

## Original Articles

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# Measurement of Stature from Arm-span – An Anthropometric Study on Garo Tribal Bangladeshi Females

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### Abstract:

*Context: Arm span is the most reliable body parameter for predicting the stature of an individual. It is useful in predicting age related loss in stature and in identifying individuals with disproportionate growth abnormalities and skeletal dysplasias. Since in Bangladesh variegated ethnic groups inhabit in different climatic, nutritional and ecological conditions, no single anthropometric formula is suitable. The present study was undertaken to measure the stature, as well as arm-span and to determine whether there is any correlation between the stature and the arm-span. And to estimate using respective multiplication factors the stature from arm span and to assess the effectiveness of the above estimation by comparing the 'estimated' values with the 'measured' values.*

*Study Design: Cross sectional descriptive type of study.*

*Materials and Method: The study was carried out with a total number of 100 Christian Garo adult female aged between 25 to 45 years. Arm-span along with their stature was measured directly from the subjects by using anthropometric technique by a measuring tape. The data were then statistically analyzed by computation to find out its normative value. Multiplication factors were estimated for estimating stature and comparison were made between measured and estimated stature using paired "t" test.*

*Result: The mean normal values of the arm-span is 154.74 ( $\pm 5.69$ ) cm and the stature 152.79 ( $\pm 5.62$ ) cm were found. The multiplication factor was estimated for the same hand measurements with the stature. Significant positive correlation was found in case of arm-span with the stature ( $r=0.89$ ).*

**Key words:** Anthropology, Correlation, Multiplication factor, Stature

### Introduction

Measurement of the stature of patients is required for determination of basic energy requirements, standardization of measures of physical capacity and for adjusting drug dosage. However, in some situations the exact height can't be determined directly because of deformities of the limbs or in patients who have undergone amputation. In such circumstances, an estimate of the height has to be

computed based on other body parameters. These estimations are also of prime importance in predicting age related loss in stature, identifying individuals with disproportionate growth abnormalities and skeletal dysplasia or height loss during surgical procedures on the spine<sup>1</sup>.

Several studies have reported the effectiveness of using various body parameters in predicting body stature and the arm span was found to be the most reliable. However the association of arm span and height was found to vary from race to race. Even though several studies of this nature are available on Bengali populations, no data is available on tribal population of Bangladesh.

Arm span is the horizontal distance between the tip of the middle fingers, with the arm extended

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laterally and at shoulder level<sup>2</sup>. Arm span is the most reliable body parameter for predicting the stature of an individual. Arm span is considered a useful alternative to stature, particularly in the elderly, since arm span does not vary significantly with age<sup>3</sup>.

The Garo (Mendi) Adivasi, a distinguished matriarchal community of Bangladesh living in the north-eastern parts of the country especially in Gazipur, Mymensingh, Netrokona, Tangail, Sherpur, Jamalpur and some in Sylhet districts close to the Indian border<sup>4</sup>. According to the Census report in 1991<sup>5</sup>, there are 64,280 Garos who live in Bangladesh. Almost all the Garo are bi-lingual because they have to speak Bengali in addition to their Garo language. Garos have their own language, which is called 'Achchik Katha'. The traditional Garo religion is 'Sangsharek', which is almost abolished. Over the years, most of the Garo have been converted to Christianity and a few into Islam.<sup>6</sup> The mass populations of the villages are literate. With the introduction of formal schooling, Garo took the opportunity to be educated which has influenced and changed Garo in their lifestyle.

