

Investigating Anthropometric characteristics and Somatotypes in Elite Indian Track & Field Athletes

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Resumen

Introducción: Introducción: El objetivo principal de este estudio fue analizar el somatotipo y los rasgos de composición corporal de competidores masculinos de pista y campo de nivel élite en la India. Métodos: Treinta y ocho atletas masculinos de pista y campo a nivel estatal y nacional (once saltadores, cuatro corredores de media y larga distancia, diecinueve velocistas y cuatro lanzadores) participaron en el estudio. Se realizaron mediciones antropométricas para masa corporal, estatura, 8 sitios de pliegues cutáneos, 3 perímetros y 2 anchos. También se calcularon los somatotipos, el porcentaje de grasa corporal, la masa grasa y la masa corporal magra para todos los sujetos. Resultados: El análisis de comparación por pares reveló diferencias significativas en el componente endomorfo para lanzadores y atletas que compiten en eventos de velocidad (p = 0,000; IC del 95%: -2,91 a -0,73), eventos de salto (p = 0,000; IC del 95%: -3,25 a -0,94) y eventos de media o larga distancia (p = 0,002; IC del 95%: -3,46 a -0,67). El componente mesomorfo también reveló diferencias significativas entre lanzadores y atletas que compiten en eventos de velocidad (p = 0,035; IC del 95 %: -3,27 a -0,09), eventos de salto (p = 0,013; IC del 95 %: -3,72 a -0,35) y eventos de media o larga distancia (p = 0,002; IC del 95 %: -5,00 a -0,92). Se encontraron diferencias significativas en el componente ectomorfo para salto y lanzamiento (p = 0,001; IC 95%: 0,72 a 3,31), para media/larga distancia y sprint (p = 0,042; IC 95%: 0,04 a 2,48), para media/larga distancia y lanzamiento (p = 0,000; IC 95%: 1,37 a 4,52), y para sprint y lanzamiento (p = 0,004; IC 95%: 0,46 a 2,91). Se encontraron diferencias significativas en el porcentaje de grasa corporal para salto y lanzamiento (p = 0,000; IC 95%: -7,50 a -1,96), para media/larga distancia y lanzamiento (p = 0,004; IC 95%: -7,97 a -1,27), y para sprint y lanzamiento (p = 0,001; IC 95%: -6,86 a -1,64). Conclusión: Se encontró que los lanzadores eran más mesomorfos endomórficos, mientras que los corredores de media y larga distancia eran mesomorfos-ectomorfos, y los velocistas y saltadores eran mesomorfos-ectomórficos. Obtener una mejor comprensión de los somatotipos de los atletas de élite de pista y campo ayuda a establecer un punto de referencia para otros atletas indios en el deporte y ayuda a los entrenadores a mejorar sus métodos de entrenamiento.

Palabras Clave: Antropometría, Somatotipo, Atletas indios, Eventos de pista y campo

Abstract

Introduction: The main aim of this study is to analyze the somatotype and body composition traits of elite-level male track and field competitors in India. **Method:** Thirty-eight male track and field athletes at the state and national level (Eleven jumpers, four middle-and long-distance runners, nineteen sprinters, and four throwers, took part in the study. Anthropometric measurements were performed for body mass, stature, 7 skinfold sites, 3 girths, and 2 breadths. Somatotypes, body fat %, fat mass and lean body mass for all subjects were also calculated. **Results:** The pairwise comparison analysis revealed significant differences in the endomorph component for throwers and athletes competing in sprint events (p = 0.000; 95% CI: -2.91 to -0.73), jump events (p = 0.000; 95% CI: -3.25 to -0.94), and middle- or long-distance events (p = 0.002; 95% CI: -3.46 to -0.67). The mesomorph component also revealed significant differences between throwers and athletes competing in sprint events (p = 0.035; 95% CI: -3.27 to -0.09), jump events (p = 0.013; 95% CI: -3.72 to -0.35), and middle- or long-distance events (p = 0.002; 95% CI: -3.72 to -0.35), and middle- or long-distance events (p = 0.002; 95% CI: -3.72 to -0.35), and middle- or long-distance events (p = 0.002; 95% CI:

