

# Positional differences in morphology, somatotype and body composition characteristics in university level Indian footballers

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**Objective:** The purpose of this study was to describe the morphological, somatotype, and body composition characteristics of Indian university level football players based upon their field position.

**Design:** Cross-sectional study.

**Methods:** A total of 204 male football players from sixteen different Indian universities volunteered for this study. Anthropometric measurements included body weight and height, five muscle girths (upper arm, forearm, chest, thigh and calf), four bone widths (humerus biepicondylar, bistyloideus, femur biepicondylar and bimalleolar) and eight skin-fold thicknesses (triceps, subscapular, pectoral, axilla, abdominal, supriliac, mid thigh and calf) were measured. Further, somatotype (endomorph, mesomorph, ectomorph) and body composition (BMI, % fat, skeletal muscle mass, skeletal mass) were assessed.

**Results:** One-way analysis of variance (ANOVA) was used to observe differences of means among the groups. In order to determine which group was different from other group Tukey post hoc test applied. Compared to other field players, goalkeepers showed higher values for body height, body weight, upper arm girth ( $p < 0.05$ ), more but not excessive body fat. Defenders, midfielders and strikers were ectomorphic mesomorph whereas goalkeepers were endomorphic mesomorph in physique.

**Conclusion:** University level Indian footballers were average in height, weight, and muscle mass.  
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**Key words:** anthropometric ■ body composition ■ somatotype

## INTRODUCTION

Many factors are important in determining the success of a football player or a team. Football players have to adapt to the physical demands of the game, which are multifactorial. Players may not need to have an extraordinary capacity within any one of the areas of physical performance but must possess a reasonably high level within all areas. Morphological characteristics, body composition and somatic dimensions play a vital role in determining the success of an athlete.<sup>1-4</sup> During a football match, the player's movements are characterized by high intensity, short-term actions and pauses of varying length. To be successful in such a team sport, football players need an optimal combination of technical, tactical, physical characteristics (e.g. somatotype and body composition), and mental motivation<sup>5-7</sup>, among other sports characteristics. Hence, for football coaches, managers, sports physiotherapists, and scientists, an in-depth understanding of the determinants of success, such as the specific anthropometric characteristics of players may be important. Some studies showed evidence for position-specific anthropometric characteristics in football players.<sup>8-11</sup>

Studies on position-specific anthropometric profiles have been reported for Australian football<sup>12,13</sup>, Gaelic football<sup>14,15</sup>, and American football<sup>8,16,17</sup>. Players' position is extremely important in interpretation of morphological data because of

the different demands for a specific play; for example, mid-field players cover a large area of a football field. It is estimated that midfielders cover approximately 10 km in a 90 minute game including walking, moving backwards, jogging, running and sprinting, whereas the forwards, outside defenders and center-halves cover shorter distances.

The aim of the present study was (i) to obtain the morphological, body composition and somatic characteristics of Indian university level football players as per their position of play, and (ii) to compare position-specific differences in morphological, body composition and somatic characteristics of the Indian university level football players.

## METHODS AND MATERIALS

### Subjects

A total of 204 male (mean and SD of age 20.79,  $\pm 1.52$  years) university level football players from 16 different Indian universities who participated in the East Zone Inter University football tournament held at Visva-Bharati University, Santiniketan, West Bengal, India in 2006, were selected as subjects in this study. Out of these 204 subjects, 24 players were goalkeepers, 65 defenders, 55 midfielders and the remaining 60 players were strikers. Their positions in the field of play were determined from their positions in the game dur-

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ing competition and were confirmed by asking them their respective field positions.

