



A Comparative study of anthropometry and body composition among male athletes and non athletes of age 18-26 years of Kamrup (M), Guwahati, Assam

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KEYWORDS

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ABSTRACT

The purpose of this study was to describe the anthropometric characters and body composition between athletes and non athletes as well as to make a comparison between them and to assess the nutritional status through BMI. A total of 120 males were enrolled in the study, which were divided into 4 groups of 30 individuals each i.e., (football players, basketball players, volleyball players and healthy sedentary subjects). The results indicated that basketball players were taller and heavier than the rest of the group, while the volleyball players have long arm span and greater bicristal breadth, and the footballers have greater biacromial breadth. The findings of the present study may be useful for future investigation or may serve as a reference standard player selection and training programme development programme.

Introduction

The anthropometrical characteristics and body compositions of athletes has been the subject of many investigations as many researchers have hypothesized that practicing athletes might be expected to exhibit structural and functional characteristics that are specifically favourable for their specific sport (Singh et al., 2010). Anthropometric measurements and body composition helps understand the relationship between the shape and size of the body and the sports performances. Every sport has its unique skills and strategies, hence every athlete requires a certain amount of physical fitness to give their maximum performance.

Anthropometric dimensions and morphological characteristics play an important role in determining the success of sportspersons (Reco-Sanz, 1998; Wilmore & Costill, 1999; Keogh, 1999). It has been well established that specific physical characteristics or anthropometric profiles indicate whether the player would be suitable for the competition at a higher level in a specific sport (Classesns et al., 1999; Bourgois et al., 2000; Reilly et al., 2000; Gabbett, 2000; Ackland et al., 2003; Slatter et al., 2005). These anthropometric and morphological parameters are sensitive indicators of physical growth and nutritional status of the sportsperson at their maximal performances (Wilmore & Costill, 1999; Chatterjee et al., 2006; Chatterjee & Bandhyopadhyay, 2006). These indicators of perspective sports performance depend largely on genetics, correlated with age, sex, socio-economic status, ethnicity, altitude, nutritional status, personal hygiene and exercise (Bouvard & Lortie, 1984; Fagard, Bielen & Amery, 1991).

Body shape and size and the level of fitness vary widely depending upon the type of sports and the playing position, body size is the most important attribute for the success in basketball. Tall players usually come with large hands and a long reach (Wood, J., 2010). During a basketball game, professional players run around 3500-5000 m (Janiera and Maia, 1998).

There are many components of fitness that are necessary for success in football, such as body fat, body weight and height are the important factors of the game. Excess of body fat would affect the player's ability to move freely around the field and the extra weight will increase fatigue. Height and arm span reach is particularly important for goalkeepers (Wood, 2018). Body height is a characteristic trait in volleyball players too; being tall is of great advantage in both indoor and beach volleyball. The body composition of the non athlete group shows variance as well as similarities to some extent with athletes.

Hence, the purpose of this study was to describe anthropometric characteristics and body composition profiles of elite soccer, basketball and volleyball players and compare them with non athletes.

Materials and method

The sample for the present study was collected from the Lakshmi Bai National Institute of Physical Education (LNIPE), Tepesia, sports complex, Sonapur, Guwahati and from the Gauhati University Boys Hostel. The current study is based on purposively selected adult male athletes of LNIPE playing three distinct types of sports, i.e. football, volleyball, basketball, and control groups or non athletes of Gauhati University with no particular playing background were also collected for comparison. The total sample size of the study is 120, divided into 4 groups each having 30 individuals.

All subjects were clinically healthy and had no recent history of any diseases. Data were collected under natural environmental condition before and after practice session for athlete group and morning and evening for the control groups / non-athletes. A total of 28 anthropometric measurements (14 linear measurement, 8 skinfold measurement and 6 girth measurement) were taken using the standardized procedure recommended by the international biological program (IBP). Height of the subject was measured using anthropometer and other body diameters and lengths were measured through rod compass and sliding calliper, weight was measured with the help of digital standing scale, and all the skinfold measurement was taken through Harpenden skinfold calliper while the circumferences of upper and lower limbs and trunk regions were calculated with the help of a steel tape.

