



Anthropometric Profile of Age Level & National Level Female Gymnasts In Bangladesh

Mone Akther ¹, Farjana Akter Bobby ^{2,*}



¹ Physical Education Teacher, Shaheed Bir Uttam Lt Anwar Girls' College, Dhaka, Bangladesh

² Department of Physical Education and Sports Science, Jashore University of Science and Technology, Bangladesh

* Corresponding authors email: farjanaboby77475@gmail.com

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Resumen

Introducción: Cada deporte tiene un perfil antropométrico único que se puede distinguir según la posición, función o tipo de evento dentro de cada disciplina deportiva. Las medidas antropométricas de las gimnastas son importantes porque juegan un papel crucial en su rendimiento deportivo. No hay mucha investigación sobre gimnasia en Bangladesh. Por lo tanto, el propósito de este estudio fue determinar los rasgos de condición física antropométrica de gimnastas de nivel nacional y de edad en Bangladesh. **Métodos:** Se incluyeron en la muestra veinte gimnastas de Bangladesh Krira Sikkha Protisthan (BKSP); sus edades oscilaban entre los 15 y los 18 años. Se dividieron en dos grupos según su nivel nacional y su nivel de edad. La Sociedad Internacional para el Avance de la Cineantropometría ha establecido ciertas técnicas para tomar medidas cineantropométricas. **Resultados:** Se analizaron las características antropométricas, incluyendo la altura, el peso, la longitud del brazo, la longitud de la pierna, la anchura de los hombros, la circunferencia de la cadera y la altura sentada, y los resultados obtenidos de los dos grupos se compararon mediante la "prueba t" analizada ($p \leq 0,05$). **Conclusión:** A partir de los resultados obtenidos, la investigadora encontró que los perfiles antropométricos de las gimnastas de nivel nacional eran significativamente mayores que los de las jugadoras de su edad.

Palabras Clave: Perfil antropométrico, Gimnastas Femeninas, Nivel de Edad, Nivel Nacional

Abstract

Introduction: Each sport has a unique anthropometric profile that may be distinguished based on the position, function, or event type within each sport discipline. Anthropometric measurements of gymnasts are important because they play a crucial role in their athletic performance. There isn't much research on gymnastics in Bangladesh. Hence, the purpose of this study was to determine the anthropometric fitness traits of age-level and national-level female gymnasts in Bangladesh. **Methods:** A total of 20 female gymnasts from Bangladesh Krira Sikkha Protisthan (BKSP) were recruited for the study, divided into two groups: 10 age-level gymnasts and 10 national-level gymnasts. Their ages ranged from 15 to 18 years. The International Society for the Advancement of Kinanthropometry has outlined certain techniques for taking kinanthropometric measurements. The anthropometric characteristics, including height, weight, arm length, leg length, shoulder width, hip circumference & sitting height, were analysed, and the results obtained from the two groups were compared by the analysed "t-test" ($p < 0.05$). **Results:** The results indicate that the national-level gymnasts had significantly lower BMI and body fat percentages compared to the age-level gymnasts. Additionally, the study found that age-level gymnasts had significantly higher body fat percentages compared to national-level gymnasts. **Conclusion:** This study's findings suggest a significant difference in the anthropometric profile of female gymnasts in Bangladesh between age-level and national-level athletes. These findings could be useful for coaches and athletes in designing training programs and optimizing performance for female gymnasts in Bangladesh.

