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Udoh Uwemedimo G
Department of Anatomy,
Faculty of Basic Medical
Sciences, College of Health
Sciences, University of Uyo,
Uyo, Nigeria

Edem Gabriel D
Department of Anatomy,
Faculty of Basic Medical
Sciences, University of Uyo,
Nigeria

Johnson Ekemini I
Department of Anatomy,
Faculty of Basic Medical
Sciences, University of Uyo,
Nigeria

Friday Solomon
Department of Anatomy,
Faculty of Basic Medical
Sciences, University of Uyo,
Nigeria

Relationship between height and Armspan length in adults of the Annang ethnic group of Nigeria

Udoh Uwemedimo G, Edem Gabriel D, Johnson Ekemini I and Friday Solomon

Abstract
This study was carried out to determine the average value for the height and arm span as well as the correlation between the two values in adults of the Annang ethnic group of Nigeria. It also aimed to establish a formula for estimation of height using the arm span length in this population. Four hundred individuals (216 males and 184 females) between the ages of 18-50years randomly selected from the eight local government areas of Akwa Ibom state where the Annangs predominantly reside participated in this study. Verbal consent was obtained and standard anthropometric techniques were used to measure height and arm span length. Pearson's coefficients of correlation and regression equations were calculated using Minitab statistical package for stature and Armspan lenght. The mean and standard deviation of the height of males and females were 165.29 ± 9.98 cm and 160.66 ± 9.09cm respectively and that of arm span length of males and females were 181.15 ± 11.94cm and 172.22 ± 11.82 cm respectively. It was observed that the Annang males had a significantly higher height and arm span length than the Annang females ($p<0.05$). Thus, there was sexual dimorphism. A positive correlation value of r=0.659 for males, r=0.457 for females was obtained in this study between the height and the arm span parameters. A regression formula of height for males was H= 65.9+0.549 armspan (cm) and for females H= 100+0.350 armspan (cm). These values are useful racial markers and will be of clinical and forensic anthropological significance when dealing with the Annang people.

Keywords: Armspan, Annang, Stature, anthropology

1. Introduction
Height is the vertical distance between the heel and vertex of a person in an upright posture and is an identifying characteristic of an individual. It is used in assessing growth and nutrition, calculating body surface area and predicting pulmonary function [1, 2]. Height is used to determine many important clinical measurements, but height may be difficult or impossible to measure accurately in some patients who cannot maintain the necessary posture [3]. Armspan length, which is distance from the tip of the middle finger of one hand to the tip of the middle finger of the other hand when both hands is raised parallel to the ground at shoulder height is one of the surrogates that can be used to predict height in this cases [3, 4, 5].

Current practice is to substitute arm span to height, once corrected either by a fixed factor or by an age and sex dependent regression equation [6]. Correlation between arm span and height are often stronger among younger subjects; the two measurements are almost interchangeable. As people age, correlation often decreases. This is due to decreasing height in older subjects without significant decrease in arm span [7]. The correlation between arm length and stature is difficult to quantify because different ethnic groups have unique body proportions [3] hence there is need to generate data for specific ethnic groups.

The Annang people occupy the North-Western territory of Akwa Ibom State of Nigeria, West Africa between latitudes 4.25' and 7.0 North and longitudes 7.15' and 9.30' East [8]. Annangland has a level landscape covered by relatively low vegetation and myriads of palms. It has a tropical climate with wet and dry seasons with mean annual rainfall of 2030-2540mm [8].

Despite the anthropological importance of arm span and height, no research has been done to determine their relationship among the Annang ethnic group of Nigeria hence the need for this study.

Correspondence
Udoh Uwemedimo G
Department of Anatomy,
Faculty of Basic Medical
Sciences, College of Health
Sciences, University of Uyo,
Uyo, Nigeria

2. Materials and method

2.1 Study popualtion

The study was carried out between May 2016 to August 2016 on four hundred subjects of both sexes between the age range of 18 to 50 years. Verbal consent was obtained before any measurement was taken. The slovens formula was used to calculate the minimum sample size as: n = N/1+N (e)^2

Where;

n=Sample size, N=Population size (Annang-1,101,160 (Federal Republic of Nigeria official gazette, 2006), e=Significant level (0.05), Sample size for Annang n=1,101,160/ 1+ 1,101,160 (0.05)$^{2.}$

Minimum sample size for Annang = 399.7 approximately 400 subjects were used.