Body mass index (BMI), body density, lean body mass and other body indices were calculated using specific mathematical expressions and results obtained, were compared to WHO and other established reference index. To reduce the measurement variation and prevent errors all the instruments were calibrated properly prior to use and measurements were taken on the subject's right side.

The data obtained in the study was analyzed using descriptive statistics, mean (SD) for each variable and analysis of variance (ANOVA) test was carried out to detect the effect of different type of sport on each variable. The significance was set at an alpha level of 0.05.

Results

Following girth measurements taken on subjects are shown in Table: - 1, the main motive of taking girth measurements specially waist and hip circumference as it is needed in determining visceral fat in

abdomen by calculating waist-hip ratio.

Table: - 1 Girth measurements

| Variables (inches) | Football | | Volleyball | | Basketball | | Non-athletes | |
|--------------------|-----------|----------|------------|-----------|------------|-----------|--------------|-----------|
| | MeanS.E | S.DS.E | MeanS.E | S.DS.E | MeanS.E | S.DS.E | MeanS.E | S.DS.E |
| Chest | 33.330.29 | 1.60.21 | 35.260.29 | 1.610.21 | 35.390.58 | 3.220.42 | 36.150.50 | 2.760.36 |
| Waist | 28.290.4 | 2.080.27 | 30.40.48 | 2.670.35 | 30.340.52 | 2.870.37 | 31.580.52 | 2.850.37 |
| Hip | 31.540.42 | 2.310.29 | 34.360.37 | 2.050.26 | 34.280.42 | 2.310.29 | 34.690.51 | 2.790.36 |
| Bicep | 10.010.11 | 0.620.08 | 10.620.162 | 0.880.11 | 10.670.27 | 1.470.19 | 10.730.26 | 1.40.18 |
| Wrist | 6.360.12 | 0.6020.1 | 6.410.055 | 0.3040.04 | 6.530.11 | 0.6050.08 | 6.630.074 | 0.4090.05 |
| Calf | 14.350.13 | 0.730.09 | 13.39013 | 0.710.09 | 13.770.44 | 2.440.31 | 13.780.22 | 1.190.15 |

All skinfold measurements were taken with the help of Harpenden skinfold calliper in millimetres and the sedentary groups indicates the higher mean values then the rest of the group, while the footballers shows the least values. Table: - 2 represent the various measurements bicep, tricep, suprailiac, subscapula, abdomen, chest, mid-thigh and calf.

Table: - 2 Skinfold measurements

| Variables (mm) | Football | | Volleyball | | Basketball | | Non-Athletes | |
|----------------|-----------|-----------|------------|-----------|------------|----------|--------------|-----------|
| | Mean | S.D | MeanS.E | S.DS.E | MeanS.E | S.DS.E | MeanS.E | S.DS.E |
| Biceps | 4.50.16 | 0.880.113 | 4.210.16 | 0.860.11 | 4.350.231 | 1.270.2 | 4.990.255 | 1.390.18 |
| Triceps | 6.120.18 | 1.0210.13 | 5.870.23 | 1.240.16 | 5.720.29 | 1.630.21 | 6.970.37 | 2.0150.26 |
| Subscapula | 9.670.49 | 2.740.35 | 9.130.49 | 2.700.35 | 9.400.56 | 3.080.39 | 12.260.86 | 4.740.61 |
| Suprailiac | 10.620.63 | 3.470.45 | 10.50.611 | 3.350.432 | 10.60.74 | 4.040.52 | 13.640.78 | 4.260.55 |
| Abdomen | 11.580.68 | 3.780.488 | 10.91.93 | 3.590.46 | 11.370.82 | 4.480.58 | 14.950.89 | 4.910.63 |
| Chest | 7.410.304 | 1.670.216 | 8.10.193 | 1.060.14 | 8.10.225 | 1.230.16 | 10.480.04 | 1.670.22 |
| Mid-thigh | 5.730.15 | 0.8230.11 | 5.580.21 | 1.1450.15 | 5.780.24 | 1.320.17 | 7.340.252 | 1.380.18 |
| Calf | 5.560.16 | 0.870.113 | 5.320.19 | 1.060.14 | 8.070.225 | 1.230.16 | 10.480.04 | 1.670.22 |

Table: - 3 shows the mean values of the variables height, weight, limb length and breadth, arm span, grip strength etc.

