

Study of Estimation of Stature from Measurements of Extremities Dimensions: A Radiological Study

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Received: 14-02-2021 / Revised: 31-03-2021 / Accepted: 28-04-2021

Abstract

Background: Personal identification is one of the main tasks of forensic research. Stature, age, sex, and ancestry helps in narrowing down the pool of the possible victim matches in the forensic investigation process and thus provide useful clues to the investigating agency in establishing the identification of the individuals. Hence, the present study was conducted with the aim of assessing the stature from measurements of extremities dimension. **Materials & Methods:** A total of 50 male cases and 50 female cases were enrolled in the present study. Only those were enrolled which were more than 20 years of age. Hand radiographs were taken. Dimensions were marked and length and breadth of hands was assessed. All the results were recorded and analysed. **Results:** Mean stature of males and females was 169.21 cm and 153.12 cm respectively. Mean right hand length was 18.12 cm and 16.95 cm respectively. Mean left hand length was 18.09 cm and 16.92 cm respectively. Mean left hand breadth was 8.89 cm and 7.49 cm respectively. While analysing statistically, it was seen that mean stature was significant correlated with hand length and hand breadth. **Conclusion:** Mean stature significantly correlates with hand length and hand breadth.

Keywords: Stature, Extremities.

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Introduction

Personal identification is one of the main tasks of forensic research. Stature, age, sex, and ancestry helps in narrowing down the pool of the possible victim matches in the forensic investigation process and thus provide useful clues to the investigating agency in establishing the identification of the individuals. The relationship between different body dimensions can be utilized to solve crimes in the absence of complete evidence[1-3]. This relationship can help a forensic scientist to calculate stature from mutilated and dismembered body parts in forensic examinations. Stature provides insight into various features of a population including nutrition, health, and genetics. Stature is considered as one of the parameters for personal identification and one of the 'big fours' of forensic anthropology. The stature of an individual is an inherent characteristic; its estimate is considered to be an important assessment in the identification of unknown human remains. Anthropometric techniques have been used for stature and bone

length estimation from unknown body parts and skeletal remains by anthropologists, medical scientists, and anatomists for over a hundred years[4-7]. Hence; the present study was conducted with the aim of assessing the stature from measurements of extremities dimension.

Materials & Methods

The present study was undertaken with the aim of assessing the stature from measurements of extremities dimension in Department of Anatomy, All India Institute of Medical Sciences (AIIMS), Rajkot, Gujarat, India. A total of 50 male cases and 50 female cases were enrolled in the present study. Only those were enrolled which were more than 20 years of age. Hand radiographs were taken. Dimensions were marked and length and breadth of hands was assessed. Subjects with presence of any structural deformity, developmental anomaly or malignant neoplasm involving hand were excluded. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Pearson's correlation was applied for evaluating the level of significance.

Results

A total of 50 male cases and 50 female cases were enrolled in the present study. Mean stature of males and females was 169.21 cm and 153.12 cm respectively. Mean right hand length was 18.12 cm and 16.95 cm respectively. Mean left hand length was 18.09 cm and 16.92 cm respectively. Mean right hand breadth was 8.95 cm and 7.56 cm respectively. Mean left hand breadth was 8.89 cm and 7.49

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cm respectively. While analysing statistically, it was seen that mean stature was significant correlated with hand length and hand breadth.

Table 1: Descriptive results

Variable	Males	Females
Mean stature	169.21	153.12
Right hand length (cm)	18.12	16.95
Left hand length (cm)	18.09	16.92
Right hand breadth (cm)	8.95	7.56
Left hand breadth (cm)	8.89	7.49

Table 2: Correlation of hand length and hand breadth with stature

Variable	Pearson's correlation coefficient (r)		p- value
	Males	Females	
Right hand length	0.695	0.593	0.001 (Significant)
Left hand length	0.629	0.582	0.003 (Significant)
Right hand breadth	0.563	0.493	0.002 (Significant)
Left hand breadth	0.493	0.458	0.002 (Significant)

Discussion

In forensic science, identifying one's gender, age, and stature is a key task to establish biological traits of a person. To precisely determine personal identification, studies relating to anthropometry have been actively conducted. In cases when bodies are dismembered or disfigured by crimes and/or disasters, identification of a body is more complex and difficult. Various studies have been conducted to improve the accuracy of regression equation models to estimate stature using measured values of feet and footprints[7-11]. Hence; the present study was conducted with the aim of assessing the stature from measurements of extremities dimension.

