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Original Research Article

The Use of Arm Span as a Predictor of Height in Young Adults: A Cross-Sectional Study

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ABSTRACT

Background: Estimation of stature is based on a principle that every body part bears more or less a constant relationship with height of an individual. Various studies in the past have utilized various body parts such as upper and lower extremities including hand and foot dimensions for the estimation of stature. Our study was intended to find out the correlation between height and arm span.
Aim: To find out correlation and formulate a linear regression equation in order to find out height from arm span.
Materials and Methods: The present study was conducted on a sample of 200 medical students (100 males and 100 females) within the age group of 20-30 years, studying in Government Medical College-Jammu. Only those students were taken who belong to J&K state and have no obvious deformity that can affect the measurements.
Results: Measurements were analyzed statistically to establish the relationship between arm span and stature. The study shows that the arm span bears a statistically significant $p<0.001$ correlation with stature [$r=0.875$ in males and $r=0.804$ in females] and can be an important tool for stature estimation. Linear regression equations were formulated to derive the stature from arm span in both males and females.
Conclusion: The mean stature and arm span of male were more than female with statistical significance. Stature can be accurately estimated from arm span using simple regression equation separately for males and females.

Key Words: Arm span, Correlation, Predictor, Height, Regression.

INTRODUCTION

The stature or standing height is defined as the distance between the head vertex and the standing surface. It is considered to be one of the most important indications of body size. [1]

Body height (BH) is anatomically complex and includes the dimensions of legs, pelvis, vertebral column and skull. The contribution of each of these to the total varies in different individuals and also in different populations. Population morphology based differences exist in the skeleton and these have changed over time. [2]

Height estimation is required for the assessment of growth of children, calculation of nutritional indices of children and adults for prediction and standardization of physiological parameters such as lung volumes, muscle strength, glomerular filtration, metabolic rate and for adjustment of drug dosage in patients. [3]

Besides this, stature provides an insight into various other features of a population including nutrition, health and genetics; geographical location, environment and climatic condition. Stature is also considered as one of the parameters of personal identification. It is an inherent characteristic, the estimation of which is considered to be an important assessment in the identification of unknown human remains. [4]

Nevertheless, there are some limitations for obtaining this crucial information in special clinical situations such as immobilized patients, elderly people, emergency and critically ill patients. Of these situations, visual estimation is one of the most common methods to guess the patient height. [5]

Several studies have reported the effectiveness of using various body parameters in predicting body height and the arm span was found to be the most reliable. [6] However the association of arm span and height was found to vary from race to race. [7] To our knowledge no such study has been reported for the J&K population.

The aim of the present study was to find out correlation between stature and the arm span of the J&K population.

MATERIALS AND METHODS

The present study was conducted on a sample of apparently healthy, 200 medical students (100 males and 100 females) within the age group of 20-30 years from Government Medical College, Jammu and Indira Gandhi Dental College, Jammu. The study was conducted in a separate post-graduate room. All measurements were taken at a fixed time of day to eliminate diurnal variation. The instruments used were Calibrated steel tape for measuring arm span and Stadiometer for the measurement of stature.

Stature:

It is the vertical distance between the highest point on the vertex and platform of stadiometer. The subject was made to stand erect, bare foot on a level platform against the stadiometer bar with his/her back and hips touching the bar, the feet were close to each other and the heals touching the bar, arms hanging by the side. The head of the subject was resting without any strain in the eye-ear plane or Frankfurt's plane i.e., trig one and the infraorbital margin of both the sides lie in the same plane.

Arm Span:

The arm span is the anthropometric measurement of the length from the tip of the middle fingers of the left and right hands when raised parallel to the ground at shoulder height at a one-hundred eighty degree angle. It was measured using a calibrated steel tape to the nearest 0.1 centimeters in bare feet on a level concrete floor with their upper backs, buttocks and heels against the wall providing support.

RESULTS

Table 1: Showing distribution of stature (in cm) among study population.

	Males	Females	Total
Number	100	100	200
Mean	172.77	157.92	165.35
Std. Error of Mean	0.638	0.549	0.673
Std. Deviation	6.384	5.495	9.524
Minimum	157.50	147.00	147.00
Maximum	188.50	175.00	188.50

Table 2: Showing distribution of arm span (in cm) among study population.

	Males	Females	Total
Number	100	100	200
Mean	174.34	157.14	165.74
Std. Error of Mean	0.678	0.590	0.756
Std. Deviation	6.785	5.905	10.704
Minimum	159.00	145.00	145.00
Maximum	189.00	179.00	189.50

The results of the present study were formulated by using SPSS-19 software and excel program. The results were compiled in the form of Tables (1,2,3 and 4) and Figures (1 and 2). Regression equations were formulated separately for males and females. The table 3 also shows the power of prediction or coefficient of determination (r^2), which is a measure of how well the variation in one variable explains the variation of the other.

Table 3:- Linear regression equation for estimating height from Arm Span in males and females.