Keywords: Anthropometric profile, Female Gymnasts, Age Level, National Level

Introduction

Physical qualities, such as anthropometric measurements and body composition, play a significant role in the requirements for success in various sports (Claessens et al., 1999). Numerous research has been carried out in recent years to determine the best body type for various sports. The average height and weight of female athletes in numerous sports, including tennis, swimming, and sports competitions, are comparable to or frequently higher than the median value of the typical non-trained peer group of females. The primary benefit in the category of aesthetic sports, however, is a smaller body size with a significantly reduced amount of fat in the body composition and performance-related acceptable fat-free mass in the female athlete. This is especially true in gymnastics (Arriaza et al., 2016). Even though the anthropometric character does not ensure a greater degree of accomplishment in a particular activity, several morphological traits have been thought to be related to individual achievement in sports like rhythmic gymnastics (RG). These gymnasts exhibit low-fat mass and lengthy extremities, as per earlier research in RG (Georgopoulos et al., 1999; Klentrou & Plyley, 2003). It is generally known that physical characteristics, such as body type and size, have a substantial impact on performance in a variety of sports, especially aesthetic sports and all forms of dance. Figure skating, rhythmic gymnastics, and artistic gymnastics are the three most difficult sports to compete in among the so-called feminine aesthetic sports (Lukić, 2020). The selection of young, outstanding female gymnasts has typically been done using anthropometric measures (Bradshaw & Le Rossignol, 2004). By measuring the body's size, shape, proportions, and composition utilizing non-invasive, reasonably priced, and portable technologies, anthropometric evaluation contributes to a better knowledge of the overall functioning of the human body (Claessens et al., 1991; Garrido-Chamorro et al., 2012). In the beginning of the rhythmic gymnastics training process as well as in the sport selection process, the establishment of morphological traits with the performance of certain abilities may be extremely beneficial (Jelčić et al., 2002). These anthropometric constitutions are associated with the gymnasts' first selection (Baxter-Jones & Maffulli, 2002) and, because of their anthropometric traits, serve as a predictor of the potential of young female gymnasts (Claessens et al., 1999; Di Cagno et al., 2009). Additionally, it is well established that morphological constitution, skill-based elements, and psychological aspects all significantly influence achieving strong achievements in gymnasts (Claessens et al., 1999; Di Cagno et al., 2009). Certain body shapes may be favorable for winning accomplishments since elite players' physical and physiological traits vary across sports (Arazi et al., 2023). To identify the features and traits of elite athletes in various sports, physiological and anthropometric profiles have been created. The gymnast's performance might well be influenced by a wide range of physiological and anthropometric parameters, according to the evidence (Faria & Faria, 1989). To our awareness, the fitness and anthropometric information on gymnasts that is accessible is sparse and lacking in Bangladesh. Thus, the goal of this study was to identify the anthropometric fitness characteristics of age level & national level female gymnasts in Bangladesh.

Methods

A total of 20 female gymnast (15.20 ± 3.4 years) were selected as subject for the present study. Among them 10 were age level & 10 were national level female gymnast. The subjects were from Bangladesh Krira Sikkha Protisthan. The regional ethics committee gave its approval to the study protocol. The Bangladesh Krira Sikkha Protisthan and the Expert Committee of the Gymnastics Federation of Bangladesh received quick written requests, and after being told of the study's significance to science and its many advantages, authorization was given for the testing to proceed. In the present study, anthropometric measurements were the measuring criteria. Anthropometric profile was assessed by measuring height, weight, arm length, leg length, shoulder width, hip circumference & sitting height.

Instruments & Tools Used

Following instruments & tools were used for collecting data in the present study:

- a. An Anthropometric tape for measuring length.
- b. Digital weighing machine for measuring weight.
- c. Stadiometer used for measuring standing height.

Procedure of Collecting Data

Seven different anthropometric parameters were measured by following standard procedures as mentioned below:

Standing Height

A stadiometer was used to determine the standing height. The subjects were instructed to stand straight up against the measurement post on the wooden platform without shoes. A movable pointer for precise measuring was fastened to the top of the post. The individual stood such that their heels were in contact with one another. The movable pointer was positioned such that it created a right angle with the post and contacted the midway of the head. Then, centimeters were measured vertically from the top of the head to the surface of the wooden platform.



Figure 1. Measurement of Height

Body weight:

It was taken by Digital weighing machine with normal dress of the subject. The measurement was taken in Kilogram



Figure 2. Measurement of Weight

Arm Length:

It was measured by anthropometric tape. The subject stands with the arm hanging loosely by the side of the body & the measurement was made from the tip of acromion process to the tip of the olecranon process. The measurement was taken in centimeter



Figure 3. Measurement of arm length

Leg length

It was measured by anthropometric tape. The leg length was measured from greater trochanter to lateral malleolus in a standing erect position. The measurement was taken in centimeter.



