Estimating Stature From Arm Span Measurement in Gujarat Region.

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Abstract :

Introduction : In some situations, it is not possible to measure height of a person because of deformities of the limbs, in person who have undergone amputations or in cadavers where only parts of deceased subject are available. In such cases, stature has to be estimated from other body parameters. Previous studies show that stature can be measured effectively from various body parameters and length of long bones also. Estimation of stature from the arm span is found to be one of the most reliable methods. However, the relation between arm span and height was found to vary from race to race. **Material and method :** This cross sectional study was conducted on 150 M.B.B.S students in one of the medical college of Ahmedabad, India during August 2013 to November 2013. Out of 150, 72 were boys and 78 were girls. Analysis was done by using computer based program (SPSS). Prediction equations were developed with study group. **Results :** Statistical analysis of the data obtained shows strong correlation between height and arm span. This was found to be 0.9313 in total subjects, 0.8061 in males and 0.8661 in females. Regression equations were derived and verified on subjects with known parameters using standard procedures. **Conclusion :** Arm span is one of the most reliable body parameter for estimating the height of an individual with high accuracy.

Key Words : Stature, arm span, correlation

Introduction :

Measurement of body size such as height and weight are required for assessment of growth and nutritional status of person, determination of basic energy requirements, standardization of measures for physical capacity, for adjusting drug dosage and for identifying an unknown cadaver. However, in some situations it is not possible to measure the stature of a person because of deformities of the limbs, in person who have undergone amputations or in unknown cadavers where lower limb (s) and / or trunk is mutated / absent. In such cases, stature has to be estimated using other body parameters. These estimations are also of prime importance in predicting the age-related loss in stature, identifying individuals with disproportionate growth abnormalities, skeletal dysplasia, medico-legal cases or height loss during surgical procedures on the spine. [1] These measurements also have found application in normalizing pulmonary function in scoliosis. [2]

Previous studies show that height can be estimated effectively from various body parameters. Among all body

parameters, correlation between stature [3, 4, 5] and the arm span was found to be the most reliable. However the relation between arm span and stature is found to vary from race to race. [6, 7] Even though several studies of this nature are available on western populations, very limited data is available on Indian subjects. [8]

Methodology :

This cross sectional study was conducted on 150 M.B.B.S students in one of the medical college of Ahmedabad, India during August 2013 to November 2013. Out of 150, 72 were boys and 78 were girls. Prior to taking measurement of student, necessary permission was taken from Institutional authorities. The stature and arm span were measured in all the subjects. Stature was measured with the subject standing on their heels together and back as straight as possible so that heels, buttocks, shoulders and the head touched the wall. The arms were by the sides of trunk with the palms facing the thighs. Students were asked to take a deep breath and hold it, a measuring steel scale was placed against the head and wall to determine maximum height on the wall, and this was marked. The students were then told to breathe out and to step away from the wall. The stature was then measured from the floor to the mark on the wall with flexible steel tape which represents the stature in centimeters to the nearest 0.1 centimeters. Arm span was measured with a flexible steel tape from the tip of the middle finger of one hand to the tip of the middle finger of the other hand with the individual standing with their back to the wall with both arms abducted to 90°, elbows and wrists extended and the palms facing directly forward.

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Readings were taken to the nearest 0.1 cm. Measurements was taken twice in each subject. When the two measurements for each parameter fell within 0.4 cm, their average was taken as the best estimate for the true value. When the two initial measures did not satisfy the 0.4 cm criterion, two additional determinations were made and the mean of the closest records was used as the best estimate.

The mean values of arm span and height were calculated separately for boys and girls. Statistical analysis included descriptive statistics, single and multiple linear regression, paired t test and analysis of covariance. Prediction equations were developed with study group. For cross-validation of the equations, actual values of height were compared with predicted values using standard procedure. [9, 10]

Results :

The observations were done on 72 male and 78 female, total 150 students. Table 1 shows the mean and standard deviations of stature and arm span in total subjects.