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-5.00 to -0.92). Significant differences were found in the ectomorph component for jump and throw (p = 0.001; 95% CI: 0.72 to 3.31), for middle/long distance and sprint (p = 0.042; 95% CI: 0.04 to 2.48), for middle/long distance and throw (p = 0.000; 95% CI: 1.37 to 4.52), and for sprint and throw (p = 0.004; 95% CI: 0.46 to 2.91). Significant differences were found in the body fat percentage for jump and throw (p = 0.000; 95% CI: -7.50 to -1.96), for middle/long distance and throw (p = 0.004; 95% CI: -7.97 to -1.27), and for sprint and throw (p = 0.001; 95% CI: -6.86 to -1.64). **Conclusion:** Throwers were found to be more endomorphic mesomorphs, while middle-and long-distance runners were mesomorphic-ectomorphs, sprinters and jumpers were ectomophic-mesomorphs. Gaining a better understanding of the somatotypes of elite track and field athletes, helps to establish a benchmark for other Indian athletes in the sport, and help coaches improve their training methods.

Keywords: Anthropometry, Somatotype, Indian athletes, Track and field events

Introduction

Track and field are by far the most contested events of any Olympic sport (Scheu et al., 2018). Track events encompass a range of distances, including short sprints, middle distance runs of approximately one to two miles, and long distance runs and a variety of jumping events such as triple jump, long jump, and high jump (Thing & Scheer, 2020). Field events encompass strength-based throwing events such as shot put, discus, javelin, and hammer (Thing & Scheer 2020). Indian athletes' recent achievements in the Olympics and Asian games have garnered international recognition, placing India prominently on the global stage. The global participation of Indian Track and Field competitors in international tournaments has experienced a substantial increase over recent years (Nandakumar & Sandhu, 2014; Ashwani et al., 2019).

The performance in sports is typically influenced by a variety of physiological, psychological, and biomechanical aspects, as well as the specific skill characteristics of the sport (Luthra et al., 2020; Dinesh et al., 2023). The significance of physique and morphological traits in athletics disciplines also leads to physiological advantages, such as efficient thermoregulation and a higher power-to-weight ratio (O'Connor et al., 2007). What sets running events in track-and-field apart from other sports is the remarkable diversity in the duration of each event, the level of energy required, and the rate at which energy is expended (Purnomo et al., 2014). Runners must bear their own body weight, necessitating the overcoming of gravitational force over varying distances. This necessitates a specific lean body composition as a prerequisite for more effective and economic performance in a single event (Purnomo et al., 2014). Throwers are renowned for their substantial anthropometric attributes and well-developed muscle size contributing to the generation of strength and power, which is required for high-level throwing performance (Zaras et al., 2021). Previous research on a related track and field event, the linear shot-put throw, has revealed that lean body mass is significant for throwing performance in well-trained shot putters (De Rose & Biazus, 1978). Higher lean body mass improves throwing performance in Hammer Throwers (Terzis et al., 2010).

Several recent studies have investigated the morphological and anthropometric characteristics of Indian athletes and have contributed greatly to the literature. Armendáriz et al. (2023) determined and compared the sport-specific (boxing, judo, and wrestling) somatotype of Indian female combat athletes. Bawari et al. (2023) examined the somatotype and body composition characteristics of male and female swimmers in India and investigated the potential association between these characteristics and countermovement jump metrics. Tsukru & Rhetso (2023) conducted a comprehensive analysis of the anthropometric profile and somatotype of Indian Track and Field athletes based on 10 pertinent research articles. Examining the anthropometric profiles of elite Indian Track and Field athletes is highly important given the increasing participation and increase in level of performance within these disciplines. Hence, the main aim of this study is to analyze the somatotype and body composition traits of elite-level male track and field competitors in India.