Figure 4. Measurement of leg length

Sitting Height

The sitting height was measured in such a way that the subject was directed to sit erect on a chair against a measured wall. The arm rested on the thigh. The ruler was placed on the head parallel to the ground from the highest point on the head to base sitting surface was measured by the anthropometric tape. The distance measured between the highest points of the head to sitting surface was considered as sitting height.



Figure 5. Measurement of sitting height

Shoulder Width

The subject was made to stand erect with shoulder relaxed and elbows closed to the body. The measurement was taken from the behind of the subject. To measure the actual shoulder width, the most lateral margins of the acromial processes was taken by a steel tape in centimeter.



Figure 6. Measurement of shoulder width

Hip Circumference

By a steel tape it was measured. The subject was instructed to stand erect position facing tester. The steel tape was placed at a level from the maximal protrusion of the buttocks to the symphysis pubis. The reading of the measurement was taken in centimeter



Figure 7. Measurement of hip circumference

Analytical procedure

For analysis of data standard statistical procedure was used. Mean was calculated as a measure of central tendency by using the formula.

$$\bar{x} = \frac{\sum x}{n}$$

The standard deviation (SD) was calculated as the measure of variability by using the formula-

$$\sigma = \sqrt{\frac{(x - \bar{y})^2}{(x - 1)}}$$

The formula used for T-test, $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$

Results and interpretation

The raw data were analysed following standard statistical technique. The central tendency of different parameters for different level female gymnast in Bangladesh were found out by calculating mean and their variability

was expressed by standard deviation. For better understanding the data have been presented separately for different parameters in the following sections.

Standing height

Table 1 represents the mean and standard deviation for age level and national level female gymnast in Bangladesh

Table 1. Mean & Standard Deviation of standing height for age level and national level female gymnast in Bangladesh

	Mean and Standard Deviation of Standing height (cm)	
	Mean	S.D.
Age level	146.68 cm	±7.49
National level	154.43 cm	±5.39

It is seen from Table 1 that the mean values of standing height for age level and national level female gymnast were 146.68 cm and 154.43cm respectively. It is clear from Table 1 that the mean values were higher for national level female gymnast than that of age level female gymnast. The mean values of standing height for age level and national level female gymnast in Bangladesh have been presented in Figure 1.

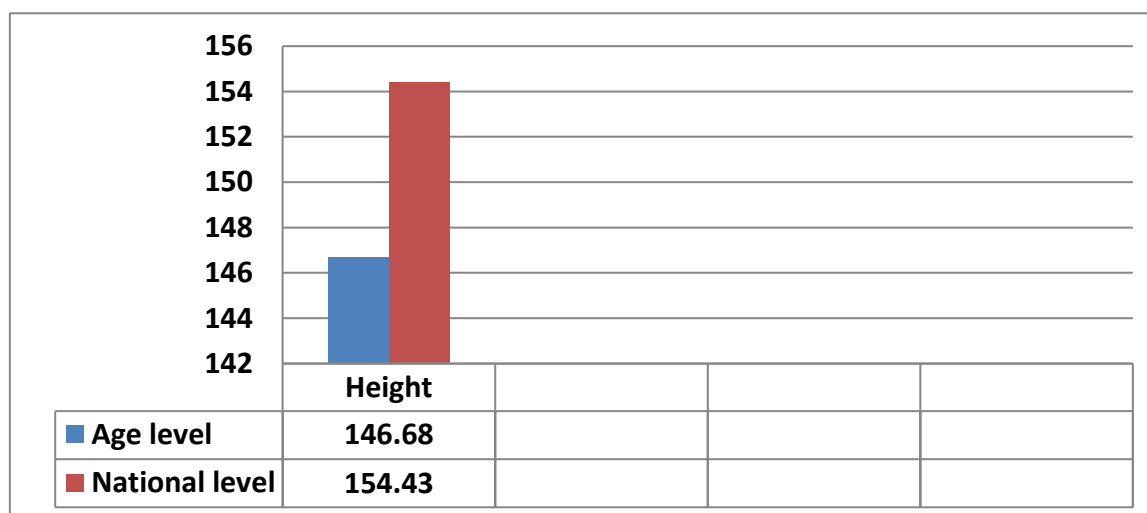


Figure 8. Mean values of standing height for age level and national level female gymnast in Bangladesh

From Fig 8 it is clearly understood that the national level female gymnasts were taller than that of age level female gymnast. In order to test whether the difference in mean height between age level and national level female gymnast was statistically significant, 't' value was calculated. Table-2 shows the result.

