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THE STUDY OF RECONSTRUCTION OF TOTAL LENGTH OF ULNA IN LIVING ADULT PERSONS FOR MEDICOLEGAL PRESPECTIVE IN INDIA

Anatomy

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ABSTRACT

Introduction: The height of an individual is a very important parameter for establishing the identification. The height can be indirectly estimated from different parts of the skeleton. Such estimations are of great use in anthropometry, forensic science, and anatomy. Ulna bone has been chosen because it is subcutaneous and can be used for measurements.

Objective: The objective of this study is to estimate the height of an individual from the length of ulna using a derived equation and to compare the results with other studies done in different populations.

Materials and Methods: The study was done on 200 students of the NIMS MEDICAL COLLEGE of India. The age of the subjects ranged from 20 to 30 years and was healthy without any skeletal deformity. After getting written consent from the subject, the height of the individual was measured from vertex to heel and the length of both right and left ulna bones was measured from olecranon process to styloid process. The data was tabulated and analyzed statistically.

Results: The correlation coefficient between ulna length and stature is **0.33** in males, **0.26** in females and **0.05564** in combined. And P value is P <.001

The regressions equation derived are:

For males: **Y=25.99X**

For females: **Y=23.05X**

For both male & female (combined): **Y=24.56X±17.27**

Conclusion: The ulna bone length is a reliable and accurate parameter which is used in estimating the height of an individual. The regression equation, is derived from this study it can be of great help to anatomists, clinicians, anthropologists and forensic scientists.

KEYWORDS

Ulnar length; Height;Anthrapometry; Regression formula

INTRODUCTION

Assessment of height from different parts of body by anthropometric study of skeleton is an area of interest to Anatomists; Anthropologists and to Forensics experts. Many of the previous workers have done this study on cadavers. But cadavers cannot represent a population and cadavers are largely of person who are aged, and might have suffered from chronic debilitating diseases, likely to have been lying in a n abnormal posture and it may not be possible to straighten the body to get accurate stature measurement. All these short comings in cadaveric material made me interested in undertaking the present study in living persons. Professor Karl pearson1898-99 first introduced the co-relational calculus into the field of work for prediction of stature from measurement of long bones. Height is one of the factors in description of impressiveness of an individual and it varies with race, age, sex, heredity, climate and nutritional status .Since over half of the century, the stature estimation has been linearly regretted with the length of the different long bones, especially for which the percutaneous measurement could be taken, like the ulna. The linear regression equation of the height on the ulna length has a definitive advantage over that of the tibia length, as it can be useful in the cases where the lower extremities are deformed, along with the deformities of the trunk even the ulna length was proven to be superior to the arm span measurement and the hand length in predicting the height. Lundy JK (1985) discussed the regression equation and the mathematical and the anatomical method of estimating the living stature from the limb's long bones.So the present study is done on persons, between the age group of 20-29 years . The forearm bone ulna is mostly subcutaneous through its length and easily approachable for measurements hence it is selected for this study. This method would be of help when regional problem of identification of unknown skeleton remains are encountered. Stature reconstruction is important as it provides a forensic anthropological estimate of the height of a person in the living state; playing a vital role in the identification of individuals from their skeletal remains, regression formulae for stature estimation have been generated for indigenous people.

MATERIALAND METHOD

The present study has been conducted on medical students of Rajasthan in NIMS Medical College Hospital, Jaipur, consisting of 220 adults who include 110 males and 110 females only those students are included who are born and brought up in Rajasthan State with ancestral origin from this region. Age groups of students ranged from 20 to 29 years are selected for measurements only after their consent for giving measurements. Following Measurements were taken-

1. Stature - Height is measured from vertex to floor by stadiometer with subject standing barefooted, erect on an even floor, in the Frankfurt's plane. Subject's head is positioned parallel to the floor with heels together and weight evenly distributed between both feet.

2. Percutaneous ulnar length- is measured with the help of spreading calipers in centimeters; by measuring the distance between the most prominent palpable portions tip of olecranon process to the tip of styliod process of ulna with the elbow flexed and palm spread over opposite shoulder. The data thus, collected is then subjected to statistical analysis using computer software named as Med Calc version 12.7, SPS (Smith's Package of Statistics) and Microsoft Excel spreadsheet.

