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Gender Difference of Ankle Circumference of 5–10 Years Aged Children: An Anthropometric Investigation

*Ismatsara M[1], Bhuiyan S[2]

Abstract

A cross-sectional, descriptive study was conducted in the Department of Anatomy, Mymensingh Medical College, Bangladesh, between January and December of 2016, to evaluate gender difference in ankle circumference among 5–10 years aged children. Nonrandom purposive sampling technique was chosen for sample collection. A total of 109 Bangladeshi children aged between 5 and 10 years (70 male and 39 female) were selected for this study hailing from different areas of Mymensingh district (Fulbaria, Trishal, Haluaghat, Fulpur and Muktagacha Upazila). Any kind of foot deformity due to either from inherited or physical injury were excluded to construct standard measurement. Ankle circumference was measured using measuring tape. The children were requested to stand with weight distributed equally on both feet. The legs were perpendicular to the feet. The mean ankle circumference of right side of 5, 6, 7, 8, 9 and 10 years aged male were 17.10±.96 cm, 17.20±.76 cm, 18.24±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively and that of left side were 17.10±.96 cm, 17.20±.76 cm, 18.23±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively. On the other hand, the mean ankle circumference of right side of 5, 6, 7, 8, 9 and 10 years aged female were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.27±1.42 cm respectively and that of left side were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.26±1.40 cm respectively. The results of the present study would be useful in anatomy, orthopedics, forensic medicine, plastic surgery, radiology, podiatry, archeology, anthropology and nutrition science.

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Introduction

Anthropometry is meant as “the measurement of man”. By its literal meaning it could include the measurements of anatomical traits of the human. For example, intelligence could have been a parameter.[1] The basic structure of the leg is formed by two typical long bones, tibia and fibula. The tibia lies medial to the fibula. The tibia represents pre-axial bone and the fibula represents post-axial bone.[2] The foot is the structure that acts as the platform to provides balance to the body, support the body weight and serves as a lever in locomotion. Foot is the part of the lower segment of the appendicular framework distal to the ankle. The framework of the foot consists of 26 bones, which are articulated to each other by synovial joints.[3] The study of quality specifications based on angular and linear measurement of human body is called anthropometry. Ankle joint is a synovial joint of the hinge variety. The upper articular surface is formed by the lower end of the tibia including the medial malleolus, the lateral malleolus of the fibula and the inferior transverse tibiofibular ligament. The inferior articular surface is formed by articular area on the upper, medial and lateral aspects of the talus.[4] A detailed knowledge of leg and foot shape, structure and function is particularly important for those involved in the design and construction of footwear and prosthesis.[2] Therefore, we proposed this study to to evaluate gender difference in ankle circumference among 5–10 years aged children.

1. *Dr. Mst Ismatsara, Assistant Professor, Department of Anatomy, Mymensingh Medical College, Mymensingh, Bangladesh.

2. Dr. Sadia Bhuiyan, M. phil (Anatomy), Thesis part student, Mymensingh Medical College, OSD, DGHS.

Address of Correspondence:
Email: ahnafmevs@gmail.com

Methods

This cross-sectional, descriptive study was carried out in the Department of Anatomy, Mymensingh Medical College, Bangladesh, from January to December 2016. Nonrandom purposive sampling technique was chosen for sample collection. A total of 109 Bangladeshi children aged between 5 and 10 years (70 male and 39 female) were selected for this study hailing from different areas of Mymensingh district (Fulbaria, Trishal, Haluaghat, Fulpur and Muktagacha Upazila). Any kind of foot deformity due to either from inherited or physical injury were excluded to construct standard measurement. The circumference at the ankle joint is called ankle circumference. Ankle circumference of foot is measured with a flexible measuring tape passing at the level of the ankle joint. The measuring tape should be snug, not tight. Children were requested to stand with weight distributed equally on both feet. The legs were perpendicular to the feet (Fig. 1). Data was analyzed using Statistical Package for Social Sciences (SPSS) version 17.0 for Windows. Continuous data was presented as mean±SD (standard deviation). Unpaired Student's t-test was applied to compare between male and female. A p-value <0.05 was considered as statistically significant. Data was presented in tabulated form.

Fig.1: Procedure of measurement of ankle circumference by measuring tape.

Ethical clearance was received from the Institutional Review Board (IRB) of Mymensingh Medical College, Mymensingh, Bangladesh.

Results

The mean ankle circumference of the right side of 5, 6, 7, 8, 9 and 10 years aged male children were 17.10±.96 cm, 17.20±.76 cm, 18.24±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively and those of female children were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.27±1.42 cm respectively (Table-I).