Table 2. Testing significance of mean difference of standing height for age level and national level female gymnast in Bangladesh

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	Nation level gymnast			
Height	146.68 cm	154.43 cm	7.75	2.66	significant

It is clearly understood from the results shown in above table that the national level female gymnasts were taller than their age level female gymnast counterpart in standing height and it was statistically significant.

Body weight

Table-3 represents the mean and standard deviation for age level and national level female gymnast in Bangladesh.

Table 3. Mean & Standard Deviation of body weight for age level and national level female gymnast in Bangladesh

Group	Mean and Standard Deviation for Body Weight (cm)	
	Mean	S.D.
Age level gymnast	36.9 kg	±6.67
National level gymnast	47.8 kg	±8.34

It is seen from Table 3 that the mean values of body weight for age level and national level female gymnast were 36.9 kg and 47.8 kg respectively. It is clear from the table that the mean values were higher for national level female gymnast than age level female gymnast. The mean values of weight for age level and national level female gymnast have been presented in Figure 9



Figure 9. Mean values of body weight for age level and national level female Gymnast

From Fig 9, it is clearly understood that the national level female gymnasts were heavier than age level female gymnast. In order to test whether the difference in mean body weight between age level and national level female gymnast was statistically significant, 't' value was calculated. Table-4 shows the result.

Table 4. Testing significance of mean difference of body weight for age level and national level female gymnast

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	National level gymnast			
Weight	36.9 kg	47.8 kg	10.9	3.23	significant

It is clearly understood from the results shown in above table that the national level female gymnasts were heavier than their age level female gymnast counterpart in body weight and it was statistically significant.

Arm length

Table-5 represents the mean and standard deviation for age level and national level female gymnast in Bangladesh.

It is seen from Table -5 that the mean values of arm length for age level and national level female gymnast were 64.5 cm and 68 cm respectively. It is clear from Table 5 that the mean values were higher for national level

female gymnast than that of age level female gymnast. The mean values of arm length for age level and national level female gymnast in Bangladesh have been presented in Figure 10.

Table 5. Mean & Standard Deviation of arm length for age level and national level female Gymnast

Group	Mean of Standard Deviation for Arm Length(cm)	
	Mean	S.D
Age level gymnast	64.5 cm	±3.23
National level gymnast	68 cm	±3.68



Figure 10. Mean values of arm length for age level and national level female gymnast

From Fig 10 it is clearly understood that the national level female gymnast got longer upper limbs than the age level female gymnast. In order to test whether the difference in mean arm length between national level female gymnast and age level female gymnast was statistically significant, 't' value was calculated. Table 6 shows the results.

Table 6. Testing significance of mean difference of arm length for age level and national level female gymnast in Bangladesh

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	National level gymnast			
Arm Length	64.5 cm	68 cm	3.5	2.27	significant

It is clearly understood from the results shown in above table-6 that the national level female gymnast had longer upper limbs than their age level female gymnast counterpart in arm length and it was statistically significant.

