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Anthropometric Somatotype Profile of the Siddi Tribe: Exploring Athletic Potential in an Afro-Indian Population

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Abstract

Introduction: Anthropometric characteristics, such as body size, shape, proportionality, and somatotype, are important factors in athletic performance and play a vital role in identifying talent. Indigenous and tribal groups have unique genetic and physical traits, yet they are often underrepresented in sports science research. The Siddi tribe of India, with African ancestry, presents a unique opportunity to study anthropometric traits associated with athletic potential. The present study aimed to examine the anthropometric somatotype profile of Siddi males and to explore its implications for athletic potential by comparing it with published somatotype data from Indian elite athletes across selected sports disciplines. **Methods:** A cross-sectional study was conducted on 143 Siddi males aged 18–23 years from Karnataka, India. Anthropometric measurements were obtained following the International Society for the Advancement of Kinanthropometry (ISAK) protocol, and somatotype was determined using the Heath–Carter anthropometric method. Statistical analysis was performed using SPSS version 20.0, and results were reported as mean, standard deviation, and range. Percentage differences and Cohen's d were calculated for descriptive comparison with published elite Indian athlete data. **Results:** The mean somatotype of the Siddi males was 2.46±1.09 – 4.57±1.10 – 3.30±1.26, indicating a predominance of ectomorphic mesomorph. Comparative analysis showed trivial-to-small differences with athletes in athletics, hockey, boxing, and sprinting (d = 0.06–0.52), while moderate-to-large differences were observed with jumpers (d = 0.75–0.89) and football players (d up to 1.01). Somatotype attitudinal distance (SAD) values indicated the closest similarity with boxers (0.48), sprinters (0.55), and athletics participants (0.61), and greater divergence with football players (1.53). **Conclusion:** Siddi males exhibit an ectomorphic mesomorph somatotype and greater morphological similarity to sprinters and boxers than to football players. These findings suggest a potential advantage for speed and power-oriented sports and provide initial data to aid evidence-based talent identification in this Afro-Indian population.

Keywords: Anthropometry, Somatotype, Siddi tribe, Afro-Indian population, Athletic potential.

Resumen

Introducción: Las características antropométricas —tales como el tamaño corporal, la forma, la proporcionalidad y el somatotipo— constituyen factores importantes en el rendimiento deportivo y desempeñan un papel vital en la identificación de talentos. Los grupos indígenas y tribales poseen rasgos genéticos y físicos únicos; sin embargo, a menudo se encuentran subrepresentados en la investigación en ciencias del deporte. La tribu Siddi de la India, de ascendencia africana, ofrece una oportunidad única para estudiar los rasgos antropométricos asociados con el potencial deportivo. El presente estudio tuvo como objetivo examinar el perfil somatotípico antropométrico de varones Siddi y explorar sus implicaciones para el potencial deportivo, comparándolo con datos de somatotipo publicados sobre atletas de élite indios en disciplinas deportivas seleccionadas. **Métodos:** Se llevó a cabo un estudio transversal con 143 varones Siddi de entre 18 y 23 años, procedentes de Karnataka, India. Las mediciones antropométricas se obtuvieron siguiendo el protocolo de la Sociedad Internacional para el Avance de la Cineantropometría (ISAK), y el somatotipo se determinó mediante el método antropométrico de Heath-Carter. El análisis estadístico se realizó utilizando el software SPSS versión 20.0, y los resultados se presentaron como media, desviación estándar y rango. Se calcularon las diferencias porcentuales y la *d* de Cohen para realizar una comparación descriptiva con los datos publicados de atletas de élite indios. **Resultados:** El somatotipo medio de los varones Siddi fue de 2.46±1.09 – 4.57±1.10 – 3.30±1.26, lo que indica un predominio del somatotipo mesomorfo ectomórfico. El análisis comparativo mostró diferencias triviales a pequeñas con los atletas de atletismo, hockey, boxeo y pruebas de velocidad (*d* = 0.06–0.52), mientras que se observaron diferencias de moderadas a grandes con los saltadores (*d* = 0.75–0.89) y los jugadores de fútbol (*d* de hasta 1.01). Los valores de la Distancia Actitudinal del Somatotipo (SAD, por sus siglas en inglés) indicaron una mayor similitud con los boxeadores (0.48), los velocistas (0.55) y los participantes en atletismo (0.61), y una mayor divergencia con los jugadores de fútbol (1.53). **Conclusión:** Los varones Siddi presentan un somatotipo mesomorfo ectomórfico y una mayor similitud morfológica con los velocistas y boxeadores que con los jugadores de fútbol. Estos hallazgos sugieren una ventaja potencial para los deportes orientados a la velocidad y la potencia, y proporcionan datos iniciales para facilitar la identificación de talentos basada en la evidencia en esta población afroindia.

