



Original article

Sexual Dimorphism in Hand and Foot Dimensions in Chhattisgarh Region

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ABSTRACT

Introduction: Relationship between different body parts especially the limbs is being used to establish sex and stature. which is a prerequisite to identification in forensic investigation. Ascertaining sex and estimation of stature from incomplete skeletal and decomposing bodies is a recurring theme in physical anthropology and forensic science. This has become useful in recent times due to mass disasters like plane crash, mass suicide, tsunamis, forest fires, earth quakes. **Material and Methods:** The present investigation was conducted to study dimorphic variation in hand lengths, widths, height, stature ratio and indices for bilateral differences. Data for the study was obtained from 140 students with mean age of 18.93 ± 1.16 years from Pt.J.N.M.Medical college Raipur. Height of subject, length and width of hand and foot of both males and females were measured following standard protocols using vernier calliper and measuring tape. **Results:** In all anthropometric parameters measured males were significantly ($P < 0.001$) higher. Significant relationships were established between height, hand lengths and width, foot length and width in both sexes. Multiple linear regression analysis of hand and foot lengths generated predictive equations with statistical significant ($P < 0.001$) ability for height prediction. **Conclusion:** The results showed a significant correlation between hand length and foot lengths in both sexes. Dimorphic variation in height could be accurately predicted from a combination of right and left hand and foot lengths which will be useful in forensic investigation, medico-legal cases for the identification of body parts as well as in cosmetic surgery.

KEYWORDS: Stature , Height, Hand length, Hand width, Foot length, Foot width

INTRODUCTION

Anthropometric measurements of height , hand and foot dimensions and their correlation are becoming milestones in Forensic science [1]. Ascertaining sex and estimation of stature from incomplete skeletal and decomposing bodies is a recurring theme in physical anthropology and forensic science. Relationship between different body parts especially the limbs is being used to establish sex and stature which is a prerequisite to identification in forensic investigation [2]. Specifically hand and foot have been used by many investigators to determine sex and estimate stature [3].

Although the relationships of hand length and foot length with various body part measurements have been studied, there is no information in the available literature regarding the correlation between hand length and foot length. Parameters that have been employed for this purpose

include hand and foot length [4], and foot indices [1]. There are many studies undertaken to emphasize the importance of the measuring the hand length as well as foot length. Some studied the correlation between foot length and general body size [5]. One study has shown that there is symmetry in the length of the feet irrespective of sex or handedness [2]. Also some found that hand length can be a good predictor of the body surface area independent of the sex of the individual [6].

The aim of this study is to investigate the dimorphic variation in the hand and foot lengths, hand and foot indices, hand and foot-stature ratio and to determine the relationship between hand and foot lengths to stature in a sample of Chhattisgarh population.

MATERIALS AND METHODS

This study was carried out on a cross sectional sample of 140 students (70 males and 70 females) without any

physical deformities or previous history of trauma to the hand or foot with mean age 18.93 ± 1.16 years of the Pt.J.N.M.Medical college Raipur. Samples were drawn randomly across the student population, after giving informed consent participate in the study.

Anthropometric measurements of height, hand length and width and foot length and width were obtained following the description of Krishan and Sharma [1]. The foot index was calculated as foot breadth/foot length x 100 as described by Agnihotri [2]. Hand and foot to stature ratio were calculated by dividing the lengths of the hand and foot by the height of the subject as described by Amirshyebani [6].

Hand Length: Each subject was asked to place his/ her hand on a white paper with the palm facing upwards keeping the fingers close together with the thumb lying comfortably but not tightly against the radial aspect of the

hand and index finger. A tracing of the hand was made with a lead pencil. The tracing proceeded from the radial styloid process to the ulnar styloid process. A line was drawn joining the two styloid tips. This line is designated as the interstyloid line [Fig. 1]. The distance between the midpoint of the interstyloid line and the tip of the middle finger in extension was measured as the length of the hand as described by Amirshyebani et al [6].

Foot Length: Each subject was made to stand on a calibrated foot board with his/her back against the wall in such a manner that the posterior most point of the heel will gently touch the wall. A vertical stop was placed against the anterior most point of the foot. The distance between the posterior most point of the heel and anterior most point of toe is measured.

Figure 1 : Measuring hand dimension

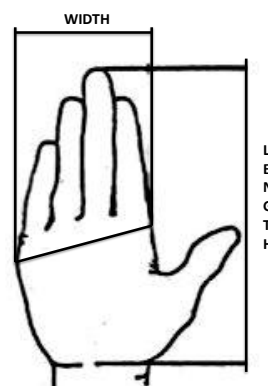


Figure2 :Measuring foot dimension



Data are expressed as means \pm standard deviation. Differences in hand and foot length and breadth were determined using Students paired and unpaired t-test relationship between body proportion and in males and

females are obtained using Pearson correlation coefficient. Multiple linear regression analysis was used to generate predictive equations of height from hand and foot lengths. Differences were declared significant when $P < 0.05$.

