

## **CHAPTER- I**

### **INTRODUCTION**

Forensic anthropologist plays an important role in identification of mass burials of humans. Forensic anthropologist identifies dead bodies from human remains including foot. Likewise the fingerprints and palm prints, foot prints are also helpful in solving crimes.<sup>[3]</sup>

The human foot is a highly complex structure consisting of 26 major bones and numerous synovial joints. It plays a role in load support and shock absorption as well as providing balance and stabilization of the body during gait. The morphology of human foot varies considerably due to the combined effects of heredity, lifestyle, and climatic factors. In addition, natural biological variance, age, population group, BMI, parity and sex have significant influences on the morphology of an individual's foot.

A footprint is an impression of the weight-bearing areas of the plantar surface of the foot. Footprints can be found on rain covered surfaces, newly waxed floors, freshly cemented surfaces, moistened surfaces, in dust, mud, sand, oil, paint and blood at murder scenes.<sup>[4]</sup> Footprints can be found at crime scenes because offenders often remove their footwear, either to avoid noise or to gain a better grip in climbing walls, etc., while entering or exiting. Like fingerprints, footprints of an individual are unique to that individual. Hence, footprints linked to a crime can be compared with a suspect's footprints as a means of confirming or ruling out involvement in that crime.

The shape of a footprint is influenced by a complex of anatomical, functional, and sedimentary (surface) variables. Several studies support the existence of dimensional sexual dimorphism in footprint morphology. Other studies suggest strong links between footprint dimensions and stature, body weight and holding weight. Thus, analysis of footprints can help in the determination of sex of an individual in forensic investigations.<sup>[11]</sup>

Human gait refers to locomotion achieved through the movement of human limbs..Different gait patterns are characterized by difference in limb-movement patterns, overall velocity, forces , kinetic and potential energy cycles and changes in the contact with the surface[ ground, floor, etc.].Different foot print can occur from the varying gait patterns.

The determination of sex is one of the first and most important steps in establishing personal identity in forensic investigations. Male feet differ from female feet in a number of shape characteristics, particularly at the arch, the lateral side of the foot, the hallux and the ball of the foot. Anthropometric studies have recorded significantly larger values for various dimensions of the foot in males than in females. Studies have shown that contact area at any region of the plantar surface of the foot is greater in men than in women. Sex differences in foot morphology and contact area imply sex differences in plantar pressure distribution, although empirical results are inconsistent.<sup>[17]</sup>

So, this study intends to determine if sex of an individual can be identified by foot length, foot breadth, foot heel breadth etc., of 30 students, comprising 15 males and 15 females of age group 14, 15 and 16.

## **CHAPTER - II** **LITERATURE REVIEW**

### **K. Krishan [2011] Hand and foot dimension in North Indian population:**

Hands and feet are often recovered from the site of natural as well as man-made disasters because of bomb blasts, train accidents, plane crashes, or mass homicides. This study is intended to establish standards for determination of sex from the dimensions of hands and feet in a North Indian population. The data for this study comprise 123 men and 123 women aged between 17 and 20 years from the “Rajput” population of Himachal Pradesh in North India. Four anthropometric measurements viz. hand length, hand breadth, foot length, and foot breadth have been taken on both sides of each subject following international anthropometric standards. The hand index (hand breadth/hand length  $\times$  100) and the foot index (foot breadth/foot length  $\times$  100) were calculated. Sectioning points and regression models are derived for the hand and foot dimensions and the derived indices. The hand and foot dimensions show a higher accuracy in sex determination by sectioning point analysis when compared to hand and foot index. Of the hand and the foot dimensions, hand breadth and foot breadth showed better accuracy in sex determination. Hand index and foot index remain poor sex discriminators in the study.

**H. Ozden [2005] Stature and sex estimate using foot and shoe dimension:** The aim of the study was to develop a formula to estimate the stature and sex of an individual using foot and shoe dimensions. To this aim the stature, right and left shoe sizes, and maximum and minimum feet length and width measurements of a target group of 569 individuals were taken. The group was composed of 294 males and 275 females. The highest correlation coefficient was found in length measurements. A notable difference between males and females existed with regard to both right and left foot and shoe length and width averages and shoe sizes ( $p < 0.001$ ). Among the group, a significant correlation was found in regard to stature and right