Table: - 3 Linear measurements.

| Variables | Football | | Volleyball | | Basketball | | Non-Athletes | |
|-------------|-----------|----------|------------|----------|------------|-----------|--------------|-----------|
| | MeanSE | S.DS.E | MeanSE | S.DS.E | MeanSE | S.DS.E | MeanSE | S.DS.E |
| Height (cm) | 169.51.06 | 5.800.75 | 171.41.12 | 6.120.79 | 172.731.23 | 6.770.87 | 167.130.8 | 4.380.56 |
| Weight (kg) | 60.281.07 | 5.880.76 | 65.031.79 | 6.460.86 | 65.91.88 | 10.291.32 | 63.061.85 | 10.171.31 |

| | | | | | | | | |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Arm Span (inch) | 22.610.21 | 1.150.15 | 23.600.38 | 2.050.26 | 23.40.225 | 1.240.16 | 21.470.19 | 1.060.14 |
| Palm Length (cm) | 18.120.12 | 0.640.082 | 18.580.17 | 0.9230.12 | 18.60.176 | 0.970.125 | 17.940.14 | 0.780.10 |
| Palm Breadth (cm) | 9.760.231 | 1.260.163 | 10.370.13 | 0.6980.09 | 10.330.13 | 0.7010.09 | 10.10.093 | 0.5140.13 |
| Foot Length (cm) | 24.010.18 | 1.0100.13 | 24.280.25 | 1.3650.18 | 24.360.29 | 1.630.21 | 22.750.41 | 2.240.29 |
| Foot Breadth (cm) | 9.90.083 | 0.460.059 | 10.10.124 | 0.680.088 | 10.050.11 | 0.6290.08 | 9.570.14 | 0.770.09 |
| Biachromial - Breadth (cm) | 36.350.39 | 2.1690.28 | 35.50.423 | 2.320.299 | 35.910.53 | 2.930.378 | 32.940.34 | 1.840.24 |
| Bicristal-Diameter (cm) | 24.810.24 | 1.230.158 | 26.540.32 | 1.750.225 | 26.050.28 | 1.5480.2 | 26.160.39 | 2.1720.3 |
| Transverse-Chest Depth | 26.920.18 | 1.0080.13 | 28.870.36 | 1.980.25 | 27.890.42 | 2.3140.29 | 27.150.39 | 2.150.28 |
| Anterior – Posterior (cm) | 18.500.35 | 1.910.25 | 19.190.24 | 1.330.172 | 19.580.37 | 2.0240.26 | 19.480.36 | 2.0030.26 |
| Grip Strength (kg) | 67.462.3 | 12.571.6 | 68.462.96 | 16.252.09 | 68.162.32 | 12.761.65 | 60.932.54 | 13.961.8 |

The importance of body composition in sports performance is a primary concern in creating athlete's profile as well as conditioning programs throughout a session at all levels of competition (Silvestre et al, 2006). Body composition greatly affects the energy-related physical strength and skills in various sports (Kitagawa, Ikuta, Hara, Hirota, 1974). Football being a high intensity game players shows low body fat and body fat % while non athletes have the higher values, as shown in Table :- 4.

Table: - 4 Body composition.

| Category | Football | Volleyball | Basketball | Non-Athletes |
|-----------------------------|----------|------------|------------|--------------|
| Mean Total Body Fat | 3.55 | 4.364 | 4.315 | 5.644 |
| Mean body fat % | 5.969 | 6.642 | 6.811 | 8.63 |
| Mean body density (MBD) | 1.0856 | 1.084 | 1.0836 | 1.0793 |
| Mean Lean Body Mass (in kg) | 56.73 | 60.66 | 61.58 | 57.08 |

An index is the ratio of two measurements expressed in terms of percentage and the value is calculated by taking the small measurement as the numerator and the larger as the denominator and multiplying it by 100 (except for Waist-Hip ratio). The values obtain from such an index are often used to classify a group into different ranges or categories. Few indices are calculated, as shown in table no. 5.

