# Estimation of stature from foot length among Uttar Pradesh population

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**Abstract**

As foot size and stature can be correlated positively in a strong way, foot length analysis can help in estimating an individual's stature; the foot length is also considered as indicators of skeletal and body structure of a person. Foot length was recorded as the distance from the most prominent part of the heel back to the most distal part of the longest toe. Height was recorded as the vertical distance between the point vertex and heel touching the floor. The statistical tests used were Unpaired or Independent t-test, Paired t-test, Pearson's correlation coefficient (r) test, and Linear Regression analysis. The comparison of mean Foot length on the Right and Left side showed no significant difference in mean Foot length between Right and Left side for over-all population, males, and females. There was a significantly positive correlation between Height and Weight with Right and Left Foot length among the over-all population, males, and females. The study concluded that the height (stature) has a strong positive correlation with the various measurements of the footprint and length of the foot. The study would be helpful in interpretation and analysis of footprints in criminal cases pertaining to rivalries, homicides, sexual offenses especially robberies, thefts, shoplifting, dacoity, etc. where the person is lifting the bags, gunny bags full of some material and leaving the footprints at the crime site.

**Keywords**: Foot length; height; footprint.



## Introduction

Forensic podiatry involves applying the knowledge of sound and research of the podiatric information and experience in forensic investigations, for demonstrating the individual's association with a crime scene or answering any legal question related to the foot or footwear requiring facts/ information of the foot which is predominantly functioning (1)(2).

There is a requirement for establishing the identity of remaining body parts which can happen during the mass disasters like attacks of the terrorists, mass murders, transport-related accidents, tsunamis, floods, and earthquakes. Stature estimation is important for forensic investigation and considered to be one of the 'big fours' of forensic anthropology (3)(4)(5)(6). Stature is the height of the person in an upright posture. It is an important physical identity. For identifying an individual, "Stature" is considered to be one of the most relevant elements (7).

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 (4)(8). The estimation of stature using the different long bones length has been used in many studies by utilization of either multiplying factors or regression formulae (9). So, the present study was conducted with an aim of finding out whether a correlation existed of foot length with stature and also for deriving regression equations for stature from the length of the foot.

The present study is an attempt to understand the relationship between stature and weight from feet dimensions of students of T.M.M.C & R.C.

1. Estimation of stature from the percutaneous measurement of foot length up-to maximum length of the foot.
2. To understand and describe regression, the equation for stature estimation from the above dimension.
3. To compare between male and female foot length.

**Materials and Method**

The study population consisted of 100(50%) male and 100(50%) female of western Uttar Pradesh. The mean height in cms and weight is in kgs

The present study was conducted to assess the estimation of stature from footprint among students of Teerthanker Mahaveer Medical College & Research Centre, Moradabad between the age group of 18-30 years of age from January to December 2016.The subjects with Flat foot and Supernumerary toes, with deformities of the foot, lower limb and vertebral column and chronic illness were excluded from the study

The subject is made to place their right foot on the osteometric board, the movable plate was adjusted to measure the most anteriorly projected point. The unit of measurement is in centimeters (cms) and calculated to the nearest millimeters (mms). A similar procedure was done for the left-sided foot too.

Height was recorded as the vertical distance between the point vertex and heel touching the floor.

**Results**

The study population consisted of 100(50%) male and 100(50%) female of western Uttar Pradesh. The mean height in cms and weight is in kgs

**Table1:** Showing a comparison of mean Height (cms), Right and Left foot length between males and females among the western UP population

| | Male | | Female | | | |
|---|---|---|---|---|---|---|
| | Mean | SD. | Mean | SD | Mean Difference | p-value |
| Height(Cm) | 174.07 | 6.1 | 157.46 | 5.6 | 16.61 | 0.001* |
| Right foot | 25.78 | 1.0 | 23.46 | 1.1 | 2.32 | 0.001* |
| Left foot | 25.69 | 1.0 | 23.49 | 1.1 | 2.20 | 0.001* |

**Unpaired t-test**

* Significant difference

**Table 2:** Comparison of mean Foot length between Right and Left sides

| | Right side | | Left side | | | |
|---|---|---|---|---|---|---|
| Foot length | Mean | SD | Mean | SD | Mean difference | p-value |
| Over-all | 24.6 | 1.5 | 24.5 | 1.5 | 0.03 | 0.47# |
| Male | 25.7 | 1.0 | 25.6 | 1.0 | 0.09 | 0.27# |
| Female | 23.4 | 1.1 | 23.4 | 1.1 | -0.03 | 0.31# |

Paired t-test

#Non-significant difference

**Table 3:** Correlation of Height with Right and Left Foot length among the over-all population, males, and females

| Height | | Foot length | |
|---|---|---|---|
| | | Right side | Left side |
| Over-all | Pearson | 0.875 | 0.849 |
| | p-value | 0.001* | 0.001* |
| Male | Pearson Correlation | 0.856 | 0.838 |
| | p-value | 0.001* | 0.001* |
| Female | Pearson Correlation | 0.795 | 0.789 |
| | p-value | 0.001* | 0.001* |

**Table 4:** Regression equations for estimation of Height (in cms) from Right and Left foot length (in cms)

| | Regression equations for Right foot length | Mean error | The regression equation for Left foot length | Mean error |
|---|---|---|---|---|
| Height (in cms) | 5.969 x Right Foot length + 23.044 | 3.89 | 5.904 x Left Foot length + 24.578 | 3.56 |

**Conclusion**

The present study concluded that height (stature) has a strong positive correlation with the various measurements of the footprint and length of the foot. The study would be helpful in interpretation and analysis of footprints in criminal cases pertaining to rivalries, homicides, sexual offenses especially robberies, thefts, shoplifting, dacoity, etc. where the person is lifting the bags, gunny bags full of some material and leaving the footprints at the crime site. Researchers are encouraged to use a variety of medium (like mud, sand, blood, dust, liquid, etc.) on which the prints can be made so that the effect of additional weight can clearly be investigated.

The stature of an individual can be successfully estimated from the foot and its segments using different regression models derived from the study. It was observed that the regression models derived from foot length measurements were more reliable than those from foot breadth measurements in the prediction of stature in forensic examinations.

**Suggestions for future studies**

Researchers are encouraged to conduct similar studies in different population groups to look into the generation of additional standards which can further be used in the identification of individuals from human remains.

**Conflict of Interest**

None

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