Palabras Clave: Antropometría, Somatotipo, Tribu Siddi, Población afroindia, Potencial atlético.

Introduction

Anthropometric characteristics, including body size, shape, proportions, and somatotype, are recognized as key determinants of athletic performance. These characteristics influence biomechanical efficiency, movement economy, force production, and sport-specific performance outcomes (Norton & Olds, 1996; Ackland et al., 2012). Consequently, anthropometric profiling plays a key role in talent identification and development programs across various sports (Vaeyens et al., 2008; Williams & Reilly, 2000). Somatotype, as defined by the Heath-Carter anthropometric method, characterizes human physique through endomorphy, mesomorphy, and ectomorphy (Carter & Heath, 1990). Distinct somatotype patterns have been observed among elite athletes, reflecting the unique physical and biomechanical demands of different sports. For instance, sprinters and jumpers typically have mesomorphic-ectomorphic profiles, whereas strength and collision sports, such as wrestling, show pronounced mesomorphic traits (Slater et al., 2006; Ackland et al., 2012).

Despite extensive research on elite and sub-elite athletes, indigenous and tribal groups are still not well represented in sports science literature, especially in India. One such group is the Siddi tribe, an Afro-Indian community of African descent mainly found in parts of Karnataka and Gujarat. Anthropological studies indicate that the Siddi population has unique physical features, including limb proportions and muscle development, that may help in certain athletic activities (Bhasin & Walter, 2001; Shah et al., 2011). However, few studies are using standard sports science methods to assess the athletic significance of these traits. It is important to establish reference data for body measurements and body types in underrepresented populations. This can help expand talent identification programs based on evidence and encourage inclusivity in sports. Profiling body measurements using standard protocols, International Society for the Advancement of Kinanthropometry (ISAK), offers a reliable and cost-effective way to identify physical traits linked to athletic potential (Stewart et al., 2011).

Therefore, the present study aims to examine the anthropometric somatotype profile of Siddi tribe males, an Afro-Indian population, and to explore its implications for athletic potential through comparative analysis with published data of Indian elite athletes across selected sports disciplines.

Material and Methods

A cross-sectional descriptive study was conducted with 143 male participants from the Siddi tribe, aged 18 to 23 years, recruited from selected regions of Karnataka, India. Participants were selected using purposive sampling. All individuals were apparently healthy and free of known musculoskeletal, neurological, or metabolic disorders at the time of data collection. Before participation, the study objectives and procedures were clearly explained to all participants, and written informed consent was obtained from each participant. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Anthropometric data were collected using the standard testing protocol of the International Society for Advancement of Kinanthropometry (ISAK) with standard instruments (Esparza-Ros et al., 2019). Body weight (kg) and height (cm) were measured using a portable weighing machine and an anthropometer (GPM, Bachenbülach, Switzerland), with a precision of 0.05 kg and 0.1 cm, respectively. A measuring tape with an accuracy of ± 0.1 cm (Hoeschstmass, West Germany) was used to measure the circumference of the upper arm (flexed) and the calf. A Vernier caliper (Holtain, precision of 0.1 cm) was used to measure the biepicondylar diameters of the humerus and femur. Skinfold thickness was measured using the GPM Skinfold caliper (DKSH Switzerland Ltd.), with a precision of 0.2 mm. Skinfold measurements were taken at four sites, i.e., triceps, subscapular, supraspinale, and medial calf. All anthropometric measurements were performed on the right side of the body.

The somatotype components (endomorphy, mesomorphy, and ectomorphy) of the subjects were computed using the equations of Heath and Carter, (1967). For plotting of somatotypes on the somatochart, X and Y coordinates were calculated as follows:

X = Ectomorphic component – endomorphic component

Y = 2 x mesomorphic component – (endomorphic component + ectomorphic component)

The Somatotype Dispersion Distance (SDD), Somatotype Dispersion Index (SDI), and Somatotype Attitudinal Distance (SAD) were computed to assess the distribution and variability of somatotype characteristics within the group following the protocol established by Heath and Carter, (1967).

Measurement reliability was assessed using the Technical Error of Measurement (TEM). A sub-sample of participants was re-measured under identical conditions to calculate intra-observer TEM using standard ISAK procedures. Relative TEM values were within acceptable ISAK limits (<5% for skinfolds and <1% for linear measurements), indicating high measurement precision and reliability.

