

# Estimation of stature from the arm span of an individual in South Indian population

## ABSTRACT

**Background:** Body height is a vital measure of body size and gives an assessment of the nutritional status of an individual. But, the precise body height cannot always be determined by the normal method because of several malformations of the extremities, or in patients who have undergone amputations or similar injuries. In such cases, an estimation of body height can be derived from other reliable anthropometric indicators, such as hand length, foot length, and arm span of the individual. **Objective:** The aim of this study is to observe the body height in both sexes of the South Indian population and the relationship between arm span and body height. **Materials and Methods:** The study was carried out on of 30 postmortem cases that came for autopsy. Their height and arm span was measured using a measuring tape. The data was statistically analyzed by computation to find out its normative value. The relationship between body height and arm span will be determined using simple correlation coefficients. **Results:** There was a significant correlation between the height of an individual and the arm span, in males ( $P$  value: 0.000) as well as in females ( $P$  value: 0.009). **Conclusion:** This study will be significant to forensic experts, human biologists, and physical anthropologists for the determination of stature from the arm span of the individual.

**Key words:** Arm span, estimation, stature

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## INTRODUCTION

Stature of an individual is an inherent characteristic, the estimate of which is significant in the identification of unidentified human remnants.<sup>[1]</sup>

The height prediction occupies a relatively central position both in anthropological research and in the identification required by medical jurisprudence or by medicolegal experts. Estimation of the stature of an individual from the skeletal material or from the mutilated or amputated limbs or parts of limbs has clear significance in personal identification in the events of murders, accidents, or natural disasters.<sup>[2]</sup>

Stature measurement is vital for the assessment of a juvenile's growth, calculation of nutritional indices of

children and adults, calculation and standardization of physiological variables such as lung volumes, muscle strength, glomerular filtration, metabolic rate, and for the tailoring of drug dosage in patients.<sup>[3,4]</sup>

However, in some cases, the exact stature cannot be determined directly because of malformations of the extremities, or in patients who have undergone amputations. In addition, determining the stature can be hard in wheelchair-bound or bedridden patients and those with osteoporosis after hip fractures or stroke. In such cases, an estimation of stature has to be done through other reliable anthropometric indicators. These estimations aid in calculating age-associated loss in stature, recognizing individuals with disproportionate growth deformities, and skeletal dysplasia or stature loss

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during surgical operations on the spine. In addition, it could be used in sports settings in calculating the stature of wheelchair athletes or other individuals involved in sports with disabilities involving amputation of a leg or other malformations. Furthermore, in many elderly people, it is hard to measure the erect stature, precisely because of mobility problems and kyphosis.<sup>[5]</sup>

Therefore, dimensions of other body parts such as arm span, knee height, skull length, scapular length, and vertebral column length can be used as a substitute to assess erect stature.<sup>[5-13]</sup>

The aging process did not alter the bone length of the arm and leg as well as the height of the vertebral bone. The arm span fairly remains unaltered by aging.<sup>[14]</sup>

So, the aim of the present study was to derive some regression formulae to indicate relationship between height and arm span in healthy adult individuals in both the sexes.

## MATERIALS AND METHODS

The study was done on 60 postmortem cases that came for autopsy at the mortuary of the Department of Forensic Medicine, Kasturba Medical College, Manipal University, Manipal, Karnataka, India.

Their height and arm span was measured using a measuring tape. The age and sex of the subject were noted from the autopsy file.

The height of the deceased was measured, with a measuring tape, from the vertex to the heel.

The arm span was measured from the tip of the middle fingers of the left and right hands, with the individual standing with the back to the wall and both arms abducted to 90°, the elbows and wrists extended and the palms facing directly forward.

The data collected were processed to get mean values, standard deviation (SD), and correlation between the stature and arm span and was done using the Student's *t*-test. Linear regression equations were derived using the Statistical Package for the Social Sciences (spss) 16 software (IBM, USA) to find the height using the arm span.

## RESULTS

The mean and range of all the parameters are shown in Table 1.

There was significant correlation between the height of an individual and the arm span, in males (*P* value: 0.000) as well as in females (*P* value: 0.009).

**Table 1: Mean and range of all parameters**

Parameters	Mean ± SD		Range	
	Males	Females	Males	Females
Height (cm)	165.67 ± 6.46	157.97 ± 6.50	154-181	149-171
Arm span (cm)	180.94 ± 6.98	171.22 ± 9.26	170-196	150-192

In our study, we got the regression equations for males as:  
Height (H) = 62.21 + 0.57 arm span (AS)

For females as:  
H = 89.88 + 0.39 AS

From our regression formulae, stature can be estimated within the standard error of + 2.8 cm in case of males and + 0.9 cm in case of females from the arm span.

## DISCUSSION

The assessment of body height using several anthropometric dimensions has been tried by numerous authors in many studies over the centuries. But it is significant to emphasize that the arm span recast is the most trustworthy body indicator for predicting the body height of an individual.<sup>[8,15]</sup>

Goon *et al.*<sup>[15]</sup> found the regression equations for males as:  
H = 67.63 + 0.577 AS

For females as:  
H = 55.16 + 0.642 AS

While in our study we got the regression equations for males as:  
H = 62.21 + 0.57 AS

For females as:  
H = 89.88 + 0.39 AS

Goon *et al.*<sup>[15]</sup> found that there was significant correlation between the height of an individual and the arm span, in males as well as females, in Nigerian adults. Bjelica *et al.*<sup>[16]</sup> have done a study on the Montenegro population and they found that arm span significantly predicts body height in both the Montenegrin sexes as well. Fatmah<sup>[14]</sup> as well found that arm span is highly correlated to stature in both the sexes in the Indonesian population. Popovic *et al.*<sup>[17]</sup> as well found that the arm span reliably predicts body height in both the genders in Serbian adults. Chawla *et al.*<sup>[18]</sup> found that the correlation between arm span and height was high and significant in all the adult males of the North Indian Punjabi population. Mohanty *et al.*<sup>[18]</sup> as well found that the correlation of arm span with standing height was very good. Banik<sup>[19]</sup> found significant correlations of arm span and height with age in growing children and adolescents aged 10–17 years. Among adults (18–59 years), they found separate correlations of height and arm span with age to

be significant. They found both sexes in this age group consistently exhibited more or less similar correlation coefficients. They found correlation between height and arm span was highly significant and females had higher coefficients than males. In our study, we got similar results as well.

Chawla *et al.*<sup>[18]</sup> found the regression equation for height in males as:

$$H = 44.0912 + 0.9987 AS$$

While in our study, we got the regression equations for males as:

$$H = 62.21 + 0.57 AS$$

Mohanty *et al.*<sup>[18]</sup> found the regression equation for height in South Indian females as:

$$\text{Standing height (cm)} = 49.57 + 0.674 AS \text{ (cm)}$$

While in our study, we got the regression equations for females as:

$$H = 89.88 + 0.39 AS$$

In all the studies that have been done till now, including the present study, showed that arm span is a good predictor of estimating the stature in all individuals who have skeletal dysplasia, amputation of the lower limb done due to various diseases and spinal deformities etc. Even this study will, in addition, be helpful for forensic experts if they found only upper half of the body to identify stature.

## CONCLUSIONS

Arm span is a good predictor of stature for males as well as females. From our regression formulae, stature can be estimated within the standard error of + 2.8 cm in case of males and + 0.9 cm in case of females from the arm span. So, this study will be significant to forensic experts, human biologists, and physical anthropologists for the determination of stature from the fragmentary remnants of the upper half of the body.

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### Conflicts of interest

There is no conflicts of interest between the authors.

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