shoe length ( $r = 0.591$ ,  $p < 0.001$ ), with the Correlation between stature and right foot length and stature and right shoe length being  $0.579$  ( $p < 0.001$ ); as for the female group, there was a significant correlation between stature and right foot length and stature and right shoe length ( $r = 0.460$ ,  $p < 0.001$ ). Thus the regression formula obtained are as follows: for the right side:  $\text{sex} = 69.169 + 0.173$  (maximum foot length)  $- 0.368$  (maximum foot width)  $- 0.820$  (shoe length)  $+ 0.224$  (shoe width)  $- 1.280$  (shoe number). For the left side:  $\text{sex} = 69.551 + 0.276$  (maximum foot length)  $- 0.504$  (maximum foot width)  $- 0.739$  (shoe length)  $+ 0.344$  (shoe width)  $- 1.360$  (shoe number). In application of the formula, if sex is lower than  $0.50$ , the shoe belongs to a male, if higher, then to female. The formula which was obtained in regression analysis in order to estimate the stature when the measurements of shoe and foot were known. For the right side,  $\text{stature} = 47.93 + 1.083$  (maximum foot length)  $+ 0.788$  (shoe length)  $+ 1.813$  (shoe number) (SEE:  $31.410$ ). For the left side:  $\text{stature} = 47.33 + 1.139$  (maximum foot length)  $+ 0.593$  (shoe length)  $\times 1.924$  (shoe number) (SEE:  $31.607$ ). It was understood that foot and shoe sizes are a criteria to estimate the stature of a person that there was a strong relationship between foot and shoe length and width and that these can be used to aid estimation. It was found that in sex estimate, foot and shoe lengths are better in helping the estimate than width measurements, and that the use of shoe measurements rather than bare foot measurements are better to obtain meaningful results.

**T. Kanchan [2008] Stature estimation from foot dimensions:** Identification of an individual is the mainstay in forensic investigations. The dimensions of the foot have been used for the determination of sex, age, and stature of an individual. The present study examines the relationship between stature and foot dimensions among Gujjars, a North Indian endogamous group. Stature, foot length and foot breadth of 200 subjects comprising 100 males and 100 females were measured. Statistical analyses indicated that the bilateral variation was insignificant for all the measurements except foot breadth in males ( $p < 0.01$ ). Sex differences were found to be highly significant for all the Measurements ( $p < 0.01$ ). Linear and multiple Regression equations for stature

estimation were calculated using the aforementioned variables and multiplication factors were computed. Prediction of stature was found to be most accurate by multiple regression analysis.

**R. Moudgil [2008] Foot index: Is it a tool for sex determination:**

Identification of an individual is of paramount importance in forensic investigations. The dimensions of the foot can be used for the determination of sex and stature of an individual in forensic investigations. No systematic studies are available on the determination of sex from foot measurements of North Indians. Therefore, foot index is derived to determine the sex of an individual in a single community of North India. The foot index for both genders is derived by dividing the foot breadth by foot length and multiplying it by hundred. In the present investigation, the foot index is found to be slightly higher in females in the right foot and males in the left foot. The study suggests that although foot length and foot breadth show significant sex differences, sex determination cannot be made conclusively from the foot index.

**J. Sen [2008]: Estimation of stature from foot length and foot breadth among Rajbangsi:** In forensic anthropology, estimation of stature from feet dimensions plays a significant role in establishing personal identity. There is a scarcity of literature on the estimation of stature from foot length and foot breadth among various Indian populations, including the indigenous populations found in the northern part of the state of West Bengal, India. The Rajbangsi's and the Meches are two such indigenous populations. The present study is an attempt to understand the relationship between stature and feet dimensions among Rajbangsi male and female individuals of North Bengal, India. Measurements of stature, foot length and foot breadth were recorded from 350 adult Rajbangsi and 100 adult Mache individuals (age range: 18–50 years) residing in different villages located in the Darjeeling District of West Bengal. The Technical Error of Measurements was within the accepted limits. The results of the present study indicate that female Rajbangsi individuals exhibit shorter stature and smaller feet than their male counterparts. Using ANOVA, it is determined