MATERIAL: -

1. Measurement scale /Stadiometer

2. Spreading caliper

OBSERVATIONS AND RESULT ;

Results were analysed using SPS 12.7 version software. Initially for summarising data, mean and standard deviation for height and ulna length were estimated and presented in Table and graphs. To study the relation between ulna length and stature correlation coefficient for each ulna with stature were estimated and significance was tested through t test. The results are presented separately for males and females with age in Table and graphs. Constant, Regression coefficient and (r2) of ulna lengths with Stature are presented in Table . Prediction function was derived through linear regression for each ulna measurement with stature for both males and females separately.

In present study we have selected both sexes of 20-29 years age group.

MALE
- Mean body height of males: 170.34cm, .
- S. D of body height of male; 11.85
- Mean. Ulna length:males:25.99cm,
- S. D. of ulna length of male;3.41cm

FEMALE
- Mean body height of female;162.42
- S. D. of body height of female;7.68
- Mean ULNA length of female;23.05
- S. D. of ULNA length of female

COMBINED
- Mean body length;166.53
- S. D. of body length;10.78
- Mean ULNA length;24.56
- S. D. of ulna length;3.07

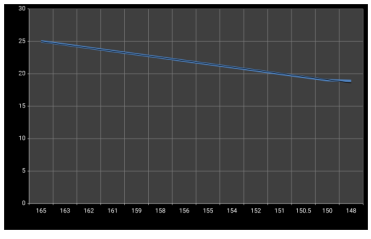
Correlation coefficients (r) of height and PCUL were calculated for males and females. The value of 'r' for males was 0.98 and for females 0.95. Both these values were statistically significant. Since there was high correlation between the height and PCUL, a simple regression analysis was done between them for males and females, to predict height from PCUL. For estimation of height from PCUL, a simple regression formula was derived as follows:
For male Stature in cm = Y = 68.9514 + 2.5902 X
For females Stature in cm = Y=85.1460+ 1.9005 X
Where, Y= stature and X = percutaneous ulnar length

Estimation of height and length of ulna in adult male of different age group (N=110)

Age group 20-22 years

Height (cm.)	165	163	162	161	159	158	156	155	154	152	151	150.5	150	148
	163	160	160	159	158	157	155	154	151	150	149	148.5	148	148
Ulna Length (cm.)	25	24.5	24	23.5	23	22.5	22	21.5	21	20.5	20	19.5	19	18.9
No. of Person	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Correlation & Regression analysis of length of ulna and height in adult male age group 20-22 years



y = -0.488x + 25.44
R^2 = 0.997
P value <0.001

Independent variable	Length of ulna in cm.
Intercept(a)	25.44
Regression coefficient(b)	.488
Correlation Coefficient(r)	.986
Coefficient of determination(r^2)	.997

The regression analysis was carried out to find the strength of relationship of ulna bone length with body height. The relationship between ulna length and body height was positive for every unit. Body height and ulna length was found to be highly significant. Correlation coefficient between total height and ulna length was found to be statistically significant and positive in male for 20-22 years age group. So here value of t test is strongly significant : $P \leq 0.001$

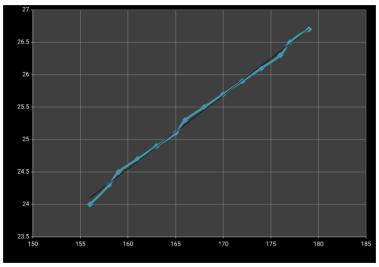
Estimation of height and length of ulna in adult male .

