Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 10, 2023

An anthropometric study on estimation of stature using height of humerus

[1]Dr. Anjali Patil , [2]Dr. Abantika Bamne, [3]Dr.Pooja Jain , [4*]Dr.Ashwini Rathore

1Assistant Professor, Department Of Anatomy, Index Medical College ,Hospital And Research Centre,Indore,Madhya Pradesh

2Professor ,Department Of Anatomy,Index Medical College,Hospital And Research Centre,Indore,Madhya Pradesh.

3Professor ,Department Of Obstetrics And Gynaecology ,Index Medical College ,Hospital And Research Centre

4, Post Graduate 1st Year Department Of Obstetrics And Gynaecology, Index Medical College, Hospital And Research Centre

Corresponding Author
Dr.Ashwini Rathore
Email –rathore.ashwini741@gmail.com

ABSTRACT

BACKGROUND

In medico-legal cases, most often the personal identity of the deceased is important. One of the methods of ascertaining the sex and stature is by using the human bones. There are several regression formulae for conducting such estimation. However, it must be remembered that these regression equations can vary depending upon the population and region.The aim of the study is to find out correlation and to drive a regression formula between the length of humerus and height of an individual, in population of central India,in M.P. The material consisted of 240 (120 males and 120 females)undergraduate and postgraduate medical students of age group 20 to 30 years .The length of humerus is measured by , asking the subject to flex the elbow joint .Height of the subject was measured with standard height measuring instrument in anatomical position. The results obtained were analyzed and attempt was made to derive a formula between length of humerus and total height of an individual. The result shows that there is definite correlation between the two.

METHODS AND MATERIALS

Equipments used are as follows

1)Anthropometer,Spreading caliper,Skin marking pencil,(Retractable tape,)caliper

Methodology- The height of the subject was measured by standard height measuring instrument in anatomical position. The length of humerus was taken by asking the subject to flex the elbow joint. The flexor surfaces of arm and forearm made an angle of 90 degree. Lateral epicondyle was felt and marked with skin marking pencil. Acromion point was traced by moving finger over clavicle's lateral end and was marked and the distance between two points was measured by spreading caliper, both side humerus length was taken.

RESULT

The equation for estimation of height by using length of humerus was 148.75+0.481 x Length of Humerus; and that in females was 143.90+0.491 x Length of Humerus by using regression equation. A positive correlation between height of the study participants and length of humerus in both males, as well as, females is present, i.e. with increase in height, the length of the humerus also increased. The correlation with age and weight was found to be negative and none of the correlation was found to be significant.

CONCLUSION

From this study, it can be concluded that since the error between actual stature and the estimated stature was not significant, the stature can be successfully estimated using humerus length. The regression equations derived in this study can be effectively used in estimating stature. In developing countries, this method of stature estimation can be highly useful for identification especially considering its cost-effectiveness.

KEYWORDS-Humerus,Stature,Upper Arm Length

INRODUCTION

Anthropometry means study of the measurements and proportions of the human body, is been widely used in forensic identification. Identification includes determining sex, age, race and stature of a person. Among these, the sex and stature are the most important.1 In 1888, Rollet2 was first to conduct a research in this field. He used measurements from 50 male and 50 female corpses to show the relationship between various body measurements and the stature. In 1899, Pearson,3 a mathematician, used this data to derive the regression equations, which he suggested were population specific. Since then numerous advancements have been made in this field, which are being efficiently applied in the identification process. As these measurements are population specific, it becomes imperative to collect data from more populations and make a comprehensive database.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 10, 2023

Using stature estimation, a forensic scientist can narrow down the pool of possible victim matches in any ongoing investigation.5The stature is directly proportional to different body parts and hence, shows a definite biological and genetic relation with each other. In forensic cases, stature (or body height) is usually estimated using 'anatomical' and 'mathematical' techniques.6 Researchers have established a relationship between stature and measurements of different body parts which are often represented using linear regression equation derived from them.1

There exist many inherent population differences among the different population, thus, giving rise to the need for different formulae to be derived from different populations.7 Forensic identification is most important in the case where parted bodies are encountered as in the natural disaster, traffic accidents, war, terror and bombing cases.1 To counter this problem we must have regression equation for different bones for representatives of same populations. Many studies have been done for stature estimation using long bones, foot dimensions, hand measurements Radius Ulna Bone measurements, Head measurements, etc. This study was conducted in population of indore region to identify whether a significant correlation exists between the stature and different parts of body namely arm length, middle finger length, knee length, foot length, foot breadth, head length and head breadth.