Table: - 5 Indices

| Indices | Football | Volleyball | Basketball | Non-Athletes |
|-----------------------------------|----------|------------|------------|--------------|
| Relative Biacromial Breadth index | 21.44 | 20.73 | 20.784 | 19.71 |
| Relative Bicristal Breadth index | 14.64 | 15.5 | 15.14 | 15.65 |
| Relative Chest-Girth index | 49.98 | 52.24 | 52.028 | 54.92 |
| Waist-Hip Ratio | 0.896 | 0.884 | 0.885 | 0.910 |
| Relative Upper Extremity index | 44.57 | 45.80 | 45.17 | 43.36 |

From the figure n^o.1, nutritional status of the study sample was worked out through BMI and it showed that maximum number of athletes falls under normal weight category while most of the non

athletes were found to be deviating from normal category.

The mean values of all the variables were compared between the groups. In the present study some significant differences were noted (at the alpha level of 0.05) between the groups whereas for some measurements values were not significant. One way ANOVA test was used to identify the differences in the results of the following groups.

Table: - 6 Comparison of following variables to identify significant differences between the groups.

| Variables | Football | | Basketball | | Volleyball | | Non-Athlete | | P –Value |
|--------------------|----------|-------|------------|-------|------------|-------|-------------|-------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | |
| Height | 169.5 | 5.80 | 172.73 | 6.77 | 171.4 | 6.12 | 167.13 | 4.38 | 0.0027 * |
| Weight | 60.28 | 5.88 | 65.9 | 10.29 | 65.03 | 6.46 | 63.06 | 10.17 | 0.05 * |
| Arm Span | 22.61 | 1.15 | 23.4 | 1.24 | 23.60 | 2.05 | 21.47 | 1.06 | 0.00028 * |
| Biacromial Breadth | 36.35 | 2.169 | 35.91 | 2.93 | 35.5 | 2.32 | 32.94 | 1.84 | 0.0019 * |
| Bicristal Breadth | 24.81 | 1.23 | 26.05 | 1.548 | 26.54 | 1.75 | 26.16 | 2.17 | 0.0013 * |
| Skinfold -Bicep | 4.5 | 0.88 | 4.35 | 1.27 | 4.21 | 0.86 | 4.99 | 1.39 | 0.008 * |
| Tricep | 6.12 | 1.02 | 5.72 | 1.63 | 5.87 | 1.24 | 6.79 | 2.015 | 0.0133 * |
| Calf | 5.56 | 0.87 | 8.07 | 1.23 | 5.32 | 1.06 | 10.48 | 1.67 | 0.00037 * |
| Mid thigh | 5.73 | 0.823 | 5.78 | 1.32 | 5.58 | 1.145 | 7.34 | 1.38 | 2.96 |
| Abdomen | 11.58 | 3.78 | 11.37 | 4.48 | 10.9 | 3.59 | 14.95 | 4.91 | 0.0013 * |
| Subscapula | 9.67 | 2.74 | 9.40 | 3.08 | 9.13 | 2.70 | 12.26 | 4.74 | 0.00077 * |
| Suprailiac | 10.62 | 3.47 | 10.6 | 4.04 | 10.5 | 3.35 | 13.64 | 4.26 | 0.0052 * |
| Girth -Chest | 33.33 | 1.6 | 35.39 | 3.22 | 35.26 | 1.61 | 36.15 | 2.76 | 1.955 |
| Waist | 28.9 | 2.08 | 30.34 | 2.87 | 30.4 | 2.67 | 31.58 | 2.85 | 0.0020 * |
| Hip | 31.4 | 2.31 | 34.28 | 2.31 | 34.36 | 2.05 | 34.96 | 2.79 | 1.96 |
| Wrist | 6.36 | 0.602 | 6.53 | 0.605 | 6.41 | 0.304 | 6.63 | 0.409 | 0.335 |
| Calf | 14.35 | 0.73 | 13.77 | 2.244 | 13.39 | 0.71 | 13.78 | 1.19 | 0.238 |

** indicated significant at the level of 0.05%.

Discussion

Football, basketball, and volleyball are high endurance games and require potential stamina to excel the performance, each player possesses specific skills that defines their role and contributes to the overall performance of the game (Stuelcken *et al.*, 2007). In the present study significant differences in some measurements were noted between the two groups, these differences were due to the type of game, position of playing, regular physical exercise, training effects and differences in nutritional intakes.