2.2 Stature (Height)

This was measured using a steel meter rule with the subjects standing in upright position with both hands on the sides. The ruler was placed on top of the subjects (the persons) vertex to indicate the upper margin. The distance between the vertex and the floor was the height recorded in centimeters (cm).

2.3 Arm span

It was measured using a steel measuring tape as the length from the tip of the middle finger of the left hand to the tip of the middle finger of the right hand when raised parallel to the ground at shoulder height of both hands at 90^0 and measurement was taken to the nearest centimeters (cm).

2.4 Arm Span Stature Ratio

The arm span stature ratio was calculated by using the length of arm span divided by stature, multiplied by one hundred. i.e. 100 x lengths of arm span / stature (height).

All linear measurements were in centimeters for each parameter. The data on the measured parameters were analyzed using the Z-test to determine the sex differences and ($p<0.05$) was taken as being statistically significant.

A correlation study was also carried out between the stature of subjects and their arm span length. A regression an analysis was carried out to predict the stature (height) of the males and females from their arm span length.

2.5 Precautions

- Measurements were taken on bare foot.
- Each participant's measurements were taken twice to obtain accurate results.
- The measurement is recorded to the nearest 0.1cm. Repeat measurements were taken after asking the subject to step off and step back onto the stadiometer. If the two measurements disagree by equal to or more than 0.5cm then a third measurement was taken.
- Individuals with recognized deformities of either arm, thigh, foot or spine were exempted from the study.
- The subjects were indigenes of Annang ethnic group in which both parents and both grandparents are also from the same ethnic group.

3. Results and Analysis

Statistical analysis was done using the Minitab statistical package version 16. Normative test was done. The result of the mean and standard deviation of stature, arm span length, arm span stature ratio of the Annang ethnic group are shown in tables1-3. The mean and standard deviation of height of the males and females were 165.29±9.98cm and 160.66±9.09cm respectively. The mean and standard deviation of arm span length of the males and females were 181.15±11.94cm and 172.22±11.82cm respectively. The mean and standard deviation of arm Span Stature Ratio for males was 109.71±5.85cm and; while, for females, it was 107.34 ±7.01cm. It was observed that for all the parameters, the males had a significantly higher values than that of the females ($p<0.05$). It was also observed that the arm span length was significantly higher than that of the height of the Annang people. Table 3 shows a comparison of the mean arm span length of present study and previous studies done in other ethnic groups. Figures 1 and 2 Shows the Pearson correlation between the Height and armspan of the Annang ethnic group. It was observed that, there was a strong positive correlation between their height and arm span ($p<0.05$). Linear Regression Equations derived for the estimation of Stature (Height) from Arm Span length is shown in Table 4.

Table 1: Showing mean values of measured parameters for the Annang ethnic group.

Parameters	Sample Size	Males	Females
	(N)	Annang	Annang
Stature (cm)	400	165.29±9.98*	160.36±9.09*
Arm Span Length(cm)	400	181.15±11.94*	172.22±11.82*
Arm Span Stature Ratio	400	109.71±5.85	107.34±7.01

*P<0.05

Table 2: Showing mean values of measured minimum and maximum parameters for the Annang ethnic group. Total Parameters Count Mean St.Dev Minimum Maximum.

Parameters	Total Count	Mean	St.Dev	Minimum	Maximum
Female Height(Cm)	184	160.66	9.09	141.15	193.10
Female ASL	184	172.22	11.82	152.80	225.80
Female A:S ratio	184	107.34	7.01	90.21	135.70
Male Height(Cm)	216	165.29	9.98	161.15	200.10
Male ASL	216	181.15	11.94	160.05	208.30
Male A:S ratio	216	109.71	5.85	90.21	130.70

ASL = ARM Span Length, A:S ratio = arm span stature ratio

Table 3: Showing a comparison of mean arm span length of present study and previous studies.