Linear Regression Equations in Males		Linear Regression Equations in Females	
Stature = Constant + Regression Coefficient (Dimension) ± Standard Error of Estimate	**Coefficient of Determination (r^2)**	**Stature = Constant + Regression Coefficient (Dimension) ± Standard Error of Estimate**	**Coefficient of Determination (r^2)**
Stature = 30.14 + 0.818(Arm Span) ± 3.083	0.766	Stature = 41.25 + 0.74(Arm Span) ± 3.25	0.646

Table 4:- Table depicting the correlation coefficient and 2-tailed significance in males and females.

Pearsons Correlation Coefficient between Stature and Arm Span in males (r)	Significance 2-tailed (p-value)	Pearsons Correlation Coefficient between Stature and Arm Span in females (r)	Significance 2-tailed (p-value)
0.875	0.000*	0.804	0.000*

***correlation is significant at 0.01 level (2-tailed)**

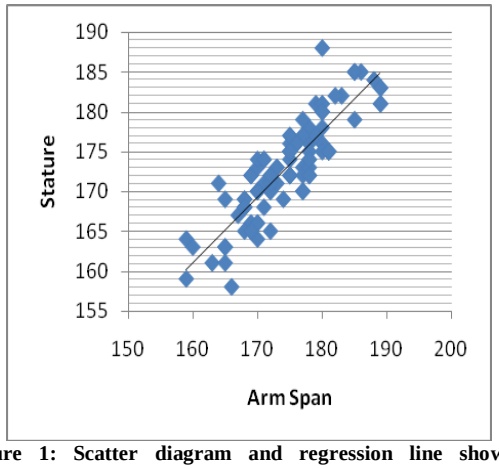

Figure 1: Scatter diagram and regression line showing relationship between stature and arm span in males.

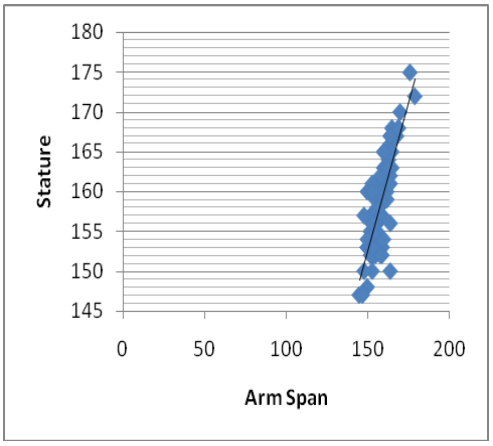

Figure 2: Scatter diagram and regression line showing relationship between stature and arm span in females.

DISCUSSION

Over many decades, a close relationship between stature and dimensions of various body segments are reported and the results are frequently used in the medico-legal investigations. The interest in the estimation of stature for identification already existed in antiquity. The skeleton is one part of the body that resists all environmental insult for maximum time and thus, can be a valuable tool in identification. Stature is a parameter that can be estimated even in mutilated and dismembered bodies, as well as in fragmentary human remains. [8]

In the present study, a total of 200 (100 males and 100 females) medical students between the age of 20 - 30 years were enrolled. Since maximum height of an individual is attained between 20 and 24 years, these individuals were selected for the study.

Recently published studies [9] also enrolled subjects of same age group. A study from Thailand [10] has reported the decrease in the correlation between Arm span and stature with increasing age, as stature decreases with age and Arm span doesn't.

In this study it was observed that males have greater stature than females. This can be explained by genetic constitution of males. Age of puberty being 2 years later in males as compared to females give them additional time for growth. This suggests that the formula for one sex cannot be applied to estimate stature for other sex. The stature found by different authors [11,12,13] in India in different region or state is different than the present study. Author [13] from Chandigarh found mean (SD) stature of male was 168.2 (±6.5) and of female was 155 (±5.2) and this can be explained by different genetic constitution, environmental factors and nutrition in different population groups.

Mean arm span in male was more than female, and it was statistically significant ($P < 0.001$). So, the same regression equation can't be used in both sexes to estimate stature. We formulate regression equation for estimation of stature separately for males

and females. We found a correlation coefficient (r) of 0.875 in male and 0.804 in female, which shows strong correlation between stature and arm span and it was similar to published studies. [11-14] Published study from Iran [15] reported that height estimated from arm span performs much better than arm span, to predict pulmonary function parameters. So, these regression equations can be used.

We contend that arm span is the most reliable indirect physical measurement for estimating height. Since the estimating equation varies from race to race, similar studies for different races and regions are recommended.

CONCLUSION

The present study was taken up with the aim of finding out the correlation between arm span with stature and also to derive linear regression equation for the estimation of stature from the arm span. The mean stature of males was 172.77 (±6.38) cm, and it was more than female 157.92 (±5.49) cm with statistical significance. Similarly, arm span of male was more than female. We found correlation coefficient (r) of 0.875 in male and 0.804 in female using simple regression, which shows strong correlation between stature and arm span. Stature can be accurately estimated from arm span using simple regression equation.

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