



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



Resumen

Introducción: El bádminton es un deporte de raqueta de ritmo rápido caracterizado por acciones intermitentes de alta intensidad intercaladas con intervalos de descanso. El papel de la antropometría es fundamental en la evaluación de los deportistas, ya que el físico, la composición corporal, el crecimiento físico y el desarrollo motor son fundamentales para un rendimiento óptimo. **Métodos:** Se recogieron datos antropométricos de 32 jugadores de bádminton mediante el protocolo ISAK. Los porcentajes de masa grasa y libre de grasa se calcularon utilizando fórmulas existentes. **Resultados:** Se observaron diferencias significativas entre géneros en los valores de superficie corporal, densidad corporal, masa grasa y masa libre de grasa. El área de superficie corporal, la densidad corporal y la masa libre de grasa y sus porcentajes son mayores en los jugadores masculinos y los valores de porcentaje y masa grasa son mayores en las jugadoras. **Conclusión:** La altura promedio de los jugadores indios es menor en comparación con la de otros jugadores internacionales, mientras que el porcentaje de grasa tanto de los jugadores masculinos como femeninos es relativamente mayor.

Palabras Clave: Bádminton, IMC, FFM, Densidad corporal, Antropometría

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) $BMI (kg/m^2) = \text{Body mass (Kg)} / \text{Height (m}^2)$

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) $BSA = 0.007186 \times \text{Body mass}^{0.425} \times \text{Height}^{0.725}$

e) Body density (Db)

$(Db) = c - m \times \log \text{ of sum of skinfolds (Triceps+Biceps+Subscapular+Supraspinale)}$

Where, the c and m values differ with the age and gender of the individual (Durnin and Rahaman 1967).

f) Percent Body Fat (PBF)

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

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

$\text{Fat mass (kg)} = (\text{Body mass}/100) \times \text{Percent body fat}$

$FFM (kg) = \text{Body mass (kg)} - \text{Fat mass (kg)}$

Results

Physical characteristics of Badminton players

Both male and female badminton players had an average age of 19.13 \pm 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 \pm 6.70 kg and female players was 59.65 \pm 5.60 kg. The average height of male players was significantly higher (175.41 \pm 6.09 cm) compared to female players (165.17 \pm 5.19 cm). Relaxed mid-upper arm circumferences in male badminton players was 28.16 \pm 1.85 cm and in female players it was 26.53 \pm 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

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

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

Badminton	Male (N=17)	Female (N=15)	P-Value
BMI (kg/m ²)	22.24 ± 1.57	21.86 ± 1.85	0.537
BSA (kg/sqm)	1.83 ± 0.11	1.65 ± 0.09	0.000
Density (g/m ³)	1.07 ± 0.01	1.05 ± 0.01	0.000
Fat (%)	13.62 ± 4.27	22.04 ± 4.04	0.000
Fat (kg)	9.39 ± 3.26	13.27 ± 3.17	0.002
FFM (%)	86.39 ± 4.27	77.96 ± 4.04	0.000
FFM (kg)	59.09 ± 5.69	46.38 ± 3.66	0.000

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 the 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, Mikkelsen 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).

In the current study, male badminton players had a fat percentage of 13.62 ± 4.27 and in females it was 22.04 ± 4.04 . A systematic review on elite badminton players reported 11.34 % fat in male and 18.9% in female players (Bartunkova, Safarik et al. 1979, Mikkelsen 1979, Mathur, Toriola et al. 1985, Withers, Craig et al. 1987, WD, Ismail et al. 1996, Majumdar, Khanna et al. 1997, Van Lieshout and Lombard 2003, Rahmawati, Budiharjo et al. 2007, Revan, Aydogmus et al. 2007, Campos, Daros et al. 2009, Ooi, Tan et al. 2009, Berral de la Rosa, Rodríguez-Bies et al. 2010, Heller 2010, Poliszczuk and Mosakowska 2010, Singh and Singh 2011, Abián, Abián-Vicén et al. 2012, Amri, Ujang et al. 2012, Hussain 2013, Raschka and Schmidt 2013, Ramos Alvarez, Del Castillo Campos et al. 2016).

