Anthropometry and Physical Characteristics of Indian Badminton Players

N.M. Kavanashri 1, Keren Susan Cherian 2, Sudip Ghosh 1, Venkata Ramana Yagnambhat 1,*

1 ICMR-National Institute of Nutrition, Hyderabad, India
2 National Sports University, Imphal, Manipur, India
* Corresponding author email: vryagnam@gmail.com
DOI: https://doi.org/10.34256/ijk2329
Received: 02-07-2023; Revised: 12-12-2023; Accepted: 17-12-2023; Published: 30-12-2023

Abstract

Introduction: Badminton is a fast-paced racket sport characterized by high-intensity intermittent actions interspersed with rest intervals. The role of anthropometry is critical in assessing athletes since the physique, body composition, physical growth, and one's motor development are fundamental for optimal performance. Methods: 32 badminton players’ anthropometry data was collected using ISAK protocol. Fat and fat free mass percentages were calculated using existing formulas. Results: Significant differences were observed across gender in body surface area, body density, fat mass, and fat free mass values. Body surface area, body density, and fat free mass and percentages are higher in male players and fat percentage and fat mass values are higher in female players. Conclusion: The average height of Indian players is less compared to other international players, whereas the fat percentage of both male and female players is relatively higher.

Keywords: Badminton, BMI, FFM, Body density, Anthropometry

Introduction

Badminton is a fast-paced racket sport characterized by high-intensity intermittent actions interspersed with rest intervals (AKTAS, GUVEN et al. 2017). The game involves all of the major muscle groups as it requires a lot of running, jumping, and hand actions. Hence players need to be extremely fit, especially in terms of aerobic capacity, agility and explosive power (Shukla, Dogra et al. 2023). The role of anthropometry is of utmost importance, since the physique, body composition, physical growth, and one’s motor development are fundamental for optimal performance (Mishra 2016). To differentiate players based on their age or skill level, more than often anthropometric measurements are employed. Anthropometric measurements including height, arm length, fat percentage and muscle mass variable appears to distinguish the level of expertise.

Badminton is the second most played sports in India, the popularity has increased significantly after the first win at the Olympic games (Anadkat 2015). However, when compared with South-East Asian and European countries,
very few Indian players have succeeded at international competitions. A dearth of sports science literature on Indian athletes has resulted in a lack of data regarding the anthropometric profiles of sub-elite Indian badminton players. Therefore, the present study appraises selected anthropometric indices and body composition of male and female badminton players.

Materials and Methods

Subjects

Thirty-two sub-elite Indian badminton players (M=17, F=15) including singles and doubles categories were recruited for the study. All the players have participated in national and international level competitions.

Anthropometric measurements

All the anthropometric measurements were carried out following the guidelines provided by ISAK by a ISAK (International Society of the Advancement of Kinanthropometry) accredited investigator (Marfell-Jones, Stewart et al. 2012). Body mass was measured using digital weighing scale with 100g accuracy (SECA-882, Germany), for height measurement, stadiometer (SECA-242, Germany) was used. Sitting height was measured by making the participants sit on the anthropometric box with the trunk raised to 90°, the back in contact with the stadiometer and the hands resting on the thigh. Arm span and body circumferences were measured using a non-stretchable measuring tape (SECA 201, Germany) with 0.1cm accuracy. The skinfold thicknesses at Tricep, Bicep, Subscapular and Supraspinale were measured using skinfold callipers (Harpenden) with 0.2 mm accuracy.

Body Composition

Body composition of the participants was derived using the two-compartment model (i.e. fat and fat free mass) by employing the skinfold measurements.

Calculations

a) Body Mass Index (BMI): Calculated using the equation given by Garrow & Webster, considering the body mass and height (Garrow and Webster 1985).

b) BMI (kg/m2)= Body mass (Kg) / Height (m2)

c) Body Surface Area (BSA): Du Bois & Du Bois equation was used which is based on the measured values of body mass and height (Du Bois and Du Bois 1916).

d) BSA = 0.007186 × Body mass0.425 × Height0.725

e) Body density (Db)

(Db) = c - m × log of sum of skinfolds (Triceps+Biceps+Subscapular+Supraspinale) Where, the c and m values differ with the age and gender of the individual (Durnin and Rahaman 1967).

f) Percent Body Fat (PBF)

PBF = [(4.95 / Db) - 4.5] ×100, (Where Db is Body density) (Siri 1956).

g) The fat mass and Fat free mass (FFM) was then obtained using the following equations:

