

Gender Determination from the Long Bones of the Arm: An Institutional Based Study

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ABSTRACT

Background: Identifying the sex of a body and estimating the body's stature are considered the most important factors in establishing the identity of indefinite dead bodies, parts of bodies, or even skeletal fragments. Many researchers studied the sexual dimorphism of adult skeletons using the dimensions of the skull, face, long bones, hands, feet, and pelvis. Hence: under the light of above-mentioned data, the present study was undertaken for assessing gender determination from long bone of arms.

Materials & Methods: A total of 50 sets of male humerus, radius and ulna and 50 sets of female humerus, radius and ulna were obtained from the cadavers. No bones with obvious pathologies or healed fractures were included. Maximum lengths of the humerus, radius, and ulna were measured with an osteometric table, measuring tape, and digital calipers and approximated to the nearest 0.5 mm. All the bones were cleaned after removal from the cadavers. A surgical knife was used to remove the articulate cartilages. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software.

Results: Mean radius length among males and females was found to be 263.12 mm and 233.27 mm respectively. Mean ulna length among males and females was found to be

277.46 mm and 251.36 mm respectively. Mean humerus length among males and females was found to be 338.24 mm and 311.24 mm respectively. Significant results were obtained while comparing the mean length of long bones among males and females.

Conclusion: Long bone measurements are important parameters with the high accuracy for the determination of gender from the skeletal remains of the human body.


Key words: Gender, Long, Bones.

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INTRODUCTION

Several factors are essential for forensic experts to be able to identify an unknown dead body in many anthropological cases and traumatic events. Identifying the sex of a body and estimating the body's stature are considered the most important factors in establishing the identity of indefinite dead bodies, parts of bodies, or even skeletal fragments. In forensic examinations, sex determination is considered the simplest assignment because the external and internal genitalia can directly assert the sex of the deceased. Of the human skeleton, the humerus often remains in good condition and is especially favorable for metric sex determination. The length of the humerus, among the long bones of the human body, is a good predictor, but the vertical head diameter of this bone is also an accurate predictor of gender.¹⁻³

Many researchers studied the sexual dimorphism of adult skeletons using the dimensions of the skull, face, long bones, hands, feet, and pelvis. Scholars proved that a specific study is

needed for each population to gain accurate results for the sexual identification of a skeleton. Discriminant function analysis had been used to estimate the sex from bones if they are suspected to be sexually dimorphic.⁴⁻⁷ Hence: under the light of above-mentioned data, the present study was undertaken for assessing gender determination from long bone of arms.

MATERIALS & METHODS

The present study was conducted in the Department of Anatomy, SMS Medical College, Jaipur, Rajasthan (India) and it included gender determination from long bones of the arm. Ethical approval was obtained from institutional ethical committee in written after explaining in detail the entire research protocol. A total of 50 sets of male humerus, radius and ulna and 50 sets of female humerus, radius and ulna were obtained from the cadavers. No bones with obvious pathologies or healed fractures were included. Maximum

lengths of the humerus, radius, and ulna were measured with an osteometric table, measuring tape, and digital calipers and approximated to the nearest 0.5 mm. All the bones were cleaned after removal from the cadavers.

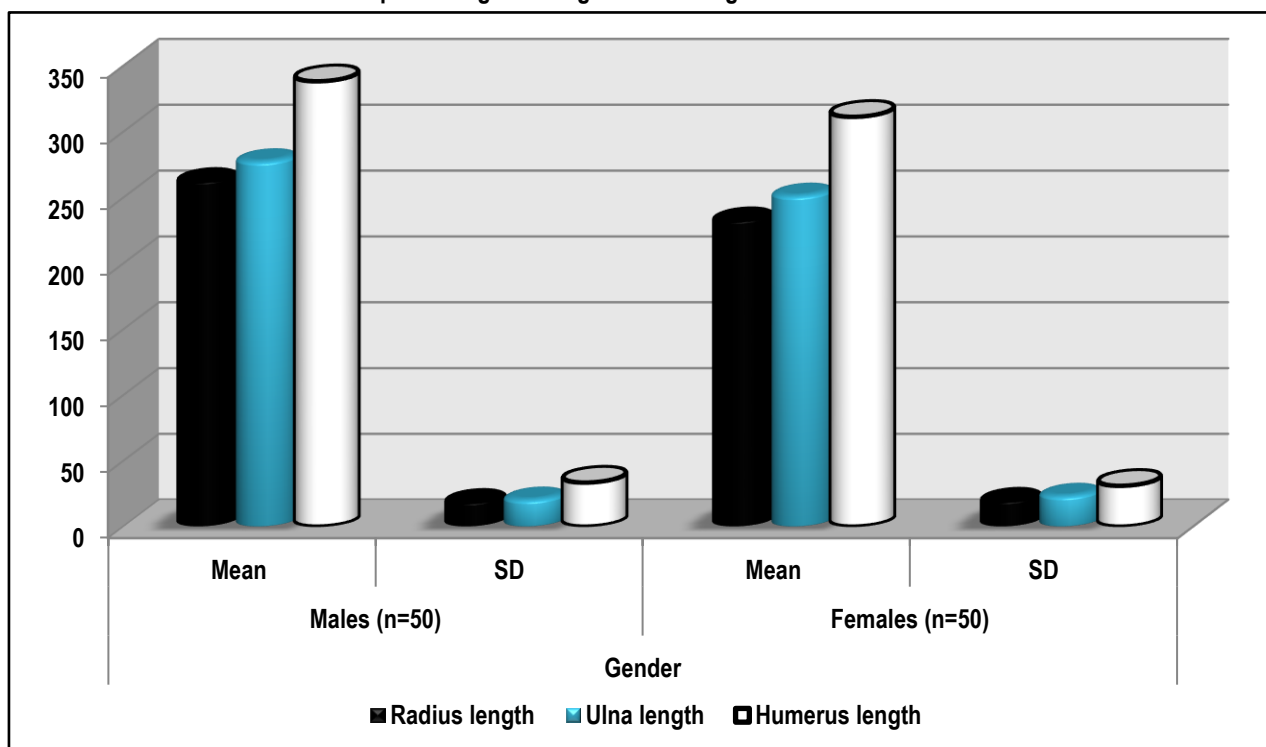
A surgical knife was used to remove the articulate cartilages. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Student t test was used for evaluation of level of significance.