When looked at the level of expertise, average values of fat percentage are 12.85 % in elite males, 10.15 % in sub-elite 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

- Abián, P., Abián-Vicén J., Sampedro, J. (2012). Anthropometric analysis of body symmetry in badminton players. *International Journal of Morphology*, 30(3): 945-951. <https://doi.org/10.4067/S0717-95022012000300030>
- Aktas, S., Guven, F., Yusuf, E. (2017). Effects of badminton training on some physical parameters in badminton players aged 10 to 12 years. *Turkish Journal of Sport and Exercise*, 19(3): 345-349. <https://doi.org/10.15314/tsed.349484>
- Amri, S., Ujang, A.F., Wazir, M.R.W.N., Ismail, A.N. (2012). Anthropometric correlates of motor performance among Malaysian university athletes. *Movement Health & Exercise*, 1(1): 75-92.
- Amusa, L., Toriola, A., Dhaliwal H., Mokgwathi, M. (2001). Anthropometric profile of Botswana junior national badminton players. *Journal of Human Movement Studies*, 40(2): 115-128.

- Anadkat, K.D. (2015). Prevalence of Musculoskeletal Injuries in Elite Badminton Players in India-A Cross Sectional Study, *Rajiv Gandhi University of Health Sciences, India*.
- Bartunkova, S., Safarik, V., Melicharova, E., Bartunek, Z., Seliger, V., F. Uk and J. Bures (1979). Energetic ky vydaju badmintonu. *Teor Praxe Tel Vych*, 27(6): 369-372.
- Berral de la Rosa, F.J., Rodríguez-Bies, E.C., Berral de la Rosa, C.J., Rojano Ortega, D., & Lara Padilla, E. (2010). Comparación de ecuaciones antropométricas para evaluar la masa muscular en jugadores de bádminon. *International Journal of Morphology*, 28(3): 803-810. <https://doi.org/10.4067/S0717-95022010000300022>
- Campos, F.A.D., Daros, L.B., Mastrascusa, V., Dourado, A.C., Stanganelli, L.C.R. (2009). Anthropometric profile and motor performance of junior badminton players. *Brazilian journal of biomotricity*, 3(2): 146-151.
- Du Bois, D., Du Bois, E.F. (1916). Clinical calorimetry: tenth paper a formula to estimate the approximate surface area if height and weight be known. *Archives of internal medicine*, 17(6_2): 863-871. <https://doi.org/10.1001/archinte.1916.00080130010002>
- Durnin, J.V.G.A., Rahaman, M.M. (1967). The assessment of the amount of fat in the human body from measurements of skinfold thickness. *British journal of Nutrition*, 21(3): 681-689. <https://doi.org/10.1079/BJN19670070>
- Garrow, J.S., Webster, J. (1985). Quetelet's index (W/H²) as a measure of fatness. *International Journal of Obesity*, 9(2): 147-153.
- Heller, J. (2010). Physiological profiles of elite badminton players aspects of age and gender *British Journal Sports Medicine*, 44(Suppl 1): 17. <https://doi.org/10.1136/bjism.2010.078725.51>
- Hussain, S. (2013). Somatotype and body composition of adolescent badminton players in Kerala. *International Journal of Advanced Scientific and Technical Research*, 6(3): 105-111.
- Hwa, O.C., Sidek M. (2010). Physiological strain in world class women badminton player during training and competition: a case study. *ISN Bulletin*, 3, (2010) 1-11.
- Lee, R.C., Wang, Z., Heo, M., Ross, R., Janssen, I., Heymsfield, S.B. (2000). Total-body skeletal muscle mass: development and cross-validation of anthropometric prediction models. *The American journal of clinical nutrition*, 72(3): 796-803. <https://doi.org/10.1093/ajcn/72.3.796>
- Majumdar, P., Khanna, G., Malik, V., Sachdeva, S., Arif, M., Mandal, M., (1997). Physiological analysis to quantify training load in badminton. *British journal of sports medicine*, 31(4): 342-345. <https://doi.org/10.1136/bjism.31.4.342>
- Marfell-Jones, M.J., Stewart, A.D., De Ridder, J.H. (2012). International standards for anthropometric assessment. *International Society for the Advancement of Kinanthropometry*.
- Mathur, D., Toriola, A.L., Igbokwe, N.U. (1985). Somatotypes of Nigerian athletes of several sports. *British journal of sports medicine*, 19(4): 219-220. <https://doi.org/10.1136/bjism.19.4.219>
- Mikkelsen, F. (1979). Physical demands and muscle adaptation in elite badminton players. *Science in racquet sports*, 55-67.
- Mishra, P.K. (2016). A comparative study of selected anthropometric measurements between badminton and table-tennis players of Sardar Patel University. *International Journal of Physical Education, Sports and Health*, 3(6), 69-71.
- Ooi, C.H., Tan, A., Ahmad, A., Kwong, K.W., Sompong, R., Mohd Ghazali, K.A., Liew, S.L., Chai W.J., Thompson, M.W. (2009). Physiological characteristics of elite and sub-elite badminton players. *Journal of Sports Sciences*, 27(14): 1591-1599. <https://doi.org/10.1080/02640410903352907>
- Poliszczuk, T., Mosakowska M., (2010). Antropometryczny profil elitarnych badmintonistów z Polski. *Medicine Sports* 1(6): 45-55.
- Rahmawati, N.T., S. Budiharjo, K. Ashizawa (2007). Somatotypes of young male athletes and non-athlete students in Yogyakarta, Indonesia. *Anthropological Science* 115(1): 1-7. <https://doi.org/10.1537/ase.051008>
- Ramos Alvarez, J.J., Del Castillo Campos, M.J., Polo Portes, C., Ramon Rey, M., Bosch Martin, A. (2016). Analysis of the physiological parameters of junior Spanish badminton players. *Revista Internacional De Medicina Y Ciencias De La Actividad Física Y Del Deporte*, 16(61): 45-54.

