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Estimation of Stature of an Individual from Forearm Length in Adults: An Anthropometric Study

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Abstract: ***Background*: Anthropometry is the study of the measurement of the human body. The present study was used to assess forearm to predict stature of individual based on gender. *Materials and Methods*: In this prospective observational study 600 subjects attending in medical, dental and other college's students of age group 21-25 years in various colleges at Jaipur, India were selected for the study. The measurement of stature, forearm length. *Results*: Mean age of females was found to be 22.82 and mean age of males was found to be 22.96. 160 persons were aged 21 years i.e. 26.6%, 175 persons were aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. In present study most common age group was found to be 22 years and 24 years was the least common age group. Body height (cm) in male and female was observed to be statistically significant, for forearm length, significant statistical difference was observed. *Conclusion*: Our study concludes that a significant difference was observed in height, forearm length in between males and females.***

Keywords: Anthropometry, Forearm length, Stature, identity of individual

1. Introduction

Anthropometry is the conventional device of physical human sciences, gives the logical strategies and the methods for evaluating the different estimations and the perceptions on the living just as the skeleton of man.[1] The word "anthropometry" is derived from the Greek word "anthropo" meaning "human" and the Greek word "metron" meaning "measure" (Ulajaszek, 1994).[2] The field of anthropometry encompasses a variety of human body measurements. Weight, stature (standing height), recumbent length, skinfold thicknesses, circumferences (head, waist, limb, etc.), limb lengths, and breadths (shoulder, wrist, etc.) are examples of anthropometric measures.[3] The historical use of anthropometry has been applied to a wide range of applications including:[4] Paleoanthropology and human evolution, Biological anthropology, Craniometry and craniofacial attributes , Criminology and Forensics, Phrenology, Physiognomy, Personality and mental typology. Anthropometry has uses in the field of medicine, selection of military personnel, industrial purposes, criminal investigations, sports, various scientific analysis and investigation etc. Stature is one of the various parameters of identification for establishing individuality of the person. It is well known that there is a definite relationship between the height of the person and various parts of the body like head length, head breadth, hand and foot length and arm span, forearm length.[5] The present study was conducted:

1) To assess the forearm length and stature of the individual.
2) To predict the stature of an individual by measuring the forearm length using regression analysis.
3) To correlate the forearm length and the stature of the individual.

2. Materials and Methods

In this prospective observational study 600 subjects attending in medical, dental and other college's students of age group 21-25 years in various colleges at Jaipur, India were selected for the study. Out of 600 patients 300 were females and 300 were males. An informed consent was obtained from each of the patients to examine the cases for inclusion in this study. Patients with similar socio-economic status, subject with age group of students ranged from 21 to 25 years, students of various colleges at Jaipur were included in the study. Measurements were taken at fixed time between 2 to 5 p.m. to eliminate the discrepancies due to diurnal variation. Patients with age above 25 and below 21 year, persons with abnormal gigantism and dwarfism were excluded from the study. Time other than between 2 to 5 p.m. excluded.

Calculation Of Sample Size:

- Population size(for finite population correction factor or fpc)(*N*):100000
- Hypothesized% frequency of outcome factor in the population (*p*):50%+/-5
- Confidence limits as% of 100(absolute +/-%)(*d*):5%
- Design effect (for cluster surveys-*DEFF*):1
- Simple size n=[DEFF*NP(1-p)]/[($d^2/Z^2_{1-\alpha/2}$*(N-1)+p*(1-p)]

Sample Size (*n*) for Various Confidence Levels

Confidence Level (%)	Sample Size
95%	383
80%	164
90%	270
97%	469
99%	660
99.9%	1072
99.99%	1492

Data Collection

1) Stature- Standing Height of Individuals in Cm.
2) Forearm Length- was measured with the arm in flexed position from the tip of olecranon process to the point between radius and ulnar tuberosity.

In above methods all the measurements will be done using following materials:-Stature Meter, Vernier calliper, Flexible steel tape. Measurement of stature was measured as vertical distance from vertex to floor. Forearm length was measured from the tip of olecranon process to the point between radius and ulnar tuberosity (with the arm in flexed position). A detailed case history was obtained from subjects. Acomplete physical examination was carried out. The data collected was compiled, tabulated, analyzed and subjectedto statistical tests. Analysis was done using SPSS.

3. Results

Table 1: Gender Distribution

Gender	Number	%
Male	300	50%
Female	300	50%
Total	600	100

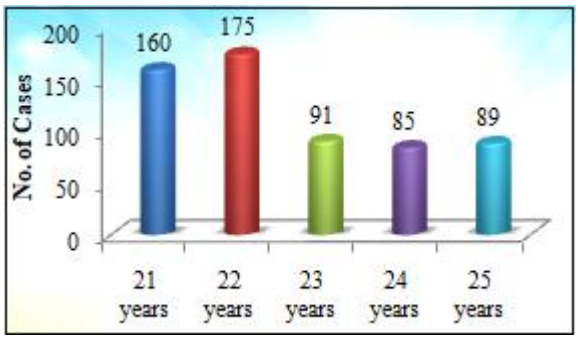
In the present study total participants were 600 in which 300 were males and 300 were females.

Table 2: Demographic Characteristics of the Study Population

Sex	Mean	N	SD	Minimum	Maximum	Median
Female	22.82	300	1.415	21	25	23.00
Male	22.96	300	1.419	21	25	23.00
Total	22.89	600	1.418	21	25	23.00

In present study results showed that of mean age of females was found to be 22.82 and mean age of males was found to be 22.96. In our study age group selected was 21 to 25 years where 21 were the minimum age found in our study and 25 being the maximum.