Material and Methods

Subjects

Thirty-eight male track and field athletes competing at state and national level (Eleven jumpers, four middle-and long-distance runners, nineteen sprinters, and four throwers; (mean \pm SD) age 20.4 \pm 3.8 yrs, body mass 69.9 \pm 10.6 kg, body stature 178.0 \pm 6.7 cm, and BMI 22.0 \pm 2.5 kg/m² volunteered to take part in this study. Only athletes who were associated with Inspire Institute of Sport (Vidyanagar, India) and regularly compete in national and/or international competitions were eligible to take part in the study. The study was part of the general sports science provision of the Institute and all the procedures used were reviewed and approved by the local ethics committee (EC/IIS/2023/007) and conformed to the recommendations of the Declaration of Helsinki.

Anthropometric Measurements

The anthropometric measurements were conducted according to the methodology established by the International Society for the Advancement of Kinanthropometry (ISAK handbook 2019). The anthropometric variables measured in this study were body mass, stature, skinfold thickness at seven different places (biceps, triceps, subscapular, supraspinale, abdominal, front thigh, and medial calf), three girth measurements (upper arm flexed, upper arm relaxed, and medial calf), and two breadth measurements (humeral and femoral epicondyles). Using a calibrated weighing scale (Essae DS-215, Bangalore, India), body mass was measured to the nearest 0.1 kg and stature to the nearest 0.1 cm using a stadiometer (Holtain Ltd., Crymych, United Kingdom). The skinfold thickness was measured with a calibrated Holtain skinfold caliper (Holtain Ltd., Crymych, United Kingdom) and recorded to the nearest 0.2 mm at a constant pressure of 10 g·mm⁻¹. Skinfolds were measured two times per site using a rotation technique, with a third measurement made if necessary. The estimation of body fat percentage was conducted using the standard equation proposed by Faulkner in 1966. Girths were measured with precision to the nearest 0.1 cm using a flexible anthropometric tape (Anthroflex, Minneapolis, USA). The measurements were performed by certified ISAK L1 (RA) and ISAK L2 (SP) practitioners who have extensive expertise in conducting measurements.

Skinfolds

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Sum of 4 Skinfolds = triceps + subscapular + supraspinale + abdominal

Sum of 6 Skinfolds = triceps + subscapular + supraspinale + abdominal + front thigh + medial calf
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Body Fat Percentage (Faulkner Equation)

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Body Fat (%) = 0.153 (Sum of 4 Skinfolds) + 5.783
Fat Mass (kg) = (Body Fat/100) X Body Weight
Lean Body Mass (kg) = Body Weight – Fat Mass
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Somatotype

The Heath-Carter [1967] method was followed for somatotype rating. The following equations were used for calculating somatotype components.

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Endomorphy = -0.7182 + 0.1451 \times \Sigma SF - 0.00068 \times \Sigma SF^2 + 0.0000014 \times \Sigma SF^3
where \Sigma SF = (sum of Triceps, Subscapular and Supraspinale skinfold) multiplied by (170.18/Height in cm).
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Mesomorphy = $0.858 \times$ Humerus breadth + $0.601 \times$ Femur breadth + $0.188 \times$ corrected Arm girth + $0.161 \times$ corrected Calf girth — Height × 0.131 + 4.5

Three different equations are used to calculate Ectomorphy according to the height -weight ratio (HWR):

- 1) If HWR is greater than or equal to 40.75 then, Ectomorphy = 0.732 × HWR 28.58
- 2) If HWR is less than 40.75 and greater than 38.25 then, Ectomorphy = $0.463 \times HWR 17.63$
- 3) If HWR is equal to or less than 38.25 then, Ectomorphy = 0.1

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X-Coordinate = Ectomorphy - EndomorphyY-Coordinate = 2 x Mesomorphy - (Endomorphy + Ectomorphy)
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Statistical Analysis

Data are presented as the mean \pm SD and the Statistical Package for the Social Sciences (SPSS), version 26.0, for Windows were used. Descriptive statistics were used to estimate the basic functional status of the athletes with the mean, SD, and range (minimum and maximum values) calculated for measured parameters. To determine the differences in somatotype components between events, a one-way ANOVA was performed. Assumptions of ANOVA, including normality and homogeneity of variances, were checked, and met. Tukey's HSD test was used as a post-hoc test to further identify which specific events differ significantly from each other. The level of significance was set to p \leq 0.05.