- Raschka, C., Schmidt, K. (2013). Sports anthropological and somatotypical comparison between higher class male and female badminton and tennis players. *Papers on Anthropology*, 22: 153-161. <https://doi.org/10.12697/poa.2013.22.17>
- Revan, S., Aydogmus, M., Balci, S.S., Hamdi, P., Huseyin, E. (2007). The evaluation of some physical and physiological characteristics of Turkish and foreign national badminton team players. *Journal of Physical Education and Sport*, 1(2): 63-70.
- Shukla, A., Dogra, D.K., Bhattacharya, D., Gulia, S., Sharma, R. (2023) A comparative study on the viewership of different professional leagues in India. *The International Sports Law Journal*, 23: 322-339. <https://doi.org/10.1007/s40318-023-00243-8>
- Singh, B.B., Singh, J., (2011). A comparative study on somatotypes of north zone badminton and tennis players. *Variorum Multidiscip e Research Journal*, 2(1): 1-8.
- Siri, W.E. (1956). Body composition from fluid spaces and density: analysis of methods. *University of California*.
- Tanner, J., Whitehouse, R. (1955). The Harpenden skinfold caliper. *American journal of physical anthropology*, 13(4): 743-746. <https://doi.org/10.1002/ajpa.1330130413>
- Van Lieshout, K.A., Lombard A.J., (2003). Fitness profile of elite junior South African badminton players. *African Journal for Physical Activity and Health Sciences*, 9(3): 114-120. <https://doi.org/10.4314/ajpherd.v9i3.24643>
- Nudri, W.W., Ismail, M., Zawiah, H. (1996). Anthropometric measurements and body composition of selected national athletes. *Malaysian Journal of Nutrition*, 2(2): 138-147.
- Withers, R., Craig, N., Bourdon, P., Norton, K. (1987). Relative body fat and anthropometric prediction of body density of male athletes. *European Journal of Applied Physiology and Occupational Physiology*, 56: 191-200. <https://doi.org/10.1007/BF00640643>

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.