that there was significant differences ( $p < 0.05$ ) in stature, foot length and foot breadth between sexes. Using paired t-test, it is further observed that bilateral variation was significant ( $p < 0.05$ ) within sexes with respect to foot length, but not with foot breadth ( $p > 0.05$ ). Stature, foot length and foot breadth are positively and significantly correlated with each other ( $p < 0.01$ ). The higher correlation coefficient between stature and foot length over that of stature and foot breadth points to the fact that foot length, rather than foot breadth, is more accurate in estimating stature. Sexual dimorphism is more pronounced than bilateral differences among Rajbangsi individuals. Using linear regression, it is observed that stature was strongly dependent on foot length and foot breadth. Foot breadth is strongly dependent on foot length. Prediction of stature is more accurate by using step-wise multiple regressions. Age does not have a significant effect on stature estimation. The equations obtained for the Rajbangshis were fitted on the Meshes to check whether the same equations could be utilized for both these indigenous communities. The equations obtained for another Indian population from the literature were also fitted and tested on the Rajbangsi. It may be concluded that the present study has provided equations to estimate stature from the feet dimensions among the Rajbangshis. It would be unwise to use the same equations for stature estimation for different Indian populations.

**SF Phang [2017] Stature and gender estimation using foot measurements:**

In forensic investigation difficulties are being experienced in the Stature and gender estimation of bodies dismembered in mass destruction. So as to eliminate these difficulties, new methods are being developed. The aim of this study is to develop formulae for estimation of the stature and gender through foot measurements when necessary. For this purpose, the length, width, malleol height, navicular height measurements of the right and left foot as well as stature have been taken from the 249 subjects who are attending Medical Faculty of DokuzEylul University and School of Physical Therapy and Rehabilitation in Turkey. In males, stature and foot measurements were higher than in females, and the difference between the average measures was significant. The highest correlation was observed in the right and left

foot length for female, male and study (mix-gender group) groups when stature and foot measurement relations were evaluated. The lowest correlation was observed in foot width for the right foot in all groups but, differed in left foot measurements for each group. Formulae were obtained by using multiple regression analysis for stature estimation and logistic regression analysis for gender estimation.

**J. Sen [2011] Sex estimation from foot dimension in an indigenous Indian population:** Dismembered/severed human remains are frequently found in cases of mass disasters and criminal mutilation. Sex estimation from foot dimensions, therefore, has a vital role in establishing personal identity. There is a paucity of literature on this issue from various Indian populations. The “Rajbangsi” is one such indigenous population located in the state of West Bengal, India. The present study attempts to estimate sex from foot length, foot breadth, and foot index among 350 living adult Rajbangsi (175 men and 175 women) individuals (age range: 18–50 years). The study concludes that foot dimensions show significant sex differences..

**K. Krishan [2012] HBindex:Sexual dimorphism of new index foot dimension:**The present research is aimed to introduce Heel–ball (HB) index from foot dimensions and determine whether this index exhibits sexual dimorphism. The study was conducted on a sample of 303 North Indian individuals (154 men, and 149 women) aged between 13 and 18 years. The stature, body weight, foot breadth at the ball (BBAL), and foot breadth at heel (BHEL) were measured. The HB index was derived by the formula  $BHEL \times 100/BBAL$ . Although the mean HB index was larger in women in both feet it showed statistically significant sex differences in the right foot only. The study shows that while the foot dimensions show a positive correlation with stature and weight, the HB index is independent of the stature and weight of an individual. This novel index (HB index) may be utilized in sex determination when a part of the foot is brought for medico-legal investigation.

**D. Atamturk [2010] Estimation of sex from the dimension of foot, footprints and shoes:** The identification of isolated extremities is an issue of great significance in the investigation of the identity of victims of mass disasters and fatal assaults. In forensic investigations, the dimensions of the hand and foot have been used for determination of sex, age and stature of an individual. However, the data on correlation within and between hand and foot dimensions are very limited. The present research aims at analyzing the anthropometrical relationships within and between hand and foot dimensions. The study was conducted on 240 Raj puts (120 males and 120 females) from North India. The results showed a significant correlation between and within the dimensions of hands and feet. Multiplication factors, linear and multiple regression models are derived to reconstruct the hand and foot even when a single dimension is available from the extremities. Besides medico-legal implications, the study may have significance in plastic and reconstructive surgery.

**T. Kanchan [2010] Study of correlation of hand and foot dimension in personal identification:** Identification is the foremost issue in crime investigation. A few studies have been performed so far in order to identify sex on the basis of single foot or hand of the victim. Moreover, these studies provide only crude measures to indicate sex and there exists no concrete methodology to predict sex using the available information. In the present paper, we have developed statistical models to identify sex based on the dimensions of foot and hand. The models containing both length and breadth of hand or foot as independent variables are capable of predicting sex in Indo-Mauritian population with fairly high accuracy as compared to those containing hand or foot indices.