Table 1 : Descriptive statistics for Total students

Characteristic	N	Range	Minimum	Maximum	Mean	SD
Stature	150	46.80	144.20	191.00	168.2340	9.38648
Arm span	150	57.60	143.40	201.00	169.9253	10.46118

Table 2 : Descriptive statistics for Male and Female

Variable	N	Range	Minimum	Maximum	Mean	SD
Stature (Male)	72	32.20	158.80	191.00	175.9472	5.91746
Arm span(Male)	72	38.20	162.80	201.00	178.1764	7.07552
Stature (Female)	78	30.30	144.20	174.50	161.1141	5.62002
Arm span(Female)	78	39.60	143.40	183.00	162.3090	6.57137

Table 2 shows the mean and standard deviation of stature and arm span in male and female separately. The linear regression analysis of the obtained data has provided regression analysis and correlation coefficient for estimation of stature as shown in Table 3 and Table 4.

Table 3 : Correlation between Stature and Arm span

Subject	Correlation coefficient(r)	95 % confidence interval for r	Significance p-value
Total	0.9313	0.9063 to 0.9498	<0.0001
Male	0.8061	0.7402 to 0.8567	<0.0001
Female	0.8661	0.8002 to 0.9141	<0.0001

Table 4 : Result of linear regression analysis in all subjects, males and females.

Subject	Regression Coefficient	Standard Error	T value	P value
Total	26.08897	4.57862	5.6980	<0.0001
Male	159.50055	0.72873	218.8744	<0.0001
Female	40.60577	7.90898	5.1341	<0.0001

From the analysis of the data, it can also be said that stature can be predicted from arm span with fairly good accuracy as they show significant correlation.

Regression equations derived from analysis of data are as following:

Total: $Ht = 26.0890 + (0.8365) As$

Male: $St = 159.5005 + (0.0934) As$

Female: $St = 40.6058 + (0.7425) As$

St – Stature in centimeters, As – Arm span in centimeters

Discussion :

Estimation of stature using various physical measurements has been attempted by many authors. Chumlea [11] estimated stature from knee height, while Mitchel [4] correlated arm length with stature. The one variable that proved to be consistently reliable in estimating stature was the arm span. Steele and Chenier, [7] in a study on black and white women in the age group 35–89, reported correlations of arm span and stature of 0.852 and 0.903 for black and white women respectively. In a similar study of blacks of both sexes in the age group 22–49, a

correlation of 0.87 was observed between arm span and stature. These results are similar to the correlation obtained in the present study (r=0.93).In Steel and Chenier's study, arm span was nearly8.3 cm more than stature for blacks, whereas for whites, this difference was only 3.3 cm. [7] In the present study, we too noted that the arm span is more than stature, which is similar to that noted in the white population. Even though these relations are similar, the estimation equations which we obtained are clearly different from those of other populations. This emphasizes the need for developing separate models for each population on account of racial and ethnic differences in anthropometric measurements.

In Korean children, [12] arm span to stature ratio is almost equal to 1.0 in the age groups 1 to 8 years. The arm span exceeds height at the age of 9 years and increases faster than height during puberty in both boys and girls. Due to the scarcity of published data on arm span in African children, it is not possible to compare. It has been demonstrated that correlation coefficient between stature and arm span measurements for adult Malawian males was 0.871 and for females was 0.8159. [13] In the present study correlation coefficient between arm span and stature male was 0.8061 and for female was 0.8661. 0.989correlation for white Canadians, [14] 0.903 correlation for white Americans[15] and 0.903 correlation for African Americans [15] has been reported earlier. Strong and significant correlation between the two anthropometric parameters indicated that stature can be predicted fairly accurately from arm span measurements.

Conclusion :

Arm span is one of the most reliable body parameter for obtaining the stature of an individual. It is useful in obtaining age-related loss in stature and in identifying individuals with disproportionate growth abnormalities. It also an important parameter medico-legally, where determination of height of subject is a major step in identification of a deceased subject when only parts of the body are available.

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