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including mean, standard deviation (SD), and range, were calculated for all anthropometric variables. Comparisons with published somatotype data of Indian elite athletes across different sports were conducted using descriptive comparative statistics. The percentage difference was calculated to describe relative differences between the present study group and elite athlete reference values. Additionally, standardised mean differences (Cohen's *d*) were computed to quantify the magnitude of differences between groups. Effect sizes were interpreted as trivial (<0.20), small (0.20–0.49), moderate (0.50–0.79), or large (≥0.80). No inferential statistical tests were applied due to the unavailability of individual-level data for the elite athlete comparison groups. All comparative analyses were interpreted descriptively.

Results

Table 1 represents the descriptive statistics of anthropometric variables, including Height, Weight, diameters, circumferences, and skinfolds of various body regions, which are essential for somatotype assessment. The mean values for height and weight were 167.52 ± 6.44 cm and 57.47 ± 8.14 kg, respectively.

Table 1. Descriptive statistics of anthropometric measurements of the Siddi Male.

Anthropometric Variables	Mean ± SD	Range
Age (yrs.)	19.94±1.82	18-23
Height (cm)	167.52±6.44	152.40-188.00
Weight (kg)	57.47±8.14	45.40-85.30
Humerus Diameter (cm)	6.73±0.37	5.90-9.00
Femur Diameter (cm)	9.51±0.46	8.20-12.10
Upper Arm Girth (Flex, cm)	29.21±2.88	24.60-37.50
Calf Girth (cm)	33.04±2.36	28.50-40.20
Triceps Skinfold (mm)	8.60±3.75	4.20-22.20
Subscapulare Skinfold (mm)	10.10±4.59	5.00-30.20
Supraspinale Skinfold (mm)	6.06±3.23	3.20-25.60
Medial Calf Skinfold (mm)	7.77±3.68	3.00-31.00

Values are expressed as mean±SD, SD=standard deviation

Table 2 shows the mean somatotype, somatochart coordinates, distance between somatotype means, dispersion index, and Somatotype attitudinal mean. The mean somatotype components were recorded as 2.46 ± 1.09 for endomorphy, 4.57 ± 1.10 for mesomorphy, and 3.30 ± 1.26 for ectomorphy. Overall somatotype of the group was classified as ectomorphic mesomorph, indicating a predominance of muscularity with notable linearity. The mean somatotype coordinates: X= 0.84, and Y= 3.39. Where somatotype dispersion distance (SDD), which represents the distance between somatotype means, was calculated as 3.15, with somatotype dispersion index (SDI) as 1.91. On the other hand, the Somatotype attitudinal mean (SAM) was calculated as 2.12 for the given dataset of the Siddi.

Table 2. Mean somatotype, somatochart coordinates, distance between somatotype means, and dispersion index.

N=143	Somatotype Components			Somatochart Coordinates		SDD	SDI	SAM
	Endo.	Meso.	Ecto.	X	Y			
Mean	2.46	4.57	3.30	0.84	3.39	3.15	1.91	2.12
SD	1.09	1.10	1.26	2.18	2.83			
Max.	6.46	7.85	5.97	4.75	11.51			
Min.	1.22	2.36	0.10	-6.36	-2.73			

SD=Standard deviation, Max. =Maximum, Min.=Minimum, SDD= Somatotype dispersion distance, SDI= Somatotype dispersion index, SAM= Somatotype attitudinal mean, Endo. =Endomorphy, Meso. = Mesomorphy, Ecto. = Ectomorphy.

Table 3. Frequency and ratio distribution of somatotype category

Somatotype Category	Frequency	Ratio
Ectomorphic mesomorph	40	27.97
Endomorph mesomorph	27	18.88
Mesomorphic ectomorph	27	18.88
Mesomorph-ectomorph	23	16.08
Balanced mesomorph	16	11.19
Mesomorph-endomorph	6	4.20
Balanced ectomorph	4	2.80

