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AN EXAMINATION OF RELATIONSHIP BETWEEN ESTIMATION OF FOREARM LENGTH FROM DIFFERENT PARAMETERS

Anatomy

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ABSTRACT

Background : An examination of relationship between estimation of forearm length from different parameters. Estimation of stature has a significant importance in the field of forensic medicine and anthropometry. Anthropometry is a series of systematized measuring techniques that express quantitatively the dimensions of human body and skeleton. The purpose of this study was to estimate of forearm length from different parameters . **Materials and Methods:** The data was collected by taking measurements of 500 students between age group of 18 to 23. Length of forearm was measured as the distance between head of radius and styloid process of radius of the same side with the subject in anatomical position. Both the lengths of right and left forearms were measured. First segment of anthropometer rod was used. **Results :** Ratio of arm-length to height is significantly higher in males of age 18, 19 and 21 than that of females of the same group. In age groups (20 and 22) the difference between ratios is not significant statistically. In males and females both, the correlation coefficient 'r' is statistically significant for majority of age groups. (p < 0.01). This indicates that there exists positive correlation between two variables, i.e. forearm length and height and length can be estimated from height and arm-length. **Conclusion :** Regression equations derived for height of individuals can be applied to calculate height and then body surface area in patients of burns. Correlation between various parameters can help in medico legal cases for identification of body parts as well as for identification in war casualties. This study can help to provide database for biometrics.

KEYWORDS

Introduction : Estimation of stature has a significant importance in the field of forensic medicine and anthropometry. Anthropometry is a series of systematized measuring techniques that express quantitatively the dimensions of human body and skeleton.1 The ultimate aim of using anthropometry in forensic science is to help the law enforcement agencies in achieving "personal identity" in case of unknown human remains.2 Establishing the identity of an individual from mutilated, decomposed, and amputated body fragments has become important in recent times, due to natural disasters (such as earthquakes, tsunamis, cyclones, and floods) and man-made disasters (such as terror attacks, bomb blasts, wars, and plane crashes). It is important for both legal and humanitarian reasons. [3]

Human beings are considered to be bilaterally symmetrical. However there may be asymmetry in the lengths of arms, forearms, hands, and feet irrespective of sex or handedness. Paul Topinard [5] suggested series of anthropometrical measurements. However international consensus on measurements of human being was reached in 1912. The German congress in 1912 approved International agreement for unification of measurements on living subjects.

The ulna is a long bone on medial side of forearm. Proximally it has an olecranon process, and at its distal end is a styloid process. The whole length of subcutaneous border of ulna is palpable down up to the styloid process.6 The length of ulna has been shown to be a reliable and precise means in predicting stature of an individual.

Combining with physiologists, psychologists and engineers, anthropologists have helped in designing spaceships for convenience of astronauts. They have made valuable contribution in designing aircrafts, uniforms, chairs and other specialized equipment for defence-personnel.Anthropometrical surveys provide norms about physique of national population.

Estimates for some physiological functions like basal metabolism, vital capacity, and nutritional requirements can be estimated by means of anthropometrical data. They help to indicate the need for medical and public health programs.

In 1964, Athawale [7] carried out a study on forearm bones. His study was based on 100 Maharashtrian male adults aged between 25 and 30

years. In 2005, Devi and Nath 8 formulated multiplication factors for stature estimation from upper extremity among male and female Tangkhul Nagas of Manipur. The purpose of this study was to estimate of forearm length from different parameters

Materials and Methods

The data was collected by taking measurements of 500 students between age group of 18 to 23. The criterion for selecting subjects was normal healthy adults (males and females) between age group of 18 to 23 years without any past history of major trauma or illness.

Following measurements were taken: Length of right arm and left arm. Length of right forearm and left forearm. Height of an individual. Following instruments were used to take above measurements: Standard height measuring instrument like anthropometer rod, rod compass,marker pens and ruler were used.

Following procedure was followed while taking measurements: Same instruments were used for all students. All students were examined between 2-30 p.m. and 4-30 p.m. to avoid diurnal variations. Measurements were taken by the same person to avoid personal errors. Length of forearm was measured as the distance between head of radius and styloid process of radius of the same side with the subject in anatomical position. Both the lengths of right and left forearms were measured. First segment of anthropometer rod was used.