Results

Table 1 presents the descriptive statistics of demographic data (age, height, weight, BMI), anthropometric measurements (skinfolds, girths, breadths, height-weight ratio, sum of skinfolds), somatotype body components (endomorph, mesomorph, ectomorph) and percent body fat.

 Table 1. Proportionality and kinanthropometric descriptive characteristics.

Parameters	Jump (n=11)			Middle/Long Distance (n=4)			Sprint (n=19)			Throw (n=4)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Basic Measurements												
Age (Years)	21.5	4.2	12.0	20.3	5.3	12.0	20.4	3.3	11.0	17.5	1.9	4.0
Height (cm)	179.5	6.5	22.6	176.3	3.1	6.7	177.5	7.2	26.6	176.2	7.86	18.4
Weight (kg)	69.6	6.9	22.2	60.7	7.4	15.6	70.0	11.5	43.3	80.6	4.8	9.7
BMI (kg/m²)	21.6	1.3	3.6	19.5	1.9	4.4	22.1	2.3	9.5	26.0	1.5	3.6
Skinfold Thickness (mm)												
Triceps	5.3	1.3	3.5	6.2	1.7	3.6	6.4	2.0	7.7	13.5	4.3	9.7
Subscapular	8.5	1.3	3.7	7.9	0.4	0.9	9.5	3.5	16.3	13.3	3.3	7.2
Biceps	3.3	0.7	2.1	4.3	1.7	3.5	3.3	0.8	3.0	6.6	3.5	7.4
Supraspinale	5.5	1.1	3.6	5.0	0.7	1.4	5.8	2.6	12.0	12.3	7.0	15.3
Abdominal	8.7	2.9	8.5	9.5	4.2	9.1	9.4	4.4	19.3	19.7	8.9	21.0
Front Thigh	6.0	1.7	5.5	8.0	1.4	2.9	7.6	3.2	14.0	16.5	7.0	15.1
Medial Calf	4.3	1.2	3.0	4.7	1.8	4.3	5.0	2.0	8.9	12.3	6.5	14.6
		1	L		Girth	s (cm)	I	I		l	l	L
Arm (Relaxed)	28.4	2.3	7.3	25.6	1.9	4.5	29.2	3.2	13.0	32.5	1.5	3.6
Arm (Flexed)	31.2	2.3	7.6	28.1	2.7	6.5	32.1	3.0	10.5	34.6	1.3	3.1
Calf	35.9	1.3	4.2	33.8	4.0	8.6	36.4	2.9	8.5	39.0	1.7	3.6
	1				Breadt	ths (cm)						
Humerus	6.6	0.3	1.0	6.2	0.4	1.0	6.4	0.5	2.0	6.9	0.3	0.8
Femur	9.2	0.5	1.7	9.2	0.1	0.3	9.3	0.6	2.0	10.0	0.4	1.0
	1			Cori	rected	Girths (cr	n)					
Corrected Arm Girth	30.7	2.3	7.4	27.5	2.8	6.9	31.5	2.9	9.9	33.3	1.2	2.8
Corrected Calf Girth	35.4	1.3	4.3	33.3	3.9	8.3	35.9	2.9	8.2	37.7	1.9	4.1
HWR (cm/kg ^{1/3})	43.7	1.0	2.8	45.0	1.4	3.3	43.2	1.2	5.0	40.8	1.3	2.9
	•			Soma	totype	Compone	ents					
Endomorphy	1.7	0.4	1.0	1.7	0.3	0.7	2.0	0.8	3.4	3.8	1.4	3.1
Mesomorphy	3.7	1.2	3.5	2.8	0.6	1.5	4.0	1.1	4.6	5.7	1.0	2.3
Ectomorphy	3.4	0.7	2.0	4.3	1.0	2.4	3.1	0.9	3.5	1.4	0.9	1.9

