Correlation of Height and Arm Wing Span among Students in Kano Metropolis

Maigari Y. K.
Department of Anatomy,
Faculty of Basic Medical Sciences,
Bayero University, Kano
Nigeria

***Maigari A. K., Adamu A., Hamza Y. I., Malami A. I. and Umar I**
Nigerian Institute for Trypanosomiasis Research,
Kano Liaison Office, Infectious Diseases Hospital,
France Road, Kano.
*akabirum@gmail.com

Abstract
Average height is a frequent characteristic of any population that shared genetic and environmental factors. Because the maximum height that an individual attains is dependent on these factors, reconstruction of body height has been a subject of discussion in forensic anthropology, legal medicine, dietetics, in predicting age related loss in height, height deformities, geriatrics and the likes. This study therefore, was carried out to determine the inter relationships between various body parameters and identify the anthropometrical measurement that correlates more closely to height among students in Kano metropolitan. Height and arm wing span of 500 apparently healthy secondary school students, including 250 males and 250 females, were measured. The relationship between the various anthropometric measurements was determined by computing their correlation coefficients. The result shows that the correlation of height with arm wing span were very good (males: r=0.882 and females; r = 0.823). The study confirms the reliability of arm wing span as anthropometric variable for height prediction. These estimations could be useful in adjusting drug dosage in patients, identifying individuals with growth abnormalities, skeletal dysplasia and in estimating age related loss in height.

Key words: *Height, arm, anthropometric measurements, correlation*

1.0. INTRODUCTION

1.1. Background to the Study

Height is generally influenced by nutrition, age, gender, environmental and genetic makeup (Sanna and Soro, 2000; Padez, 2002). For instance, the height of mother and son as well as that of father and daughter genetically correlates (Roner *et al.*, 2003), suggesting that shorter mother will likely gave birth to a shorter son whereas taller father will likely have tall daughter. It is therefore pertinent to assert the human body as a very good example of nature's proportion considering its pattern and symmetry. Moreover, different individuals exhibit different climatic variations as stated in Allens' rule, which stated that individuals in cold climates will tend to have shorter limbs than those in warm climates thereby justifying the need to probe into systematic, comparative and holistic science of man (Alho *et al.*, 2011).

Anthropological studies are essential for determining the proportions and evolutionary variations among different populations (Brown *et al.*, 2002). It is confirmed that, the

evaluation of general body composition is necessary in the determination and diagnosis of many disorders; response to therapy and severity (Tanphachitr and Leelahagul, 1995) essentially in areas of applied anthropology such as epidemiology, metabolic research clinical and biological anthropology.

Mohanty *et al.*, (2001) noted that measurements of the heights of individuals are essential for the determination of basic energy requirements, standardization of measures of physical capacity and for adjusting drug dosage. However, in some situations the exact height cannot be determined directly because of deformities of the limbs or in patients who have undergone amputations. In such circumstances, an estimate of the height has to be computed based on arm span, leg length, body mass, femur length and so on (Mohanty *et al.*, 2001).
In forensic investigations, estimation of arm span is used for determination of height, sex and age of individuals (Chabra, 2008). Similarly, determination of height is of major concern in forensic medicine since it attested that standards for skeletal modifications vary among different populations and the standard for a particular population may not be used for another (Iscan, 2001). Furthermore, estimation for height from limbs and their parts play important roles in ascertaining the identity of corpses through forensic examination but most records are that of Western population, which by default, became the international standard. However, there is evidence that these western standards may not be applicable to all populations (Krishan and Sharma, 2007).

Several studies have reported the effectiveness of using arm span in predicting body height. However, despite these numerous studies on association of height and arm span, the variation of these parameters among different species is inevitable and, according to Reeves *et al.* (1996), the association of arm span and height vary from race to race. This implies that the empirical reasoning on the variation among Nigerians, with respect to arm span and height has long been neglected. Therefore, the basic objective of this study is to find out the correlation of height and arm span among Secondary School students in Kano metropolitan.

2.0. MATERIALS AND METHODS

2.1. Study Area

The study was undertaken in Kano metropolitan, which has an area of 17 Km^2. Three schools were randomly selected including Kano Day Science College, Girls Day Science College and Al- Fauzyslim Group of Schools. Regular enrolment of students within the age of 15 – 20 among these school was found to be 780.