In present study result showed that of the 600 samples 160 persons were aged 21 years i.e. 26.6%, 175 persons were aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. In present study most common age group was found to be 22 years and 24 years was the least common age group.



Graph 1: Age Distribution

Table 3: Comparison for Height, fore arm Length (FAL in Cm) Among Male and Female

Sex		Total Height	Forearm Length
Female	Mean	157.19	22.78
	N	300	300
	Std. Deviation	1.108	1.099
	Minimum	155.16	21.11
	Maximum	159.51	26.88
Male	Mean	169.41	23.78
	N	300	300
	Std. Deviation	.949	.849
	Minimum	167.21	22.68
	Maximum	170.65	26.88
t test		140.216	17.535
p value		<0.001*	<0.001*
Total	Mean	163.30	23.28
	N	600	600
	Std. Deviation	6.204	1.103
	Minimum	155.16	21.11
	Maximum	170.65	26.88

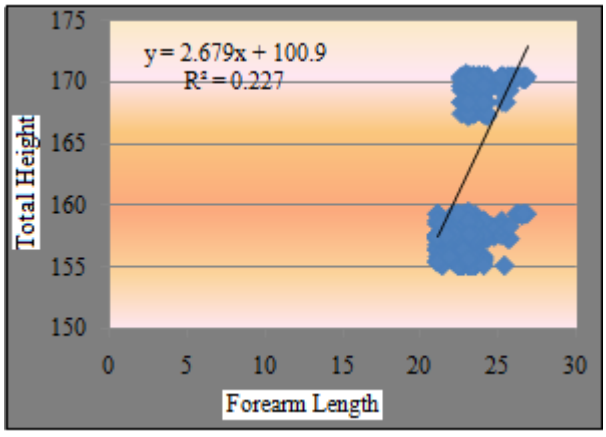
*: statistically significant

Body height (cm) in male and female was observed to be statistically significant [Male 169.41 (SD: 0.949) and female 157.19 (SD: 1.108)], forforearm length, significant statistical difference was observed [Female 22.78 (SD: 1.099) and Male 23.78 (SD: 0.85)].

Table 4: Analysis with derivation of regression equation of forearm length

Sex	b	r	R^2	a	Regression equation
Male	0.234	0.210	0.044	163.83	y = 0.234x + 163.83
Female	0.160	0.159	0.025	153.53	y = 0.160x + 153.53
Total	2.679	0.476	0.227	100.92	y = 2.679x + 100.92

b – regression coefficient, r – correlation coefficient, a – intercept, y = stature(cm),
x = forearm length



Graph 2: Pearson Correlation Between forearm Length and Body Height in Both Male & Female

4. Discussion

Bodily proportions and absolute dimensions vary widely with respect to age, sex, within racial groups and between racial groups. In spite of this variation, height has been estimated from measuring various other parameters of the body by refining formulae. The values have become increasingly important in the identification of persons.

In present study 600 medical, dental and other college students, 300 male and 300 female was undertaken to evaluate the correlation of body height and forearm length. In our study mean age of females was found to be 22.82 and mean age of males was found to be 22.96. In our study age group selected was 21 to 25 years where 21 were the minimum age found in our study and 25 being the maximum. In present study result showed that of the 600 samples 160 patients were aged 21 years i.e. 26.6%, 175 patients were aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. in present study most common age group was found to be 22 years and 24 years was the least common age group.

In our study mean total height of male is 169.41, and standard deviation is 0.949 and mean total height of female is 157.19, and standard deviation is 1.108.In our study mean forearm length of male is 23.78, and standard deviation is 0.849 and mean forearm length of female is 22.78, and standard deviation is 1.099.In our study for forearm length significant statistical difference was observed (p value <0.001*).In our study correlation coefficient (r) for male is 0.210, female is 0.159, and both male & female is 0.476.

In our study we derived regression equation for male is Y= 0.234X + 163.83, for female is Y= 0.160X + 153.53 and both male & female is Y= 2.679X + 100.92.

[6]Bikramjeet Singh et al in their study included total of 400 (200 males and 200 females) healthy, asymptomatic subjects in age group of 17- 25 years belonging to various regions of North India. Mean height +/- std. dev. for Males 175.98 ± 6.76, Females (n= 200) 160.91 ± 5.75 and Mean forearm length +/- std. dev. For Males is 27.39± 2.237 & Female is 26.56± 15.018. 'r' value for male 0. 601 & female is 0.531.regression equation. In males: S= 126.28 + 1.815 (Forearm length) & In females: S= 160.37 + 0.020 (Forearm length).

[7]A. Sandhya in their study included 300 subjects were randomly selected for this study , whose Age was limited between 18-22. Study were done in Tamilnadu,Chennai. the regression equation of males was found to be Height of individual= -253.02+17.5(x) And females Height of individual= 32.11+5.74(x). Height range for both male & female was 150-154.5, mean forearm length for male was 23.4 and female was 21.45.

[8]Biswa Bhusan Mohanty et al in their study included 300 students (M = 206, F = 94) aged 18-25 years were studied at SCB Medical College, Cuttack. Mean Height range for male 155-160 +/-0.247, and female was 155-160 +/- 0.736. Mean forearm length for male 23.6 +/-0.247, and female was 21.82 +/- 0.736. Regression equation for male was (Y) = -254.03+17.45x & female was (Y) = 32.16 + 5.66x.

5. Conclusion

With the limits of current study we conclude that the usefulness of forearm length measurement in the estimation of stature amongst medical students age b/w 21 -25 years belonging to Jaipur Rajasthan. Regression formulae for stature estimation from forearm length measurements were derived in both malesand females. A significant difference was observed in height, forearm length in between males and females.

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