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Anthropometric Characteristics and Somatotype of Elite Indian Boxers

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Resumen

Introducción: existe una investigación limitada sobre las características antropométricas y los somatotipos de los boxeadores masculinos indios de élite, lo que motiva este estudio para llenar el vacío y proporcionar información sobre las variaciones entre las categorías de peso para la identificación de talentos y la mejora del rendimiento en el boxeo indio. El estudio tuvo como objetivo examinar las variaciones en las características antropométricas y los somatotipos de los boxeadores indios de élite en tres categorías de peso diferentes: boxeadores de peso ligero (< 60 kg), boxeadores de peso medio (61-74 kg) y boxeadores de peso pesado (> 75 kg). **Métodos:** se recopilaron datos de 35 boxeadores indios de élite con rangos de edad de 19 a 29 años en NSNIS, Patiala durante el campamento nacional de boxeo 2021. Las variables antropométricas se midieron siguiendo los métodos estandarizados de la Sociedad Internacional para el Avance de la Cineantropometría (ISAK), Heath y la ecuación de somatotipo de Carter se utilizaron para el cálculo del somatotipo. **Resultados:** La altura, el peso y el somatotipo medios de los boxeadores masculinos indios de élite fueron 175,2 ± 8,4, 69 ± 15,3 y 2,3 ± 1,0 – 4,9 ± 0,9 – 2,9 ± 1,1 respectivamente. **Conclusiones:** Los boxeadores de peso ligero son mesomorfos ectomorfos, los boxeadores de peso medio son mesomorfos equilibrados y los boxeadores de peso pesado son mesomorfos endomórficos con mayor talla e IMC.

Palabras Clave: Variables antropométricas, Endomorfia, Mesomorfia, Ectomorfia

Abstract

Introduction: Limited research exists on the anthropometric characteristics and somatotypes of elite Indian male boxers, motivating this study to fill the gap and provide insights into the variations across weight categories for talent identification and performance enhancement in Indian boxing. The study aimed to examine variations in anthropometric characteristics and somatotypes of elite Indian boxers in three different weight categories: light weight boxers (< 60 kg), middle weight boxers (61-74 kg), and heavy weight boxers (> 75 kg). **Methods:** Data were collected from 35 elite Indian male boxers with age ranges from 19 - 29 years at NSNIS, Patiala during the boxing national camp 2021. Anthropometric variables were measured following the International Society for the Advancement of Kinanthropometry (ISAK) standardized methods, Heath and Carter's somatotype equation were used for somatotype calculation. **Results:** Mean height, weight and somatotype of the elite Indian male boxers were 175.2 ± 8.4, 69 ± 15.3 and 2.3 ± 1.0 – 4.9 ± 0.9 – 2.9 ± 1.1 respectively. **Conclusions:** Light weight boxers are ectomorphic mesomorph, middle weight boxers are balanced mesomorph and heavy weight boxers are endomorphic mesomorph with greater height and BMI.

Keywords: Anthropometric variables, Endomorphy, Mesomorphy, Ectomorphy

Introducción

Sports performance of boxing is determined by various factors for optimum performance at an elite level, boxing is a game where body composition, size, proportion and shape play an important role in providing a distinct advantage in the game of boxing. To understand the quantification of body physique in terms of body shape and composition independent of body size, somatotype is a convenient shorthand method. Anthropometric variables are measured to obtain somatotypes and somatotypes are calculated using Heath and Carter's anthropometric somatotype method. Somatotype combines an appraisal of the body physical components – endomorphy or relative adiposity; mesomorphy or relative musculoskeletal robustness; and ectomorphy or relative linearity – into a three-number rating (Carter & Heath, 1990). Somatotyping has been used in talent identification for many sports such as gymnastics, rowing, strength training, basketball, martial arts, swimming, netball, and figure skating (Berry, 1972; Biswas & Ghosh, 2020; Gakhar & Malik, 2002; Gualdi-Russo & Graziani, 1993; Gupta et al., 2011; Parnell, 1954; Smith & Norton, 2002; Sterkowicz-Przybycien & Gualdi-Russo, 2019; Sterkowicz-Przybycień et al., 2011; Tóth et al., 2014). The purpose of this study is to examine variations in anthropometric characteristics and somatotypes among the weight categories.