2.2. Sampling Technique

Cross sectional study was carried out on 500 apparently healthy students of both sexes. The inclusion criteria were an age range of 15 – 20 years while the exclusion criteria were students above 20 years or below 15 years.

2.3. Methods

Variables were measured in accordance to the Centre for Disease Control and Prevention, CDC (2008). Each subject was measured twice and average value was taken to estimate the true value.
Standing height was measured with each student standing bare feet on the platform of Stadiometer with their upper back, buttocks and heels pressed against the upright position of the instrument while the head of each subject was brought in contact with the head plate of the Frankfort. Readings were taken to the nearest 0.1 cm.

Arm wing span was measured with a flexible steel tape from the tip of the middle finger on one hand to the tip of the other hand with the individual standing with his/ her back to the wall with both arms abducted to 90°, the elbow and wrists extended and the palms directly forwarded. All readings were taken to the nearest 0.1 cm.

2.4. Data Analysis

The data was analysed using Max Stat, Version 3.0. The relationships between height and arm wing span was determined using simple correlation coefficients at 95% confidence interval (5% probability level). The linear and multiple regression analysis were performed to derive the estimate of stature (height) in terms of arm wing span. Similarly, the statistical difference between male and female subjects was determined using Mann – Whitney Rank Sum test.

3.0. RESULTS AND DISCUSSION

A total of 250 male and 250 female secondary school students among the age group of 15 – 20 years were sampled. A summary of their physical measurements was shown in **Table 3.1** and **Table 3.2**. The average age of male and female subjects was 16.7 and 17.3, respectively. The mean of height for males was 161.968 ± 9.101 cm while that of females was 155.324 ± 6.670 cm. Similarly, the mean arm wing span for males was 168.412 ± 9.486 cm while that of females was 160.296 ± 7.913 cm. This implies that, the mean arm wing span was 6.444 cm more than the height for males and also 4.972 cm more than the height for females. **Table 3.3** presents the correlations between height and arm wing span which was found to be very good in both males (r = 0.882) and females (r = 0.823). Regression equation for males is HT = -0.746 + (0.765 * AWS) while that of females is HT = 39.825 + (0.678 * AWS) with standard error of estimate of 3.911 (R^2 = 0.818) and 3.799 (R^2 = 0.680) for males and females, respectively (**Table 3.3**). Thus, the dependent variable (height) can be predicted from linear combination of the independent variable. Results of Mann – Whitney Rank Sum T – test for both height and arm wing span as summarized in **Tables 3.5** and **3.6** indicated that the differences in the median values among the two groups is greater than would be expected, thus there is significant difference.

The fact that this result shows arm wing span, in both male and female subjects, was significantly greater than height, justifies the deduction that, the anthropometrical values obtained in this study reflect the usual anthropometric characteristics of blacks as reported by many authors. Mitchel and Lipstchitz (1982) correlated height with sitting height, leg length and arm wingspan while Chumlea (1985) uses knee height to estimate height. However, in all these studies, the variable that proved to be consistently reliable was the arm wing span. Similarly, the correlation between arm wing span and height with 0.882 cm for males and 0.823 cm for females, respectively, agreed with the study of Steel and Chenier (1990) on blacks and white populations, where a correlation of 0.852 was recorded for black population. However, the estimation equations obtained from this study differs from those obtained by other studies thereby justifying the need to develop separate models for each population on account of racial and ethnic differences in anthropometric measurements.

4.0. CONCLUSION AND RECOMMENDATIONS

This study confirms the reliability of arm wing span as anthropometric variable for indirect physical measurements of height prediction. The variations with respect to height and arm wing span as found from the study equally disputes Leonardo's hypothesis that arm wing span exactly equals height. The study therefore, recommends further studies among different

age groups in various geographical areas to determine more accurately the relevance of using various anthropometric parameters in predicting height.

