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Estimation of stature (height) of Ibibio ethnic group of Akwa Ibom state, Nigeria using measurement of hand length

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Abstract
This present study was to determine stature and hand length and to ascertain (if any) the correlation between stature and hand length among adults of the Ibibio ethnic group of Nigeria. Adults of the Ibibio ethnic group participated in this anthropometric study. A total of 350 people (209 males and 141 females) between the ages of 18 and above were studied. These participants were randomly selected from the fourteen local government areas of Akwa Ibom state which constitute the Ibibio ethnic group. Verbal consent was obtained from each individual before Stature and hand lengths were measured using standard anthropometric techniques. Pearson's coefficient of correlation and scatter plot graphs were calculated and obtained using Minitab statistical package for stature and hand length. The mean and standard deviation for stature in this study was 167.69±6.82 and 159.69±5.26 for male and female respectively. Mean and standard deviation for hand length was 21.05±1.24 and 21.24±1.26 for male right and left hands respectively; and 19.84±1.11 and 20.05±1.03 for female right and left hands respectively. Hand length showed a moderately strong significant linear correlation(r) with stature. (r=0.538 and r=0.503 ($p<0.005$) for male right and left hands respectively and (r=0.473 and r=0.511, ($p<0.005$) for female right and left hands respectively. The results from this study showed that the male had significantly higher figures in all parameters than their female counterpart except in the correlation coefficient of female stature to left hand, thus indicating the existence of sexual dimorphism in these parameters among the Ibibio ethnic group of Akwa Ibom State, Nigeria. The result from this study is comparable to studies done in other ethnic groups and may be relevant in further anthropometric or forensic studies as it concerns Ibibio ethnic group of Akwa Ibom State, Nigeria.

Keywords: stature, hand length, sexual dimorphism, Ibibio

1. Introduction

Human height or stature is the distance from the bottom of the feet to the top of the head in a Human when standing erect. It is measured using a stadiometer, usually in centimetres when using the metric system, or feet and inches when using the imperial system. When populations share genetic background and environmental factors, average height is frequently characteristic within the group. Exceptional height variation (around 20% deviation from average) within such a population is sometimes due to gigantism or dwarfism, which are medical conditions caused by specific genes or endocrine abnormalities [1].

The development of human height can serve as an indicator of two key welfare components, namely nutritional quality and health [2]. In regions of poverty or warfare, environmental factors like chronic malnutrition during childhood or adolescence may result in delayed growth and/or marked reductions in adult stature even without the presence of any of these medical conditions. The study of height is known as auxology [3]. Growth has been recognized as a measure of the health of individuals, hence part of the reasoning for the use of growth charts. For individuals, as indicators of health problems, growth trends are tracked for significant deviations and growth is also monitored for significant deficiency from genetic expectations. Genetics is a major factor in determining the height of individuals, though it is far less influential in regard to differences among populations. Average height is relevant to the measurement of the health and wellness (standard of living and quality of life) of populations [4]. Height, like other phenotypic traits, is determined by a combination of genetics and environmental factors. A child's height based on parental heights is subject to regression toward the mean, therefore extremely tall or short parents will likely have correspondingly taller or shorter offspring, but their offspring will also likely be closer to average height than the parents themselves. Genetic potential and a number of hormones, minus illness, is a basic determinant for height. Other factors include the genetic response to external factors such as diet, exercise, environment, and life circumstances. Humans grow fastest (other than in the womb) as infants and toddlers, rapidly declining from a maximum at birth to roughly age 2, tapering to a slowly declining rate, and then during the pubertal growth spurt, a rapid rise to a second maximum (at around 11–12 years for female, and 13–14 years for male), followed by a steady decline to zero. On average, female growth speed trails off to zero at about 15 or 16 years, whereas the male curve continues for approximately 3 more years, going to zero at about 18–20. These are also critical periods where stressors such as malnutrition (or even severe child neglect) have the greatest effect [5].

