

Stature and Arm Span Correlation among adults in Southern Rajasthan: A Prospective Study**Kalpna Sharma¹, Runjhun Vijayvergia², Kavita G. Bodar³, Ram Prakash Saini⁴**¹Assistant Professor Department of Anatomy Pacific Institute of Medical Sciences, Umarda, Udaipur²Assistant Professor, Department of Anatomy, Mahatma Gandhi Medical college, Jaipur³Assistant Professor, Dept. of Community Medicine, Pacific Institute of Medical Sciences, Umarda, Udaipur⁴Demonstrator, Department of Anatomy, Pacific Institute of Medical Sciences, Umarda, Udaipur

Received: 15-08-2024 / Revised: 11-09-2024 / Accepted: 03-10-2024

Corresponding Author: Ram Prakash Saini

Conflict of interest: Nil

Abstract:**Background:** Stature is the qualitative and quantitative measurement of a personality. The purpose of this present study is to estimate the correlation of stature with arm span and to derive regression formulae for calculating the stature from arm span in adult males and Females of Southern Rajasthan population.**Materials and Methods:** This research was done on 400 adult human subjects, (200 males and 200 females) of selected Population. The total number of subjects were categorised into four groups according to the age: Category- 1 23 - 26 years of age, Category- 2 27- 30 years of age, Category- 3 31-34 years of age, Category- 4 35-39 years of age. Stature and arm span were measured and mean value, standard deviation and Pearson's correlation coefficient was calculated. Correlation between parameters with age group and gender has been estimated.**Results:** Correlation of Stature and arm Span is 0.66 in males, 0.65 in females and p value is <0.001. The results of the study found that stature and arm span shows statistically significant positive correlation.**Conclusion:** Stature shows a statistically significant positive correlation with arm span in adult males and females. Thus, for reconstruction surgeries of limb, it is a critical anthropologic tool. It can also be applicable in identifying an individual in mass disasters where the case is deteriorated, damaged and disfigured.**Keywords:** Anthropometry, Arm Span, Stature

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Physical anthropology deals with the study of human behavior in time and space. Identity is the birth-right of every individual. For recognition of a missing person, external features and body parts are very significant. If there is any mass casualty in any natural disaster, and body remnants are available for identification, they become an important source for medico-legal investigation. Stature of an entity is a major variable that helps in the identification even after death. Correlation of height of an individual can be done with various parameters like hand length, foot length and arm span. [1]

In the Anthropometric studies, correlation of stature with arm span in standing posture is found to be highly significant than correlation of stature in the sitting position. 1 Estimating stature and weight are helpful in evaluating growth and nutritional status of children. In children, both variables like stature and arm-span increases with age and they depends on both the variables of genders. In adults, both variables decrease with age but the rate of decadency in stature is higher than the age related to arm span. Many previous research work showed that age

related decrease in height is lower in the white population than in black population [2]. In bed bound patient, Arm-span helps to estimate stature of that patient. In the forensic study, arm- span has significance in estimating stature in disabled sports persons in the identification of individual. Parameters like arm-span and stature are used in normalizing pulmonary function in scoliosis patients. By measuring standing height, longitudinal growth as well as body fatness and energy requirements to adjust drug dosage can be estimated. In children who cannot stand on their feet, stature estimation becomes difficult. This study determines the precision of use of arm span in predicting stature. This study finds out the correlation of stature with arm span in Rajasthan population. So, the aim of this study is to determine the correlation of stature with arm span and to determine the regression equation for stature from arm span.

Materials and Methods

This present study was done on 400 adult Human subjects (200 male and 200 female) of Indian origin. This study was conducted in the department of

Anatomy, Pacific Institute of Medical Sciences, Udaipur. Written informed consent was obtained from the subjects prior to the study. The subjects were selected regardless of their position, socio-economic status, religion, and dietary habits and were apparently healthy, without any spinal or limb deformity.

Exclusion criteria was subjects with congenital spinal deformity or limb deformity i.e scoliosis, kyphosis, Acromegaly, etc. And any subject with acquired bone deformity i.e arthritis, missing extremity.