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	Sum of Skinfolds (mm)											
Sum of 4 Skinfolds	27.9	5.3	15.3	28.6	6.0	14.3	31.0	11.8	54.1	58.8	23.0	50.6
Sum of 6 Skinfolds	38.2	7.3	21.2	41.3	6.1	12.8	43.5	16.5	77.0	87.6	35.3	78.3
Body Fat (%)	10.1	8.0	2.3	10.3	0.9	2.2	10.5	1.8	8.3	14.8	3.5	7.7
Fat Mass (kg)	7.0	0.9	2.57	6.3	0.8	1.73	7.5	2.4	11.6	11.9	2.8	6.4
Lean Body Mass (kg)	62.6	6.3	19.8	54.5	6.9	14.5	62.5	9.6	32.6	68.7	5.1	11.4

Note: M = Mean; SD = Standard Deviation; HWR = Height Weight Ratio (cm/kg^{1/3})

Table 2 and Table 3 provide an inferential statistical analysis comparing somatotype components across the different events in track and field. Figure 1 illustrates the individual positions of each event on the somatotype chart. The pairwise comparison analysis revealed significant differences in the endomorph component for jump and throw (p = 0.000; 95% CI: -3.25 to -0.94), for middle/long distance and throw (p = 0.002; 95% CI: -3.46 to -0.67), and for sprint and throw (p = 0.000; 95% CI: -2.91 to -0.73). Additionally, significant differences were found in the mesomorph component for jump and throw (p = 0.013; 95% CI: -3.72 to -0.35), for middle/long distance and throw (p = 0.002; 95% CI: -5.00 to -0.92), and for sprint and throw (p = 0.035; 95% CI: -3.27 to -0.09). Moreover, significant differences were found in the ectomorph component for jump and throw (p = 0.001; 95% CI: 0.72 to 3.31), for middle/long distance and sprint (p = 0.042; 95% CI: 0.04 to 2.48), for middle/long distance and throw (p = 0.000; 95% CI: 1.37 to 4.52), and for sprint and throw (p = 0.004; 95% CI: 0.46 to 2.91). In addition, significant differences were found in the body fat percentage for jump and throw (p = 0.000; 95% CI: -7.50 to -1.96), for middle/long distance and throw (p = 0.004; 95% CI: -7.97 to -1.27), and for sprint and throw (p = 0.001; 95% CI: -6.86 to -1.64).

Table 2. ANOVA of Results

			Sum of Squares	df	Mean Square	F	sig.
	Between (Combined)	Groups	14.02	3	4.673	8.736	0.000
Endomorphy * Event	Within Groups		18.188	34	0.535		
	Total		32.208	37			
	Between (Combined)	Groups	19.135	3	6.378	5.589	0.003
Mesomorphy * Event	Within Groups		38.803	34	1.141		
	Total		57.938	37			
	Between (Combined)	Groups	18.789	3	6.263	9.229	0.000
Ectomorphy * Event	Within Groups		23.074	34	0.679		
	Total		41.864	37			
Sum of 4 Skinfolds *	Between (Combined)	Groups	3102.984	3	1034.328	7.851	0.000
Event	Within Groups		4479.202	34	131.741		
	Total		7582.186	37			
Sum of 6 Skinfolds *	Between (Combined)	Groups	7804.259	3	2601.42	9.578	0.000
Event	Within Groups		9234.113	34	271.592		
	Total		17038.372	37			

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Percent Body Fat * Event	Between Group (Combined)		72.6	3	24.2	7.846	0.000
	Within Groups		104.866	34	3.084		
	Total		177.466	37			
	Between (Combined)	Groups	86.998	3	28.999	7.152	0.001
Fat Mass * Event	Within Groups		137.869	34	4.055		
	Total		224.867	37			

Table 3. Post Hoc Analysis (Tukey's HSD)