**CHAPTER - III**  
**AIM AND OBJECTIVES**

**AIM**

The aim of this project is to identify the gender of a person from a bare foot print.

**OBJECTIVES**

- It is to find out the utility of footprint for sex determination.
- To determine the correlation of various measurements of the feet with sex.
- To evaluate logistic regression equations to predict sex of a person by using dimensions of feet.

## **CHAPTER-IV**

### **MATERIALS AND METHODOLOGY**

#### **MATERIALS**

- Paper
- Glass slide
- Scale
- Black paint
- Pencil
- Paint brush

#### **METHODOLOGY**

All the study participants were students of Nilgiri Matriculation Higher Secondary School, of class 9<sup>th</sup>, 10<sup>th</sup> and inter. The study was carried out on 30 individuals (15 males, 15 females) of Indian origin of the age group 14, 15 and 16 years. Healthy individuals without any deformity of the foot were included in the study.

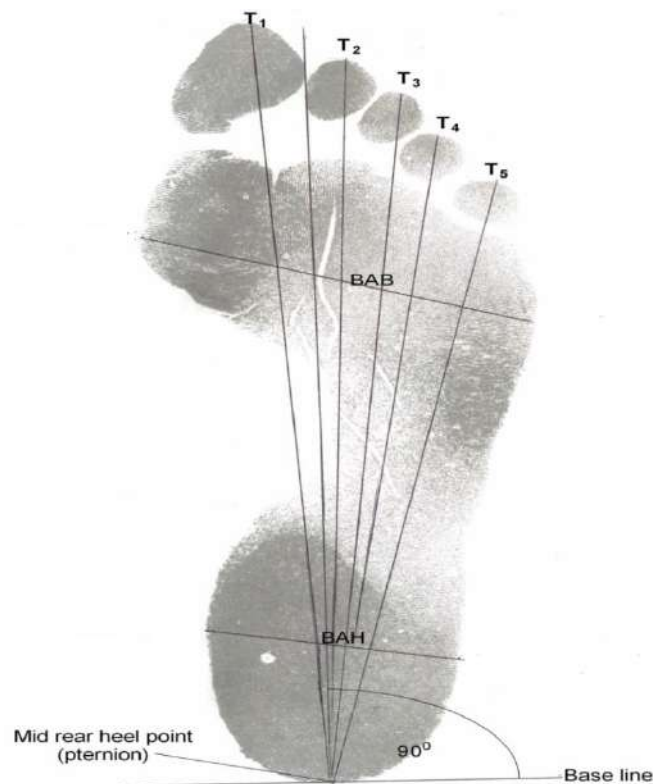
Thirty bilateral footprints were obtained from the study participants using a paint, with a non-reactive, non-indelible black paint. After cleansing their feet, the participants were requested to step their soles on the paint on the glassslide with minimal pressure, and then transfer the inked foot onto a plain white paper kept aside on a flat surface. Right footprints were recorded one by one for each participant. A total of 7 measurements, comprising five length dimensions and two breadth dimensions were obtained from right footprints of each participant.

The Determination of the ethnicity of the footprint may not be possible and hence, study samples in the present study were comprised of a mixed population. Footprints were obtained from right feet of the study participants using standard techniques like by using black ink and white papers. Foot impressions were then taken on paper, which were further evaluated. Thus, a total of 30 footprints were obtained. Measurements like foot length (FL) to each t, BAB, BAH, foot breadth (FB), baseline, mid rear heel point was taken using standardized technique.

- T1- Length measurement taken from the heel to the most anterior point of toe 1.
- T2- Length measurement taken from the heel to the most anterior point of toe 2.
- T3- Length measurement taken from the heel to the most anterior point of toe 3.
- T4- Length measurement taken from the heel to the most anterior point of toe 4.
- T5- Length measurement taken from the heel to the most anterior point of toe 5.

Breadth at ball (BAB) - Measurement between the most lateral and the most medial projecting points of the footprint margin at the ball (which corresponds to the most prominent areas of the metatarsal-phalangeal joints).

Breadth at heel (BAH) - Measured as the widest distance across the heel all the values are then added to know the mean value and it is then tabulated.