Fat mass (kg) = (Body mass/100) × Percent body fat

FFM (kg) = Body mass (kg) - Fat mass (kg)

Results

Physical characteristics of Badminton players

Both male and female badminton players had an average age of 19.13 ±2.97 years. Significant difference was observed across gender in weight, height, sitting height and body surface area measurements. The average weight of male badminton players was 68.48 ±6.70 kg and female players was 59.65 ±5.60 kg. The average height of male players was significantly higher (175.41 ±6.09 cm) compared to female players (165.17 ±5.19 cm). Relaxed mid-upper arm circumferences in male badminton players was 28.16 ±1.85 cm and in female players it was 26.53 ±1.79 cm. No difference in maximal calf circumference measurement was observed across genders. Arm length in male players was significantly higher than in female players.
All the skinfold measurements were higher in male players compared to female players. Significant difference was observed in bicep tricep and calf skin fold thickness measurements. The difference in sub-scapular and supra-spinal thickness measurements were not statistically significant.

### Table 1. Anthropometric measurements of Badminton players

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Male (N=17)</th>
<th>Female (N=15)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>19.98 ± 3.52</td>
<td>18.10 ± 1.77</td>
<td>0.069</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>68.48 ± 6.70</td>
<td>59.65 ± 5.60</td>
<td>0.000</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>175.41 ± 6.09</td>
<td>165.17 ± 5.19</td>
<td>0.000</td>
</tr>
<tr>
<td>Sitting Height (cm)</td>
<td>130.42 ± 2.66</td>
<td>124.74 ± 3.17</td>
<td>0.000</td>
</tr>
<tr>
<td>Arm Span (cm)</td>
<td>176.94 ± 10.28</td>
<td>166.66 ± 6.40</td>
<td>0.002</td>
</tr>
<tr>
<td>MUAC Relaxed (cm)</td>
<td>28.16 ± 1.85</td>
<td>26.53 ± 1.79</td>
<td>0.015</td>
</tr>
<tr>
<td>Calf Maximal (cm)</td>
<td>34.49 ± 1.60</td>
<td>34.66 ± 2.37</td>
<td>0.807</td>
</tr>
<tr>
<td>Bicep (mm)</td>
<td>4.58 ± 1.54</td>
<td>6.40 ± 1.58</td>
<td>0.002</td>
</tr>
<tr>
<td>Tricep (mm)</td>
<td>8.36 ± 2.23</td>
<td>13.07 ± 2.69</td>
<td>0.000</td>
</tr>
<tr>
<td>Subscapular (mm)</td>
<td>10.29 ± 3.42</td>
<td>12.35 ± 3.85</td>
<td>0.114</td>
</tr>
<tr>
<td>Supraspinale (mm)</td>
<td>8.67 ± 4.52</td>
<td>10.31 ± 3.69</td>
<td>0.269</td>
</tr>
<tr>
<td>Calf (mm)</td>
<td>6.28 ± 2.13</td>
<td>13.63 ± 4.26</td>
<td>0.000</td>
</tr>
</tbody>
</table>

All the values in the table are pressed as mean ± standard deviation Level of significance is considered at P<0.05

### Body composition of badminton players

#### Table 2. Physical characteristics of Badminton players

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Male (N=17)</th>
<th>Female (N=15)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>22.24 ± 1.57</td>
<td>21.86 ± 1.85</td>
<td>0.537</td>
</tr>
<tr>
<td>BSA (kg/sqm)</td>
<td>1.83 ± 0.11</td>
<td>1.65 ± 0.09</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/m³)</td>
<td>1.07 ± 0.01</td>
<td>1.05 ± 0.01</td>
<td>0.000</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>13.62 ± 4.27</td>
<td>22.04 ± 4.04</td>
<td>0.000</td>
</tr>
<tr>
<td>Fat (kg)</td>
<td>9.39 ± 3.26</td>
<td>13.27 ± 3.17</td>
<td>0.002</td>
</tr>
<tr>
<td>FFM (%)</td>
<td>86.39 ± 4.27</td>
<td>77.96 ± 4.04</td>
<td>0.000</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>59.09 ± 5.69</td>
<td>46.38 ± 3.66</td>
<td>0.000</td>
</tr>
</tbody>
</table>

All the values in the table are pressed as mean ± standard deviation Level of significance is considered at P<0.05

Body mass index measurement was similar across gender. Significant differences were observed across gender in body surface area, body density, fat mass and fat free mass values. Body surface area, body density and fat free mass and percentages are higher in male players and fat percentage and fat mass values are higher in female players. Female players fat percentage was 22.04 ± 4.04 and in male players it was 13.62 ± 4.27. Fat free mass was 59.09 ± 5.69 kg in male players and in female players it was 46.38 ± 3.66 kg.

