

ANTHROPOMETRIC ANALYSIS OF FOOT LENGTH, BREADTH AND SHAPE IN ADULT BANGALEE FEMALES OF CHATTOGRAM: AN OBSERVATIONAL STUDY

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Abstract

Background: Foot is a complex, multi-segmented structure. Each segment act in a coordinated manner to provide support and absorb shock during locomotion. Foot morphology differs among population groups. The objectives of this study were to determine the selected foot dimensions and foot shape of adult Bangalee females to find out any ethnic characteristics of their own.

Materials and methods: The study was conducted on 200 Bangalee adult females within 18-44 years age. Foot length and foot breadth were measured by slide caliper. Foot index was calculated from foot length and foot breadth. Foot shape was determined from foot index by using a pre determined formula.

Results: The mean value for length, breadth and index of foot in Bangalee females were 22.91±0.79 cm, 8.55±0.4cm and 37.35±1.92 respectively. Most of the participants (68%) had standard foot shape. 17.5% women had slender foot whereas 14% had broad foot shapes.

Conclusion: The results of this study should be useful for anatomists, anthropologists and forensic experts.

Key words

Anthropometry; Bangalees; Foot length; Foot breadth; Foot shape.

Introduction

Anthropometry deals with the size and shape of different body segments and their variations in populations. It has always been considered as a useful tool for determination of ethnicity, stature,

age and sex of an individual in forensic investigations. Now a days anthropometric techniques are being used in ergonomics and in clinical assessment of diseases^{1,2,3}.

Foot structure varies among individuals according to their age, gender, ethnicity and environment. These factors should be taken into account to design suitable footwear, instruments and workstations for different populations. Ill-fitting footwear may alter foot morphology and biomechanics. Any changes on those regards may lead to injury of foot^{4,5}.

Though many researchers have investigated the foot structure of other ethnic groups in different parts of the world, there is limited information on the adult Bangalee females of Bangladesh at present^{6,7,8}. The present study aims at bridging the gaps regarding foot length, breadth and shape of adult females of Bangalee ethnic group.

Materials and methods

This cross sectional and observational study recruited 200 Bangalee adult females of 18 to 44 years of age from Chattogram city with no history of operation or deformity of lower limb, any genetic, endocrine or neurological disorders. The selected subject was asked to stand straight with her heels slightly apart and to keep her weight evenly distributed between both feet. Height was measured from the floor to the crown of the head with a measuring tape. A weighing machine was used to measure weight. BMI was calculated and women with BMI>24.9 were excluded. All the soft tissue and bony landmarks were located and the measurements of the both feet of the each subject were obtained. Measurements taken from both feet were pooled together for statistical analysis. Foot Length (FL) was measured from the posterior prominence of the heel to the tip of the longest toe⁹. Foot Breadth (FB) was measured as the distance between the most medial point on the head of the first metatarsal to the most lateral point on the head of the fifth metatarsal⁹. A manual sliding caliper was used to measure all the foot dimensions. Foot Index (FI) was calculated for each individual by dividing the foot breadth by the foot length × 100⁹. Three types of foot shapes were determined according to the foot index.

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Submitted on : 14.11.2019

Accepted on : 07.02.2020

- i. Slender foot: $FI^* < FI - SD$
- ii. Standard foot: $FI - SD < FI^* < FI + SD$
- iii. Broad foot: $FI^* > FI + SD$

(FI^* - Individual Foot Index, FI - Mean Foot Index, SD - Standard Deviation).

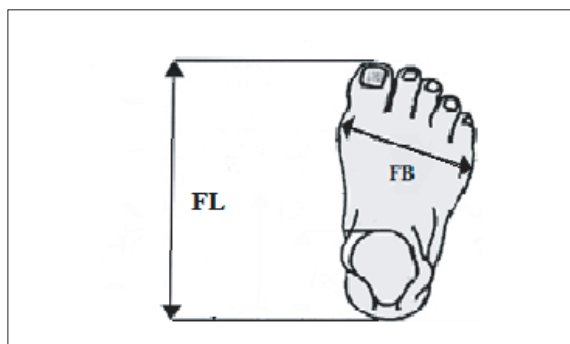


Fig 1: Diagrammatic representation of selected foot measurements

(Source: Modified from Parham et al¹⁰.)

* FL-Foot Length, FB-Foot Breadth.

Results

Table I : Demographic characteristics of the participants.

Variable	Bangalee (n=200)	
	Mean	SD
Age (Yr)	27.46	7.36
Height (cm)	155.03	5.41
Weight (Kg)	50.69	6.08
BMI (Kg/m ²)	21.46	2.08

* BMI- Body Mass Index.

Table I showed the mean values and standard deviations of age, height, weight and BMI of the Bangalee females.

Table II : Descriptive statistics of foot variables of adult Bangalee females.

