International Journal of Forensic Expert Alliance
https://doi.org/10.70818/ijfea.v02i01.30
Vol. 2, No. 1, 2025

ISSN (Print): 3078-6673
ISSN (Online): 3078-6681

ARTICLE | OPEN ACCESS

Exploring The Correlation of Stature with Length and Breadth of Proximal Phalanx of Middle Finger for Forensic Assessment: A Radiological Study

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ABSTRACT: ***Background:*** Dimensional relationship among various body parts and stature has been the focus of anatomists, forensic medicine special8ists, anthropologists, plastic and reconstructive surgeons and orthopedicians. Standard radiographic measurements can provide accuracy in measurement of bony dimensions. Thus, the present study was performed to calculate length and breadth of proximal phalanx of middle finger from digital radiographs of hand and wrist joints and to find out their correlation with stature. The objective of the study was to determine length and breadth of proximal phalanx of middle finger from digital radiographs of hand and wrist joint (P/A view), to estimate stature and also to find out the correlation of length and breadth of proximal phalanx of middle finger with stature. ***Materials and Methods:*** Digital radiographs of hand and wrist joint (P/A view) were taken from 50 male students of Sir Salimullah Medical College, Dhaka within the age of 20-25 years of age. Stature of study subjects were measured by stadiometer. Then the radiographs were imaged and transferred to computer according to scale. Finally, length and breadth of proximal phalanx of middle finger were measured by using MB ruler software. Correlation between length and breadth of proximal phalanx of middle finger with stature was observed by using Pearson's Correlation Coefficient test. ***Results:*** The mean ± SD of stature was 169.72 ± 5.06 cm. The mean ± SD of length of proximal phalanx of middle finger was 4.56 ± 0.24 cm and the mean ± SD of breadth of proximal phalanx of middle finger was 0.94 ± 0.11 cm. Length of proximal phalanx of middle finger (r = 0.314) and breadth of proximal phalanx of middle finger (r = 0.407) both had significant positive correlation with stature ($p<0.001$). ***Conclusion:*** So, it can be concluded that there is significant positive correlation of stature with length and breadth of proximal phalanx of middle finger in the Bangladeshi male population.

Keywords: Stature, Length of Proximal Phalanx of Middle Finger, Breadth of Proximal Phalanx of Middle Finger, Forensic Osteology.

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How to cite this article:
Urmi TM, Paul UK, Ahmed A, Laboni TK; Exploring The Correlation of Stature with Length and Breadth of Proximal Phalanx of Middle Finger for Forensic Assessment: A Radiological Study. *Int. J. Forensic Expert Alliance*. 2025; 2 (1): 14-20

Article history:
Received: January 30, 2025
Revised: March 14, 2025
Accepted: April 24, 2025
Published: June 30, 2025

Peer Review Process:
The Journal abides by a double-blind peer review process such that the journal does not disclose the identity of the reviewer(s) to the author(s) and does not disclose the identity of the author(s) to the reviewer(s).

INTRODUCTION

Application of anatomical science in legal set up is dealt with in a branch of forensic medicine named Forensic anthropology. There are three sections in Forensic anthropology – Forensic osteology, Forensic archeology and Forensic taphonomy.[1] Among them Forensic Osteology deals with study of skeleton. In murder cases, mass disasters or natural calamities identification of bodies from dismembered body parts requires obvious involvements of forensic anthropologists. Stature of a person is a very important anatomical parameter for personal identification.[7] Being in the central position in identification of an individual (living or dead) done by forensic experts, stature estimation bears great significance.[2] When mutilated body parts are the one to deal with in conditions like earthquakes, cyclones, tsunamis, floods, bomb blasts, railway accidents, plane crushes, wars and homicides the examination of human skeletons from amputed body parts can help in personal identification. This is due to significant constant correlation between stature and different

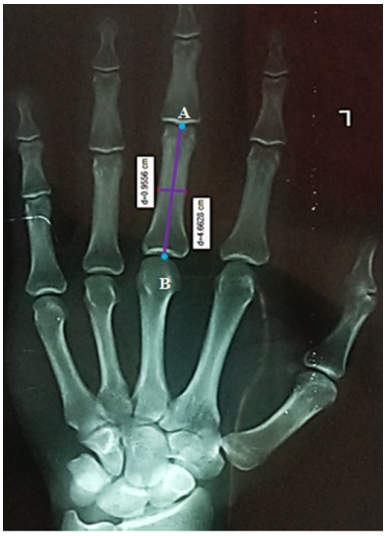
body measurements.[1, 2, 4] Human hand consists of fourteen miniature long bones–phalanges in five digits. Except the thumb each of the other digits have three phalanges–distal, intermediate and proximal. Fingertips contain the distal one and the proximal phalanx is the last one which is attached to the palm. It is generally accepted in medical literature that there is certain regularity in the proportion of finger segments.[13] Among the five fingers, middle finger length is significantly correlated with stature.[4]