**Figure.1: Sample Foot Print Dimension**



**Figure.2 Foot Prints of Female of Age 14**



**Figure 3. Foot Prints of Male of Age 14**



**Figure 4. Foot Prints of Female of Age 15**



**Figure.5 . Foot Prints of Male of Age 15**



**Figure 6. Foot print of Female of Age 16**



**Figure 7. Foot print of Male of Age 16.**

**CHAPTER - V**  
**OBSERVATION**

**OBSERVATION TABLE-1: FEMALE FOOTPRINT DETAILS OF AGE-14**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Female</b>	<b>7.7</b>	<b>4.9</b>	<b>22.8</b>	<b>22.2</b>	<b>21.7</b>	<b>20.6</b>	<b>19.2</b>
<b>2.</b>	<b>Female</b>	<b>7.3</b>	<b>3.9</b>	<b>20.8</b>	<b>20.4</b>	<b>19.6</b>	<b>18.5</b>	<b>17.1</b>
<b>3.</b>	<b>Female</b>	<b>7.2</b>	<b>4.3</b>	<b>22.4</b>	<b>22</b>	<b>21.4</b>	<b>19.8</b>	<b>18.1</b>
<b>4.</b>	<b>Female</b>	<b>7.2</b>	<b>4.6</b>	<b>21.9</b>	<b>21.8</b>	<b>21.2</b>	<b>20.1</b>	<b>18.7</b>
<b>5.</b>	<b>Female</b>	<b>7.6</b>	<b>4.3</b>	<b>21.6</b>	<b>21.5</b>	<b>20.8</b>	<b>19.9</b>	<b>18.5</b>
<b>AVERAGE</b>		<b>7.4</b>	<b>4.4</b>	<b>21.9</b>	<b>21.58</b>	<b>20.94</b>	<b>19.78</b>	<b>18.32</b>

**OBSERVATION TABLE- 2: MALE FOOT PRINT DETAILS OF AGE-14**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Male</b>	<b>8.4</b>	<b>5.0</b>	<b>21.6</b>	<b>23</b>	<b>21.8</b>	<b>20.5</b>	<b>19.8</b>
<b>2.</b>	<b>Male</b>	<b>8.2</b>	<b>4.5</b>	<b>20.5</b>	<b>20.2</b>	<b>19.7</b>	<b>18.8</b>	<b>20.1</b>
<b>3.</b>	<b>Male</b>	<b>8.2</b>	<b>5.1</b>	<b>23.7</b>	<b>22.5</b>	<b>21.4</b>	<b>20.3</b>	<b>20.3</b>
<b>4.</b>	<b>Male</b>	<b>8.4</b>	<b>4.6</b>	<b>23</b>	<b>23.7</b>	<b>22.8</b>	<b>21.4</b>	<b>20</b>
<b>5.</b>	<b>Male</b>	<b>8.6</b>	<b>4.8</b>	<b>23.5</b>	<b>24</b>	<b>23.4</b>	<b>22.4</b>	<b>20.6</b>
<b>AVERAGE</b>		<b>8.36</b>	<b>4.8</b>	<b>22.46</b>	<b>22.68</b>	<b>22.82</b>	<b>20.68</b>	<b>20.16</b>



**OBSERVATION TABLE-3: FEMALE FOOT PRINT DETAILS OF AGE-15**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Female</b>	<b>8.2</b>	<b>6.1</b>	<b>23.7</b>	<b>23.8</b>	<b>23.2</b>	<b>21.6</b>	<b>19.8</b>
<b>2.</b>	<b>Female</b>	<b>7.1</b>	<b>4.6</b>	<b>21.3</b>	<b>21</b>	<b>20.2</b>	<b>19.2</b>	<b>18</b>
<b>3.</b>	<b>Female</b>	<b>7.6</b>	<b>4.4</b>	<b>20</b>	<b>20</b>	<b>19.3</b>	<b>18.5</b>	<b>17.9</b>
<b>4.</b>	<b>Female</b>	<b>8.3</b>	<b>4.2</b>	<b>23</b>	<b>24</b>	<b>22.5</b>	<b>21.6</b>	<b>20</b>
<b>5.</b>	<b>Female</b>	<b>7.2</b>	<b>4</b>	<b>19.1</b>	<b>19</b>	<b>18.5</b>	<b>19.8</b>	<b>16.6</b>
<b>AVERAGE</b>		<b>7.68</b>	<b>4.66</b>	<b>21.42</b>	<b>21.56</b>	<b>20.74</b>	<b>20.14</b>	<b>18.46</b>