Identification appears to be a critical consideration in the forensic medicine. The necessity of identifying dismembered human remain in cases of suicide, bomb blast, war, accident, earthquakes and crimes is a challenging task for medicolegal experts.1 Estimation of stature from anthropometric measurement of different part of skeletal elements has been area of critical interest to anatomist, anthropologists and forensic experts for century.
Reconstruction of stature from long bones of the upper extremity is of great medico-legal relevance. There is a strong relationship between stature and long bones of the upper limb segments.

For this purpose many sets of linear equation have been developed which are easiest and reliable methods for predicting relation between stature and body segments. Regression formulae derived from major long bones are generally considered to be more accurate than those utilizing other bones of hand and foot for estimating stature.

Upper arm length (UAL) estimate stature with reasonable accuracy and is reliable factor for predicting stature.

Studies have shown that regression formulas derived reliably reconstructed stature with no statistically significant difference TriptiShakyaet.al. Estimation of stature from upper arm length. These derived regression equations are population based and cannot be applied in other populations.3 Therefore, Population specific studies are necessary for deriving population specific regression equation for reconstruction of stature. Several studies have been conducted to estimate stature from arm span, ulnar length, hand length and foot length but studies on upper arm length for estimation of stature is lacking among indian population. Hence, present study was conducted to investigate relationship between stature and upper arm length and to formulate regression formula for estimation of stature from upper arm length among Nepalese population.

AIMS AND OBJECTIVES OF THE STUDY
AIM-The present study is aimed to find out correlation and to derive a regression formulae between the length of humerus and height of an individual, in western region of Maharashtra. Correlation of height with the humerus of both sides and also the gender wise comparison.

METHODS AND MATERIALS
Equipments used are as follows

1)Anthropometer-
2) Spreading caliper –
3)Skin marking pencil
4(Retractable tape
5)calliper
Methodology –
Medical students were selected due to easy availability. Measurements were taken at a fixed time, to avoid diurnal variations. Any obvious deformity or limb defects were not included in the present study. The height of the subject was measured by standard height measuring instrument in anatomical position. The length of humerus was taken by asking the subject to flex the elbow joint. The flexor surfaces of arm and forearm made an angle of 90 degree. Lateral epicondyle was felt and marked with skin marking pencil. Acromion point was traced by moving finger over clavicle's lateral end and was marked and the distance between two points was measured by spreading caliper, both side humerus length was taken. The measured length was subtracted by 2.0 mm as the acromion point is 2 to 5 mm above humeral head.
IMG 1

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 10, 2023

IMG 1.VERNIER CALLPIER

RESULTS

TABLE 1

Age and anthropometric parameters of the study participants

Parameter	Minimum	Maximum	Mean	Std. deviation
Age (in years)	18	25	19.89	1.73
Height (in cm)	152.4	188.0	161.45	4.99
Weight (in kg)	46	66	56.81	3.90
Length of humerus (in cm)	27.4	34.8	31.15	1.48

The age of the study participants ranged from 18 to 25 years with the mean age of 19.89±1.73 years. The mean height observed was 161.45±4.99 cm with the minimum being 152.4 cm and maximum 188.0 cm. Weight of the study participants was also measured. The mean weight was found to be 56.81±3.90 kg, with a range of 46-66 kg. The mean length of the humerus was 31.15±1.48 cm. The shortest length was 27.4 and maximum was 34.8 cm. this has been depicted in Table 1

TABLE 2

Mean parameters of males and females

Parameter	Gender				p-value
	Male		Female		
	Mean±SD	*Median*	*Mean±SD*	*Median*	
Height (in cm)	164.13±4.66	163.83	158.79±3.73	157.48	<0.0001
Weight (in kg)	58.57±3.83	59.00	55.05±3.10	55.00	<0.0001
Length of humerus (in cm)	31.98±1.16	32.05	30.32±1.30	30.20	<0.0001
Parameter	**Gender**				**p-value**
	Male		**Female**		
	Mean±SD	***Median***	***Mean±SD***	***Median***	
Height (in cm)	164.13±4.66	163.83	158.79±3.73	157.48	<0.0001
Weight (in kg)	58.57±3.83	59.00	55.05±3.10	55.00	<0.0001
Length of humerus (in cm)	31.98±1.16	32.05	30.32±1.30	30.20	<0.0001