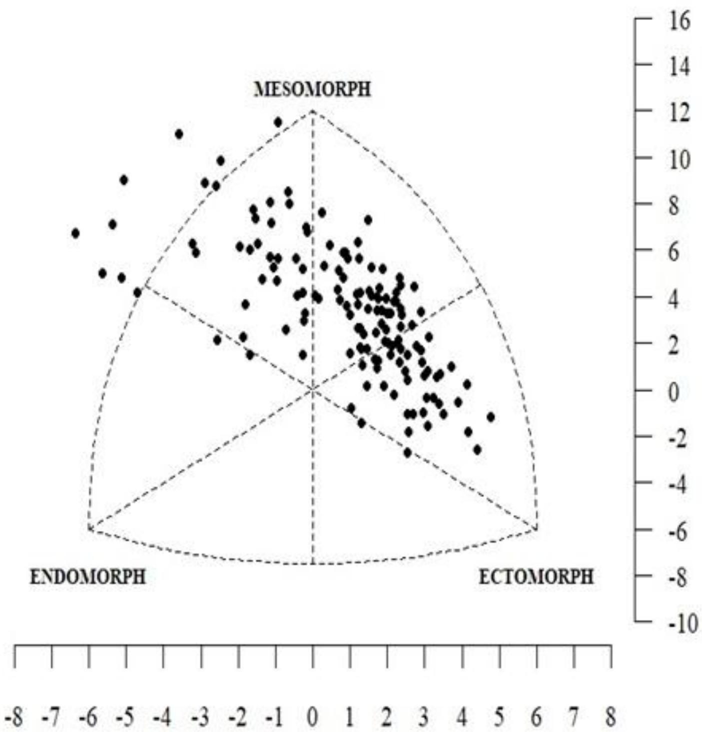

Figure 1. Somatochart of the male Siddi

Table 3, presents the frequency and ratio distribution of the somatotype category of Siddi males. The Ectomorphic mesomorph category emerges as the most prevalent (27.97%), reflecting a predominance of muscularity combined with linearity in the population. Both Endomorph mesomorph, and Mesomorphic ectomorph types are equally represented (18.88%), indicating a substantial proportion of individuals exhibiting muscular characteristics along with either adiposity or slenderness. In contrast, Balanced Ectomorph (2.80%) appears least frequently, suggesting that purely ectomorphic physiques—characterized by tall and slender builds—are uncommon in this cohort.

The somatotype chart of the male Siddi tribe using R Programming for Somatoplotting (Nandikolmath et al, 2024) is shown in Figure 1.

Table 4. Percentage Difference, Cohen's *d*, and Somatotype Attitudinal Distance (SAD)

Group	Endo Mean±SD	%Diff	*d*	Meso Mean±SD	%Diff	*d*	Ecto Mean±SD	%Diff	*d*	SAD
Present Study (Siddi, n=143)	2.46 ± 1.09	—	—	4.57 ± 1.10	—	—	3.30 ± 1.26	—	—	—
Athletics (n=26) Choudhary et al. 2019	2.40 ± 0.92	+2.5	0.06	4.38 ± 2.24	+4.3	0.11	2.75 ± 1.77	+20.0	0.35	0.61
Football (n=18) Choudhary et al. 2019	3.32 ± 1.01	−25.9	−0.82	4.46 ± 1.09	+2.5	0.10	2.06 ± 1.07	+60.2	1.01	1.53
Hockey (n=18) Choudhary et al. 2019	2.57 ± 0.87	−4.3	−0.11	4.26 ± 1.67	+7.3	0.21	2.81 ± 1.21	+17.4	0.39	0.74
Jumper (n=11) Kamath et al. 2024	1.70 ± 0.40	+44.7	0.89	3.70 ± 1.23	+23.5	0.75	3.40 ± 0.70	−2.9	−0.08	0.94
Sprinter (n=19) Kamath et al. 2024	2.00 ± 0.80	+23.0	0.47	4.00 ± 1.10	+14.3	0.52	3.10 ± 0.90	+6.5	0.16	0.55
Boxing (n=35), Singh et al. 2023	2.30 ± 1.00	+6.9	0.15	4.90 ± 0.90	−6.7	−0.31	2.90 ± 1.10	+13.8	0.33	0.48

Endo= Endomorphy; Meso=Mesomorphy; Ecto=Ectomorphy; %Diff= Percentage difference; d=Cohen's d: trivial (<0.20), small (0.20–0.49), moderate (0.50–0.79), large (≥0.80); SAD=Somatotype Attitudinal Distance: <1.0 = very similar; 1.0–2.0 = moderate difference; >2.0 = large difference

Descriptive comparisons with Indian elite athletes across various sports are presented in Table 4. Percentage difference analysis showed that Siddi males had slightly higher ectomorphy than athletes in athletics (+20.0%), hockey (+17.4%), sprinting (+6.5%), and boxing (+13.8%), with a markedly greater difference compared with football players (+60.2%). In contrast, ectomorphy was nearly identical to that of jumpers (−2.9%). Regarding mesomorphy, the Siddi group showed small positive differences compared with athletics (+4.3%), football (+2.5%), hockey (+7.3%), sprinting (+14.3%), and jumpers (+23.5%), whereas mesomorphy was slightly lower than that reported in boxing (−6.7%). Endomorphic values were comparable to athletics (+2.5%), hockey (−4.3%), and boxing (+6.9%), but were lower than those of football players (−25.9%) and higher than those of jumpers (+44.7%) and sprinters (+23.0%).