**OBSERVATION TABLE- 4: MALE FOOT PRINT DETAILS OF AGE- 15**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Male</b>	<b>7.3</b>	<b>4.3</b>	<b>21.4</b>	<b>20.3</b>	<b>19.5</b>	<b>18.9</b>	<b>17.5</b>
<b>2.</b>	<b>Male</b>	<b>7.9</b>	<b>5.3</b>	<b>25</b>	<b>24.9</b>	<b>24</b>	<b>22.8</b>	<b>21</b>
<b>3.</b>	<b>Male</b>	<b>7.9</b>	<b>4.6</b>	<b>21</b>	<b>21</b>	<b>20.9</b>	<b>20.2</b>	<b>17.9</b>
<b>4.</b>	<b>Male</b>	<b>9.2</b>	<b>5.3</b>	<b>24.6</b>	<b>24.8</b>	<b>23.6</b>	<b>22.4</b>	<b>21.3</b>
<b>5.</b>	<b>Male</b>	<b>8.5</b>	<b>4.4</b>	<b>23</b>	<b>23.6</b>	<b>22.6</b>	<b>21.8</b>	<b>20.4</b>
<b>AVERAGE</b>		<b>8.16</b>	<b>4.78</b>	<b>23</b>	<b>22.92</b>	<b>22.12</b>	<b>21.22</b>	<b>19.62</b>

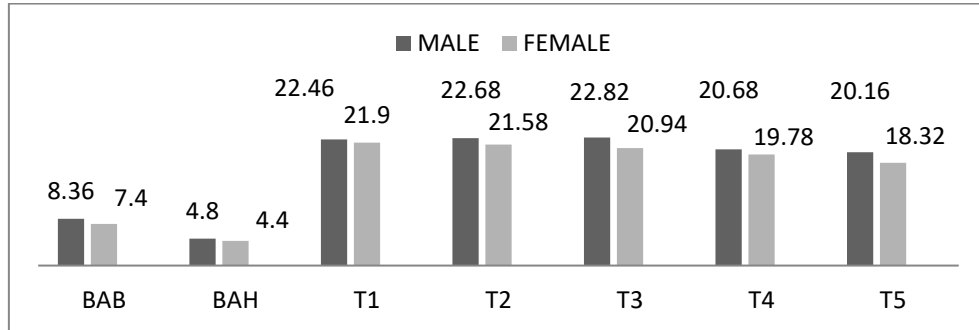
**OBSERVATION TABLE-5 :FEMALE FOOT PRINT DETAILS OF AGE-16**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Female</b>	<b>7</b>	<b>4.1</b>	<b>19.9</b>	<b>20.6</b>	<b>20</b>	<b>19</b>	<b>17.7</b>
<b>2.</b>	<b>Female</b>	<b>6.9</b>	<b>4.5</b>	<b>19.6</b>	<b>19.6</b>	<b>18.7</b>	<b>18</b>	<b>16.7</b>
<b>3.</b>	<b>Female</b>	<b>7.4</b>	<b>4.5</b>	<b>20.6</b>	<b>21</b>	<b>20.2</b>	<b>19.3</b>	<b>17.6</b>
<b>4.</b>	<b>Female</b>	<b>7.4</b>	<b>4.3</b>	<b>20.3</b>	<b>21.1</b>	<b>20.4</b>	<b>19.5</b>	<b>17.5</b>
<b>5.</b>	<b>Female</b>	<b>6.9</b>	<b>3.4</b>	<b>19.5</b>	<b>20.5</b>	<b>20</b>	<b>19</b>	<b>16.8</b>
<b>AVERAGE</b>		<b>7.12</b>	<b>4.16</b>	<b>19.98</b>	<b>20.56</b>	<b>19.86</b>	<b>18.96</b>	<b>17.26</b>

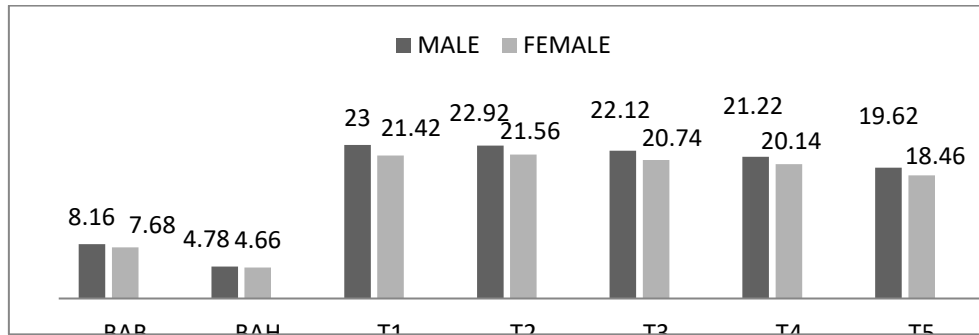
**OBSERVATION TABLE-6: MALE FOOT PRINT DETAILS OF AGE- 16**

