

# Determination Of Sex From The Foot Measurements

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## Abstract

The aim of our physical anthropometric study was to determine sex (male/female) by foot measurements. Two hundred and fifty students (125 males and 125 females) of the age above 18 years were examined in the year 2005. The average foot length was found to be about 3cm greater in males as compared to females and the average foot breadth of males was about 1cm longer than females. The foot index was calculated and has been used for the determination of sex. To conclude, the foot index more than 37 is suggestive of female and less than 37 is that of male.

## INTRODUCTION

Identification is often required in medico-legal practice. The problem mainly arises when the body is recovered in advanced stage of decomposition, mutilated state and skeletanized state. Sometimes, fragments of soft tissues are found disposed off in the open, in ditches, or rubbish dumps, etc. and this material is brought to forensic pathologist for examination.<sub>1</sub>

Sex determination is a vital part of the analysis of human remains. Lots of researches are going on for assessing stature, sex, race, etc from anthropometric measurements of different parts of the body for identification purpose. In the present study, attempt has been made to find out co-relation of foot measurements with the sex (male/female).

## METHODOLOGY

The study was conducted in the Department of Forensic Medicine & Toxicology, SSR Medical College, Mauritius in the year 2005 with collaboration of the Department of Anatomy. The material consists of 250 young and healthy students (125 males and 125 females) in the age group of 18-30 years. In this study, the sample included only the students above the age of 18 years. Above this age, most people attain their maximum growth and therefore their maximum foot length and breadth.

The foot length was measured as a straight distance between the most posterior projecting point of heel and the most anterior projecting point (the end of great toe or second toe) when placed on flat surface. This measurement excluded any nail extending over the end of the toe. The breadth of foot

was measured as straight distance from the most medially placed point on the head of 1<sup>st</sup> metatarsal to the most laterally placed point located on the head of 5<sup>th</sup> metatarsal. The apparatus used for this study were osteometric board and measuring tape.

The foot index was calculated by dividing the foot breadth by foot length and multiplied by 100. To obtain better results, the entire sample of study has been categorized in to different age groups like 18-19 years, 19-20 years, 20-21 years, 21-22 years and more than 22 years. The mean values of foot length and foot breadth of each age group have been used for calculating foot index.

## RESULTS

Foot length: In males, the right foot length varied from 23.30 cm to 29.00 cm (mean 26.17 & SD 1.05) and left foot length varied from 23.10 cm to 29.10 cm (mean 26.14 & SD 1.06). In females, the right foot length varied from 21.10cm to 26.30cm (mean 23.33 & SD 1.08) and left foot length varied from 21.20cm to 26.30cm (mean 23.28 & SD 1.09). (Table1)

### Figure 1

Table 1: Measurements (cm) of Foot Length in Males and Females (n=250)

Male	Minimum	Maximum	Mean	S.D
Right	23.30	29.00	26.17	1.05
Left	23.10	29.10	26.14	1.06
Female	Minimum	Maximum	Mean	S.D
Right	21.10	26.30	23.33	1.08
Left	21.20	26.30	23.28	1.09

Foot breadth: In males, the right foot breadth varied from

8.00cm to 10.80cm (mean 9.63 & SD 0.54) and left foot breadth varied from 7.90cm to 11.10cm (mean 9.62 & SD 0.54). In females, the right foot breadth varied from 7.50 cm to 10.00cm (mean 8.74 & SD 0.50) and left foot breadth varied from 7.50cm to 10.30cm (mean 8.75 & SD 0.52). (Table 2)

**Figure 2**

Table 2: Measurements (Cm) of Foot Breadth in Males and Females (n=250)

Male	Minimum	Maximum	Mean	S.D.
Right	8.00	10.80	9.63	0.54
Left	7.90	11.10	9.62	0.54
Female	Minimum	Maximum	Mean	S.D.
Right	7.50	10.00	8.74	0.50
Left	7.50	10.30	8.75	0.52

Foot index: In males, the foot index ranged from 36.50 (18-19 yrs) to 36.97 (20-21 yrs). In females, it ranged from 37.04 (18-19 yrs) to 37.93 (20-21 yrs). (Table 3 & 4)

**Figure 3**

Table 3: Age Wise Distribution of Foot Index in Males (n=125)

Age group (yrs)	Foot length (mean) in cm	Foot breadth (mean) in cm	Foot Index
18 to 19			
Right	26.19	9.56	36.50
Left	26.26	9.59	36.51
19 to 20			
Right	26.44	9.73	36.80
Left	26.46	9.77	36.93
20 to 21			
Right	26.20	9.69	36.97
Left	26.16	9.67	36.95
21 to 22			
Right	26.19	9.60	36.65
Left	26.16	9.56	36.56
More than 22			
Right	25.72	9.49	36.90
Left	25.62	9.46	36.91

**Figure 4**

Table 4: Age Wise Distribution of Foot Index in Females (n=125)

Age group (yrs)	Foot length (mean) in cm	Foot breadth (mean) in cm	Foot Index
18 to 19			
Right	23.55	8.72	37.04
Left	23.59	8.75	37.08
19 to 20			
Right	23.35	8.72	37.33
Left	23.28	8.77	37.66
20 to 21			
Right	23.29	8.78	37.72
Left	23.22	8.81	37.93
21 to 22			
Right	23.21	8.70	37.50
Left	23.20	8.67	37.38
More than 22			
Right	23.29	8.80	37.79
Left	23.13	8.70	37.62

## DISCUSSION

Many physical anthropometric studies show the gender difference.<sup>2, 3, 4</sup> The average male is ten centimeters taller than the average female and this difference will also be translated in an overall trend that males will have greater foot length as compared to females.<sup>5</sup>

In our study, males had an average foot length about 3cm greater than the females' foot length. The foot breadth was about 1cm greater in males as compared to females. In all age groups, the foot index in females was found to be more than 37, and in males, it was less than 37. Therefore, this value i.e. 37 can be used as deviation point for the determination of sex. Thus the present study indicates a positive correlation between an individual's foot measurements and gender, which is consistent with the study conducted by Tyagi et al.<sup>6</sup> Thus sex can be determined by foot index with fair accuracy. Further researches are needed in this field.

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