Table 2 depicts the mean anthropometric parameters in males and females. The mean height in males and females was 164.13±4.66 and 158.79±3.73 cm respectively, and mean weight was 58.57±3.83 and 55.05±3.10 kg respectively. The length of the humerus was 31.98±1.16 cm in males and 30.32±1.30 cm in females. The association of height, weight and length of the humerus with gender of the study population was found significant with a p-value of <0.0001.

TABLE 3

Correlation between length of humerus and height, weight and age of the study participants

Parameters		Length of humerus	
		Male	Female
Height	Pearson Correlation (r)	0.120	0.172
	P-value	0.193	0.060

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 10, 2023

Weight	Pearson Correlation (r)	-0.050	-0.111
	P-value	0.591	0.227
Age	Pearson Correlation (r)	-0.082	-0.068
	P-value	0.373	0.462

Table 3 shows a positive correlation between height of the study participants and length of humerus in both males, as well as, females i.e. with increase in height, the length of the humerus also increased. The correlation with age and weight was found to be negative and none of the correlation was found to be significant.

TABLE 4
Linear regression between length of humerus and height of the study participants

Coefficient						
Model	**Parameters**	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**P-value**
		B	**Std. Error**	**Beta**		
Male	(Constant)	148.75	11.758		12.651	<0.0001
	Length of Humerus	0.481	0.367	0.120	1.309	0.193
Female	(Constant)	143.90	7.866		18.292	<0.0001
	Length of Humerus	0.491	0.259	0.172	1.896	0.060

As seen in Table 4 among males, the equation for estimation of height by using length of humerus was 148.75+0.481 x Length of Humerus; and that in females was 143.90+0.491 x Length of Humerus by using regression equation.

DISCUSSION

In the present study, Indian males were found to be taller than the females. The age of the study participants ranged from 18 to 25 years with the mean age of 19.89±1.73 years. The mean height in males and females was 164.13±4.66 and 158.79±3.73 cm respectively, and mean weight was 58.57±3.83 and 55.05±3.10 kg respectively. The length of the humerus was 31.98±1.16 cm in males and 30.32±1.30 cm in females.The association of height, weight and length of the humerus with gender of the study population was found significant with a p-value of <0.001.

Our findings are similar to studies of some major ethnic groups in Nigeria Among Malaysians, males were also reported to be taller than females . The findings on stature in the study are useful for predictive anthropometry as they indicate sexual dimorphism. The features of sexual dimorphism in human anatomy are essential in creating the biological profile of groups and individuals for sex estimation.

CONCLUSION

From this study, it can be concluded that since the error between actual stature and the estimated stature was not significant, the stature can be successfully estimated using humerus length. The regression equations derived in this study can be effectively used in estimating stature. In developing countries, this method of stature estimation can be highly useful for identification especially considering its cost-effectiveness.

REFERENCES

1. G. Zeybek, I. Ergur, Z. DemirogluStature and gender estimation using foot measurementsForensic Sci Int, 181 (1–3) (2008), pp. 54.e1-54.e5
2. E. RolletDe la mensuration des os longs des members dans ses rapports avec l'anthropologie, la Clinique *et al.* me′dicinejudiciareA. Storck, Lyon (1889)
3. K. Pearson, Mathematical contributions to the theory of evolution. V. On the reconstruction of the stature of prehistoric racesPhilos Trans R Soc London Ser A Contain Pap Math Phys Character, 192 (1899), pp. 169-244
4. M. Trotter, G.C. Gleser, Estimation of stature from long limb bones of American whites and NegroesAm J Phys Anthropol, 10 (1952), pp. 463-51
5. M. Trotter, G.C. Gleser,A re-evaluation of stature based on measurements of stature taken during life and of long bones after deathAm J Phys Anthrop, 40 (1958), pp. 762-767
6. K. Krishan, T. Kanchan, R.G. Menezes, A. GoshForensicanthropology casework—essential methodological considerations in stature estimationJ Forensic Nurs, 8 (2012), pp. 45-50View article
7. J.K. Lundy, The mathematical versus anatomical methods of stature estimate from long bonesAm J Forensic Med Pathol, 6 (1985), pp. 73-76
8. A. Telkka, On the prediction of human stature from the long bonesActa Anat(Basel), 9 (1950),pp. 103-117J.I. Muñoz, M. Liñares-Iglesias, J.M. Suárez-Peñaranda, M. Mayo, X. Miguéns, M.S. Rodríguez-Calvo, *et*