Age group 23-25 years

Height (cm.)	179	177	176	174	172	170	168	166	165	163	161	159	158	156
	177	175	174	172	170	168	166	164	162	161	159	158	156	154
Ulna Length (cm.)	26.7	26.5	26.3	26.1	25.9	25.7	25.5	25.3	25.1	24.9	24.7	24.5	24.3	24
No. of Person	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Independent variable	Length of ulna in cm.
Intercept(a)	6.446
Regression coefficient(b)	.113
Correlation Coefficient(r)	.994
Coefficient of determination(r^2)	.99

Correlation & Regression analysis of length of ulna and height in adult male age group 23-25 years



y = 0.113x + 6.446
R^2 = 0.996
P value <0.001

The regression analysis was carried out to find the strength of relationship of ulna bone length with body height. The relationship between ulna length and body height was positive for every unit. Body height and ulna length was found to be highly significant. Correlation coefficient between total height and ulna length was found to be statistically significant and positive in male for 23-25 years age group. So here value of t test is strongly significant : $P \leq 0.001$

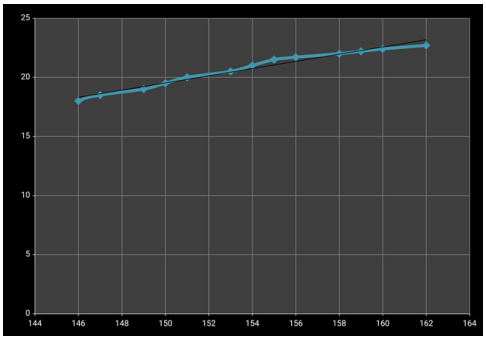
Estimation of height and length of ulna in adult female .

Age group 20-22 years

Height (cm.)	162	160	159	158	156	155	154	153	151	150	149	147	146
	161	159	158	157	155	154	153	152	151	149	148	146	145
Ulna Length (cm.)	22.7	22.4	22.2	22	21.7	21.5	21	20.5	20	19.5	19	18.5	18
No. of Person	2	2	2	2	2	2	2	2	2	2	2	3	3

Independent variable	Length of ulna in cm.
Intercept(a)	26.14
Regression coefficient(b)	.304
Correlation Coefficient(r)	.969
Coefficient of determination(r^2)	.971

Correlation & Regression analysis of length of ulna and height in adult female age group 20-22 years



y = 0.304x - 26.14
R^2 = 0.971
p value <0.001

The regression analysis was carried out to find the strength of relationship of ulna bone length with body height. The relationship between ulna length and body height was positive for every unit. Body height and ulna length was found to be highly significant. Correlation coefficient between total height and ulna length was found to be statistically significant and positive in female for 20-22 years age group. So here value of t test is strongly significant : $P \leq 0.001$

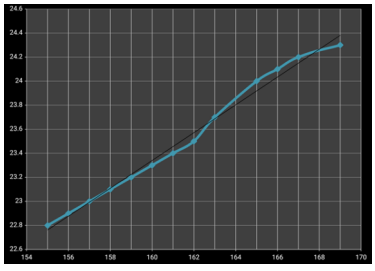
Estimation of height and length of ulna in adult female.

Age group 23-25 years

Height (cm.)	169	167	166	165	163	162	161	160	159	158	157	156	155
	167	166	165	164	162	160	159	158	157	156	155	154	153
Ulna Length (cm.)	24.3	24.2	24.1	24	23.7	23.5	23.4	23.3	23.2	23.1	23	22.9	22.8
No. of Person	2	2	2	2	2	2	2	2	2	2	2	2	2

Independent variable	Length of ulna in cm.
Intercept(a)	4.826
Regression coefficient(b)	.115
Correlation Coefficient(r)	.979
Coefficient of determination(r^2)	.989

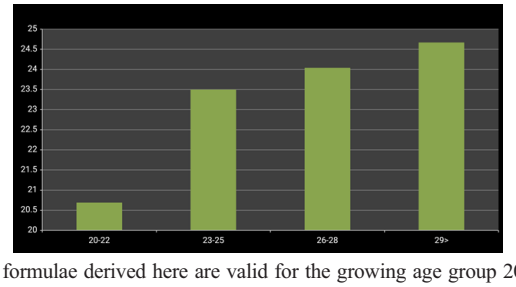
Correlation & Regression analysis of length of ulna and height in adult female age group 23-25 years



y = 0.115x + 4.826
R^2 = 0.989
P value <0.001

The regression analysis was carried out to find the strength of relationship of ulna bone length with body height. The relationship between ulna length and body height was positive for every unit. Body height and ulna length was found to be highly significant. Correlation coefficient between total height and ulna length was found to be statistically significant and positive in female for 23-25 years age group. So here value of t test is strongly significant : P ≤ 0.001

The formulae derived here are valid for the growing age group 20-22 and above. In male the height of ulna increase progressively with advancing age due to increase in body height. But in age group 23-25 to 26-28 ulnar length remains same. It is recommended that similar studies on different age groups should be carried out to complement the results of the present study. Hence, it is possible to determine the height of a person by using the data and formulae derived from the present study fairly accurately within a standard error of estimate, which is acceptable from biological consideration in determining the height.