Table 1: Comparison of length of long bones

Bone length (mm)	Gender				p- value
	Males (n=50)		Females (n=50)		
	Mean	SD	Mean	SD	
Radius length	263.12	19.25	233.27	20.17	0.00*
Ulna length	277.46	20.42	251.36	23.28	0.01*
Humerus length	338.24	33.38	311.24	30.92	0.00*

*: Significant

Graph 1: Length of long bones among males and females



RESULTS

In the present study, a total of 50 males and 50 female long bones were analysed. Mean radius length among males and females was found to be 263.12 mm and 233.27 mm respectively. Mean ulna length among males and females was found to be 277.46 mm and 251.36 mm respectively. Mean humerus length among males and females was found to be 338.24 mm and 311.24 mm respectively. Significant results were obtained while comparing the mean length of long bones among males and females.

DISCUSSION

Determination of sex is an important first step in the identification process of an individual in a forensic examination. A biological profile which includes age, race, and stature when determined from the various human remains are amongst several other key parameters that need to be rapidly determined. Reports from previous studies have indicated that virtually every human bone has been used for sex determination with varying accuracy rates.

Although studies have demonstrated both higher and more reliable accuracies using the pelvis and cranium, recent studies have shown similarly high accuracy rates in postcranial long bones foregrounding the relevance of the humeral bone for sex determination.⁷⁻⁹ Hence: under the light of above mentioned data, the present study was undertaken for assessing gender determination from long bone of arms.

In the present study, a total of 50 males and 50 female long bones were analysed. Mean radius length among males and females was found to be 263.12 mm and 233.27 mm respectively. In a previous study conducted by Lee JH et al, authors established metric standards for the determination of sex from the upper limb bones. They took a set of eleven measurements on each of 175 right sides of adult skeletons. Classification accuracy dropped only one or two individuals when only vertical head diameter of humerus is used. Variables in relation with maximal length were less accurate than head diameter of humerus. Two variables were

selected by the stepwise procedure: maximal length of humerus, vertical head diameter of humerus. The combined accuracy was 87%. This study of skeletons underscored the need for population-specific techniques, not only for medicolegal investigations, but also for the study of population affinities and factors affecting bone configurations.¹⁰

In the present study, mean ulna length among males and females was found to be 277.46 mm and 251.36 mm respectively. Mean humerus length among males and females was found to be 338.24 mm and 311.24 mm respectively. Ogedengbe OO et al established sex identification using osteometric standards for the humerus in a contemporary. A total of 11 parameters were measured in a sample of n=211 humeri (males, 113; females, 98) from the osteological collection. The difference in means for nearly all variables were found to be significantly higher in males compared to females ($P < 0.01$) with the most effective single parameter for predicting sex being the vertical head diameter having an accuracy of 82.5%. Stepwise discriminant analysis increased the overall accuracy rate to 87.7% when all measurements were jointly applied. They concluded that the humerus is an important bone which can be reliably used for sex determination based on standard metric methods despite minor tribal or ancestral differences amongst an otherwise homogenous population.¹¹

In the present study, significant results were obtained while comparing the mean length of long bones among males and females. In another study conducted by Ali DM et al on One hundred and fifty dry adult right humeri (75 male and 75 female) were studied. The humeri were divided into seven fragments according to specific anatomical landmarks. Data obtained was subjected to descriptive statistical analysis. The longest fragmentary portion revealed a good result with closest proximity to the total length of humerus. All fragments showed significant sexual differences ($P < 0.001$) between males and females except H2. Total length of humerus revealed the highest percentage of accuracy (93.3%) followed by H4 (86.7%) and H7 (83.3%) for sex identification. Finally, from measurements of different humeral fragments in Egyptian population; the length of the humerus can be estimated and the sex can be identified.¹²

CONCLUSION

From the above results, the authors concluded that long bone measurements are important parameters with the high accuracy for the determination of gender from the skeletal remains of the human body. However; further studies are recommended.

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