Stature is the vertical distance from vertex to floor. For measurement of arm span, arms were outstretched at right angles to the body, elbow and wrist extended with the palm facing forwards palms and the head was aligned in the Frankfort plane. Arm-span was measured with the subject standing adjacent to the wall, shoulder joint abducted to 90 degree, arms spread at the shoulder joint level and equivalent to floor. The measurements were taken from tip of middle finger of one hand to tip of middle finger of other hand. A non-elastic tape was used to measure arm span. A calibrated steel tape to the nearest 0.1 centimetres on a level concrete floor with their upper backs, buttocks and heels against the wall supporting. For the measurement of stature, subject was in the anatomical position, standing on their heels together, buttocks, shoulder and head touching the walls. The subjects were asked to take a deep breath and hold it. Measurement was taken

from vertex to the heel. A non-elastic tape was placed against the head and wall to measure the maximum height. For the purpose of study, the total number of subjects has been divided into four groups according to the age: Group I - 23 to 26 years, Group II - 27 to 30 years, Group III - 31 to 34 years, Group IV - 35-39 years.

Anthropometric measurements of stature and arm span were measured in centimeters for both males and females, by using the measuring tape. To eliminate the diurnal variation in subject's height, these measurements had been taken by the same person between 12PM to 4PM daily. Three readings were taken for all the measurements and mean of the three readings for each variable was taken into consideration, to minimize subjective errors. Data was analyzed in SPSS version 22. Mean and S.D (Standard Deviation) were noted and the difference in means were analyzed. With these measurements, correlation coefficient between arm span with stature is calculated & regression equation for stature estimation with gender from arm span was derived.

Results

In the present study, it was calculated that the mean and standard deviation of stature in males was 167.24 6.37 cm and 154.17 8.35 cm in females and it was observed that the mean and standard deviation of stature in males higher than in females (Table 1).

Table 1: Frequency Distribution of Arm Span.

Age Group	Freq	Range	Mean	Diff	P Value
Group 1	Male-89	157-186	163.11. ± 12.41	17.290	<0.001
	Female-110	114-176	172.77 ± 6.56		
	Total 199	114-186	163.11±12.41		
Group 2	Male-40	132-188	171.73±9.55		
	Female-36	127-172	155.13±10.55		
	Total 76	127-188	163.87±13.00	16.600	<0.001
Group 3	Male-29	160-185	173.15±7.09		
	Female-25	118-165	147.78±13.63		
	Total 54	118-185	161.40±16.55	25.370	<0.001
Group 4	Male-42	153-183	169.32±7.20		
	Female-29	119-168	151±11.77		
	Total 71	119-183	161.83±12.96	18.320	<0.001

In the present study, it was calculated that the mean and standard deviation of arm-span in males and females and it was observed that the mean and standard deviation in males higher than in females (Table 1).

Arm-span of both males and females (mean 163.11) of group I increases with increase in stature (mean 161.70) which shows a positive correlation with stature. Arm-span of both males and females (mean 163.87) of group II increases with increase in stature (mean 160.89) that indicates arm-span has a positive correlation with stature. Arm-span of both

males and females (mean 161.40) of group III increases with increase in stature (mean 159.09) that signifies arm-span has a positive correlation with stature. Arm-span of both males and females (mean 161.83) of group IV increases with increase in stature (mean 158.74) that means arm-span has a positive correlation with stature. Ratio between stature and arm-span was 0.99 in group I, 0.98 in group II, 0.98 in the group III and 0.98 in the group IV.

In the present study, the correlation of stature and arm-span value was 0.666 in males, 0.654 in females and p value was <0.001. The results of the study found that there was statistically significant

positive correlation between stature and arm span.