Several methods are available for determination of stature from different body parts, mostly upper and lower limb bones such as–humerus, ulna, femur, tibia, foot and phalanges.[8] Some studies were done by physical measurements of bone using knowledge of regional topography. But radiological measurements provide more accurate data because radiologically anatomical structures are well visualized, and their localization is not a problem as in surface landmarks. A number of studies are there on stature estimation from different hand dimensions. But very few are reported based on length and bredth of phalanges.[12] Even more limited are the studies taking into account the proximal phalanx of middle finger and stature. Thus, the present study is aimed at exploring the correlation of stature with radiological length and breadth of proximal phalanx of middle finger in Bangladeshi population.

METHODOLOGY

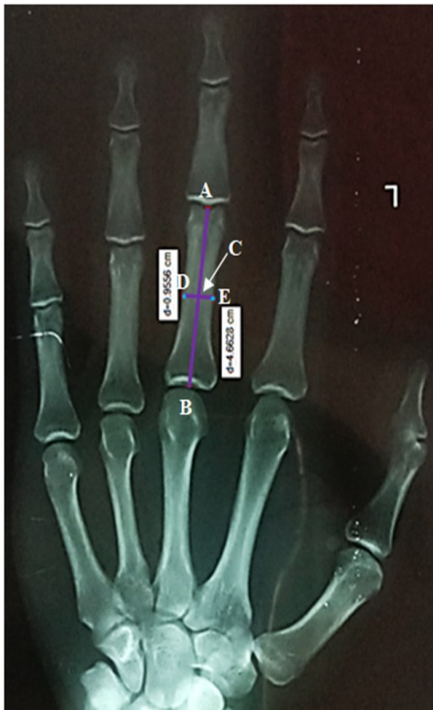
A cross-sectional analytical study was carried out in the Department of Anatomy of Sir Salimullah Medical College, Dhaka from July 2018 to June 2019 on 50 Bangladeshi male medical students aged between 20-25 years. Age and Nationality of the study subjects were confirmed by Natinal Identity Card. Those with any type of deformity, anomaly or history of trauma or surgery of left hand were excluded from the study. According to the International Agreement for the unification of anthropometric measures on the living for paired measurements, it is recommended to operate on the left side.[14] So, in this study left hand of study subjects were used to take digital radiograph. Digital radiographs of left hand and wrist joint in posteroanterior view were taken in Radiology and Imaging Department of Sir Salimullah Medical College and Hospital. The subjects were instructed to sit at the end of radiographic table, so that there left forearm could rest on the table with the palm facing down on the cassette and fingers spreaded slightly. The X-ray beam was given perpendicularly centered on the 3rd metacarpophalangeal (MCP) joint [15]

The digital radiograph of hand was imaged with a digital camera and was transferred to a computer. Before taking image, one variable (length of 3rd metacarpal) was measured by a ruler (in cm). After transferring the image to the laptop, the image was enlarged keeping the 3rd metacarpal length fixed by using MB ruler software, as per previous measurement. Length of proximal phalanx of middle finger (LPP3) was measured as the distance between the mid-point of line in the proximal interphalangeal space of middle finger to midpoint of the line in the 3rd metacarpophalangeal space (Photograph-1).



Photograph 1: Photograph of digital radiograph of left hand in P/A view showing the measurement of length of proximal phalanx of middle finger (A- midpoint of a line in the PIP space of middle

finger, B- midpoint of a line in the 3rd M-P space, AB - length of proximal phalanx of middle finger).



Photograph 2: Photograph of digital radiograph of left hand in P/A view showing the measurement of breadth of proximal phalanx of middle finger (AB - length of proximal phalanx of middle finger, C- midpoint of phalangeal length, DE- breadth of proximal phalanx of middle finger).