### Morphology

Nineteen anthropometric variables were gathered; body height and weight, five muscle girths (upper arm, forearm, chest, thigh and calf), four bone diameters (humerus biepicondylar, bistyloideus, femur biepicondylar and bimalleolar), eight skinfold thicknesses i.e. triceps, subscapular, pectoral, axilla, abdominal, suprailiac, midthigh and calf. The anthropometric measurements were conducted according to the guidelines of the International Society for the Advancement of Kinanthropometry (ISAK).<sup>18</sup> The Technical Error of Measurement was lower than 5% for skinfolds and 2% for the other measurements.<sup>19</sup> Technical devices used for the investigation included a stadiometer (Wellington: GPM, Sibner Hegner, Zurich, Switzerland), electric weighing scales (Soehnle: Personenwaage Pharo, Nassau, Germany), a tape for the girth (Rosscraft Innovation: Fiberglass Anthropometric Tape, Surrey, Canada), a bone caliper (Rosscraft Innovation: Campbell 10 Caliper Tommy 3, Surrey, Canada), as well as a Harpenden skinfold caliper (Baty: Harpenden Skinfold Caliper, West Sussex, UK) for skinfold thickness.

### Body Composition and Somatotype

Body mass index (BMI) was calculated as body mass over body height in meters squared. For measurement of % body fat, the Siri Equation<sup>20</sup> was used where body density was calculated as per the Jackson and Pollock<sup>21</sup> seven sites equation ( $\sum 7$  skinfolds i.e. triceps, subscapular, pectoral, axilla, abdominal, suprailiac and midthigh). Poortman<sup>22</sup> and Drinkwater et al.<sup>23</sup> formula were adopted for estimating skeletal muscle mass and skeletal mass respectively. To assess endomorphy, mesomorphy and ectomorphy of the subjects, the Heath and Carter<sup>24</sup> somatotype estimation equations were used.

### Statistical Analyses

Descriptive analysis (means and standard deviations) were conducted for all the variables under investigation. One-way analysis of variance (ANOVA) was used to observe differences of means among the groups (goalkeeper, defender, midfielder, and striker). In order to determine which group was different from other group Tukey post hoc test applied. The level of significance or the p-value was set at 0.05. Analysis was carried out with SPSS 13.0 (SPSS Inc., Chicago, Illinois, USA) software.

**Table 1.** Comparison of morphological characteristics of Indian university level footballers according to specific field positions

Variables		Goalkeeper		Defender		Midfielder		Striker		ANOVA	
		M	SD	M	SD	M	SD	M	SD	F	P
	Height (cm)	172.40	4.56	169.28	5.70	167.28	6.20	168.05	5.34	3.22	0.02
	Weight (kg)	62.10	5.82	60.15	5.91	60.18	6.57	59.90	5.70	2.81	0.04
Muscle Girth (cm)	Upper Arm Girth	29.62	1.72	28.94	2.01	28.42	2.15	28.21	1.68	2.74	0.04
	Forearm Girth	25.72	1.44	25.05	1.37	24.79	1.35	24.80	1.13	1.17	0.32
	Chest Girth	84.58	4.47	87.81	4.15	86.06	3.76	86.14	3.93	1.75	0.16
	Thigh Girth	49.68	3.29	51.41	3.39	50.55	3.12	50.38	2.57	2.59	0.05
	Calf Girth	32.29	2.37	34.10	2.13	33.85	1.86	33.80	2.30	2.51	0.05
Bone Width (cm)	Humerus Biepicondylar Diameter	6.85	0.32	6.77	0.30	6.60	0.43	6.79	0.28	5.66	0.001
	Bistyloideus Diameter	5.49	0.22	5.44	0.46	5.28	0.27	5.38	0.33	2.74	0.044
	Femur Biepicondylar Diameter	9.45	0.49	9.52	0.41	9.46	0.53	9.48	0.54	0.24	0.867
	Bimalleolar Diameter	7.24	0.45	7.26	0.39	7.03	0.58	7.19	0.37	2.82	0.04
Skinfold Thickness (mm)	Triceps	7.41	1.50	6.96	1.84	7.12	2.01	6.68	1.91	0.62	0.601
	Subscapular	8.69	1.69	8.39	1.89	8.16	1.55	7.89	1.32	1.02	0.385
	Suprailiac	8.96	2.01	8.40	2.51	8.42	2.36	8.24	2.01	0.07	0.975
	Pectoral	7.50	1.27	6.86	2.20	6.60	1.36	6.39	1.13	0.93	0.429
	Axilla	6.55	1.68	5.61	2.07	5.65	1.64	5.30	1.32	0.48	0.697
	Abdomen	10.90	2.59	8.81	3.43	8.66	2.35	8.29	2.30	0.48	0.695
	Thigh	8.71	1.78	7.95	1.94	8.18	2.17	7.64	1.87	0.80	0.429
	Calf	7.63	1.63	6.85	1.58	7.12	1.71	6.73	1.65	0.73	0.535

