorphy), alongside a moderate degree of leanness (ectomorphy). This body type is indicative of the strength and agility required in Kabaddi.

In contrast, football players are categorized as Ectomorphic Mesomorphs (3.1–4.8–3.0), showcasing a predominance of mesomorphy with enhanced muscularity and a slight emphasis on leanness (ectomorphy) over adiposity (endomorphy). This body composition aligns with the physical demands of football, which include endurance, speed, and overall strength.

The results underscore notable differences in body composition and somatotype between state-level Kabaddi and football players, suggesting that athletes in different sports develop distinct physical profiles that are tailored to the specific demands of their respective disciplines.

Figure 2 compares the morphological characteristics of kabaddi and football athletes, focusing on Endomorphy, Mesomorphy, and Ectomorphy.

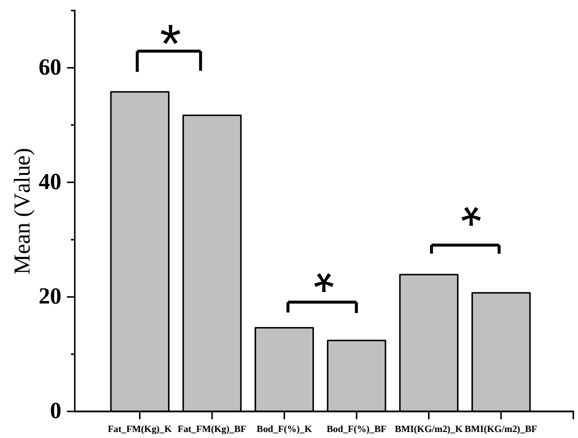


Note: *End_K: Endomorphy Kabaddi. End_FB: Endomorphy Football Players. Mes_K: Mesomorphy Kabaddi. Mes_FB: Mesomorphy Football Players. Ect_K: Ectomorphy Kabaddi. Ect_FB: Ectomorphy Football Players.*

Figure 2. Graphical comparison of morphological characteristics of state-level kabaddi and football player

Notably, Football players exhibit higher values in both Endomorphy (3.1) and Mesomorphy (4.8) compared to kabaddi players, who score lower in Endomorphy (2.4) and slightly less in Mesomorphy (3.6). This suggests that football athletes possess a more prominent mesomorphic build, characterized by increased muscularity and strength, while kabaddi players display a leaner physique with less emphasis on body fat. Regarding Ectomorphy, football players score 3.0, while Kabaddi players score slightly higher at 3.3, indicating that both sports require a degree of leanness, with football athletes exhibiting a more muscular and robust physique overall.

Figure 3 presents a visual comparison of the physical characteristics of football and kabaddi players, focusing on three key metrics: Fat-Free Mass (kg), Body Fat (%), and Body Mass Index (BMI).



Note: *Fat_FM(Kg)_K: Fat-Free Mass (Kg) Kabaddi. Fat_FM (Kg)_BF: Fat-Free Mass (Kg) Football Players. Bod_F(%)_K: Body Fat (%) Kabaddi. Bod_F (%) BF: Body Fat (%) Football Player. BMI (Kg/m²). K: BMI (Kg/m²) Kabaddi. BMI(Kg/m²). BF: BMI (Kg/m²) Football player.*

Figure 3. Graphical comparison of BMI, % of body fat and fat-free mass of state-level kabaddi and football players

Football players display a significantly higher Fat-Free Mass, with an average of 55.8 kg compared to 51.7 kg in kabaddi players, suggesting that football athletes generally have more muscle and lean tissue. In terms of Body Fat percentage, football players also show a lower value at 14.6%, whereas kabaddi players have a slightly higher percentage of 12.4%. This difference may be associated with the agility demands inherent in kabaddi. Regarding BMI, football players exhibit a mean value of 23.9 kg/m², while kabaddi players have a lower mean of 20.7 kg/m², indicating that football players tend to have a higher body mass relative to their height. These findings highlight the distinct physical profiles between the two groups, reflecting the specific physical requirements of each sport.

4. DISCUSSION

The aim of this study was to compare the anthropometric characteristics and somatotype profiles of state-level Kabaddi and Football players, to identify sport-specific morphological adaptations that may influence athletic performance.