Material and Methods

The present cross-sectional study was conducted on 35 elite Indian male boxers with age ranges from 19 to 29 years at the Department of Anthropometry, SAI NSNIS Patiala, India. Boxers are categorized into three weight categories: Light Weight Boxers (LWB: < 60 kg); Middle Weight Boxers (MWB: 61-74 kg); and Heavy Weight Boxers (HWB: > 75kg).

A total of 31 anthropometric variables were recorded where stature was taken by SECA digital BMI machine (Model no. 284: precision of 0.1cm), body weight was measured by Body composition analyzer (Accuniq; BC 720: precision of 0.1kg), with participants wearing shorts only (Smith & Norton, 2002). Skinfold measurements were taken using a GPM Holtain skinfold caliper, with a gradation of 1.0 mm. Skinfold thickness were obtain from the biceps, triceps, lateral forearm, sub scapulare, suprailliac, supraspinale, front thigh, calf (Hume & Marfell-Jones, 2008). The circumference of the midle upper arm relax (MUAC), upper arm flexed and tensed (UAF), forearm, waist, hip, thigh and calf were obtained by using a flexible measuring tape (Hoechstmass, West Germany). The bone breadth of the humerus, wrist, femur and ankle were measured by using a Holtain vernier caliper. Bi-acromial (Bi-acr.) and bi-iliac breadth was measured by rod compass and long linear parameters viz. height trochanterion (Ht. tro.), height tibiale (Ht. tib.), height acromiale (Ht. acr.), height radiale (Ht. rad.), height stylion (Ht. sty.), height dactylion (Ht. dact.), and arm span were measured with anthropometric rod (GPM), sitting height was measured by sitting height table (Holtain Ltd.). All the participants were clinically healthy without morphological aberrations. Consent was taken from each athlete for this study.

All the anthropometric measurements were taken before the practice session following the standard protocol of ISAK (ISAK Manual 2019). Body mass index (BMI) is calculated by the formula weight in kg. divided by the square of height in meters. Waist-hip ratio (WHR) is calculated as waist circumference divided by hip circumference. Heath - Carter (1967) method is used for calculating somatotype components namely Endomorphy (ENDO.), Mesomorphy (MESO.), and Ectomorphy (ECTO.). Data analysis was performed using Analysis of Variance (ANOVA) followed by post hoc tests to assess the differences among the weight categories at a significance level of ≤ 0.05.

Results

The chronological age of LWB ranged from 19.0 to 26.8 years, with a mean age of 22.6 ± 2.2 years. The MWB mean chronological age was 24.0 ± 3.2 years, ranging from 20.4 to 29.3 years. And HWB chronological age ranged from 19.0 to 28.9 years, with a mean age of 23.7 ± 3.6 years. Anthropometric characteristics and somatotypes of LWB, MWB and HWB are described in Table 1 and Table 2. The MWB are found older as compared to HWB followed by LWB. The result of the analysis of variance of anthropometric variables and somatotype components are shown significant differences among weight categories for height, weight, BMI, height acromiale, arm span, sitting height, and bi-iliac breadth. Whereas LWB and HWB was found significantly different in the height trochanterion, height tibiale. Further, height radiale, height stylion, height dactylion and bi-acromial breadth were found significant difference between LWB to HWB and MWB to HWB.