Table 3.1: Descriptive statistics of male subjects (n = 250)

Physical Measurement	Mean ± STD	Range
Age (years)	16.704 ± 1.199	5.00
Height (cm)	161.968 ± 9.101	48.00
Arm wing span (cm)	168.412 ± 9.486	47.00

Table 3.2: Descriptive statistics of female subjects (n = 250)

Physical Measurements	Mean ± STD	Range
Age (years)	17.336 ± 1.2922	5.00
Height (cm)	155.324 ± 6.670	32.00
Arm wing span (cm)	160.296 ± 7.913	35.00

Table 3.3: Correlation between Height and Arm Wing Span of Males and Females

Sex	Physical Measurement	Correlation Coefficient
Males	Height Versus Arm Wing Span	*0.882
Females	Height Versus Arm Wing Span	*0.823

***Statistically Significant at p < 0.05**

Table 3.4: Multiple Linear Regression Analysis of Height and Arm Wing Span

Variable		Regression Coefficient	Standard error	T - value	P – value
Constant:	**Males**	-0.746	5.371	-0.139	0.890
	Females	39.825	5.966	6.675	0.001
Arm Wing Span:	**Males**	0.765	0.029	25.971	0.001
	Females	0.678	0.033	20.833	0.001

Table 3.5: Mann – Whitney Rank Sum T – test for Arm Wing Span

Group	Median	25%	75%
Males	170.00	161.00	175.00
Females	160.00	154.00	166.00

T = 77639.50 (P < 0.001)

Table 3.6: Mann – Whitney Rank Sum T – test for Height

Group	Median	25%	75%
Males	162.00	155.00	169.00
Females	155.00	150.00	160.00

T = 76760.50 (P < 0.001)

Competing Interest: The Authors declared no any conflict of interest

Acknowledgement: The authors are grateful to the management of Kano day Science College, Kano Girls science College and Al Fauzyslim Group of School, Kano for granting the permission to carry out this study.

REFERENCES

Alho, J., Herczeg, G., Laugen, A., Rasanen, K., Laurila, A. and Merila, J. (2011) Allen's rule revisited: Quantitative genetics of extremety length in the common frog along a latitudinal gradient. *Journal of Evolutionary Biology*, **3**: 57 – 59

Brown, J., Knapp, T. and Feng, J. (2002) Is self – reported height or arm span a more accurate alternative measure of height? *Clinical Nursing Research*, **11** (4): 417 – 432

Centre for Disease and Control, CDC (2008) Measuring Height accurately at home

Chabra, S. (2008) Using arm span to derive height on interpretation of spirometry. *Annals of thoracic medicine*, **8**: 23 – 29

Chumlea, W. C., Roche, A. E. and Steinberg, M. L. (1985) Estimating stature from Knee – height for persons 60 to 90 years of age. *Journal of American Geriatrics Soc.*, **33**: 116 – 120

Iscan, M. (2001) Editorial; Global forensic Anthropology in the 21st century. *Forensic Science International*, 117: 1 – 6

Krishan, K. and Sharma, A. (2007) Estimation of stature from dimension of hands and feet in North Indian Population. *Journal of Forensic and Legal Medicine*, **14**: 327 – 332

Mitchell, C. O. and Lipschitz, D. A. (2001) Arm length measurement as an alternative to height in nutritional assessment of elderly. *Journal of Parenter and Enteral Nutrition*, **22** (5): 443 –458

Mohanty, S., Suresh, S. and Sreekumaran, S. (2001) The use of Arm span as a predictor of height: A study of Southern Indian women. *Journal of Orthopaedic Surgery*, **9** (1): 19 – 23

Padez, C. (2002) Stature and Stature Distribution in Portuguese male adults 1904 – 1998. The role of Environmental Factors. *American J. of Physical Anthropology*, **14**: 39 – 49

Reeves, S., Varakamin, C. and Henry, C. (1996). The relationship between arm wing span measurement and height with special reference to Gender and Ethnicity. *European J.*

of Clin. Nutrition, **50** (6): 398 – 400

Rona, R. J., Mahabir, D., Rocke, B., Chinn, S. and Gulliford, M. C. (2003) Social nine equalities and Children's height in Trinidad and Tobago. *European J. of Clin. Nutrition*, **57** (1): 38 – 40

Sanna, E. and Soro, M. (2000) Anthropometrical Changes in Urban Sardinian Children Ages 7 and 10 years. *American J. of Human Biology*, **12**: 782 – 791

Steel, M. F. and Chenieer, T. C. (1990) Arm span, height and age in black and white women. *Annals of Human Biology*, **14** (6): 541 – 553

Tanphaichitr, V. and Leehagul, P. C. (1995) Needs and Opportunities in accessing body composition. *Asia Pacific J. of Nutrition*, **4** (1): 23 – 24