**Table 2.** Tukey post hoc multiple comparison analysis of morphological characteristics of Indian university level footballers according to specific field positions

Variables	Field Position		Mean Difference	Variables	Field Position		Mean Difference
Height	Goalkeeper	Defender	3.1112	Calf Girth	Goalkeeper	Defender	-1.7119 *
	Goalkeeper	Midfielder	5.1140 *		Goalkeeper	Midfielder	-1.4587 *
	Goalkeeper	Striker	4.3458 *		Goalkeeper	Striker	-1.0042
	Defender	Midfielder	2.0028		Defender	Midfielder	0.2531
	Defender	Striker	1.2346		Defender	Striker	0.7077
	Midfielder	Striker	-0.7682		Midfielder	Striker	0.4545
Weight	Goalkeeper	Defender	3.8750 *	Humerus Biepicondylar Diameter	Goalkeeper	Defender	0.0846
	Goalkeeper	Midfielder	2.6932		Goalkeeper	Midfielder	0.2499 *
	Goalkeeper	Striker	2.9667		Goalkeeper	Striker	0.0192
	Defender	Midfielder	-1.1818		Defender	Midfielder	0.1654
	Defender	Striker	-0.9083		Defender	Striker	0.0654
	Midfielder	Striker	0.2735		Midfielder	Striker	-0.1845 *
Upper Arm Girth	Goalkeeper	Defender	0.5122	Bistyloideus Diameter	Goalkeeper	Defender	0.0501
	Goalkeeper	Midfielder	1.0311		Goalkeeper	Midfielder	0.2098
	Goalkeeper	Striker	1.2417		Goalkeeper	Striker	0.1100
	Defender	Midfielder	0.5189		Defender	Midfielder	0.1597
	Defender	Striker	0.7295		Defender	Striker	0.0599
	Midfielder	Striker	0.2106		Midfielder	Striker	-0.0998
Thigh Girth	Goalkeeper	Defender	-1.7817	Bimalleolar Diameter	Goalkeeper	Defender	-0.0276
	Goalkeeper	Midfielder	-0.8670		Goalkeeper	Midfielder	0.2035
	Goalkeeper	Striker	-0.6958		Goalkeeper	Striker	0.0450
	Defender	Midfielder	0.9147		Defender	Midfielder	0.2310
	Defender	Striker	1.0859		Defender	Striker	0.0726
	Midfielder	Striker	0.1712		Midfielder	Striker	-0.1585

\* indicates p< 0.05.

**Table 3.** Comparison of somatic characteristics of Indian university level footballers according to specific field positions

Variables	Goalkeeper		Defender		Midfielder		Striker		ANOVA	
	M	SD	M	SD	M	SD	M	SD	F	P
Endomorphy	3.67	0.52	2.36	0.60	2.39	0.59	2.28	0.56	0.44	0.724
Mesomorphy	4.09	0.87	4.81	0.95	4.66	0.91	4.64	0.96	3.47	0.01
Ectomorphy	2.79	0.79	2.76	0.94	2.73	0.91	2.90	0.92	0.45	0.724

**Table 4.** Tukey post hoc multiple comparison analysis of somatic characteristics of Indian university level footballers according to specific field positions

Variables	Field Position		Mean Difference
	Goalkeeper	Defender	
Mesomorphy	Goalkeeper	Defender	-0.7186 *
	Goalkeeper	Midfielder	-0.5725
	Goalkeeper	Striker	-0.5520
	Defender	Midfielder	0.1461
	Defender	Striker	0.1666
	Midfielder	Striker	0.0205

\* indicates p< 0.05.

