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Anthropometric Study of the Heel Breadth among 5 to 10 Years Old Bangladeshi Children

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Abstract

A cross-sectional, descriptive study was conducted in the Department of Anatomy, Mymensingh Medical College, Mymensingh, Bangladesh, to determine heel breadth among 5 to 10 years old children as well as to explore sexual dimorphism, if any. A nonrandom purposive sampling technique was adopted for sample collection. Any kind of foot deformity due to either from inherited or physical injury were excluded to construct standard measurement. A total of 109 Bangladeshi children (70 male and 39 female) hailing from different areas of Fulbaria, Trishal, Haluaghat, Phulpur and Muktagacha Upazila under Mymensingh district, aged between 5 and 10 years, were finally included in this study. Heel breadth was measured using Vernier slide calipers. Children were requested to stand with weight distributed equally on both feet. The legs were perpendicular to the feet. The mean heel breadth of right side of 5, 6, 7, 8, 9 and 10 years aged male children were 3.92±.49 cm, 4.21±.44 cm, 3.87±.54 cm, 4.41±.39 cm, 4.61±.56 cm and 4.34±.61 cm respectively, while 3.86±.43 cm, 3.50±.24 cm, 4.11±.59 cm, 3.94±.56 cm, 3.27±.33 cm and 3.91±.54 cm among female children respectively. The mean heel breadth of left side of 5, 6, 7, 8, 9 and 10 years aged male children were 3.92±.49 cm, 4.18±.44 cm, 3.84±.52 cm, 4.36±.39 cm, 4.54±.53 cm and 4.30±.60 cm respectively and 3.81±.41 cm, 3.50 ±.24 cm, 4.07±.59 cm, 3.88±.60 cm, 3.27±.33 cm and 3.86±.51 cm among females respectively. Comparison of heel breadth showed no significant difference between male and female ($p>0.05$), except in 6 and 9 years old children, the difference was statistically significant ($p<0.05$). The present anthropometric study was designed to construct data of 5 to 10 years aged Bangladeshi children regarding heel breadth and an attempt has been made out to create interest among the researchers for future study. Our study findings are expected to enrich the information pool for use in research and practice in multiple disciplines, e.g., anatomy, orthopaedics, forensic medicine, plastic surgery, radiology, podiatry, archeology, anthropology and nutrition science.

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Introduction

The foot is a complex 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, 33 joints, and related muscles, tendons, and ligaments and this complex structure contributes to the overall foot size and shape.[1,2] Children's feet need to be properly measured. This is helpful in determining the correct length and width of their feet, which may help to avoid potential foot problems. It is beneficial for observation the walking pattern and detecting problems, which may be indicative of specific foot conditions.[2-5]

Such studies based on angular and linear measurement of human body or its parts are called anthropometry. A detailed knowledge of measurement relating to foot size and shape, e.g., heel breadth is particularly important for those involved in the design and construction of footwear and prosthesis.[3,5] Apart from that, evidence showed that formulas can be developed as predictive models for estimating both height and weight when only a

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subject's footprint dimensions are known.[6] Moreover, research revealed that sexual dimorphism and ethinic variations exist in the foot morphology due to differences in contributing factors in development of foot size and shape.[7] Therefore, anthropometry related to children's heel breadth is important in multiple disciplines in research and practice, such as anatomy, orthopaedics, forensic medicine, plastic surgery, radiology, podiatry, archeology, anthropology and nutrition science. Hence, we proposed this study to determine heel breadth among 5 to 10 years old Bangladeshi children as well as to explore sexual dimorphism, if any.

Methods

This cross-sectional, descriptive study was conducted in the Department of Anatomy, Mymensingh Medical College, Mymensingh, Bangladesh, from January to December of 2016. A nonrandom purposive sampling technique was adopted for sample collection. Any kind of foot deformity due to either from inherited or physical injury were excluded to construct standard measurement. A total of 109 Bangladeshi children (70 male and 39 female) living in different areas of Fulbaria, Trishal, Haluaghat, Fulpur and Muktagacha Upazila under Mymensingh district aged between 5 and 10 years were finally included in this study.

The maximum breadth of the heel is called heel breadth. The sliding and fixed jaws of the caliper were placed respectively on the medial and lateral surface of the heel from behind to measure the heel breadth. The jaws were kept at 450 angles to the platform on which the foot was placed.[3] Heel breadth was measured using Vernier slide calipers (Fig. 1). Children were requested to stand with weight distributed equally on both feet. The legs were perpendicular to the feet.

Data was collected through data collection sheet containing the age, laterality, and heel breadth of the children. Data was scrutinized, compiled and transferred to the computer in MS-Excel sheet. Statistical analysis was performed by using Statistical Package for the Social Sciences (SPSS) version 16.0 for Windows. Data was presented as mean±SD (standard deviation) in tabulated form. Unpaired Student's 't' test was applied to determine the difference in heel breadth between male and female children. A p-value <0.05 was considered as statistically significant.