Stature is one of the most important elements of identification of an individual. Establishment of the identity of an individual is essential in cases when only fragmentary remains of human body are found [6]. Such need may arise from mass disasters i.e. aeroplane crash, stampede, tsunami, earthquake, flood, cyclones, Terrorist attack, close compartment fire, wars, public vehicle

(train, bus, ship,) accidents. Mutilation of body could also be possible by humans, animals or by natural process of decomposition. Genetic and geographical variations exist in different populations. When the accurate measurement for stature is unobtainable, other surrogates are used to predict stature. It is a proven fact that stature can be estimated from hand length [7, 8, 9, 10, 11, 12]. Human height varies greatly between individuals and across populations for a variety of complex biological, genetic, and environmental factors, among others. Due to methodological and practical problems, its measurement is also subject to considerable error in statistical sampling. The average height in genetically and environmentally homogeneous populations is often proportional across a large number of individuals. Exceptional height variation (around 20% deviation from a population's average) within such a population is sometimes due to gigantism or dwarfism, which are caused by specific genes or endocrine abnormalities [1]. Hand length is the distance measured from distal wrist crease to the tip of the middle finger in a supine position using a measuring tape [13]. It could also be defined as the distance measured from the end of the small wrist bone (Lister tubercle) at the base of the thumb to the tip of the middle finger of the right hand, palm turned up, with the fingers extended together [14].

Eight short carpal bones of the wrist are organized into a proximal row (scaphoid, lunate, triquetral and pisiform) which articulates with the bones of the forearm, and a distal row (trapezium, trapezoid, capitate and hamate), which articulates with the bases of the five metacarpal bones of the hand. There are five metacarpals. The heads of the metacarpals will each in turn articulate with the bases of the proximal phalanx of the fingers and thumb. These articulations with the fingers at the metacarpophalangeal joints are known as the knuckles. Fourteen phalanges make up the fingers and thumb, and are numbered I-V (thumb to little finger) when the hand is viewed from an anatomical position (palm up). The four fingers each consist of three phalanx bones: proximal, middle, and distal. The thumb only consists of a proximal and distal phalanx. Together with the phalanges of the fingers and thumb these metacarpal bones form five rays or poly-articulated chains [15]. The Ibibio people are from southern Nigeria. They are related to the Anaang and Efik peoples. During the colonial period in Nigeria, the Ibibio Union asked for recognition by the British as a sovereign nation. The Annang, Efik, Ekid, Oron and Ibeno share personal names, culture, and traditions with the Ibibio, and speak closely related varieties of Ibibio-Efik which are more or less mutually intelligible [16].

The Ibibio people are reputed to be the earliest inhabitants of the south eastern Nigeria. It is estimated that they arrived at their present abode from very earliest times, about 7000 B.C. In spite of the historical account, it is not clear when the people known as Ibibio arrived the state. According to some scholars, they might have come from the central. Benue valley, particularly, the Jukun influence in the old Calabar at some historical time period. Another pointer is the wide-spread use of the manila, a popular currency used by the Jukuns. Coupled with this is the Jukun southern drive to the coast which appears to have been recently compared with the formation of Akwa Ibom settlements in their present location. Another version had it that the Cameroon will offer a more concise explanation of the Ibibio migration story [16]. This was corroborated by oral testimonies by field workers who say that the core Ibibio people were of the Afaha lineage whose original home was Usak Edet in the Cameroon. This was premised on the fact that among the Ibibio people, Usak Edet is popularly known as Edit Afaha (Afaha's Creek) which reflects the fact that Ibibio people originated from Usak Edet. After the first bulk of the people arrived in what later became Nigeria, they settled first at Ibom then in Arochukwu. The Ibibio must have lived in Ibom for quite some time, but as a result of clashes with the Igbo people culminating into the famous 'Ibibio War' which took place about 1300 and 1400A.D, they left Ibom and moved to the present day Ibibio land [17].

The Ibibio people are located in Southeastern Nigeria also known as Coastal Southeastern Nigeria. Prior to the existence of Nigeria as a nation, the Ibibio people were self-governed. The Ibibio people became a part of the Eastern Nigeria of Nigeria under British colonial rule. During the Nigerian Civil War, the Eastern region was split into three states. Southeastern State of Nigeria was where the Ibibio were located, one of the original twelve states of Nigeria) after Nigerian independence. The Efik, Anaang, Oron, Eket and their brothers and sisters of the Ogoja District, were also in the Southeastern State. The state (Southeastern State) was later renamed Cross Rivers State. On 23 September 1987, by Military Decree No.24, Akwa Ibom State was carved out of the then Cross Rivers State as a separate state. Cross Rivers State remains as one of neighbouring states. Southwestern Cameroon was a part of present Cross River State and Akwa Ibom State of Nigeria. During the then Eastern Region of Nigeria it got partitioned into Cameroon in a 1961 plebiscite. This resulted in the Ibibio, Efik, and Annang being divided between Nigeria and Cameroon. However, the leadership of the Northern Region of Nigeria was able to keep "Northwestern section" during the plebiscite that is now today's Nigerian Adamawa and Taraba states. Before the Christianization of beliefs, it is said that the traditional religion of the Ibibio people was of two dimensions. One was centred on the pouring of libation, worship, consultation, communication and invocation of the God of Heaven (Abasi Enyong) and God of the Earth (Abasi Isong). Traditionally, these rites were carried out by the constitutional and religious King/Head of a particular Ibibio Community who was known from the ancient times as the Obong-Ikpaisong (the word 'Obong Ikpaisong' directly interpreted means King of the Principalities of the Earth' or 'King of the Earth and the Principalities' or Traditional Ruler). On the other hand, the second dimension of Ibibio traditional religion was centered on the worship, consultation, invocation, sacrifice, appeasement, etc. of the God of the Heaven (Abasi Enyong) and the God of the Earth (Abasi Isong) through other spiritual entities. And similar to that of the first dimension, rites were carried out by the Priests of these spiritual entities (Ndem), which were the Temple Chief Priests of the various Ibibio Divisions. It is, however, important to state here that a particular Ibibio Division could consist of many inter-related autonomous communities or Kingdoms. These kingdoms are ruled by an autonomous Priest-King called Obong-Ikpaisong, which is assisted by heads of the various large families (Mbong Ekpuk) which make up the Community. This is how the religious and political system of the Ibibio people have been structured from time immemorial.