Researchers	Ethnic group	Males(cm)	Females(cm)
Fawehinmi and Paul [9]	Igbo	185.95±9.16	172.95±7.64
	Hausa	202.37±6.56	191.15±10.43
Samira et al. [10]	Banglaheshi	168.78±7.64	154.74±5.69
Ogoun et al. [11]	Ijaw	188.4± 9.48	171.7± 11.30
	Ikwerre	174.8± 10.10	166.4±8.34
Okoseimiema [12]	Esan	187.30±8.41	173.75±8.47
Monika et al. [13]	Ahmedabad	166.28±4.751	147.11±4.879
Kithmini et al. [14]	Kamataka, India	176.22±8.90	161.93±8.56cm
Present study	Annang	181.15±11.94*	172.22±11.82*

Table 4: Showing Linear Regression Equation for Stature (Height) from Arm Span

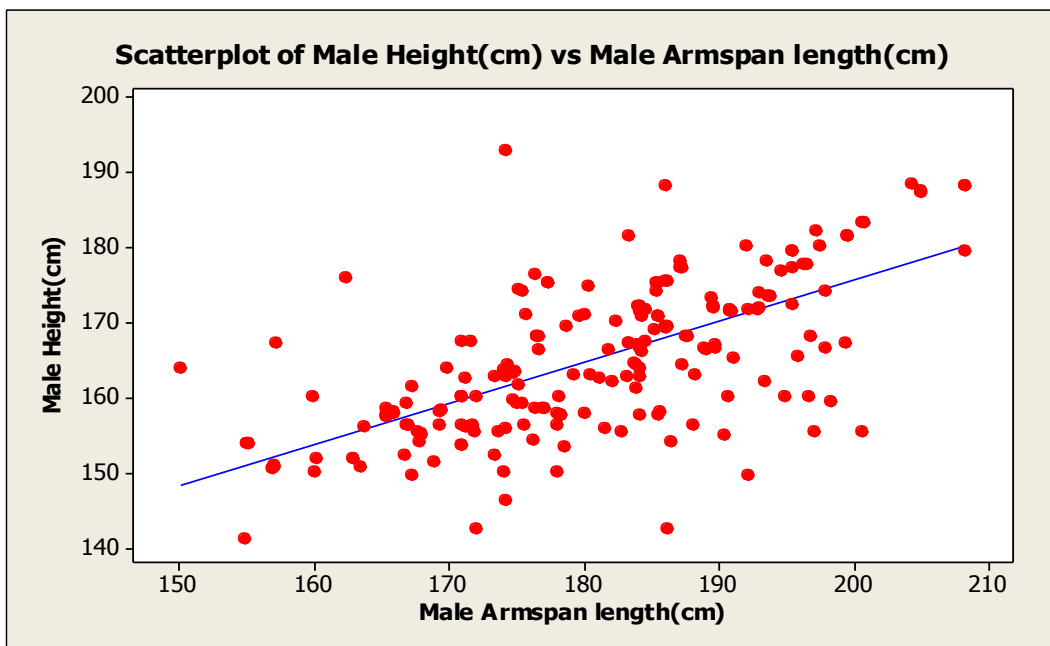| Variable	Regression Equation
Annang Males Arm Span Length(cm)	Annang Males Height (Stature) = 65.9 + 0.549 Annang Male Armspan length(cm)
Annang Females Arm Span Length(cm)	Annang Females Height (Stature) = 100 + 0.351 Annang Female Armspan length(cm)