The girth was typically significantly greater among HWB than MWB followed by LWB, except for waist girth which was not showing a significant difference between MWB and HWB. HWB and MWB generally possessed larger bony diameters than light weight boxers but a significant difference was only found between the LWB and HWB. Skinfold thickness was found significant difference between LWB and HWB. Moreover, calf skinfold was shown

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significant differences among all the weight categories. No significant difference was observed for waist-hip ratio. BMI was significantly greater among HWB than MWB followed by LWB. A significant difference was found in the endomorphy component for LWB to HWB. Mesomorphy and ectomorphy components are found significant differences between the LWB to MWB and LWB to HWB.

Table 1. Weight Category-wise Anthropometric Characteristics of Elite Indian Boxers

	Light weight	**Middle weight** □	**Heavy weight #**	**Combined**	***F* VALUE**
n	16	8	11	35	
Age (years)	22.7 ± 2.3	24.0 ± 3.2	23.7 ± 3.6	23.3 ± 2.9	0.710^{NS}
Height (cm)	168.7$^{\square\#}$ ± 5.0	176.3$^{\#}$ ± 4.6	183.9 ± 6.3	175.2 ± 8.4	26.45
Weight (kg)	55.9$^{\square\#}$ ± 4.5	70.5$^{\#}$ ± 3.3	87.0 ± 11.3	69.0 ± 15.3	61.08
Ht. tro.	88.5$^{\#}$ ± 4.1	92.7 ± 3.9	96.6 ± 4.4	92.0 ± 5.4	12.44
Ht. tib	48.4$^{\#}$ ± 3.1	48.7 ± 2.1	54.6 ± 9.1	50.4 ± 6.2	4.45
Ht. acr.	137.4$^{\square\#}$ ± 4.7	143.6$^{\#}$ ± 4.9	151.3 ± 6.4	143.2 ± 8.0	22.54
Ht. rad.	105.6$^{\#}$ ± 3.9	110.0$^{\#}$ ± 3.8	115.6 ± 5.8	109.7 ± 6.2	15.67
Ht. sty	80.7$^{\#}$ ± 3.4	84.4$^{\#}$ ± 3.5	89.3 ± 4.0	84.2 ± 5.1	18.67
Ht. dact.	62.0$^{\#}$ ± 2.7	65.3$^{\#}$ ± 3.2	69.1 ± 3.4	65.0 ± 4.3	17.51
Arm span	177.4$^{\square\#}$ ± 5.5	183.8$^{\#}$ ± 4.4	192.6 ± 6.8	183.6 ± 8.7	22.85
Sitting ht.	86.2$^{\square\#}$ ± 2.3	90.1$^{\#}$ ± 2.3	93.6 ± 3.5	89.4 ± 4.2	24.44
Bi-acr.	38.5$^{\#}$ ± 1.2	39.6$^{\#}$ ± 2.7	42.9 ± 1.0	40.2 ± 2.5	23.74
Bi-iliac	25.1$^{\square\#}$ ± 1.3	27.8$^{\#}$ ± 1.3	30.1 ± 2.2	27.4 ± 2.7	30.00
Bone diameter (cm)					
Humerus	6.6$^{\square\#}$ ± 0.4	7.2 ± 0.1	7.5 ± 0.4	7.0 ± 0.5	21.50
Wrist	5.7$^{\#}$ ± 0.5	5.9 ± 0.3	6.1 ± 0.4	5.8 ± 0.4	3.35
Femur	9.2$^{\square\#}$ ± 0.4	10.0 ± 0.4	10.3 ± 0.5	9.7 ± 0.6	21.41
Ankle	6.8$^{\square\#}$ ± 0.3	7.4 ± 0.3	7.6 ± 0.5	7.2 ± 0.5	15.89
Girths (cm)					
UAN	26.4$^{\square\#}$ ± 1.0	29.5$^{\#}$ ± 1.2	33.0 ± 1.7	29.2 ± 3.2	82.58
UAF	30.2$^{\square\#}$ ± 1.2	32.8$^{\#}$ ± 1.1	37.3 ± 2.3	33.0 ± 3.5	63.24
Forearm	25.0$^{\square\#}$ ± 1.0	27.4$^{\#}$ ± 1.1	29.2 ± 1.8	26.9 ± 2.2	33.51
Thigh	49.1$^{\square\#}$ ± 2.3	53.5$^{\#}$ ± 1.7	58.8 ± 3.6	53.2 ± 5.0	41.31
Calf	32.1$^{\square\#}$ ± 1.0	35.4$^{\#}$ ± 1.5	37.3 ± 2.0	34.5 ± 2.8	41.31
Waist	66.3$^{\square\#}$ ± 11.6	77.6 ± 4.4	83.5 ± 10.2	74.3 ± 12.4	10.27
Hip	83.0$^{\square\#}$ ± 3.6	91.9$^{\#}$ ± 3.3	99.8 ± 6.9	90.3 ± 8.8	40.10
Skinfolds					
Biceps	2.9$^{\#}$ ± 0.5	3.9 ± 1.0	4.1 ± 1.8	3.5 ± 1.3	4.52
Triceps	6.3$^{\#}$ ± 1.7	9.1 ± 3.1	10.0 ± 3.3	8.1 ± 3.1	7.51
Fore	4.2$^{\#}$ ± 1.0	5.3 ± 0.9	6.1 ± 2.7	5.1 ± 1.9	3.83
Subscapulare	7.6$^{\#}$ ± 1.8	9.5 ± 2.0	12.9 ± 5.7	9.7 ± 4.2	7.51
Supaspinale	6.1$^{\#}$ ± 1.6	9.8 ± 4.3	11.2 ± 5.2	8.5 ± 4.3	6.80
Suprailliac	4.5$^{\#}$ ± 1.3	7.6 ± 3.5	9.5 ± 4.4	6.8 ± 3.7	8.59
Thigh	6.2$^{\#}$ ± 2.0	10.3 ± 4.3	15.0 ± 7.2	9.9 ± 6.0	11.42
Calf	3.9$^{\square\#}$ ± 1.2	5.7$^{\#}$ ± 1.7	7.6 ± 1.6	5.5 ± 2.1	20.09