Breadth of proximal phalanx of middle finger (BPP3) was measured as is the measurement at the level of the mid-point of phalangeal length (Photograph-2). Stature was measured by stadiometer. Stature is the natural height of a human expressed as distance from the vertex (the highest point on the head held in the Frankfort horizontal plane) to the sole of the foot in an upright position. Data were collected by quantitative method and were recorded using an Excel spreadsheet (Microsoft Office 2010; Microsoft, Redmond, WA). Then the data were expressed as mean±standard deviation (mean±SD) with range. Correlation between stature and length and breadth of proximal phalanx of middle finger were obtained by Pearson's Correlation Coefficient test. All statistical analyses were performed by using the statistical software SPSS (IBM SPSS Statistics Base, version 25). P-value <0.05 was considered as statistically significant.

RESULTS

The results are shown in Table 1 and 2. The mean ± SD of length of proximal phalanx of middle finger was 4.56 ± 0.24 cm (range 4.1 – 5.1 cm) and the mean ± SD of breadth of proximal phalanx of middle finger was 0.94 ± 0.11 cm (range 0.70 – 1.20 cm). The mean ± SD of sature was 169.72 ± 5.06 cm (range 157.5 – 180 cm). Both length of proximal phalanx of middle finger (r = 0.314) and breadth of proximal phalanx of middle finger (r = 0.407) had significant positive correlation with stature (p<0.001) (Figure1 and 2).

Table 1: Stature of Study Subjects

Variable	Measurements Mean ± SD (Range)
Stature (cm)	169.72 ± 5.06 (157.5 - 180)

Table 2: Different measurements of Proximal Phalanx of Middle Finger and Their Correlations with Stature

Variables	Measurements Mean ± SD (Range)	Correlation with stature r	p-value
Length of proximal Phalanx of middle finger (cm)	4.56 ± 0.24 (4.1 - 5.1)	.314	<0.05
Breadth of proximal Phalanx of middle finger (cm)	0.94 ± 0.11 (0.7 – 1.2)	.407	<.001

Pearson's correlation coefficient test was performed to get the correlation between two variables.
r = Pearson's correlation coefficient

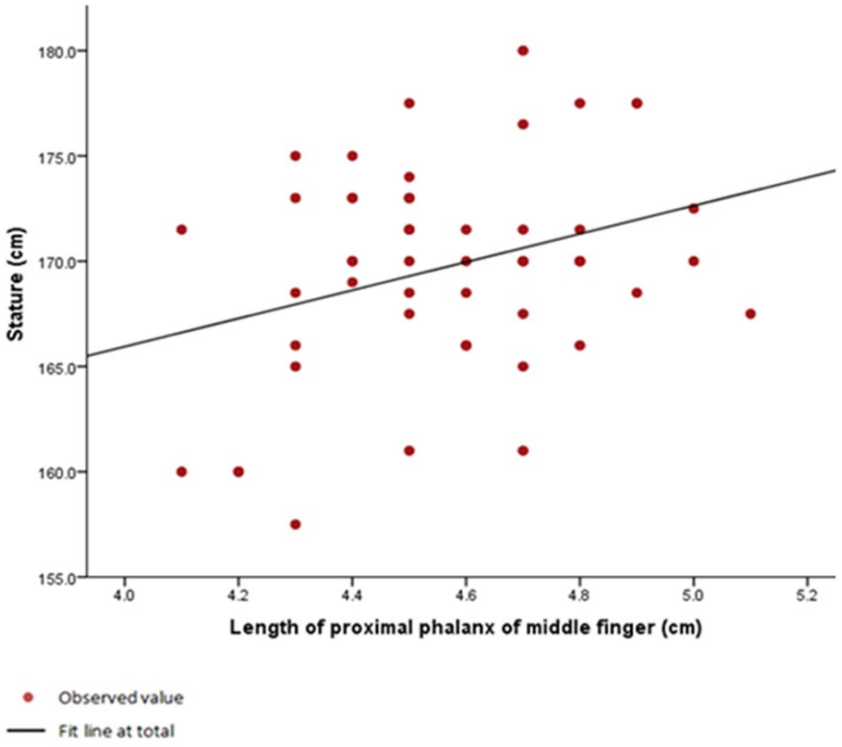


Figure 1: Scatter Diagram Showing Significant Positive Correlation Between Stature and Length of Proximal Phalanx of Middle Finger of The Study Subjects