<b>S.NO</b>	<b>GENDER</b>	<b>BAB</b>	<b>BAH</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>1.</b>	<b>Male</b>	<b>8.9</b>	<b>4.9</b>	<b>25.1</b>	<b>25.2</b>	<b>23.9</b>	<b>23</b>	<b>20.1</b>
<b>2.</b>	<b>Male</b>	<b>7.9</b>	<b>4.2</b>	<b>22.3</b>	<b>22.8</b>	<b>22.5</b>	<b>21.4</b>	<b>19.8</b>
<b>3.</b>	<b>Male</b>	<b>8.8</b>	<b>5.2</b>	<b>22.7</b>	<b>22.8</b>	<b>22.3</b>	<b>20.7</b>	<b>18.9</b>
<b>4.</b>	<b>Male</b>	<b>7.5</b>	<b>4.4</b>	<b>20.8</b>	<b>20.4</b>	<b>19.5</b>	<b>18.4</b>	<b>17.2</b>
<b>5.</b>	<b>Male</b>	<b>8.5</b>	<b>4.7</b>	<b>22</b>	<b>21.8</b>	<b>21.1</b>	<b>20.4</b>	<b>19.9</b>
<b>AVERAGE</b>		<b>8.32</b>	<b>4.68</b>	<b>22.58</b>	<b>22.6</b>	<b>21.86</b>	<b>20.78</b>	<b>19.18</b>

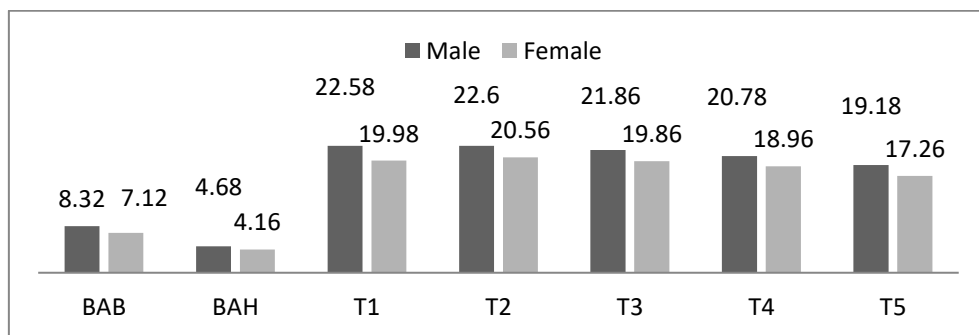
**GRAPH 1: Showing the frequency distribution of foot print dimension in both men and women of age 14**



**GRAPH 2: Showing the frequency distribution of foot print dimension in both men and women of age 15**



**GRAPH 3: Showing the frequency distribution of foot print dimension in both men and women of age 15**



**CHAPTER - VII**  
**RESULT AND CONCLUSION**

**RESULT:**

Male Feet differ from Female feet in shape, characteristics, especially at the Arch, the Lateral side of the Foot, the Hallux and the Ball of the Foot. All the foot print dimensions are significantly greater in males than females. This finding is consistent with general agreement that Men have longer and broader feet than Women.

**CONCLUSION:**

From the present study it has been conclude that foot prints have an important role in determining the sex of an individual. This study would be helpful in gender determination in most of the cases where foot prints are found and other evidences are destroyed or not enough for identification.

The study needs to analyse the Age and Height of the individual by using the Foot Print dimension.

## **CHAPTER -VI**

### **REFERENCES**

1. Tsung BYS, S Zhang M, Fan YB, Boone DA. Quantitative comparison of plantar foot shapes under different weight-bearing conditions. *J Rehabil Res Dev.* 2003; 40: 517. Pmid: 15077664

[View ArticlePubMed/NCBIGoogle Scholar](#)

2. Deepashini H, Omar B, Paungmali A, Amaramalar N, Ohnmar H, Leonard J. An insight into the plantar pressure distribution of the foot in clinical practice: Narrative review. *Polish Ann Med. Polish Pediatric Society.* 2014; 21: 51–56.