Leg length

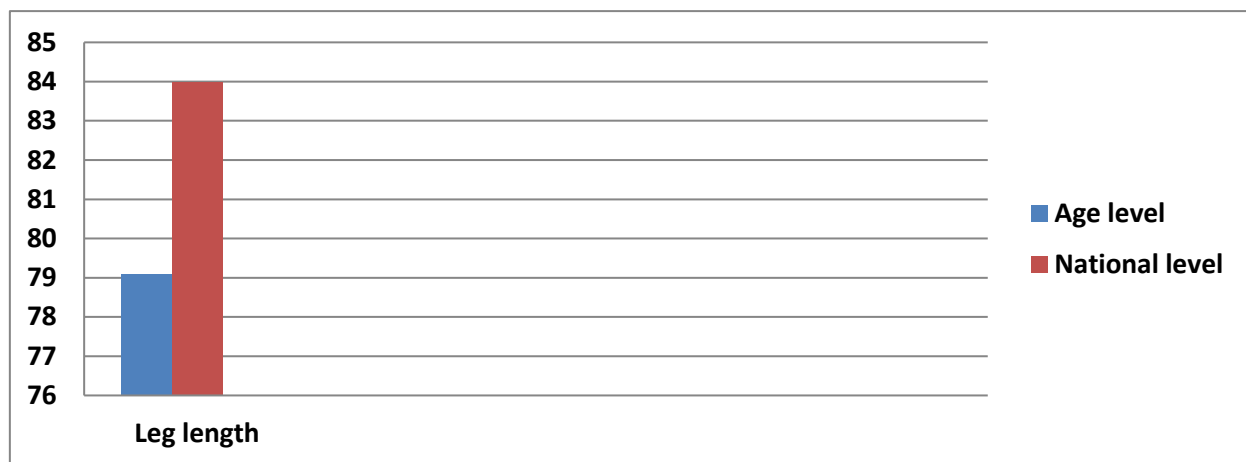
Table 7 represents the mean and standard deviation leg length for age level and national level female gymnast.

From the table it is seen that the mean value of leg length age level female gymnast was 79.1 cm whereas this value for National level female gymnast was 84 cm. It is clear from the table that the value was higher for National level female gymnast than their counterpart age level female gymnast.

The mean values of leg length for age level and national level female gymnast in Bangladesh have been presented in Fig 11

Table 7. Mean & Standard Deviation of leg length for age level and national level female Gymnast in Bangladesh

Group	Mean of Standard Deviation for Leg Length (cm)	
	Mean	S.D.
Age level gymnast	79.1 cm	±3.7
National level gymnast	84 cm	±2.89

**Figure 11.** Mean values of leg length for age level and national level female Gymnast

From Fig 11 it is clearly understood that the national level female gymnast got longer lower limbs than the age level female gymnast. In order to test whether the difference in mean leg length between national level female gymnast and age level female gymnast was statistically significant, 't' value was calculated. Table 8 shows the results.

Table 8. Testing significance of mean difference of leg length for age level and national level female Gymnast

Parameters	Group of mean		Mean Difference	t-value	Remarks
	Age level gymnast	National level gymnast			
Leg Length	79.1 cm	84 cm	4.9	3.33	significant

It is clearly understood from the results shown in above table that the national level female gymnast had longer lower limbs than their age level female gymnast counterpart in leg length and it was statistically significant.

Sitting Height

Table 9 represents the mean and standard deviation for age level and national level female gymnast in Bangladesh.

Table 9. Mean & Standard Deviation of sitting height for age level and national level female Gymnast in Bangladesh

Group	Mean of Standard Deviation for Sitting Height(cm)	
	Mean	S.D.
Age level gymnast	73.4 cm	±4.40
National level gymnast	80.7 cm	±2.68

It is seen from Table 9 that the mean values of sitting height for age level and national level female gymnast were 73.4 cm and 80.7 cm respectively. It is clear from the Table that the mean value was higher for national level female gymnast than age level female gymnast.

The mean values of sitting height for age level and national level female gymnast have been presented in figure-12.

