

Relationship between Arm Span and Stature in Adolescent Age Groups: A Cross Sectional Study

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Abstract:

Background and Objectives: A person's height may not always be able to be measured due to limb malformations, amputations, or cadavers in which just a portion of the deceased individual is still present. One of the most accurate ways for estimating tall is to measure arm span.

Material and Method: This cross sectional study was conducted on 150 students of adolescent age groups from aged 10-19 years in one of the school of Datia during August 2023 to January 2024. Out of 150, 78 were boys and 72 were girls. Analysis was done by using computer based program (SPSS).

Results: Statistical analysis of the data obtained shows strong correlation between height and arm span. This was found to be 0.91 in total subjects, 0.82 in males and 0.88 in females. Regression equations were derived and verified on subjects with known parameters using standard procedures.

Conclusion: One of the best bodily measurements for accurately determining a person's height is arm span.

Keywords: Stature, Arm span, adolescent, limb deformity.

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Introduction

Measurements of body size, such as height and weight, are necessary for determining a person's fundamental energy needs, assessing growth and nutritional condition, standardizing physical capability measurements, modifying medication dosage, and identifying an unidentified corpse. [1,2] But in other cases—such as those involving limb deformities, amputations, or unidentified cadavers with altered or absent lower limbs or a trunk—it is impossible to gauge a person's stature. In these situations, different bodily measures must be used to estimate stature [3,4,5]. These estimates play a critical role in the prediction of age-related stature loss, in the identification of patients with skeletal dysplasia, disproportionate growth abnormalities, medico-legal issues, or height loss following spine surgery. [6] These measurements also have found application in normalizing pulmonary function in scoliosis. However, the relation between arm span and stature is found to vary from race to race. Even though several studies of this nature are available on western populations, this type of study was not done in the areas of Datia so this study was planned.

Materials and Methods

It was a cross sectional study was conducted on 150 students of age group 10-19 years in one of the

school of Datia, India during August 2023 to January 2024. 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

The individual was measured while standing with their heels together and their back as straight as possible, allowing their head, shoulders, and buttocks to touch the wall. With the palms toward the thighs, the arms were by the sides of the trunk. Pupils were instructed to inhale deeply and hold it while a steel measuring scale was positioned against the wall and the head to find the highest point on the wall, which was then noted. Next, using flexible steel tape that measures stature in centimeters to the nearest 0.1 centimeter, the stature was measured from the floor to the mark on the wall.

Arm Span

The subject stood with their back to the wall, both arms abducted to a 90-degree angle, wrists and elbows extended, and palms facing straight forward. The measurement was taken using a flexible steel

tape, measuring from the tip of one hand to the tip of the other.

Data were recorded to the closest 0.1 centimeter. Every individual underwent two measurements. The best estimate for the true value was determined by taking the average of the two measurements for each parameter where the differences fell within 0.4 cm. The mean of the closest records was taken as the best estimate after two further determinations were performed when the first two measures failed to meet the 0.4 cm requirement.

The mean values of arm span and height were calculated separately for boys and girls.

Statistical Analysis

Data analysis was conducted using SPSS Statistics version 22 (IBM Corporation, Armonk, New York). The data were analyzed using descriptive statistics. Categorical variables were expressed as numbers and percentages. Continuous variables were expressed as mean \pm standard deviation if normally distributed and median with range if skewed. Multiple linear regression analysis was used to determine variables. Prediction equations were developed with study group. A p-value of <0.05 is considered statistically significant.

Results-

Table 1: Descriptive Statistics for all Study Participants

Characteristic	N	Range	Minimum	Maximum	Mean	SD	p-value
Stature	150	46.52	144.20	193.00	168.13	9.24	0.01
Arm span	150	57.30	143.20	204.00	169.42	10.31	

The stature and arm span mean and standard deviations for all subjects (N=150) are displayed in Table 1. Arm span ranged from 57.30 to 169.42 \pm 10.31, with a statistically significant mean ($p<0.05$) observed. Thus, the most trustworthy indicator is arm span.

Table 2: Stature and Arm Length Comparison between Boys and Girls

Variable	N	Range	Minimum	Maximum	Mean	SD	p-value
Stature (Boys)	78	32.21	156.70	191.00	175	5.81	0.01
Arm span(Boys)	78	38.22	161.70	202.00	178	7.17	0.01
Stature (Girls)	72	30.27	143.40	175.50	161	5.51	0.01
Arm span(Girls)	72	39.24	142.60	183.00	162	6.37	0.01

Table 2 presents the mean comparison stature and arm span between boys and girls. It is evident that boys have a greater arm spread and stature than girls. While there may be a few outliers, overall the results were significant and acceptable.

Table 3: Correlation between Arm Span and Stature

Subject	Correlation coefficient(r)	5 % confidence interval	p-value
Total	0.91	0.906 to 0.949	0.01
Boys	0.82	0.740 to 0.856	0.01
Girls	0.88	0.800 to 0.914	0.01

Table 3 shows a significant link between stature and arm span, however in girls compared to boys, the relationship was stronger. This demonstrates the arm span's validity as a crucial indication. Because of the strong link between arm spread and stature, it is also possible to infer this information from the data analysis.

Table 4: Regression Analysis between the Participants

Subject	Regression Coefficient	SE	T value	P value
Total	26.21	4.42	5.54	0.01
Boys	159.42	0.60	218.71	0.01
Girls	40.53	7.81	5.10	0.01

As per table 4 linear regression analysis of the obtained data has provided a significant prediction of stature and arm span. Regression equations derived from analysis of data are as following:

Total: $Ht = 26.21 + (0.83) As$

Male: $St = 159.42 + (0.09) As$

Female: $St = 40.53 + (0.74) As$

Ht- Height, St – Stature in centimeters, As – Arm span in centimeters

Discussion

The measure of stature can be determined in both dismembered and maimed bodies as well as in

fragmentary remains. It can also be used to estimate stature in living persons in cases where deformities make it impossible to measure stature. Numerous authors have attempted to estimate stature using different physical measurements. Mitchell⁴ found a correlation between arm length and stature, another few studies assessed stature based on knee height. [7,8] The arm span was the only factor that consistently showed promise in determining size. In a research on white and black women aged 35 to 89, found that the correlations between black and white women's stature and arm span were, respectively, 0.903 and 0.852.7.

Males are taller than females, as we have seen. Male genetic makeup provides an explanation for this. Males have an extra year to grow since they reach puberty two years later than girls. This implies that one sex's formula cannot be used to estimate the stature of another sex. The current study differs from the stature discovered by many authors in various states or regions of India. [9,10] The average (SD) stature of the male and female populations, according to the author, was 168.2 (6.5) and 155 (5.2), respectively. These differences can be attributed to variations in genetic makeup, environmental influences, and dietary habits. [11]

It has been shown that there is a 0.871 correlation coefficient for adult male Malawian stature and a 0.8159 correlation value for adult female Malawian arm span measurements. The correlation coefficient between stature and arm span for boys in the current study was 0.80, while for females it was 0.86. Previous studies have indicated correlations of 0.989 for white Canadians, 0.903 for white Americans, and 0.903 for African Americans. [12,13,14] The two anthropometric characteristics showed a strong and substantial association, suggesting that arm span measurements can be used to reasonably reliably predict stature.

Conclusion

One of the best physical characteristics to use to determine a person's stature is arm span. It is helpful in determining age-related height loss and in locating people with aberrant growth patterns that are disproportionate. It's also a crucial parameter from a medical and legal standpoint, as figuring out a subject's height is crucial for identifying a deceased person when only a portion of their body is available.

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