**Table 6.** Tukey post hoc multiple comparison analysis of body composition characteristics of Indian university level footballers according to specific field positions

Variables	Field Position		Mean Difference
	Goalkeeper	Defender	
BMI	Goalkeeper	Defender	-1.4545 *
	Goalkeeper	Midfielder	-1.2672 *
	Goalkeeper	Striker	-0.9941
	Defender	Midfielder	0.1873
	Defender	Striker	0.4604
	Midfielder	Striker	0.2731
Skeletal Mass	Goalkeeper	Defender	0.0727
	Goalkeeper	Midfielder	0.5516
	Goalkeeper	Striker	0.2671
	Defender	Midfielder	0.4789*
	Defender	Striker	0.1943
	Midfielder	Striker	-0.2846

\* indicates p< 0.05.

**Table 5.** Comparison of body composition characteristics of Indian university level footballers according to specific field positions

Variables	Goalkeeper		Defender		Midfielder		Striker		ANOVA	
	M	SD	M	SD	M	SD	M	SD	F	P
BMI	20.21	1.49	21.66	1.75	21.47	1.76	21.20	1.67	4.52	0.004
% Body Fat	7.05	1.80	6.34	2.25	6.50	2.10	6.06	1.96	0.47	0.707
Skeletal Muscle Mass (kg)	30.07	3.28	30.85	3.35	29.78	3.01	29.57	2.63	2.10	0.102
Skeletal Mass (kg)	8.33	0.85	8.26	0.83	7.78	0.97	8.06	0.85	3.66	0.013

**RESULTS**

Descriptive statistics and analysis of variance of various morphological parameters according to their specific field positions of Indian university level footballers are presented in table 1. F value indicated that there are significant means difference among the groups in height, weight, upper arm girth, thigh girth, calf girth, humerus biepicondylar diameter, bistyloideus diameter and bimalleolar diameter. In order to determine which group different from other group Tukey post hoc test applied and the results are presented in table 2. Tukey post hoc multiple comparison analysis reveals that goalkeepers are significantly (p<0.05) taller than the midfielders and strikers, as well as, heavier than the defenders. Defenders and midfielders are possessors significantly (p<0.05) large calf girth than the goalkeepers. Further, strikers have significantly (p<0.05) more humerus biepicondylar diameter than midfielders.

Descriptive statistics and analysis of variance of various somatic characteristics according to their specific field positions of Indian university level footballers are presented in

table 3. F value indicated that there are significant means difference among the groups in mesomorphy component. In order to determine which group different from other group Tukey post hoc test applied and the results are presented in table 4. Tukey post hoc multiple comparison analysis demonstrates that defenders possess significantly (p<0.05) higher mesomorphy value than the goalkeepers.

Table 5 demonstrates the descriptive statistics and analysis of variance of various body composition characteristics according to their specific field positions of Indian university level footballers. F value indicated that there are significant means difference among the groups in BMI and skeletal mass. In order to determine which group different from other group Tukey post hoc test applied and the results are presented in table 6. Tukey post hoc multiple comparison analysis demonstrates that defenders are significantly (p<0.05) higher BMI and skeletal mass than goalkeepers, and midfielders have significantly (p<0.05) higher BMI value than the goalkeepers.