NS: Non-significant

□ Significant difference ($p < 0.05$) from the middle weight categories.

Significant difference ($p < 0.05$) from the heavy weight categories.

Figure 1, reveals that skinfold thickness was greater in the HWB as compared to MWB and LWB. Despite the difference in the anthropometric measurements between the weight categories, there is a distinct skinfold profile covering all three categories. Based on this profile can be divided into three categories; large variability site (thigh and subscapulare skinfolds) mid variability site (supra iliac, supraspine, calf and triceps skinfolds) and small variability site (biceps and forearm skinfolds). Figure 2 shows the category-wise somatochart of elite Indian boxers.

Table 2. Weight Category-wise Derived Indices and Somatotype of Elite Indian Boxers

	Light weight	**Middle weight** □	**Heavy weight #**	**Combined**	***F* VALUE**
n	16	8	11	35	
Derived Indices					
WHR	0.80 ± 0.14	0.84 ± 0.03	0.83 ± 0.08	0.82 ± 0.10	0.51^{NS}
BMI	$19.6^{\square\#}$ ± 1.2	$22.8^{\#}$ ± 0.8	25.6 ± 2.3	22.2 ± 3.0	49.59
Somatotype					
ENDO	$1.7^{\#}$ ± 0.5	2.5 ± 0.8	3.0 ± 1.1	2.3 ± 1.0	8.05
MESO	$4.3^{\square\#}$ ± 0.6	5.2 ± 0.7	5.7 ± 0.8	4.9 ± 0.9	13.62
ECTO	$3.7^{\square\#}$ ± 0.7	2.7 ± 0.6	1.9 ± 0.7	2.9 ± 1.1	24.54

NS: Non-significant

□ Significant difference ($p < 0.05$) from the middle weight categories.

Significant difference ($p < 0.05$) from the heavy weight categories.