This study revealed distinct somatotype and anthropometric patterns between the two groups, reflecting the physiological demands of each sport. Football players exhibited significantly greater endomorphy and ectomorphy, while Kabaddi athletes were characterized by a more mesomorphic–

endomorphic profile. These patterns mirror findings from previous sport-specific morphological studies (Sarafyniuk et al., 2024; Toselli et al., 2021; Pradhan, 2017), supporting the notion that biomechanical and physiological demands influence physical development.

To control for Type I error due to multiple comparisons, Bonferroni corrections were applied. For somatotype and body composition variables (Table 5), significance was set at $p < .01$. Football players showed significantly higher endomorphy ($p = .001$, $d = -0.81$) and Kabaddi players exhibited significantly greater ectomorphy ($p = .006$, $d = -1.24$), with large effect sizes indicating practical relevance. Although mesomorphy, body fat percentage, and fat-free mass did not reach statistical significance, the moderate-to-large effect sizes ($d = 0.46$ to 0.74) suggest meaningful differences that may not have been fully captured due to the limited sample size.

For anthropometric variables (Table 6), with a Bonferroni-adjusted threshold of $p < .0033$, statistically significant differences were observed in humerus ($p = .002$, $d = -1.59$) and femur widths ($p = .002$, $d = -1.52$), indicating structural adaptations potentially linked to long-term sport-specific loading (Norton et al., 1996; Massuça & Fragoso, 2011). Although height and body mass did not meet this stricter threshold, their large effect sizes ($d = -0.73$ to -0.84) suggest real-world differences that warrant further examination.

These differences may have practical implications. Higher endomorphy among football players might elevate the risk of overuse injuries (Santos et al., 2014), highlighting the need for conditioning programs that manage body composition, such as high-intensity interval training (HIIT). In contrast, Kabaddi athletes' higher ectomorphy and narrower bone structure support agility but require complementary strength and neuromuscular training.

Interestingly, football players also presented slightly higher mesomorphic values, a finding that contradicts typical assumptions regarding Kabaddi athletes' muscularity. This variance may result from positional differences, specific training regimens, or sample characteristics. Moreover, as Phukon and Dhar (2024) noted, mesomorphic dominance does not necessarily predict explosive power, emphasizing the need to integrate morphological findings with biomechanical and skill-based metrics.

Fat-free mass and body fat percentage were similar across groups, indicating a baseline level of conditioning. These findings align with Popovic et al. (2014), who observed similar regulation of adiposity among athletes with consistent training regimens.

The present study supports a growing shift from subjective to objective talent identification methods (Masanovic, Popovic, & Bjelica, 2019), facilitated by advances in body composition assessment (Ackland et al., 2012). Morphological profiling serves not only as a tool for selection but also for customizing training and minimizing injury risk.

4.1. LIMITATIONS AND FUTURE DIRECTIONS

This study is constrained by a small sample size (n = 24), which limits generalizability and the ability to detect subtle differences. Additionally, factors such as training history, playing position, and nutrition were not controlled. Future research should adopt larger, multicentric samples and longitudinal designs to explore how consistent training, maturation, and diet influence morphological development. Enhanced measurement tools such as DXA (Bilsborough et al., 2014) and contextual factors like socioeconomic status should also be considered (Kabir et al., 2024).

Findings from other sports wrestling (Norton et al., 1996), arm wrestling (Akpinar et al., 2012), and Kho-Kho (Muniraju et al., 2019) suggest that specific segment lengths and compositions can offer biomechanical advantages. This principle is applicable to team sports like Kabaddi and Football, where tailored training aligned with morphological traits can optimize athlete development.

This study contributes to our understanding of sport-specific somatotype and structural differences, reinforcing the need for individualized, evidence-based athlete development strategies. As highlighted by Alneama et al. (2023) and Knechtle & Nikolaidis (2018), such profiling should complement technical and tactical training to enhance strength, agility, and endurance outcomes (Massuça & Fragoso, 2011).

5. CONCLUSIONS

This study identified clear morphological distinctions between state-level Kabaddi and Football players, with Football athletes demonstrating significantly higher endomorphy and ectomorphy. Kabaddi players exhibited a leaner, more agile profile with narrower skeletal dimensions. While not all comparisons reached statistical significance, several showed large effect sizes, underscoring relevant sport-specific physical trends. These findings support the integration of somatotype profiling into athlete monitoring systems to enhance talent identification, inform training design, and reduce injury risk. Future research with broader cohorts and longitudinal tracking is warranted to expand upon these insights.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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