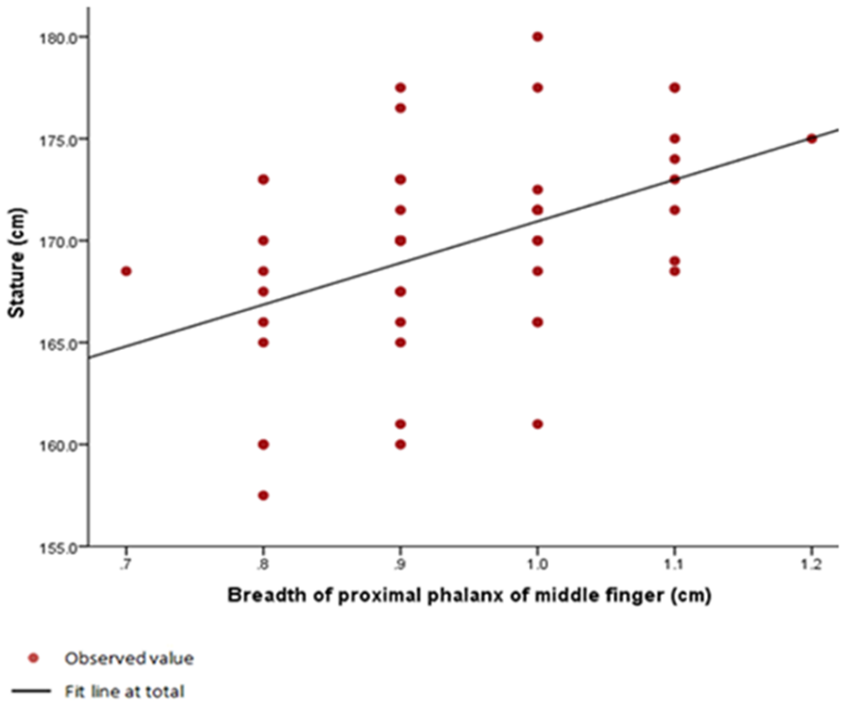


Figure 2: Scatter Diagram Showing Significant Positive Correlation Between Stature and Breadth of Proximal Phalanx of Middle Finger of the Study Subjects

DISCUSSION

Stature is one of the determinant factors to identify a person. Numerous studies in the field of forensic medicine and anthropology have estimated stature from hand features. In comparison of our results with previous studies several observations can be made. The mean stature of the present study population was similar to the people of India, Saudi Arabia and Nepal, whereas was lower than the people of Saudi Arabia and Iran.[2, 4, 7-12] The mean length of proximal phalanx of middle finger of the present study population was similar to the people of India and Saudi Arabia.[10, 12]

The mean breadth of proximal phalanx of middle finger of the present study population was similar to the Indian and Saudi Arabian population.[10, 12] Similarities of the results of present study with the results of other researchers were probably due to the selection of study population of same age, sex, ethnicity, physical activities and geographical orientation. Dissimilarities might be due to different age, study groups, occupation and geographical distribution. Use of different techniques for measurement and racial factors might also be a cause of dissimilarities. Stature was found to have significant positive correlation with length of proximal phalanx of middle finger ($r = 0.314$, $p<0.001$) in our study. In agreement with the present study, significant positive correlation between stature and length of proximal phalanx of middle finger was found in Indian population.[12] In the present study the stature had significant positive correlation with breadth of proximal phalanx of middle finger ($r = 0.407$, $p<0.001$). Similarly, significant positive correlation between stature and breadth of proximal phalanx of middle finger was also found in people of India.[12] So, stature has significant positive correlation with length and breadth of proximal phalanx of middle finger can be concluded.

CONCLUSION

The identification of intermingled mutilated body remains is a challenge for forensic experts in a crime scene or in a place with natural or manmade disasters. The present study can help in victim matches in such cases from unidentified body or dismembered remains. Stature is sifnificantly correlated with length and breadth nof proximal phalanx of middle finger as per our study. The result of this study is, however, applicable only when intact proximal phalanx of middle finger is found.

As references indicate that a good number of research have been done on stature estimation from digital length, but very little work has been done for estimation of stature from length and breadth of proximal phalanx of middle finger. Last but not the least this study can be of great help in forensic investigations worldwide.

Recommendations

In further studies, large sample size with multistage sampling technique may be applied. Similar study can be done on the female population and that may be the basis for comparison between male and female population. The study can be extended to people of different countries with different races and ethnicities. For measurement of stature digital stadiometers may be used to avoid minor errors. To get more précised data on radiographic hand dimensions, use of newer and advanced imaging techniques, like CT (Computed Tomography) Scan, MRI (Magnetic Resonance Imaging) may be recommended.

Acknowledgements

We would like to express our heartfelt gratitude to all the participants of the study as well as the adminstrators and staffs of Sir Salimullah Medical College, Dhaka. Special thanks to Department of Radiology and Imaging whose support and cooperation were the most to make this study possible.

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