Results :
Table 1: Ratio Of Forearm Length To Height

		Males			Females		
		Number	Mean	Sd	Number	Mean	Sd
Age Group	18 - < 19	43	.164491	.0068766	113	.158490	.0107924
	19 - < 20	68	.162060	.0109744	55	.158411	.0080090
	20 - < 21	84	.171899	.0935671	55	.157542	.0096806
	21 - < 22	43	.162478	.0089056	17	.153655	.0113957
	22 - < 23	6	.164133	.0079952	16	.158677	.0073296

Table 2: Percentage ratio of Forearm Length to Height

Age Group	Percentage Ratio			
	Males	Females	't' value	'p' value
18 - < 19	16.4491	15.8490	3.390	0.001 HS
19 - < 20	16.2060	15.8411	2.061	0.041 S
20 - < 21	17.1899	15.7542	1.122	0.264 NS
21 - < 22	16.2478	15.3655	3.189	0.002 HS
22 - < 23	16.4133	15.8677	1.519	0.144NS

Ratio of arm-length to height is significantly higher in males of age 18, 19 and 21 than that of females of the same age group. In age groups (20 and 22) the difference between ratios is not significant statistically.

In males and females both, the correlation coefficient 'r' is statistically significant for majority of age groups. (p < 0.01). This indicates that there exists positive correlation between two variables, i.e. forearm length and height. So, linear regression coefficients were found out, which again were statistically highly significant; p < 0.01.

 However in the age group of 20-<21of males, 21 - < 22 of females and 22 - <23 of males & females; the correlation coefficient and regression coefficient were not statistically significant. So the regression equation will not give us a good fit for these age groups. This indicates that, forearm length can be estimated from height.

In males and females both, the correlation coefficient 'r' is statistically significant for almost all age groups. (p < 0.01). This indicates that there exists positive correlation between two variables, i.e. forearm length and arm-length. So, linear regression coefficients were found out, which again were statistically highly significant; p < 0.01. Only in the age group 22 - <23 of males; the correlation coefficient and regression coefficient were not statistically significant. So the regression equation will not give us a good fit for these age groups.This indicates that, forearm length can be estimated from arm-length.

Discussion:
To assess the height of an individual from measurements of different parts of body has always been of particular interest to the anthropologists for a long time. In forensic medicine also the estimation of height from the hand length forms an important piece of evidence in court of law. Present study is undertaken to find out correlation between height and arm length, forearm length, among age group 18 to 23, males as well as females. Anthropological studies were carried out earlier to find correlation between hand lengths and foot lengths to height.

Majority studies have correlated only one parameter like foot lengths with height or length of clavicle with height. So the data available for comparison is restricted to few parameters. Hence present study is undertaken to find out correlation of forearm length, with height. Attempt is made to find correlation of these three parameters with each other.

Following are the results of previous studies:
Athawale 7 (1963) derived a regression equation between height of an individual and length of forearm bones. He had done study of 100 male Maharashtrian adults. He used X rays to calculate length of bone.

Musgrave and Harneja8 (1978) worked out height from lengths of various metacarpals amongst British adults. They found significant degree of association in both sexes (Male: r =0.58 to 0.67, female r=0.49 to 0.71). They also obtained a successful prediction of height in 9 out of 10 subjects by using metacarpal measurements.

Anitha Oommen3 et al (2005) found correlation between hand length and foot length. The result showed highly significant correlation, p < 0.01) between hand length and foot length on both sides of both sexes. The differences in various studies occur due to difference in races, different ethnic origins and difference in level of nutrition.   10,11,12 Forearm length showed significant correlation with arm length and height. Regression equations derived can be of help in artificial limb centres for construction of prosthesis required in cases of amputations following gangrene, trauma, frostbite etc.The different formulae derived can be useful for corrective surgeries for leprosy patients.Regression equations derived for height of individuals can be applied to calculate height and then body surface area in patients of burns. Correlation between various parameters can help in medico legal cases for identification of body parts as well as for identification in war casualties.This study can help to provide database for biometrics

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