Table-I: Right ankle circumference (in cm) in different age and gender groups (N=109)

Age	Gender	Mean±SD (Range)
5 years	Male	17.10±.96 (15.50–19.00)
	Female	16.21±1.20 (14.20–18.00)
6 years	Male	17.20±.76 (16.00–18.20)
	Female	16.95±.57 (16.20–17.60)
7 years	Male	18.24±1.23 (16.80–20.00)
	Female	17.35±.69 (16.00–18.20)
8 years	Male	18.20±.92 (16.00–19.40)
	Female	18.14±1.23 (16.90–20.00)
9 years	Male	19.43±1.02 (17.50–21.20)
	Female	18.25±.95 (17.00–19.00)
10 years	Male	19.62±1.51 (17.00–22.00)
	Female	19.27±1.42 (17.20–21.80)

The mean ankle circumference of the left side of 5, 6, 7, 8, 9 and 10 years aged male children were 17.10±.96 cm, 17.20±.76 cm, 18.23±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively and those of female children were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.26±1.40 cm respectively (Table-II). In case of 5, 6, 7, 8, 9 and 10 years old children, the mean ankle circumference was larger in male children. However, the difference between male and female children was not statistically significant ($p>0.05$) (Table-III).

Table-II: Left ankle circumference (in cm) in different age and gender groups (N=109)

Age	Gender	Mean±SD (Range)
5 years	Male	17.10±.96 (15.50–19.00)
	Female	16.21±1.20 (14.20–18.00)
6 years	Male	17.20±.76 (16.00–18.20)
	Female	16.95±.57 (16.20–17.60)
7 years	Male	18.23±1.23 (16.80–20.00)
	Female	17.35±.69 (16.00–18.20)
8 years	Male	18.20±.92 (16.00–19.40)
	Female	18.14±1.23 (16.90–20.00)
9 years	Male	19.43±1.02 (17.50–21.50)
	Female	18.25±.95 (17.00–19.00)
10 years	Male	19.62±1.51 (17.00–22.00)
	Female	19.26±1.40 (17.20–21.80)

Table-III: Comparison of mean ankle circumference of male and female children (N=109)

Age	Mean difference	Standard error difference	p-value
5 years	.897	.485	.081^{NS}
6 years	.259	.424	.552^{NS}
7 years	.894	.454	.066^{NS}
8 years	.067	.532	.900^{NS}
9 years	1.186	.590	.066^{NS}
10 years	.351	.650	.594^{NS}

Unpaired Student's t-test was applied; NS=not significant.

Discussion

According to the present study, the mean ankle circumference of right side of 5, 6, 7, 8, 9 and 10 years aged male were 17.10±.96 cm, 17.20±.76 cm, 18.24±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively and that of left side were 17.10±.96 cm, 17.20±.76 cm, 18.23±1.23 cm, 18.20±.92 cm, 19.43±1.02 cm and 19.62±1.51 cm respectively. On the other hand, the mean ankle circumference of right side of 5, 6, 7, 8, 9 and 10 years aged female were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.27±1.42 cm respectively and that of left side were 16.21±1.20 cm, 16.95±.57 cm, 17.35±.69 cm, 18.14±1.23 cm, 18.25±.95 cm and 19.26±1.40 cm respectively.

Rawangwong, Chatthong & Boonchouytan conducted a study on foot anthropometry of kindergarden children in the South Thailand and found the mean ankle circumference of boys as 196.31±17.10 mm and that of girls as 187.79±15.63 mm.

They conducted another study in 2011 on foot anthropometry of primary school children in the South Thailand and found the same mean ankle circumference. The findings were higher than the present study.[5] Another study done by Boucher on lower extremity anthropometry found that right mean ankle circumference as 15.4±1.5 cm and that of left as 15.3±1.6 cm which was less than that of the present study.[6] Bari, Othman & Salleh conducted a study on foot anthropometry for shoe design among preschool children in Malaysia and found the mean ankle circumference of 5 years old boys as 16.36±1.73 cm and that of 6 years old boys as 16.43±1.33 cm. The mean ankle circumference of 5 years old girls was 16.31±1.49 cm and that of 6 years old girls was 16.43±1.49 cm. All the above findings were less than the present study except the finding of 5 years old female which was more or less similar to the present study.[7] We did comparison of mean ankle circumference between male and female children, which was statistically not significant. However, study regarding comparison of ankle circumference between male and female children was not found in any other country to compare with the present study. Future studies with larger sample size should elucidate possible foot differences when comparing children with overweight and with obesity (based on BMI), and in older age groups.

Conclusion

Our study revealed that in case of 5, 6, 7, 8, 9 and 10 years old children, the mean ankle circumference was larger in male children. However, the difference between male and female children was not statistically significant.

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