RESULTS

Table: 1 Height and Right Hand Dimensions

| Parameter | | Height (H) Male mm. | Height (H) (Female) | Right Hand (RHM) (mm.) | Right Hand (RHF) (mm.) |
|-----------|---------|------------------------|------------------------|---------------------------|---------------------------|
| LENGTH | MIN | 1510 | 1380 | 162 | 151 |
| | MAX | 1820 | 1640 | 216 | 194 |
| | MEAN | 1688.93+78 | 1540+45 | 187.23± 11.36 | 171.54± 9.49 |
| WIDTH | MINIMUM | | | 75 | 67 |
| | MAXIMUM | | | 115 | 102 |
| | MEAN | | | 92.53±9.32 | 86.78 ±7.91 |
| | P Value | Significant <0.05 | | Significant <0.05 | Significant <0.05 |

Table : 2 Dimensions of Left hand and Both Feet

| Parameter | | Left Hand (LHM) (mm.) | Left Hand (LHF) (mm.) | Right Foot (RFM) (mm.) | Right Foot (RFF) (mm.) | Left Foot (LFM) (mm.) | Left Foot (LFF) (mm.) |
|-----------|---------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
| LENGTH | MIN | 161 | 150 | 212 | 196 | 213 | 194 |
| | MAX | 218 | 195 | 277 | 248 | 278 | 245 |
| | MEAN | 187.22± 11.54 | 171.43± 9.38 | 248.07 ±16.51 | 229.78 ± 13.98 | 249.20 ±16.48 | 228.95 ± 13.88 |
| WIDTH | MINIMUM | 73 | 66 | 82 | 68 | 82 | 67 |
| | MAXIMUM | 116 | 104 | 112 | 105 | 112 | 104 |
| | MEAN | 92.59±9.28 | 86.69 ±7.89 | 97.73± 8.04 | 88.70 ± 6.82 | 98.19±7.84 | 88.55 ± 6.78 |
| | P Value | Significant <0.05 | Significant <0.05 | Significant <0.05 | Significant <0.05 | Significant <0.05 | |

The following relationship is derived from the above data :

1. $H = 8.78 \text{ RHL}$
2. $H = 17.76 \text{ RHW}$
3. $H = 6.6 \text{ RFL}$
4. $H = 16.8 \text{ RFW}$
5. $FL = 1.32 \text{ HL}$
6. $\text{RHLM} = 1.12 \text{ RHLF}$
7. $\text{LHLM} = 1.09 \text{ LHLF}$
8. $\text{RFLM} = 1.08 \text{ RFLF}$
9. $\text{LFLM} = 1.09 \text{ LFLF}$

Where (H –Height of person, RHL- Right hand length, RHW – Right hand width, FL –Foot Length, HL – Hand Length, RFLM – Right hand length male, RFLM – Right foot length male, HM – Height of male , HF – height of female).

DISCUSSION

Even though the hand length and foot length has been studied in relation to various body parameters, the correlation between the hand length and foot length has not been studied. The present study has shown that there is a significant correlation between hand length and foot length ($p < 0.05$). The results, therefore, indicate that if the hand length is known, foot length can be predicted and if the foot length is known, hand length can be predicted and vice versa [4].

A significant correlation is found between hand length and hand width, foot length and foot width in both sexes ($p \text{ value} < .05$). Since if hand length is known we can establish the dimension of both hand ,if foot length is known we can establish the dimension of both foot and reconstruct the stature. Similar study was done by Agnihotri [2].

Range for the hand length as well as foot length when one parameter is known. This can be of tremendous use in medico-legal cases especially in the identification of severed body parts. The data can also be of help in plastic and reconstructive surgery.

The height of males are significantly higher in comparison to females ($p \text{ value} < .05$). For both hand and foot the indices are significantly ($P < 0.05$ and < 0.001) higher in the males than the females. But within the same sex males did not show significant difference in the hand index, but significant ($P < 0.001$) difference was observed in the foot.

CONCLUSION

The present study has shown that there is a significant correlation between hand and foot length of male and female, foot length and width of male and female ($p < 0.05$). It is concluded that height ,hand length of both hands ,hand width of both hands and foot dimensions are significantly lower in female in comparison to male in chhattisgarh region. Dimorphic variation in height could be accurately predicted from a combination of right and left hand and foot

lengths which will be useful in forensic investigation, medico-legal cases for the identification of body parts as well as in cosmetic surgery.

Competing interest: The authors declare that they have no competing interests.

REFERENCES

1. Krishan K, Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian population. *J Forensic Legal Med* 2007; 14:327-332
2. Agnihotri AK, Shukla S, Purwar B. Determination of sex from the foot measurements. *The Internet J Forensic Sci* 2007; 2:1.
3. Levy J, Levy MJ. Human lateralization from head to foot – sex related factors. *Science*, 1978; 200: 1291– 1292.
4. Taylor MC, MacLarnon AM, Lanigan PM. Foot length asymmetry, sex and handedness. *Science*, 1981; 212: 1416 – 1417.
5. Ashizawa K, Kumakura C, Kusumoto A, Narasaki S. Relative foot size and shape to general body size in Javanese, Filipinas and Japanese with special reference to habitual footwear types. *Ann. Hum. Biol.*, 1997; 24 (2): 117 – 129.
6. Amirshayban HR, Crecelius GM, Timothy NH, Pfeiffer M, Saggars GC, Manders EK. The natural history of growth of hand. Part II: Hand length as a treatment guide in paediatric trauma patients. *J. Trauma*, 2000; 49 (3): 457 – 460.

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