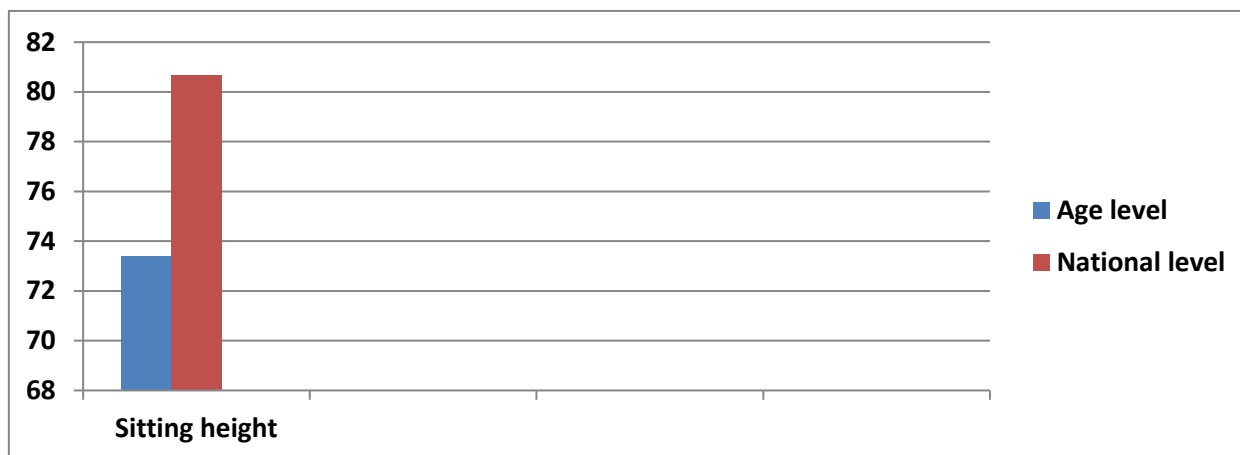


Figure 12. The mean values of sitting height for age level and national level female Gymnast

From Fig 12 it is clearly understood that the national level female gymnasts were greater in sitting height than the age level female gymnasts. In order to test whether the difference in mean sitting height between age level female gymnasts and national level female gymnasts was statistically significant, 't' value was calculated. Table 10 shows the result.

Table 10. Testing significance of mean difference of sitting height for age level and national level female Gymnast

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	National level			
Sitting Height	73.4 cm	80.7 cm	7.3	24.25	significant

It is clearly understood from the results shown in above table that the national level female gymnasts were higher in sitting height than the age level female gymnasts counterpart and the mean difference was statistically significant. So the difference in sitting height between age level and national level female gymnast was to be accepted as significant.

Shoulder width

Table-11 represents the mean and standard deviation for different level female gymnasts in Bangladesh.

Table 11. Mean & Standard Deviation of shoulder width for age level and national level female Gymnasts in Bangladesh

	Mean and Standard Deviation of shoulder width (cm)	
	Mean	S.D.
Age level	32 cm	±2
National level	34.9 cm	±1.3

It is seen from Table 11 that the mean values of shoulder width for age level and national level female gymnast were 32 cm and 34.9 cm respectively. It is clear from table that the mean values were greater for national level female gymnast than that of age level female gymnasts. The mean values of shoulder width for different level female gymnast have been presented in Fig 13.