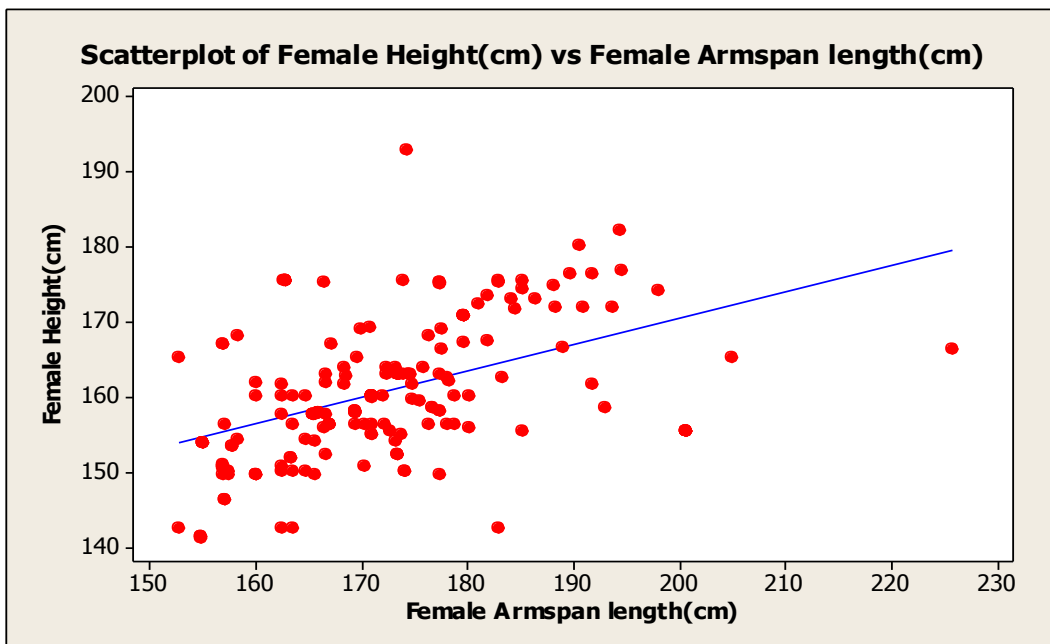**Fig 1:** Pearson correlation of Stature (cm) and Arm Span Length (cm) for the Annang males. R= 0.656

Fig 2: Pearson correlation of Stature (cm) and Arm Span Length (cm) for the Annang females. R= 0.457

4. Discussion

Anthropometry is the external measurement and description of human body and its parts for the purpose of comparison and establishing norms for sex, age and race [9]. There are biologically and statistically significant variations between human populations in body shape and anthropometric parameters such as height and arm span and their ratios can be used to determine ethnic differences [15].

The mean height of the annang ethnic group was seen to be significantly higher than the Efe pygmies of African jungle [16] but also significantly lower than the Dutch of the Netherlands [17] for both male and females. Compared with other studies done for height and armspan in other ethnic groups in Nigeria, it can be observed that the mean values for these parameters in the Annang group is lower than that of the Igbo and Hausa [9], Ijaw [11] and Esan [12] ethnic groups for both male and females. The values were also observed to be higher than that of the Ikwere ethnic group [11]. These observations are in line with previous works that have shown that ethnicity plays a confounding role in the values of armspan and height and hence must be taken into consideration when interpreting these values [3].

In this study, it was observed that the armspan was consistently greater than the height and the average values for males was greater than that of females, indicating the presence of sexual dimorphism with respect to these values. These observations are in line with previous studies across many ethnicities [9, 12, 18].

Many studies have reported an excellent positive correlation between armspan and height [9, 12, 19, 20]. However, in our study the correlation was good (r= 0.657) for males and moderate (r=0.457) in females. Regression model was used to establish a formula to predict height from armspan of annang people. Estimating height using a fixed correction factor derived from the armspan stature ratio or obtained from the linear regression formula produced values that similar to the actual measure height in both males and females, indicating that this formula is reliable and can be used to predict height from armspan of adults of the annang ethnic group of Nigeria.

5. Conclusion

The mean height and arm span of adults of the annang ethnic group of Nigeria were determined in this study. A positive correlation was found to exist between the two parameters and a linear regression equation was derived to predict height from armspan length. It is hoped that the values obtained will be of clinical, forensic and anthropological use when dealing with the people of this ethnicity.

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