A total of 50 male cases and 50 female cases were enrolled in the present study. Mean stature of males and females was 169.21 cm and 153.12 cm respectively. Mean right hand length was 18.12 cm and 16.95 cm respectively. Mean left hand length was 18.09 cm and 16.92 cm respectively. Mean right hand breadth was 8.95 cm and 7.56 cm respectively. Krishan K et al examined the relationship between stature and dimensions of hands and feet. Hand length, hand breadth, foot length and foot breadth of 246 subjects comprising 123 males and 123 females ranging in age from 17 to 20 years were taken independently on left and right side of each individual. Statistical analyses indicated that the bilateral variation was insignificant for all the measurements except hand breadth in both the sexes ($P < 0.01$). Sex differences were found to be highly significant for all the measurements ($P < 0.01$). The correlation coefficients between stature and all the measurements of hands and feet were found to be positive and statistically significant. The highest correlation coefficient between stature and foot length and lowest SEE (standard error of estimate) indicate that the foot length provides highest reliability and accuracy in estimating stature of an unknown individual[12]. Rastogi P et al predicted the stature of a person using hand length and breadth. The study included 500 right-hand dominant medical students. Hand length was measured 'between the distal wrist crease and the tip of middle finger (HL-1)' and 'between the mid-point of inter-styloid line to the tip of middle finger (HL-2)'. Hand breadth was measured between radial side of the second metacarpophalangeal joint and ulnar side of the fifth metacarpophalangeal joint(HB).

No significant difference was present in hand dimensions between north and south Indians. When compared between both hands, right-hand dimensions were larger than the left hand, with statistically significant difference in HL-2 and HB. Linear regression equations using hand length is more helpful in estimating stature than the hand breadth. The correlation coefficients ranged from 0.673 to 0.665 and 0.740 to 0.732 in north Indian males and females, respectively. Multiple regression equations give better results than linear regression equations. HL-2 gives more accurate results in stature estimation than the HL-1[13].

In the present study, mean left hand breadth was 8.89 cm and 7.49 cm respectively. While analysing statistically, it was seen that mean stature was significant correlated with hand length and hand breadth. In another study conducted by Geetha GN et al, authors documented anthropological work on the tribes of Kasargod district, Kerala, India. Two hundred subjects comprising of 100 males and 100 females in 20-30 years age group were included. Statistical analysis indicated that the bilateral variations were insignificant for all the measurements except foot breadth among females ($p < 0.001$). The paired sample t-test showed that the statistical difference between males and females was highly significant for all the measurements ($p < 0.001$). The correlation between the stature and various parameters studied in males and females were found to be positive and statistically highly significant. Linear and multiple regression equation for stature estimation were calculated separately for males and females. The significant positive correlation between the study variables and the stature indicates that these variables can be successfully used to predict stature[14].

Conclusion

Mean stature significantly correlates with hand length and hand breadth. However, further studies are recommended.

References

- Mohanty NK. Prediction of height from percutaneous tibial length amongst Oriya population. *Forensic Sci Int.* 1998; 98:137-41.
- Terazawa K, Alkabane H, Gotouda H, Mizukami K, Nagao M, Takatori T. Estimating stature from the length of the lumbar part of the spine in Japanese. *Med Sci Law.* 1990;30:354-7.
- Pelin C, Duyar I, Kayahan EM, Zagyapan R, Agildere AM, Erar A. Body height estimation based on dimensions of sacral and coccygeal vertebrae. *J Forensic Sci.* 2005;50:294-7.
- Vallois HV. Anthropometric techniques. *Curr Anthropol.* 1965;6:127-44
- Mall G, Hubig M, Buttner A, Kuznik J, Penning R, Graw M. Sex determination and estimation of stature from the long bones of the arm. *J Forensic Sci.* 2001;117:23-30.
- Radoinova D, Tenekedjiev K, Yordanov Y. Stature estimation from long bone length in Bulgarians. *Homo* 2002;52:221-32.
- Duyar I, Pelin C. Body height estimation based on tibial length in different stature groups. *Am J Phys Anthropol.* 2003;122:23-7.
- Warren MW, Smith KR, Stubblefield PR, Martin SS, Walsh-Haney HA. Use of radiographic atlases in a mass fatality. *J Forensic Sci.* 2000;45:467-70.
- Pelin C, Duyar I. Estimating stature from tibia length: a comparison of methods. *J Forensic Sci.* 2003;48:708-12.

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10. Ozaslan A, Iscan MY, Ozaslan I, Tugcu H, Koc S. Estimation of stature from body parts. *Forensic Sci Int.* 2003;132:40–5.
 11. Duyar I, Pelin C, Zagyapan R. A new method of stature estimation for forensic anthropological application. *Anthropol Sci.* 2006;114:23–7.
 12. Krishan K, Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian population. *J Forensic Leg Med.* 2007;14(6):327-32.
 13. Rastogi P, Nagesh KR, Yoganarasimha K. Estimation of stature from hand dimensions of north and south Indians. *Leg Med (Tokyo).* 2008;10(4):185-9.
 14. Geetha GN, Swathi, Athavale SA. Estimation of Stature From Hand and Foot Measurements in a Rare Tribe of Kerala State in India. *J Clin Diagn Res.* 2015;9(10):HC01-HC4.

Conflict of Interest: Nil

Source of support: Nil