Dependent Variable	(I) Event	(J) Event	Mean Difference (I-J)	Std. Error	Significance	95% Confide Interval	
						Bound	Bound
ENDOMORPHY	JUMP	MD/LD	-0.0248	0.42705	1	-1.178	1.1286
		SPRINT	-0.2736	0.27711	0.758	-1.022	0.4748
		THROW	-2.0923*	0.42705	0	-3.246	-0.939
	MD/LD	JUMP	0.0248	0.42705	1	-1.129	1.1781
		SPRINT	-0.2488	0.40236	0.925	-1.336	0.8379
		THROW	-2.0675*	0.51718	0.002	-3.464	-0.671
	SPRINT	JUMP	0.2736	0.27711	0.758	-0.475	1.022
		MD/LD	0.2488	0.40236	0.925	-0.838	1.3355
		THROW	-1.8187*	0.40236	0	-2.905	-0.732
	THROW	JUMP	2.0923*	0.42705	0	0.9389	3.2456
		MD/LD	2.0675*	0.51718	0.002	0.6707	3.4643
		SPRINT	1.8187*	0.40236	0	0.732	2.9054
MESOMORPHY	JUMP	MD/LD	0.9248	0.62376	0.459	-0.76	2.6094
		SPRINT	-0.359	0.40475	0.812	-1.452	0.7341
		THROW	-2.0377*	0.62376	0.013	-3.722	-0.353
	MD/LD	JUMP	-0.9248	0.62376	0.459	-2.609	0.7599
		SPRINT	-1.2838	0.5877	0.148	-2.871	0.3034
		THROW	-2.9625*	0.75541	0.002	-5.003	-0.922
	SPRINT	JUMP	0.359	0.40475	0.812	-0.734	1.4522
		MD/LD	1.2838	0.5877	0.148	-0.303	2.8711
		THROW	-1.6787*	0.5877	0.035	-3.266	-0.091
	THROW	JUMP	2.0377*	0.62376	0.013	0.3531	3.7224
		MD/LD	2.9625*	0.75541	0.002	0.9223	5.0027
		SPRINT	1.6787*	0.5877	0.035	0.0914	3.2659

ECTOMORPHY	JUMP	MD/LD	-0.927	0.481	0.236	-2.226	0.372
		SPRINT	0.3323	0.31211	0.713	-0.511	1.1753
		THROW	2.0155*	0.481	0.001	0.7164	3.3145
	MD/LD	JUMP	0.927	0.481	0.236	-0.372	2.2261
		SPRINT	1.2593*	0.45319	0.042	0.0354	2.4833
		THROW	2.9425*	0.58252	0	1.3692	4.5158
	SPRINT	JUMP	-0.3323	0.31211	0.713	-1.175	0.5107
		MD/LD	-1.2593*	0.45319	0.042	-2.483	-0.035
		THROW	1.6832*	0.45319	0.004	0.4592	2.9071
	THROW	JUMP	-2.0155*	0.481	0.001	-3.315	-0.716
		MD/LD	-2.9425*	0.58252	0	-4.516	-1.369
		SPRINT	-1.6832*	0.45319	0.004	-2.907	-0.459
PERCENT BODY	JUMP	MD/LD	-0.1098	1.02541	1	-2.879	2.6597
FAT		SPRINT	-0.4767	0.66537	0.89	-2.274	1.3203
		THROW	-4.7298*	1.02541	0	-7.499	-1.96
	MD/LD	JUMP	0.1098	1.02541	1	-2.66	2.8792
		SPRINT	-0.367	0.96613	0.981	-2.976	2.2424
		THROW	-4.6200*	1.24183	0.004	-7.974	-1.266
	SPRINT	JUMP	0.4767	0.66537	0.89	-1.32	2.2738
		MD/LD	0.367	0.96613	0.981	-2.242	2.9763
		THROW	-4.2530*	0.96613	0.001	-6.862	-1.644
	THROW	JUMP	4.7298*	1.02541	0	1.9603	7.4992
		MD/LD	4.6200*	1.24183	0.004	1.266	7.974
		SPRINT	4.2530*	0.96613	0.001	1.6437	6.8624