#### Methods:

The study was basically observational, cross-sectional and descriptive in nature. The study was carried out on 100 Christian Garo adult females at different locations of Dhaka city and Mymensingh district. To measure the stature the subject was said to stand with her heel together and her back as straight as possible so that her heels, buttocks, shoulders and the head touched the wall. The arms were hung freely by the sides with the palm facing the thighs<sup>7</sup>. After asking the subject to take a deep breath and holding it, a measuring scale (steel plate) was placed against the head and wall to determine maximum height on the wall, and this was marked. The subject was then told to breathe and to step away from the wall. The height was then measured from the floor to the mark on the wall with steel tape which represents the stature in centimeters to the nearest 0.1 centimetres<sup>8</sup>. Arm span was measured with a flexible steel tape from the tip of the middle finger on one hand to the tip of the middle finger on the other hand with the individual standing with her back to the wall with both arms abducted to 90°,

the elbows and wrists extended and the palms facing directly forward (Figure 1). Readings were taken to the nearest 0.1 centimetres. Each subject was measured twice. When the two measurements for each parameter agreed within 0.4 centimetres, their average was taken as the best estimate for the true value. When the two initial measures did not satisfy the 0.4 centimetres criterion, two additional determinations were made and the mean of the closest records was used as the best estimate.<sup>1</sup>



Fig.-1 Procedure of measuring the arm span

#### Calculation of multiplication factor:

Each multiplication factor is the ratio of the stature to the respective physical measurements. A mean multiplication factor was then calculated for each measurement. These mean multiplication factor were used for estimating the stature from those variables.

$$M.F = \frac{\text{Stature}}{\text{Upper limb variables(e.g.arm span)}}$$

#### Statistical analyses of data

Results were prepared on the basis of collected data and their distribution, central tendencies and standard deviations (SD) were calculated using a computer based programme (SPSS version-11.5 & MS Excel). Regression analysis were done. Mathematical relationships between sets of two measurements were calculated as multiplication factor (i.e., ratios between the two). Using the paired t test, the measured values were compared with the corresponding values estimated (using the corresponding multiplication factor) from other relevant measurement.

#### Results:

As mentioned in Methods, measurements of stature and arm span were taken using direct

physical procedure in 100 subjects. Mean and standard deviation were calculated for each variable and frequency distribution were also determined. Multiplication factor was calculated for estimating stature from each arm span measurement. Correlation of arm span with stature was also assessed. The effectiveness of the use of the multiplication factor in these estimations was tested by testing whether there are significant differences.

The stature of the 100 Garo Christian adult female subjects ranged from 137.00 to 168.50 centimeters, as shown in Table 1. The mean ( $\pm$  SD) of the stature

was found  $152.79 \pm 5.62$  cm and arm span was  $154.74 \pm 5.69$  (Table-I). In more than 75% of the subjects, the arm span was between 152.00 and 166.99 cm (Fig. 2). The arm span showed significant positive correlation ( $r=0.89$ ,  $p=0.000$ ) with the stature (Figure 3).

The multiplication factor (M.F.) regarding the arm span for estimating stature is mentioned in Table I

In this study, arm span was multiplied by mean multiplication factor and then estimated stature was obtained and then calculating the mean for 100 estimated values. This is shown in Table-II.

**Table-I**

*Stature and arm span, their descriptive statistics, multiplication factors and correlation with stature*

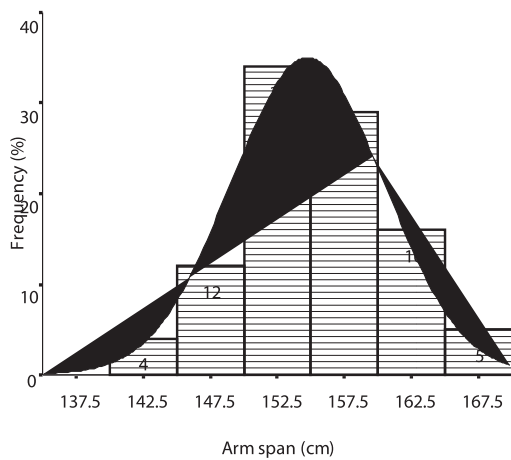
Variable	Range (cm)	Mean (cm) $\pm$ SD	Meanmultiplication factor	Significance of correlation (p value)
Stature	137.00-168.50	$152.79 \pm 5.62$	—	—
Arm span	140.00-168.50	$154.74 \pm 5.69$	0.99	0.00 (S)