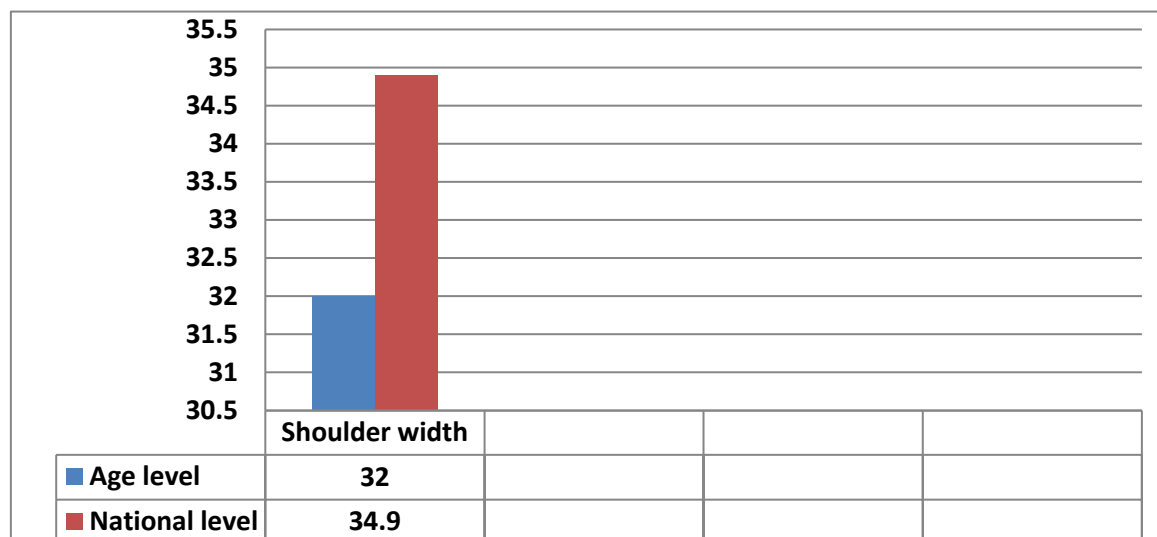


Figure 13. Mean values of shoulder width for age level and national level female Gymnast

It is clearly understood from the above Fig 13 that the national level female gymnasts had greater shoulder width than the age level female gymnasts. In order to test whether the difference in mean shoulder width between age level female gymnasts and national level female gymnasts was statistically significant, 't' value was calculated. Table-10 shows the result.

Table 12. Testing significance of mean difference of shoulder width for age level and national level female Gymnast

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	Nation level gymnast			
Shoulder width	32 cm	34.9 cm	2.9 cm	3.91	Significant

It is clearly understood from the results shown in above table that the national level female gymnasts had greater shoulder width than the age level female gymnasts counterpart and the mean difference was statistically significant. So the difference in shoulder width between age level and national level female gymnast was to be accepted as significant.

Hip circumference

Table 13 represents the mean and standard deviation for different level female gymnast.

Table 13. Mean & Standard Deviation of hip circumference for age level and national level female Gymnast

	Mean and Standard Deviation of hip circumference (cm)	
	Mean	S.D.
Age level	78.6 cm	±6.77
National level	87 cm	±7.49

It is seen from Table 13 that the mean values of hip circumference for age level and national level female gymnast were 78.6 cm and 87 cm respectively.

It is clear from table that the mean values were higher for national level female gymnast than age level female gymnast.

The mean values of hip circumference for different level female gymnast have been presented in Fig 14

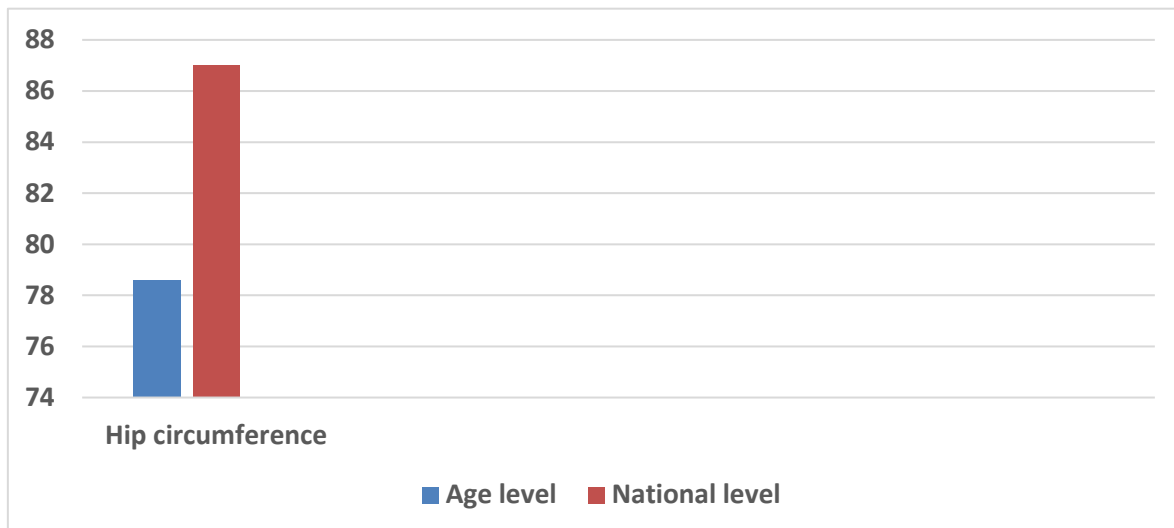


Figure 14. Mean values of hip circumference for different level female Gymnast

It is clearly understood from the above figure that the national level female gymnasts had greater hip circumference than the age level female gymnasts. In order to test whether the difference in mean hip circumference between age level female gymnasts and national level female gymnasts was statistically significant, 't' value was calculated. Table-14 shows the result.