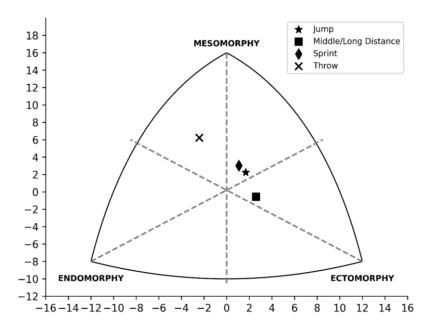


Figure 1. Somatoplot of male jumpers, middle/long distance runners, sprinters and throwers.

Discussion

The primary aim of this study was to determine the anthropometric characteristics of elite Indian male track and field athletes. This study shows the anthropometric characteristics of each athlete and the findings revealed that all the three components related to endomorphy, mesomorphy and ectomorphy were significantly different in throwers, when compared to jumpers, sprinters, and middle- and long-distance runners (Table 1, 2 and 3; Fig.1). The anthropometric parameters of the study's participants align with previous research on track and field athletes' anthropometric traits (Abraham, 2010; Eiin et al., 2007; Stachon et al., 2023). Shafeeq et al. (2010) conducted a study on university level jumpers, throwers, sprint, middle-and long-distance events in athletics and reported that the sprinters and middle-distance runners are more ectomorphic-mesomorphs, that middle distance runners are more mesomorphic-ectomorphs, that jumpers are balanced mesomorphs and that throwers are endomorphic-mesomorphs. The study's cohort only consisted of athletes from the southern part of India, unlike the present study.

The body composition and physique can help determine the level at which an athlete would be able to perform during competitions (Bell & Rhodes, 1975; Toriola et al., 1987). According to Carter et al. (1982), middle-and long-distance runners are typically more mesomorphic. However, the current study's participants for middle-and long-distance events exhibit more ectomorphic characteristics in these groups, indicating a lower fat mass compared to top Olympic athletes as described by Carter et al. (1982). In contrast, the somatotype traits of the throwers, jumpers, and sprinters in this study correspond with those reported by Carter et al. (1982).

Notably, this study found a higher prevalence of endomorphic-mesomorph throwers, which is in line with the study conducted by Ashwani et al. (2019) who looked at the somatotype of Indian Under-17 track and field athletes and found a similar body type to the present study. This is likely due to the specific muscle requirements for maximizing throwing distance by overcoming the reactive resistance force of the object (Eiin et al., 2007). The body composition also assists athletes to maintain balance during the release of the object. The substantial energy required by throwers is facilitated by the composition of their muscles. In order to develop more strength and power capacities, throwers usually undergo rigorous strength and conditioning training in order to build the muscles required to facilitate them to generate enough power in 150-240 milliseconds (Bartlett & Best, 1988; Gutierrez et al., 2002). This continual strength and power training increases the muscle composition in the body which is attributed to most professional and elite throwers being a more endomorphic-mesomorph body type. This indicates that the build is usually and mostly made up of muscles. It has been reported that heavier built athletes encompass more distance when compared to lighter athletes, however the correlations between the two was found to be minimal (Zaras et al., 2021). This is due to the method in which the athlete releases the object, as it has already been established that athletes with lower lean mass cannot generate as much explosive power and strength compared to athletes with greater lean mass (Singh et al., 2011; Singh et al., 2012; Zaras et al., 2021). This is exclusively appropriate for events such as hammer throw, discus throw and shot put where the main technique requires a rotational release of the object. Contrary to that, while using linear throwing technique, having a lower lean mass has been seen to be beneficial for shot put and hammer throw athletes (Anousaki et al., 2018; Kyriazis et al., 2010).