The formulae derived here are valid for the growing age group 20-22 and above . In female the height of ulna increase progressively with advancing age due to increase in body height . But in age group 23-25 to 26-28 ulnar length remains same. It is recommended that similar studies on different age groups should be carried out to complement the results of the present study. Hence, it is possible to determine the height of a person by using the data and formulae derived from the present study fairly accurately within a standard error of estimate, which is acceptable from biological consideration in determining the height.

DISCUSSION

The simple linear regression equation which has so far been derived can be used for the estimation of the height. The Height is more if the length of Ulna is more. This holds true for the sample size taken. 't' test for regression coefficient was found to be statistically significant. It suggests that a significant contribution of length of Ulna towards height. Two separate formulae were derived:

The average height of adult males within a population is significantly higher than that of adult females.. The results obtained in this study also show the same result.

The result shows that there is Positive Correlation between Stature and Ulna bone length. Simple linear regression equation so far derived can be used for estimation of height. If either of the measurement (Ulna length or Total Height) is known, the other can be calculated. The same parameters were found to be significantly higher ($p<0.001$) in males than females for both group. This fact will be our findings are at par with the findings of the previous researchers. known, the other can be calculated. This fact will be of practical use in Medico Legal investigations and in Anthropometry. Study would be useful for Anthropologist and Forensic Medicine experts..

Various workers had shown significant Correlation between Height and Ulna bone length, other long bones and different parts of the body. Trotter M et al(1958) have stated requirement of different regression equations among different races after studying different races for relationship between lengths of long bones and stature. It is important to note that every race of particular age group and sex should have its own table for estimation of height using various parameters. The regression formulae for estimation of stature from the length of Ulna as- Stature: 88.94 + 3.06(ulna length) ± 4.4 (Standard error).

A study which was done by Lundy JK et al. (1985) discussed the regression equation and the mathematical and the anatomical method of estimating the living stature from the ulna bones in the south African population. , results showed that mean height: 164.32cm,length of Rt.Ulna:27.13cm & of Lt.Ulna:27.01cm.Correlation Coefficient for Rt.Ulna:0.78 & Lt.Ulna:0.68.

The reports of Agnihotri AK et al. (2009) from Mauritius and those of Barbaosa VM et al. (2012) [15] from Portuga lalso found the linear regression model to depict an individual's stature from the percutaneous ulnar length.

regression formula was derived as follows:
For male Stature in cm = Y = 61.8251 + 1.3240 X
For females Stature in cm = Y=58.1732+ 1.3002 X
Where, Y= stature and X = percutaneous ulnar length

CONCLUSION:

The Height is more if the length of ulna is more. This holds true for the sample size taken. 't' test for regression coefficient was found to be statistically significant. It suggests that a significant contribution of length of ulna towards height. Two separate formulae were derived: The result shows that there is positive correlation between stature and ulna bone length. Simple linear regression equation so far derived can be used for estimation of height. If either of the measurement (Ulna length or Total Height) is known, the other can be calculated. This fact will be of practical use in medico legal investigations and in anthropometry. Study would be useful for Anthropologist and Forensic Medicine experts.

With respect to age, sex and racial groups, dimensions and body proportions are widely variable it is highly significant when the body length is increased then the ulna length is also increased with different age groups. The present study has shown the usefulness of ulna length measurement in the estimation of stature amongst aged between 20-29 years belonging to medical student in Rajasthan region. Regression formulae for stature estimation from head length measurements were derived in both males and females. The correlation coefficient between ulna length and stature is **0.33** in males, **0.26** in females and **0.05564** in combined. And P value is P <.001

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