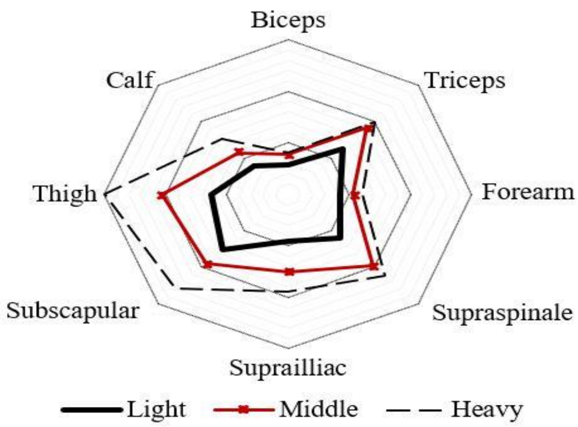

Figure 1. Weight Category-wise Skinfold thickness (mm) of Elite Indian Boxer

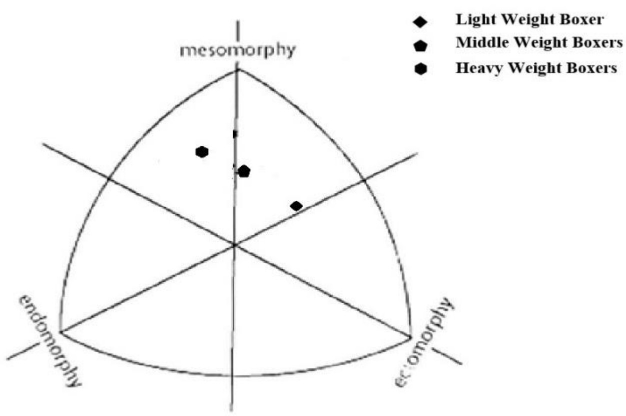

Figure 2. Weight Category-wise Somatochart of Elite Indian Boxer

Discussion

Heavy weight boxers tend to be significantly taller and heavier, have higher mesomorphy than their lighter counterpart. Middle weight boxers generally possessed anthropometric characteristics that were intermediate to those of the light weight and heavy weights. LWB were ectomorphic mesomorph, MWB were balanced mesomorph, and HWB have a higher endomorphy component denoted endomorphic mesomorph somatotype (Table: 2). Despite the somatotypic difference between weight categories Table 2 reveals that among the boxers of all the weight categories endomorphy and mesomorphy increased and ectomorphy decreased with the ascending order of weight categories.

Further, the identification of the physical attributes that may contribute to success in sports has long interested sports scientists and coaches (Carter et al., 2005), this is especially important in power games like boxing. Boxing, not only for male but female also, differ significantly from the normal population in their physical and morphological make up. Also, there are structural differences among the athlete in the different sports (Bonilla et al., 2021; Pion et al., 2015) and even among the weight categories (Davis & Beneke, 2016; Keogh et al., 2007a, 2007b; Lal Khanna & Manna, 2006; Lovera & Keogh, 2015). Although anthropometric characteristics of Olympic athletes are already available (Carter J & Heath-Roll B., 1990) but there is still a need for sports-specific reference value, to establish sports-specific anthropometric characteristics. Evidence shows that there is structural as well as functional differences among athletes of different sports (Bertini et al., 2003; Chandra Saha, 2012; Ochi et al., 2015) even among events (Mooses et al., 2013) and weight categories.

Conclusion

A significant difference was found in the anthropometric characteristics in the light weight and heavy weight categories. So, it can be concluded that the light weight category had different anthropometric characteristics as compare to the middle and heavy weight categories. Since anthropometric statistics on Indian boxers are insufficient, the recent study might supply useful data help to promote boxing training. Anthropometric characteristics are considered indicators of changes in body systems as a result of training. In short, detecting relationships associated with the effects of training on anthropometric aspects adds new dimensions that can assist in evaluating, directing and developing athletes training programme.

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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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