Table 14. Testing significance of mean difference of hip circumference for age level and national level female Gymnast

Parameters	Group of mean		Mean Difference	T-value	Remarks
	Age level gymnast	Nation level gymnast			
hip circumference	78.6 cm	87 cm	8.4	2.63	Significant

It is clearly understood from the results shown in above table that the national level female gymnast had greater hip circumference than the age level female gymnast counterpart and the mean difference was statistically significant. So the difference in hip circumference between age level and national level female gymnast was to be accepted as significant.

Discussion

Anthropometric profiling of female gymnasts involves measuring and analyzing the physical characteristics of the athletes such as height, weight, body mass index (BMI), and body composition. This information is useful in understanding the physical demands of the sport, as well as in determining the optimal body type and physical abilities needed to excel in gymnastics (Mohammad, 2015).

Anthropometric measurements, such as height, weight, limb lengths, and joint range of motion, can vary among female gymnasts of different age levels and national levels. However, some common characteristics of gymnasts include a small body frame, proportional limb lengths, and high levels of flexibility and strength (Bauli & Mridha, 2018). It's important to note that the ideal anthropometric profile for a gymnast will vary based on the specific requirements of each event and the rules of the governing body (Ávila-Carvalho et al., 2013). For example, taller gymnasts may have an advantage in events such as the uneven bars, while shorter gymnasts may have an advantage in tumbling and floor exercise. Additionally, national level gymnasts may have unique anthropometric profiles based on their training and coaching programs, cultural background, and genetics (Bauli & Mridha, 2018).

At the age level, female gymnasts are usually between the ages of 5 and 18, and the anthropometric profiles can vary greatly depending on the gymnast's age and skill level. Generally, younger gymnasts tend to be shorter and lighter, while older gymnasts tend to be taller and have a higher body mass index (Sinning & Lindberg, 1972). This can be attributed to the natural growth and development that occurs during adolescence.

At the national level, female gymnasts have a high level of athleticism, with a lean and muscular physique. This body type allows for the strength, flexibility, and coordination necessary for performing difficult gymnastics skills (Bauli & Mridha, 2018).

From the results of the research, we found significant differences ($p < 0.05$) in the values of body height, weight, arm length, leg length, shoulder width, hip circumference & sitting height which are observed between two groups. To evaluate an athlete's development, growth, the impact of training, nutritional planning, as well as the choice and orientation of possible skills, it is advantageous to look at their body composition (Cabañas-Armesilla & Esparza-Ros, 2009). Regarding the findings, it was discovered that participants' performance increased as they grown up (relative to their age) (Lindner et al., 1991). This might be because gymnastic exercises required training, and older individuals put in a lot more practice time than younger subjects did, as Kaur also observed in her research (Kaur, 2014).

In summary, the anthropometric profile of female gymnasts at both the age and national level can vary greatly, with the ideal body type being lean, muscular, and athletic. However, the most important factor for success in gymnastics is not physical size, but rather technical skill, strength, flexibility, and mental preparation.

Conclusions

On the basis of the results obtained, following conclusions are drawn:

- a) National level female gymnasts were taller than age level female gymnasts.
- b) National level female gymnasts were heavier than age level female gymnasts.
- c) In regard to arm length, the national level female gymnasts had longer upper limbs than age level female gymnasts.
- d) In regard to leg length, the national level female gymnasts had longer lower limbs than age level female gymnasts.
- e) National level female gymnasts sitting height was more than the age level female gymnast.
- f) National level female gymnasts were superior to age level female gymnasts in shoulder width.
- g) National level female gymnasts were superior to age level female gymnasts in hip circumference

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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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