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Estimation of Standing Height using Sitting Height Measurements among Indigenes of Northern Senatorial District of Cross River State, Nigeria.

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ABSTRACT
The estimation of standing height (stretched stature) is considered as one of the important parameters in the identification of a person. The aim of this research is to correlate and estimate Standing height using sitting height amongst indigenes of Northern Senatorial district of Cross River State. This study was conducted on 600 subjects (300 males and 300 females), aged 18 to 48 years, the subjects were further grouped into three sub age groups of 18-28, 29- 38 and 39-48 years old. The result of the study showed that the overall mean of the Standing height irrespective of age for male was 176.2±7.4cm and sitting height was 84.8±4.4cm, while for female the Standing height was 165.7±9.2 cm and sitting height was 80.3±3.0cm. Sexual dimorphism was also noted in age groups 18 to 28 and 29 to 38 years old with male values being higher than their female counterpart. Pearson regression coefficients of standing height and sitting height were recorded for both male and female as 0.606 and 0.610 respectively. The high values of the regression coefficient signify that sitting height reliably predicts Standing height in both genders. Linear regression equations were determined for males and females respectively. This study has provided a data base for the measured parameter and a linear regression equation for the estimation of Standing height specific for indigenes of Northern Senatorial District of Cross River State. This can be used to estimate stature in individuals with standing defects. The data will be of immense value to physical anthropologists.

KEY WORDS: Cross River State, Sitting height, Standing height, Stature estimation

INTRODUCTION
Standing height gives an overall assessment of growth that can be used to compare the general health and nutrition of populations and groups such as ethnic, social and economic groups. [1-3] It is also used to assess the Body Mass Index (BMI = weight in kilograms/ height in metres^2) which is a measure of obesity. Standing height also allows the lung function tests to be interpreted, since lung capacity varies with height. There are findings which confirms that the measurement of standing height is a vitally important variable when assessing nutritional status, as well as when assessing the growth of children, evaluating the basic energy requirements, adjusting the measures of physical capacity, predicting the drug dosage and setting standards of physiological variables such as muscle strength, metabolic rate, lung volumes and glomerular filtration rate.[4-7] However, the exact standing height cannot always be identified and resolved in the usual way in cases of paralysis, fractures, amputation, scoliosis and pain. Because of these factors, an estimate of standing height has to be acquired from other reliable anthropometric indicators such as sitting height, upper and lower limb anthropometric variables as well as cephalometric parameters [8-11]

Therefore, all these anthropometric indicators, which are used as an alternative to estimate standing height, are very important in predicting loss in standing height connected with aging. Also, to diagnose individuals with disproportionate growth abnormalities and skeletal dysplasia or standing height loss during surgical procedures on the spine, as well as to anticipate standing height in many older people as it is very difficult to measure it precisely, and sometimes impossible because of mobility problems and kyphosis. [1,12] This knowledge finds its importance in sport science as the standing height represents a significant factor which influences the success in various sport disciplines.[13,14] For these reasons, relative Standing height must be calculated from various anthropometric measures that can reliably predict the true Standing height.

Different body segments have also shown significant correlation with stature in different population of the world [1-8]. Stature estimation using arm span length have been reported for the Bekwara ethnic group of Cross River State, Nigeria. In the same ethnic group, stature estimation from Percutaneous Tibia Length have also

been reported.[15,16] More so, estimation of stature from some selected anthropometric parameters of the upper limbs of the Efik people in Cross River state have been documented. [17] All these estimation of Stature studies are of interest in forensic science and could aid in identification process when the need arises. Relationship of various body segments and standing height has been reported to vary in different ethnic and racial groups. [18] Hence, there is need for researchers to generate data and derive linear regression formulae for calculating standing height from various body parameters which are ethnic or population specific.

The aim of the present study was to derive linear regression equation for the estimation of standing height using the sitting height of Indigenes of Northern Senatorial District of Cross River State, Nigeria.

MATERIALS AND METHODS

This study was carried out in Bekwara, Obudu, Obanlikwu, Ogoja and Yala Local Government Areas which falls under the Northern Senatorial District of Cross River State of Cross River State-Nigeria. The sample consisted of 300 males and 300 females who were found physically fit with no deformities and neuromuscular disorders and fall within the age range of 18-48 years. It is believed that this is the most active adult age group. This research work includes subjects who confirmed that both of their parents are indigenes of either Bekwara, Obudu, Obanlikwu, Ogoja or Yala Local Government Areas of Cross River State.

Ethical approval was obtained from the Faculty Research and Ethics board, Faculty of Basic Medical Sciences, Cross River University of Technology (CRUTECH). Permission to conduct the study was obtained from the respective communities and the subjects involved in the research via verbal consultation and approval.

Measurement Procedure: The anthropometric measurements, including sitting height and stature, were taken according to the protocol of the International Society for the Advancement of Kinanthropometry.[19] The trained measurer had measured selected anthropometric indicators (same measurer for each indicator), while the quality of their performance was evaluated against the prescribed "ISAK Manual" [9-11,19]

Figure 1: Measurement of: (a) Standing height and (b) Sitting height

Stature: The height was measured using a standard anthropometer (Figure 1a). It is the vertical distance between vertex and heel touching the floor or ground surface when the person is standing barefooted with his/her head in the Frankfurt Plane.[11,15,19]

Sitting height: Sitting height was measured as the vertical distance from the sitting surface to the top of the head (Vertex) using an anthropometer. With the subject seated erectly with head in the Frankfort plane (Figure 1b).[10,19]

Statistical Analyses: Results were prepared on the basis of collected data and their distributions from 600 subjects of Northern Senatorial district of Cross River State, between the ages of 18-48yrs. Data were analyzed using statistical package for Social Sciences (SPSS) version 20.0. (SPSS Inc., Chicago, USA). Mean and standard deviation (SD) were obtained for both anthropometric variables. A comparison of means of

standing height and sitting height between genders were performed using Student T test, Pearson's correlation coefficients at ninety-five percent confidence interval was employed to evaluate the extent to which the sitting height can reliably predict standing height. Statistical significance was set at P<0.05.