Discussion

Each human being relates to the one species, Homo sapiens. An individual can never be same as another in all his measurable characters, even monozygotic twins also vary in few traits. This change in these characters occurs in complete life cycle and these changes are affected by various elements causing changes in skeletal ratio in various geographical regions. The approximation of the stature, build, race and identity of an individual from the Human fragments is done by Archaeologists and forensic experts from time to time. Females are on average shorter than males in each known populace. This difference in stature between males and females is called sexual dimorphism of stature and exists almost in each populace. In the present study, the mean stature of males was found significantly higher than the mean of stature in females. The other previous studies also found the similar results. It is seen in many studies that female skeleton is smaller than males. If the exact measurement for stature is not obtainable, it is calculated by using other methods. Different measurements were taken by different researchers for the approximation of stature. Among these measurements, measurement of Arm span is the most commonly used. Arm Span can be said to be most useful in approximating the stature. Knee height is used by Chumlea et al. (1985) [3] to estimate the stature. This present study is done on living human beings and for estimation of the correlation of arm span with stature, a regression equation is derived. This study was done of four hundred participants, in which males and females were kept in same proportions. Similar study sample were taken by Sharma S et al [4] in which 200 males and 200 females were studied. Shah et al. [5] did a work on 150 MBBS students in a medical college of Ahmedabad, and he found a positive and significant correlation of 0.9313 of arm-span with stature. Patel et al [6] did similar study on 273 subjects and studied correlation of stature with the five variables which are hand length, hand breadth, arm span, foot breadth and foot length. On doing statistical analysis, he found the greatest correlation of stature with arm span ($r = 0.908$). Alam et al [7] also found a strong and significant ($r = 0.798$, $p < 0.05$) correlation of arm span with stature in his cross-sectional study on 124 students in Uttar Pradesh. In this present study, like the stature, the average Arm span was lower in females than in males, which is similar with the findings of Shah [5] and Alam. [7] Different regression equations for different genders are derived for estimating the stature as there is significant difference in the measurements of males and females. [8-9] In studied males and females, the correlation R for arm span and stature is calculated as 0.66 and 0.65 respectively. Other researchers also found the similar results [10-12]. In this present study, the

female outstretched arm span shows a strong and statistically significant positive slightly lower coefficient correlation ($r = 0.65$) with stature than the male ($r = 0.66$), this correlates with the study done by Barwa J et al [8] in Dehradun and Ter Goon D et al [9] in Nigeria. But the work done by Alam MT et al 7 in Uttar Pradesh showed that male outstretched arm span showed a lower correlation coefficient (r) with stature than in the female.

Conclusion

This study was done on 400 adult human subjects (200 males and 200 females) of Southern Rajasthan population. From the study, a regression equation was derived which shows a positive correlation of stature with arm span. This fact can be used by Anthropologists for estimation of stature with arm span when the identity of a person is unknown.

References

1. Zverev YP. Relationship between arm span and stature in Malawian adults. *Ann Hum Biol.* 2003;30(6):739-43.
2. Malli SM, Vyas VM, Gosai P, Gupta S. Estimation of height of the person by using arm span and hand length measurements. *Gujarat Medical Journal.* 2015; 70:105-70.
3. Chumlea WC, Roche AF, Steinbaugh ML. Estimating stature from knee height for persons 60 to 90 years of age. *J Am Geriatric Soc.* 1985;33(2):116-20.
4. Sharma S, Jain SK, Sharma N. Use of Arm Span as Proxy Indicator of Stature- An Anthropometric Study in Western U. P *Ann Int Med Den Res.* 2016;2(5):10-14.
5. Shah RP, Bhaskar RK. Body height and its estimation utilizing arm span measurements in Nepal population. *J Coll Med Sci Nepal,* 2013;9(4):9-14.
6. Patel PN, Tanna JA, Kalele SD. Correlation between hand length and various anthropologic parameters. *Int J Med Toxicol Forensic Med.* 2012;2(2):61-3.
7. Alam T, Singh S, Rai R, Shaheen S. Correlation between stature and arm Span: A Prospective. *Ann Int Med Dent Res.* 2016;2(3):56.
8. Barwa J, Singh R. Estimation of stature from arm span using regression equation in Dehradun region. *J Forensic Med Toxicol.* 2019;4(2):56-9.
9. Ter GD, Toriola AL, Musa DI, Akusu S. The relationship between arm span and stature in Nigerian adults. *Kinesiology.* 2011;43(1):38-43.
10. Singh A, Kumar A, Chavali KH, Harish D. Use of arm span and foot length for estimation of height of the person. *J Panjab Acad Forensic Med Toxicol.* 2012;12(2):87-91.
11. Arifi F, Sami S, Alaj I, Toverlani A. Body height and its estimation utilizing arm span measurements in kosovian population. *Sport*

Mont. 2017;15(2):31–4.
12. Popovic S, Bjelica D, Doina G, Tanase. Body height and its estimation utilizing arm span

measurements in Bosnian and Herzegovinian adults. Monten J Sports Sci Med. 2015;4(1):29–36.