Variables	Bangalee (n=200)		Range	
	Mean	SD	Min	Max
FL (cm)	22.91	0.79	19.95	25.15
FB (cm)	8.55	0.40	7.25	9.70
FI	37.35	1.92	32.25	42.48

*FL-Foot Length, FB-Foot Breadth, FI-Foot Index, SD-Standard Deviation, cm- Centimeter.

Table II presents the descriptive statistics of foot variables of Bangalee adult females. Their mean foot length and foot breadth were 22.91 ± 0.79 cm and 8.55 ± 0.4 cm respectively. The mean foot index value was 37.35 ± 1.92 .

Figure 1 shows the percentage distribution of Bangalee females according to foot shape. The percentages of standard foot were higher among the Bangalees (68%) followed by 17.5% slender and 14.5% broad foot shapes.

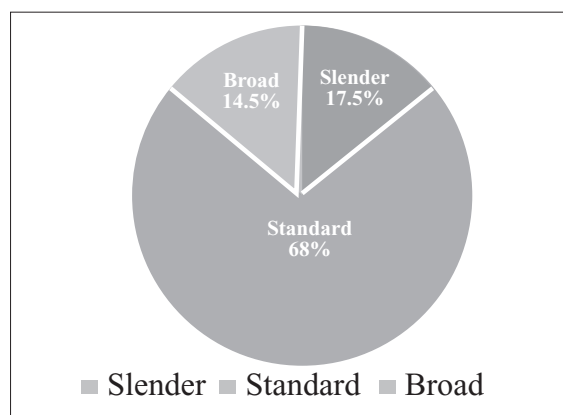


Fig1: Distribution of the participants by shapes of foot.

Discussion

In the present study, the age range of the participants was kept within the range of 18-44 years. The minimum age was set at 18 years as bones continue to mature prior to that age⁷. As menopause leads to loss of bone mass, the maximum age of the participants was set at 44 years. Obesity affects foot structure and function. Obese women show shorter and broader feet than the non-obese ones¹¹. Therefore, women with $BMI > 24.9$ were excluded.

A study on 100 Bangalee female of West Bengal in India showed that that the right foot length and breadth was 22.98 ± 1.44 cm and 8.55 ± 0.31 cm respectively¹². Their findings are in agreement with that of the present study. These resemblance may occur due to similar ethnicity and environment shared by these groups. The right foot length and breadth of Thai (FL 23.17 ± 0.99 cm, FB 9.3 ± 0.5 cm) and Nigerian females (FL 24.77 ± 0.98 cm, FB 9.35 ± 0.58 cm) were much greater than the Bangalees of the present study^{8,9}. Each of the groups belong to different ethnicity which may be the cause for such dissimilarities.

The right foot length (23.14 ± 1.11 cm) and breadth (8.65 ± 0.45 cm) of Punjabi women were greater than the Bangalee females of the present study despite their similar ethnicity. But foot index value for Punjabi women (37.42 ± 1.63 cm) resembled to that of the Bangalees⁶. Although, foot length and breadth were different proportion of their foot is similar to the Bangalee females. According to Kouchi, the mean values for foot index in Japanese, Australian aborigine, French and Indonesian females were 41.0, 38.2, 38.6 and 40.8 respectively¹³. Each of those groups showed higher foot index value than their Bangalee counter parts. Higher foot index value mean wider foot for a given foot length. This finding is in accordance with Kouchi who observed that Mongoloid populations tend to have a wider foot for foot length¹³. Regarding foot shape, the Nigerian females have higher percentage of broad (16.67%) foot shape whereas the Bangalees in the present study have greater percentages of standard foot shape⁹. The larger dimensions of foot in Mongoloid and African females are suggestive of increased surface area as a result of genetic adaptation to temperature stress in the warmer climate of the tropical region¹⁴. Different lifestyle should also be taken into account for these variations in foot proportions.

Limitations

- For gathering information on genetic disorders, history of the patients and physical examinations were relied upon instead of other concrete tests.
- Even though subjects were instructed to distribute their body weight equally when standing so that the assessed foot supported 50% weight bearing, this could not be controlled with accuracy.

Conclusion

The foot dimensions among ethnic groups may vary according to their ethnicity, environment and lifestyle. The successful production of footwear, prosthetics etc. and identifying ethnicity in forensic investigations require population specific measurements. So the results of this study should provide the information on foot dimensions of Bangalee females of Bangladesh which can be used on those regards.

Recommendations

- Future studies should include an expanded set of variables for better understanding of foot morphology of the Bangalee females.
- In addition to Bangalee, other ethnic population can be included and their foot structure can be compared to trace the differences.

Acknowledgement

The authors would like to thank Professor Dr. Shaikhul Islam (Head of the Department of Anatomy of Marine City Medical College, Chattogram) for his valuable advice.

Contribution of authors

SB - Conception, design, acquisition of data, drafting & final approval.

MA - Interpretation of data, critical revision of content & final approval.

RC - Data analysis, critical revision of content & final approval.

Disclosure

All the authors declared no competing interests.

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