The mean body height and weight along with the upper limb length is found to be maximum among basketball players then the rest of the groups. Volleyball players are also found to be tall and heavy but slightly less than basketball players. The grip strength for volleyball players were noted to be maximum, as their palms and fingers are used to blocking, serving, setting and hitting the ball. Basketball and volleyball players have slightly higher percentage of muscle content and bone mass than the footballers, because they use both upper and lower extremities (Popovic *et al.*, 2012) to make frequent jumps

and dives, spiking, blocking, dodging and sudden fake movements to beat the opponents etc. Hence basketball and volleyball players have showed greater body height and weight along with longer arm span reach than the footballers who use only lower extremities.

On contrary the footballers are shorter and broader than the other two athlete group with greater biacromial breadth and high mean blood pressure, because football is a high endurance aerobic sport in which activity last longer and running distance is greater. Therefore, footballers must show lower values of subcutaneous adipose fat, as greater fat content in footballers will act as a hindrance in their performance (Bandyopadhyay and Chatterjee, 2003; Chatterjee *et al.*, 2005) but the present study does not show the same trend as the waist-hip ratio (0.896), the values of sub-scapular, suprailiac and abdominal skinfold (9.670.49, 10.620.63, 11.580.68) respectively, were higher than the basketball and volleyball players, which was probably due to skipping of practice, less exposure to professional competitors and the habit of eating junk foods rather than their prescribed diets.

On the other hand, all the values for skinfold measurement and body circumferences were found to be significantly higher in the sedentary groups (non-athletes) than the sports persons, indicating greater quantity of subcutaneous fat deposition, the reason behind their higher skinfold and girth measurements is be due to their lack of physical activities (very little or no exercise), insufficient and irregular sleep hours, eating unhealthy diets on regular basis. By taking girth measurements, the waist-hip ratio is calculated and it is found that non athletes were in the range of moderate health risk (0.90–1) than the athletes who were in the range of low health risk (<0.90, reference range WHO, 2012).

Body mass can influence athlete's speed, endurance and power (Massuca & Fragoso, 2011). Body mass index ($BMI = \text{weight}/\text{Height}^2$) is a parameter that is widely used in adult populations such as an internationally recognized definition of overweight and obesity (Kovac, Jurak, & Leskosek, 2012). Almost all the athletes were found to have normal BMI (18.5–24.9) according to the range set up by WHO, while few players were found in the overweight category (25–29.9) and very less in underweight category (<18.5) which is probably due to their habit of eating junk foods or skipping of meals. But most of the subjects from non athlete group shows deviation from normal BMI that may be due to improper diet, very less or no exercise, inadequate amount of sleep and rest etc.

Conclusion

The results of the present study showed that the basketball players were taller and heavier than the rest of the group with the mean height and weight being (172.73 cm and 65.9 kg) respectively. They also have larger bicep and wrist size (10.67 cm and 6.53 cm) respectively from the other groups. Basketball and volleyball players have showed longer limb lengths. Among the volleyball players the arm span is found to be maximum (23.60 cm) and greater bicristal diameter (26.54 cm). Volleyball players have greater grip strength (68.46 kg). Both basketball and volleyball players have intermediate body size with higher lean body mass than footballers making them mostly mesomorphs.

Footballers showed the highest biacromial breadth (36.35 cm) and blood pressure rates, (138/85 mmHg) after practice. They also have larger calf size (14.35 cm) than the three groups, and their mid-thigh skinfold (5.730.15) and calf skinfold (5.560.16) is much less than the basketball players (5.780.24) & (8.070.225) and the non athletes (7.340.252) & (10.480.04) indicating greater muscle content in lower extremities. Footballers have low amount of total body fat, lower mean % body fat and the minimum lean body mass. They have slightly denser body form then the rest of the groups, making the

body type ectomorphic.

The non-athlete group showed high values of skinfold measures and greater amount of body fat. The waist and hip circumference is maximum among this group i.e., 36.15” and 31.58” respectively. Individuals in this group shows high mean body fat % and low mean body density, resulting in an endomorphic body type.

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Authors' contributions

In conceptualizing the present the study both the authors have their contributions. Data collection was done by M. Hijam, D. Medhi contributed to data presentation, interpretation and draft of the manuscript was done by both. With approval and agreement from both the authors the final manuscript is processed to be published.

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Images

Figure: - 1 Nutritional assessment through BMI.