### Discussion

Badminton is characterized as a high-intensity intermittent sport requiring jumps, lunges, and rapid arm movement from a wide variety of postural positions. Anthropometry studies among badminton players are unable to differentiate between singles players and doubles players, suggesting that general anthropometric characteristics...
are not necessary to differentiate these events (Mathur, Toriola et al. 1985, WD, Ismail et al. 1996, Amusa, Toriola et al. 2001, Rahmawati, Budiharjo et al. 2007, Revan, Aydogmus et al. 2007, Campos, Daros et al. 2009, Poliszczuk and Mosakowska 2010, Amri, Ujang et al. 2012, Ramos Alvarez, Del Castillo Campos et al. 2016). However, some measurements including height, arm length, fat percentage and muscle mass variable appears to distinguish the level of expertise. A study on top 13 male world ranking competitors showed that they are generally taller (185cm) than lower level players (2008), suggesting that tallness is an advantageous trait for badminton players probably, by increasing the percentage of situations in which an attack shot can be used and to cover the area of the court (Poliszczuk and Mosakowska 2010). In our study male and female badminton players average height was 175.41 ±6.09 cm and 165.17 ±5.19 cm respectively, which is considered short according to international standards and in agreement with the reports of a systematic review (Lee, Wang et al. 2000). The height of Indian players was similar to international level players from other countries, including Nigerian, Malaysian, Indonesian, Turkish and Spanish players( Average height 171 cm) (Mathur, Toriola et al. 1985, Majumdar, Khanna et al. 1997, Amusa, Toriola et al. 2001, Rahmawati, Budiharjo et al. 2007, Revan, Aydogmus et al. 2007, Ooi, Tan et al. 2009, Hwa and Sidek 2010).

As for weight, many studies have shown differences in race. In this study male badminton players average weight was 68.48 ±6.70 kg and female players weight was 59.65 ±5.60 cm. Among the top 13 international male competitors mean body weight was 70 kg (Poliszczuk and Mosakowska 2010). A study by Lee et al. showed a difference between Asian, African American, White and Hispanic populations (Lee, Wang et al. 2000). When compared international players by continent, the Caucasians had the highest values (mean 74 kg, 180 cm), whereas the African players had intermediate values (mean 70 kg, 176 cm) and the Asian players had the lowest values (mean 60 kg, 167 cm) (Bartunkova, Safarik et al. 1979, Mikkelson 1979, Mathur, Toriola et al. 1985, Withers, Craig et al. 1987, WD, Ismail et al. 1996, Van Lieshout and Lombard 2003, Rahmawati, Budiharjo et al. 2007, Revan, Aydogmus et al. 2007, Ooi, Tan et al. 2009, Heller 2010, Abián, Abián-Vicén et al. 2012, Amri, Ujang et al. 2012).


When looked at the level of expertise, average values of fat percentage are 12.85 % in elite males, 10.15 % in sub-expert males, 9.84 % in junior males, 18.41 % in elite females and 14.11 % in junior females. Studies on Malaysians and Turks reported an average fat percentage of 14.6 ±1.7 % and 22.8 ±3.8 %) respectively (Tanner and Whitehouse 1955, Revan, Aydogmus et al. 2007). Which was similar to the values observed on Indian male players in this study. On the other hand, lowest fat percentage was observed among Nigerians players (8.2 ±1.7 %), Czechs players (8.3 ±2.6) and Spanish players (8.4 ±1.4) (Mathur, Toriola et al. 1985, Majumdar, Khanna et al. 1997, Heller 2010, Abián, Abián-Vicén et al. 2012). Another study by in 1997, Majumdar et al. [61] on Indian players showed similar percentage of fat in the badminton players (mean 12.1 ±3.4 %). In general badminton players are lean (mean 11–12 %) (Heller, 2010).

Conclusion
Average height of Indian players is less compared to other international players, whereas fat percentage of both male and female players is relatively more.

References


**Funding**

We thank the Director, National Institute of Nutrition- ICMR, Government of India, New Delhi, India for their support. Athletes, coaches, and management of Suchitra Badminton Academy, Hyderabad.

**Funding**

This work was supported by the Ministry of Youth Affairs and Sports, GOI.

**Conflicts of Interest**

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

**About the License**

© The Author(s) 2023. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License.