Effect size analysis supported these percentage-based observations. Cohen's d values indicated trivial-to-small differences between Siddi males and athletes in athletics, hockey, boxing, and sprinting (d = 0.06–0.52). Moderate-to-large effect sizes were observed when comparing with jumpers for endomorphy and mesomorphy (d = 0.75–0.89), while a large effect size was evident when comparing with football players for ectomorphy (d = 1.01) and endomorphy (d = −0.82).

Somatotype Attitudinal Distance (SAD) analysis further demonstrated close morphological similarity between Siddi males and boxers (SAD = 0.48), sprinters (SAD = 0.55), and athletes (SAD = 0.61). In contrast, greater divergence was observed compared with football players (SAD = 1.53).

Discussion

The present study provides the anthropometric somatotype profile of Siddi tribe males. The dominance of ectomorphic mesomorph components in the Siddi indicates a muscular and moderate linearity. Such a profile is commonly associated with speed and power-based sports, particularly sprinting and selected track-and-field events, where the specific combination of muscular strength and limb proportionality enhances performance efficiency (Carter & Heath, 1990; Norton & Olds, 1996; Ackland et al., 2012). The low somatotype attitudinal distance (SAD) of 0.55 and 0.48 with sprinters and boxers, respectively, as well as the trivial-to-moderate Cohen's d values rewarding a close somatotype similarity to these athlete types proposes beneficial structural characteristics requisite for explosive force production during anaerobic power events that involve high neuromuscular efficiency.

Previous literature has shown that successful sprinters typically exhibit moderate to high mesomorphy with balanced ectomorphy, facilitating optimal stride length, force application, and running economy (Brughelli et al., 2011; Slater et al., 2006). Similarly, combat sport athletes such as boxers often display mesomorphic dominance with controlled ectomorphic characteristics, supporting both strength generation and agility (Chaabène et al., 2017). The moderate ectomorphic component observed in Siddi males may therefore confer biomechanical advantages in sports where limb length and body mass distribution influence acceleration and movement economy (Norton & Olds, 1996).

In contrast, the greater differences in somatotype when compared to football players reflect variations in structural requirements. The notably higher ectomorphy and lower endomorphy in the Siddi group suggest differences in body composition and proportions that can affect positional roles and adaptability in specific sports. Team sports like football often require a mixed somatotype profile, with greater variability in muscularity and adiposity (Reilly et al., 2000). The moderate to large effect sizes in selected components emphasize the need for sport-specific morphological optimization.

Additionally, the moderate differences seen compared to jumpers indicate that while mesomorphic and ectomorphic components are generally similar, variations in body fat and muscle distribution might affect performance in highly elastic and reactive strength events. Jump performance is closely associated with relative strength, lean body mass, and neuromuscular coordination (Markovic & Jaric, 2007). This suggests that targeted training programs could change certain body shape traits for greater specialization.

The current study has several limitations. First, the cross-sectional design restricts the ability to determine cause and effect between body measurements and athletic performance. Second, comparisons with elite athletes were based on published average values and standard deviations instead of individual data, which limited the use of statistical tests. Third, the study only included male participants aged 18 to 23 years, meaning the results cannot be applied to females or other age groups in the Siddi population. Finally, the lack of direct measurements of performance, physiology, and biomechanics makes it difficult to relate body traits directly to sport-specific performance outcomes. Future studies should use longitudinal designs, include female participants, and combine body measurements with physiological and performance assessments to improve talent identification models for indigenous populations.

Conclusion

The present study shows that Siddi tribe males exhibit an ectomorphic mesomorph somatotype marked by muscular robustness and moderate linearity. Comparative analysis revealed the closest morphological similarity to sprinters and boxers, with greater divergence from football players, reflecting sport-specific structural demands. Moderate differences with jumpers further suggest general alignment with track and field profiles, though event-specific conditioning may be required for specialization. These findings highlight the potential relevance of incorporating indigenous Afro-Indian populations into structured, evidence-based talent identification frameworks. The study provides reference data for the Siddi population and lays a scientific foundation for future multidisciplinary research to promote inclusivity and optimize talent development in sport.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding this research work.

Informed Consent Statement

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

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