RESULTS

A summary of the anthropometric measurements in male and female are as shown in Table 1-3. Table 1 shows the comparison of the means and standard deviation of the measured parameter for male and female for each age group. The overall mean of the standing height irrespective of age for males was 176.2±7.4cm and sitting height was 84.8±4.4cm, while for females the standing height was 165.7±9.2 cm and sitting height was 80.3±3.0cm (Table 2). The variations noted in the mean values of the standing and sitting height were statistically significant at P<0.05 with male values for both parameters being higher (Table 1 and 2). Sexual dimorphism was also noted in age groups 18 to 28 and 29 to 38 years old with male values being higher than their female counterpart (Table 1).

In Table 3, the Pearson's correlation coefficients of the anthropometric measurements are shown. The associations between standing height and sitting height were significant (P<0.05) and positive in this sample, for both genders (male: 0.606; female: 0.610).

Table 1: The mean value and standard deviation of the measured parameter for each age group with regards to sex.

AGE	SEX	STANDING HEIGHT	SITTING HEIGHT
	MALE	180.0±5.9[A]	86.3±3.4[B]
	FEMALE	163.8±5.6 [A]	79.9±3.5[B]
18 - 28 years	Total	171.9±9.9	83.1±4.7
	MALE	178.5±7.0 [C]	86.8±4.2 [D]
	FEMALE	160.6±5.1 [C]	79.7±2.7 [D]
9 - 38 years	Total	169.6±10.8	83.3±5.0
	MALE	170.1±4.9 [E]	81.3±3.2
	FEMALE	163.7±4.6 [E]	81.3±2.4
39 - 48 years	Total	166.9±5.7	81.3±2.8
	MALE	176.2±7.4 [F]	84.8±4.4 [G]
	FEMALE	162.7±5.3 [F]	80.3±3.0 [G]
18 - 48 years	Total	169.4±9.3	82.6±4.4

** Variations in the Mean values of parameters with Similar superscript are significant at P<0.05

Table 2: The mean value of the measured parameter for male and female values irrespective of age

AGE	SEX	STANDING HEIGHT	SITTING HEIGHT
18 - 48 years	MALE	176.2±7.4 [A]	84.8±4.4 [B]
18 - 48 years	FEMALE	162.7±5.3 [A]	80.3±3.0 [B]

*Variations in the Mean values of parameters with Similar superscript are significant at P<0.05

Table 3: Correlation values and Linear Regression Equations (LRE) for the estimation of Standing height using the Sitting height irrespective of age.

SEX	CORRELATION	Significant Level	Linear Regression Equation	Standard Error of Estimate
MALE	0.606	0.00	89.111 + 1.027(STH)	9.401
FEMALE	0.610	0.00	75.602 + 1.085(STH)	9.316

DISCUSSION

The assessment of standing height using various anthropometric measures is very typical from the past centuries and it has been attempted by many researchers.[1-8, 11-18] Generally, developing a linear regression equation using sitting height in estimating the Standing height of indigenes of Northern Senatorial District of Cross Rivers State in Nigeria is necessary in conditions where measurement for stature cannot be obtained due to lower limb and spinal cord deformities, or any acquired physical deformity that could affect stature or in situations where the ability to stand unaided is difficult to achieve for example in bed ridden individuals. It is also important to emphasize that the individual and ethnic variations referring to standing height and its association with sitting height might vary based on Ethnic group as well as on Race because the racial and ethnic differences are affective on these measures and reduce the possibility of generalizing. [2] This fact is consistent with other studies which have confirmed high linear correlation between standing height and sitting height in both genders.[20,21,22]

The present study. Showed statistically significant correlation between sitting height and standing height of Northern Cross River indigenes. The correlation coefficient of sitting height and standing height in the present study were found to be 0.606 and 0.610 in males and females, respectively. In a study by Fatmah,[22] for height models in an Indonesian population, there was significant correlation between standing height and sitting height in both genders. The correlation coefficient in this population was (r=0.756) for males and (r=0.782) for females.

The association between stature and sitting height were also significant high in a study carried out on the indigenes of Kosovo.[10] The Author reported a regression coefficient of 0.691 for Males and 0.629 for females.

Linear regression equation determined for males and females in this study are shown in Table 2 and the overall mean of the standing height and sitting height for male and female are shown in Table 1. The variations noted in the mean values of the standing and sitting height were statistically significant at $P<0.05$ with male values for both parameters being higher. This trend was also observed in the Kosovan population. The mean stature for Kosovan males was reported to be 179.52±5.96 cm and the sitting height was 95.13±3.56 cm; for females the stature was 165.72±4.93 cm, and the sitting height was 90.17±3.03 cm.[10] It is obvious that they have relatively higher sitting height when compared to the values revealed for male and female in the current study. The sex difference between sitting height measurements was statistically significant

CONCLUSION

The present study just as in other studies revealed the existence of positive correlation between sitting height and standing height, as such regression equations developed using sitting height can also be used for the estimation of Standing height. The results of this study also provide a new reference data for the studied population and further confirm the need for the development of specific models when it comes to stature estimation for both genders in Northern Senatorial District of Cross River State of Nigeria.

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