The middle- and long-distance athletes who participated in this study exhibited more of mesomorphicectomorph characteristics, exhibiting more ectomorphic characters than previously conducted research on somatotype of middle- and long-distance athletes (Carter et al., 1982; Stachoń et al., 2023). Tsukru & Rhetso (2023) reported that Indian runners are placed in the balanced mesomorphic category. However, it should be noted that the mean was established by using the data of runners of all categories including sprinters compromising of shorter distances. Shafeeg et al., (2010) reported that the middle- and long- distance runners in their study had more endomorphic characteristics which is different from the current study. The somatotype of the participants of the current study are very similar to that of the female somatotype of the participants in the study conducted by Eiin et al. (2007). This indicates that the participants from the middle- and long-distance events of the current study exhibit more ectomorph characteristics than their male counterparts from existing studies. It has already been established that somatotype and body fat percentage correlate with sport performance (Carter & Yuhasz, 1984; Legaz & Eton, 2005). This is especially true for middle- and long-distance athletes as carrying as little weight as possible throughout the race makes it easier to maintain an economical pace. Hence having a lean body mass would be very beneficial for middle- and long-distance runners. Additionally, having lesser body fat aids athletes as they would be running for a long time, the core body temperature of the athlete increases as the time progresses and having lesser body fat mass helps in the convection of body heat from the body to the surrounding environment (Ashwani et al., 2019). The improved heat exchange that is experienced by these athletes helps keep the core body temperature lower and in turn delaying the performance detriments caused due to the heat.

The sprinters and jumpers in this study have exhibited the somatotype of ectomorphic- mesomorph, which meets the expected somatotype with regards to their respective events. Battinelli (2000) reported that sports requiring both strength and speed rank higher towards mesomorphic body type and lesser on ectomorphic type. There have been many studies that have assessed the somatotype of runners and jumpers, and our results are in close alignment with previously established results (Arazi et al., 2015; Bale et al., 1985; Singh & Sharma, 2019). The mean height of the jumpers recruited for this study is shorter than many existing studies (Hollings & Robson, 1991; Singh et al., 2010; Singh & Sharma, 2019). This may be due to the fact that many other research included only high jumpers whereas the cohort of the current study consists of long jumpers, triple jumpers and high jumpers. Most high jumpers who are recruited or participate in the event are mostly tall as they have an added advantage during competitions. Another reason behind why the height of the current cohort is lesser may be because the jumpers are recruited from all across India. Whereas the previous research is from parts of India where the people are generally taller or from countries where the average height of the population is taller than the average height of Indian athletes. Weyand & Devis (2005) have reported that running performance is inherently dependent on the structural predisposition of the athlete. This statement is supported by Barbieri et al. (2017), who stated that mesomorphic somatotype in sprinters was largely positively correlated to performance whereas, ectomorphic somatotype was negatively correlated to performance. The interlink between performance and body type is due to the demands of the sport. Both sprinting and jumping events require athletes to generate a substantial amount of power instantaneously and this generation of power is acquired with the presence of adequate muscle mass. It is interesting to highlight that, athletes who are sprinters and jumpers have a mesomorphic body type is something most commonly seen in elite level athletes as it is not the presence of excess fat composition in the body that makes them look heavily built; rather it is the composition of muscle density in their body.

Conclusion

This study was conducted to gain a better understanding of the somatotypes of elite track and field athletes, aiming to establish a benchmark for other Indian athletes in the sport. Insights into the somatotypes of these athletes will also help coaches improve their training methods. Participants recruited for the current study consisted of elite Indian male national track and field athletes. Based on the results obtained from this study, it has been found that athletes from different track and field events have different somatotypes. This difference is directly correlated to their performance. Throwers were found to be more endomorphic mesomorphs, middle-and long-distance runners were mesomorphic-ectomorphs, sprinters and jumpers were ectomorphic-mesomorphs.

Practical Applications

Somatotype-based research in track and field athletes is crucial as it helps tailor training and nutrition plans to individual body types, optimizing performance, and reducing injury risk. It enhances talent identification by matching athletes' somatotypes to suitable events. Additionally, it contributes to a deeper understanding of the physiological demands and adaptations in various track and field disciplines.

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Data availability

Full access to data on request.

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Conflicts of Interest

The Authors have no conflicts of interest to declare that they are relevant to the content of this article.

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