## DISCUSSION

The mean values of height and weight of the Indian national club footballers<sup>25</sup>, West-Bengal football players<sup>26</sup> and Indian university level football players (present study) were found to be well comparable. The mean body height and weight of the Indian university level football players were larger and heavier as described by the previous researchers like Kutlu and colleagues<sup>27</sup>, Rienzi et al.<sup>10</sup>; Strudwick et al.<sup>28</sup>. This discrepancy might be due to different methods of measurement, different times of data collection, differences in training performance levels and training duration. The results of the present study showed that the goalkeepers were significantly ( $p < 0.02$ ) taller (172.40 cm) than the other players, whereas midfield players proved to be the shortest (167.28 cm). Similar results were reported by the previous researcher Carter<sup>29</sup>, Matkovic et al.<sup>30</sup>, Arnason et al.<sup>31</sup>; Gil et al.<sup>11</sup>. Tall players tend to have an advantage in certain playing positions and, therefore, are oriented towards these roles, notably in goalkeeping and defense.<sup>32,33</sup> The present study revealed that the mean values of height, weight, mesomorphic and ectomorphic component were less than their International counterparts but BMI, % fat and skeletal muscle mass, essentially required in the game of football, fell within the normal range. Generally Asians are smaller in size than Non-Asians.<sup>34</sup> The small sizes of Indians are probably due to genetics. It is well established that ethnic and racial factors affect the average body size.<sup>35</sup> Goalkeepers possessed a greater quantity of subcutaneous fat deposition which was also reflected in their higher value of % fat than the other players but, interestingly, BMI was significantly ( $p < 0.05$ ) lower in the goalkeepers than the other players.

In regards to body composition, an important aspect of fitness for the football players, the percentage body fat of the present subjects were found to be lower than the Indian sedentary male population of same age.<sup>36</sup> The mean values of % body fat of Indian university level footballers were less than Indian national club footballers, Indian national footballers, European and Australian footballers. The authors cannot explain the probable cause of this result due to lack of information about socioeconomic life style, and food habits as these are the very important factors while making any conclusions about % body fat variations of an individual. However, goalkeepers possessed more fat (7.05) than the players of other field positions although the differences were found to be statistically insignificant. De Rose<sup>37</sup> and Kundu<sup>38</sup> also recorded higher % body fat in goalkeeper than in outfield players and concluded that the difference was probably because of the lighter metabolic loading encountered during match play and training of the goalkeepers. Such a difference may also be due to less activity of the goalkeeper in the game. However, habitual physical activity, diet and stage of competitive seasons were not systematically considered when the % body fat was evaluated in the present subjects, although those are also important factors in this context.

Goalkeepers had higher values for endomorphy (3.67) when compared to other field position players (defender = 2.36, midfielder = 2.39 and striker = 2.28). Defenders, midfielder and

striker (4.81, 4.66, and 4.64) had significantly ( $p < 0.01$ ) higher mesomorphic value than the goalkeeper (4.09). The results agreed with the findings of Kundu<sup>38</sup> and were inconsonant with Ramadan and Byrd<sup>9</sup>. No significant differences in ectomorphy component among the Indian university level football players in relation to their field positions were existed. The intensive training, exhaustive running and frequent movement during game situation of the defenders, midfielders and strikers may contribute to their possessing higher values for mesomorphy component. The study revealed heterogeneity in mesomorphy and endomorphy components among goalkeepers and other field players.

## CONCLUSION

Although the specific football skills, motor qualities and physiological conditions of the footballers were not accounted here for, on the basis of body composition variables, morphological and somatic characteristics it may be concluded that:

1. Goalkeepers were endomorphic mesomorph whereas defenders, midfielders and strikers were ectomorphic mesomorph in physique;
2. Less accumulation of fat in the body of the Indian university level footballers was a positive indicator to aid in competition;
3. Average height, weight and muscle mass of the players may be the important factors to endure the strain of international competitions.

## RECOMMENDATIONS

1. A similar study may be conducted by physiological and psychological variables as criterion variables.
2. A similar study may be attempted by selecting the national and international level football players as subjects.
3. Future studies on Indian footballers are necessary to find out the deficient than the other countries.

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