[View ArticleGoogle Scholar](#)

3. Ukoha UU, Ewer OA, Ezeani MC, Anyabolu AE, Ejimofor OC, Nzeako HC, et al. Estimation of Stature using footprints in an adult student population in Nigeria. *IJBAR.* 2013; 4: 827–833.

[View ArticleGoogle Scholar](#)

4. Krauss I, Grau S, Mauch M, Maiwald C, Horstmann T. Sex-related differences in foot shape. *Ergonomics.* 2008; 51: 1693–1709. Pmid: 18941975

[View ArticlePubMed/NCBIGoogle Scholar](#)

5. Wunderlich RE, Cavanagh PR. Gender differences in adult foot shape: implications for shoe design. *Med Sci Sports Exerc.* 2001; 33: 605–611. Pmid: 11283437

[View ArticlePubMed/NCBIGoogle Scholar](#)

6. Hemy N, Flavel A, Ishak N, Franklin D. Sex estimation using anthropometry of feet and footprints in a Western Australian population. *Forensic Sci Int. Elsevier Ireland Ltd;* 2013; 231: 402.e1–402.e6. [View ArticleGoogle Scholar](#)

7. Krishan K, Kanchan T, Passi N, DiMaggio JA. Heel-ball (HB) index: sexual dimorphism of a new index from foot dimensions. *J Forensic Sci.* 2012; 57: 172–5.

Pmid: 22074354

[View ArticlePubMed/NCBIGoogle Scholar](#)

8. Ozden H, Balci Y, Demiru C, Turgut A, Ertugrul M. Stature and sex estimate using foot and shoe dimensions. *Forensic Sci Int.* 2005; 147: 181–184. Pmid: 15567624

[View ArticlePubMed/NCBIGoogle Scholar](#)

9. Periyasamy R, Mishraa A, Sneha A, Amminib AC. Preliminary investigation of foot pressure distribution variation in men and women adults while standing. *Foot.* 2011; 21: 142–148.

[View ArticleGoogle Scholar](#)

10. Putti AB, Arnold GP, Abboud RJ. Foot pressure differences in men and women. *Foot Ankle Surg.* 2010; 16. Pmid: 20152750

[View ArticlePubMed/NCBIGoogle Scholar](#)

11. Krishan K. Estimation of stature from footprint and foot outline dimensions in Gujjars of North India. *Forensic Sci Int.* 2008; 175: 93–101. Pmid: 17590549

[View ArticlePubMed/NCBIGoogle Scholar](#)

12. Fawzy IA, Kamal NN. Stature and body weight estimation from various footprint measurements among Egyptian population. *J Forensic Sci.* 2010; 55: 884–8. Pmid: 20384932 [View ArticleGoogle Scholar](#).

13. Moorthy NT, Ling AY, Sarippudin SA, Nik Hassan NF. Estimation of stature from footprint and foot outline measurements in Malaysian Chinese. *Aust J Forensic Sci.* 2014; 46:136–159. [View ArticleGoogle Scholar](#).



14. Krishan K. Individualizing characteristics of footprints in Gujjars of North India-forensic aspects. *Forensic Sci Int.* 2007; 169: 137–44. Pmid: 16965880

[View ArticlePubMed/NCBIGoogle Scholar](#)

15. Kennedy RB, Pressman IS, Chen S, Petersen PH, Pressman AE. Statistical Analysis of Barefoot Impressions. *J Forensic Sci.* 2003; 48: 4–12.

[View ArticleGoogle Scholar](#)

16. Moorthy NT, Sulaiman SFB. Individualizing characteristics of footprints in Malaysian Malays for person identification in forensic perspective. *Egypt J Forensic Sci.*ForensicMedicineAuthority 2014 [View ArticleGoogle Scholar](#)

17. Kennedy RB. Uniqueness of bare feet and its use as a possible means of identification. *Forensic Sci Int.* 1996; 82: 81–87. Pmid: 8828175

[View ArticlePubMed/NCBIGoogle Scholar](#)

18. Hatala KG, Dingwall HL, Wunderlich RE, Richmond BG. The relationship between plantar pressure and footprint shape. *J Hum Evol.* Elsevier Ltd; 2013; 65: 21–28. Pmid: 23725794

[View ArticlePubMed/NCBIGoogle Scholar](#)

19. Bates KT, Savage R, Pataki TC, Morse SA, Webster E, Falkingham PL, et al. Does footprint depth correlate with foot motion and pressure? *J R Soc Interface.* 2013; 10: 1–11.

[View ArticleGoogle Scholar](#)