n :100 for each variable S: significant at 5% level in regression analysis

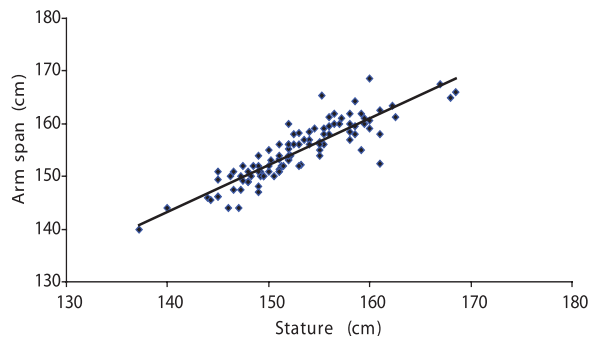
**Table -II**

*Comparison between the 'measured' stature and the stature 'estimated' from arm span*

Measurement from which the stature was estimated	Measured stature (cm)	Estimated Stature (cm) †		Significanceof difference(p value)
	Mean $\pm$ SD	Range	Mean $\pm$ SD	
Arm-span	$152.79 \pm 5.62$	138.32-166.48	$152.88 \pm 5.62$	0.95(NS)



**Fig. 2** Frequency curve showing the frequency distribution of the arm span.



**Fig. 3** Scatter diagram with regression analysis showing significant ( $p<0.001$ ) positive correlation ( $r=0.89$ ) between the stature and the arm span of the Garo Christian adult female ( $n=100$ )

### Discussion:

Although no statistical analysis could be done between the results of the present study and those of other studies, some observations may be worth mentioning. The mean arm span of the subjects of the present study was  $154.74 \pm 5.69$ . Higher value was seen in the Caucasian such as Spaniard females and Afro- Caribbean (Negroid) studying in the Oxford university.<sup>10</sup> Oriental groups were almost similar in their mean arm span value to a greater extent. Afro-Caribbean had the highest mean arm span among the arm span considered.

As the Garo tribe belongs to the Mongoloid race, some similarities are expected to exist with the other ethnic groups of Mongoloid race but we have found that variation is present among mongoloid race. Malay, Chinese and Indians which comprising Malaysian females<sup>12</sup> showed nearer to this value of the Garo females. If we see the other ethnic groups such as Urban Bengali females,<sup>13</sup> South<sup>1</sup> and North Indians females<sup>14</sup> of India and Asians studying in Oxford Brooks University,<sup>10</sup> we have found that all of them considered in this study showed higher value than this. In the present study, the mean stature of the Garo females was found as  $152.79 (\pm 5.62)$  centimetres. The mean stature of the Japanese and Chinese<sup>11</sup> females has been found somewhat closer to this value. The urban Bengali females<sup>12</sup> and the females of some Indian ethnic groups like South Indians<sup>1</sup> appear to show a higher mean stature than the Garo females. However, rural Bengali females<sup>15</sup> and Indians like Santhals of West Bengal<sup>16</sup> had lower value than the Garo female population. Higher mean stature was also being noted in the Caucasian females of Mexican<sup>17</sup> origin. It should be noted that the highest mean stature was found in the Negroid adult females like the Somali in Ethiopia<sup>3</sup>.

From the above view it may be suggested that variation is not only present in between races or ethnic groups but also present among individual races or ethnic groups.

### Conclusion:

Though the sample size was small and the convenience sampling had to be applied due to time constraints as well as because the study was done

on such a group of people where a sampling frame could not be constructed, results of the present study will provide a baseline information, regarding some variables of a particular population (defined for the present study as Christian adult Garo females). It could be lead to the development of a standard for such data on various subgroups of the population (and the population as a whole). Comparisons made with other population could contribute to the understanding of the relative status of our Garo population in the context of the anthropometric variations around the world. Significant correlations, as detected in the study between some of the measurements and their implications in the development of proper multiplication factors to be useful in estimating one measurement from another. This should encourage others in taking up further research in the field. The similar study might be done on the tribals like Chakma, Marma, Santhals, Tipra, Murong and others, while relationship of stature with other parameters (lower limb dimensions etc) of the body could also be considered.

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