Ethical clearance was obtained from the Institutional Review Board (IRB) of Mymensingh Medical College, Mymensingh, Bangladesh. Before inclusion in the study, each child was greeted politely. All pros and cons of the study were described to the parent(s) or guardian of the child. As the participating children are minors (<18 years), we sought assent from them as well as written informed consent from their parent(s) or legal guardian.

Fig. 1: Procedure of measurement heel breadth using Vernier slide calipers

Results

The mean heel breadth of right side of 5, 6, 7, 8, 9 and 10 years aged male children were 3.92±.49 cm, 4.21±.44 cm, 3.87±.54 cm, 4.41±.39 cm, 4.61±.56 cm and 4.34±.61 cm respectively, while 3.86±.43 cm, 3.50±.24 cm, 4.11±.59 cm, 3.94±.56 cm, 3.27±.33 cm and 3.91±.54 cm among female children respectively (Table-I). The mean heel breadth of left side of 5, 6, 7, 8, 9 and 10 years aged male children were 3.92±.49 cm, 4.18±.44 cm, 3.84±.52 cm, 4.36±.39 cm, 4.54±.53 cm and 4.30±.60 cm respectively and 3.81±.41 cm, 3.50 ±.24 cm, 4.07±.59 cm, 3.88±.60 cm, 3.27±.33 cm and 3.86±.51 cm among females respectively (Table-II). Comparison of heel breadth showed no significant difference between male and female ($p>0.05$), except in 6 and 9 years old children, the difference was statistically significant ($p<0.05$) (Table-III).

Table-I: Right heel breadth in different age and sex groups (N=109)

Age (in years)	Sex	Measurement in cm	
		Range	Mean±SD
5	Male	3.20–4.80	3.92±0.49
	Female	3.10–4.40	3.86±0.43
6	Male	3.50–4.90	4.21±0.44
	Female	3.20–3.80	3.50±0.24
7	Male	2.90–4.50	3.87±0.54
	Female	2.70–5.00	4.11±0.59
8	Male	3.50–4.90	4.41±0.39
	Female	3.00–4.30	3.94±0.56
9	Male	3.60–5.45	4.61±0.56
	Female	2.90–3.70	3.27±0.33
10	Male	3.50–5.32	4.34±0.61
	Female	3.00–4.50	3.91±0.54

Table-II: Left heel breadth in different age and sex groups (N=109)

Age (in years)	Sex	Measurement in cm	
		Range	Mean±SD
5	Male	3.20–4.80	3.92±0.49
	Female	3.10–4.30	3.81±0.41
6	Male	3.50–4.90	4.18±0.44
	Female	3.20–3.80	3.50±0.24
7	Male	2.90–4.50	3.84±0.52
	Female	2.70–5.00	4.07±0.59
8	Male	3.40–4.80	4.36±0.39
	Female	2.90–4.30	3.88±0.60
9	Male	3.60–5.30	4.54±0.53
	Female	2.90–3.70	3.27±0.33
10	Male	3.50–5.32	4.30±0.60
	Female	3.00–4.50	3.86±0.51

Table-III: Difference of mean heel breadth between male and female children

Age	Mean difference	Standard error difference	p-value
5 years	.053	.212	.803^{NS}
6 years	.718	.235	.009^{S}
7 years	-.232	.261	.387^{NS}
8 years	.470	.233	.062^{NS}
9 years	1.338	.304	.001^{S}
10 years	.435	.260	.109^{NS}

p-value reached from Unpaired Student's 't' test; S=significant, NS=not significant

Discussion

According to the present study, the right heel breadths were found between 2.90 cm and 5.45 cm in males and between 2.70 cm and 5.00 cm in females, while the heel breadths of the left side were found between 2.90 cm and 5.32 cm in males and between 2.70 cm and 5.00 cm in females. However, there was

no significant difference between male and female ($p>0.05$), except in 6 and 9 years old children ($p<0.05$). Rawangwong et al. conducted a study on foot anthropometry of children aged 7-12 years in the south of Thailand and found the mean heel breadth of 52.21±5.85 mm and 50.32±5.53 mm in male and female respectively; no significant difference between male and female was observed ($p>0.05$).[8] Their findings are a bit higher than that of the present study. Boucher conducted a study on lower extremity anthropometry and reported the mean breadths of right and left heels were 3.8±0.5 cm and 3.8±0.5 cm respectively.[9] The findings were more or less similar to the findings of some of the age groups of the present study. Jiménez-Ormeño *et al*. conducted a study on foot morphology in normal-weight, overweight and obese school children and found the mean heel breadth of 6, 7, 8, 9 and 10 years old normal-weight children as 43.8±3.8 mm, 44.4±3.5 mm, 46.5±3.5 mm, 48.9±4 mm and 50.5±3.8 mm respectively.[10] All the above findings were more or less similar to our findings according to the age, except in 7 and 10 years children, which were a bit higher than that of the present study.

Conclusion

Findings of the present study indicate anthropometric variations of heel breadth of 5-10 years old Bangladeshi children; however, no sexual dimorphism was observed except in 6 and 9 years old children. These data will be helpful to enrich the information pool in our anthrpological archives and compare with other ethnicities across the globe.

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