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 10, 2023

*al.*Stature estimation from radio graphically determined long bone length in a Spanish population sampleJ Forensic Sci (2001), pp. 363-366

9. G. Soni, U. Dhall, S. Chabra, Determination of sex from humerus: discriminant analysisAust J Forensic Sci, 45 (2) (2013), pp. 147-152
10. K. Krishan, T. Kanchan, N. Passi, J.A. DiMaggioSexual dimorphism in foot length ratios among North Indian adolescentsJ Forensic Leg Med, 36 (2015), pp. 96-101
11. K. Krishan, T. Kanchan, A. Sharma, Sex determination from hand and foot dimensions in a North Indian populationJ Forensic Sci, 56 (2) (2011), pp. 453-459
12. J. Sen, S. Gosh, Estimation of stature from foot length and foot breadth among the Rajbanshi: an indigenous population of North BengalForensic Sci Int, 18 (2008), pp. 55.e1-55.e6
13. J. Sen, T. Kanchan, A. Ghosh, N. Mondal, K. Kewal, Estimation of stature from index and ring fingers in northeastern Indian populationJ Forensic Leg Med, 22 (2014), pp. 10-15
14. O.P. Jasuja, G. Singh, Estimation of stature from hand and phalange lengthJ Indian Acad Forensic Med, 26 (3) (2004), pp. 100-106
15. T. Kanchan, K. Krishan, Anthropometry of hand in sex determination of dismembered remains – a review of literature, J Forensic Leg Med, 18 (2011), pp. 14-17
16. O. Celbis, H. Agritmis, Estimation of stature and determination of sex from radial and ulnar bone lengths in a Turkish corpse sampleForensic Sci Int, 158 (2006), pp. 135-139
17. K. Krishan, Estimation of stature from cephalo-facial anthropometry in north Indian populationForensic Sci Int, 181 (2008), pp. 52.e1-52.e6
18. Z. Akhtar, L.A. Banu, M.I.M. Alam, A.E. RahmanStature estimation using head measurements in Bangladeshi Garo adult femalesMymensingh Med J, 7 (2) (2009), pp. 101-104
19. S. Kalia, S.K. Shetty, K. Patil, V.G. MahimaStature estimation using odontometry and skull anthropometryIndian J Dent Res, 19 (2) (2008), pp. 150-154
20. P.W. Kanchankumar, Estimation of stature from head length & head breadth in central Indian population: an Anthropometric studyInt J Anat Res, 3 (1) (2015), pp. 954-955
21. A.H. Shiva Kumar, G.M. Raju, V. VijayanathStature estimation by right upper limb length among the males in Karnataka of South Indian populationAnat Karnataka, 6 (3) (2012), pp. 49-52
22. S.R. Habib, N.N. Kamal, Stature estimation from hands and phalanges length of EgyptiansJ Forensic Leg Med, 17 (2010), pp. 156-160
23. S. Kumaran, B.B. Kumar, L. Kumar, N. Keyur, Stature estimation from length of fingers in Gujarati populationIndian J Forensic Med Toxicol, 8 (2) (2014), pp. 8-11
24. S.S. Kumar, S. Pavanchand, Shankar, Stature estimation from middle dinger length in Salem regionIndian J Forensic Med Toxicol, 8 (2) (2014), pp. 30-33
25. G.M. Raju, S. Shahina, S. Dubey, V. VijayanathEstimation of stature from Index Finger length in Davangre DistrictIndian J Forensic Med Toxicol, 8 (2) (2014), pp. 97-100