The Ibibio people are known to be very rich when it comes to food. As a matter of fact, only a few ethnic groups can match up with them when it comes to indigenous meal. And popular among

the Ibibio dishes are afang soup, which is an important dish in Ibibio and must be made available in traditional marriages, edikang nkong (vegetable soup), and afere atama (atama soup) [18]. This ethnic group numbers approximately 4.5 million people which is equivalent to 3.5% of the population of Nigeria [19].

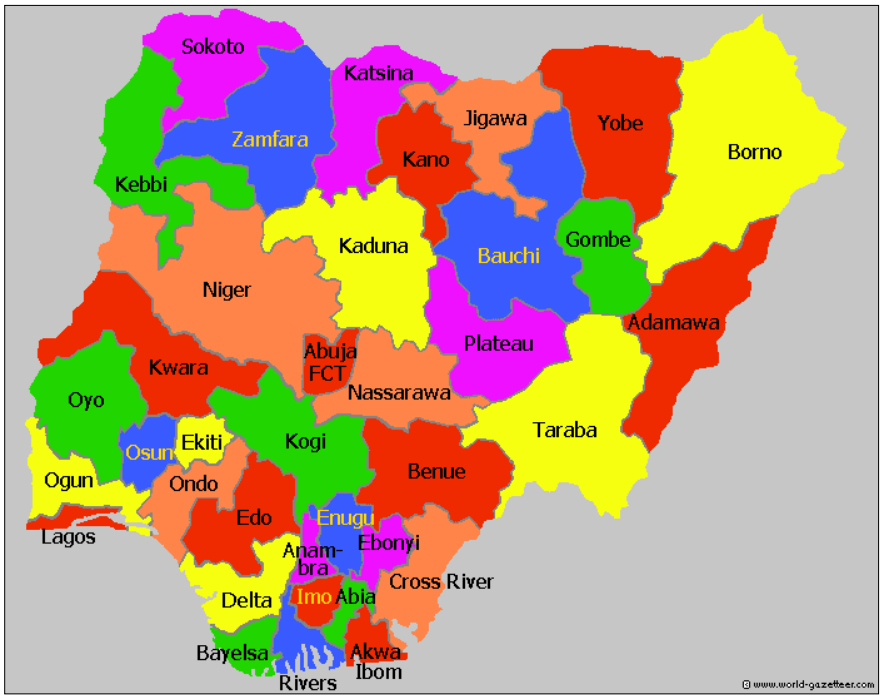

Fig 1: Map of Nigeria showing Akwa Ibom State below in red (www.google.images.com)

2. Materials and Methods

Study Population

The study was carried out between May 2018 to August 2018 on three hundred and fifty (350) Ibibio adults (209 males, 141 females) between the age range of 18 to 50. Male and female subjects were selected at random from fourteen local government areas which include Etinan, Uyo, Uruan, Mkpat-enin, Ikono, Ibiono-ibom, Ini, Itu, Ibesikpo, Onna, Nsit-ibom, Nsit-ubium, Nsit-atai and Ikot-abasi Local Government Areas within Ibibio ethnic group in Akwa Ibom State, Nigeria. The slovens formula was used to calculate the minimum sample size of subject in this research.

$n = N/1+N (e)^2$

n=Sample size, N=Population size (Ibibio-4,500,000, e=Significant level (0.05)

Sample size for Ibibio $n=4,500,000/ 1+ 4,500,000 (0.05)^2$

Minimum sample size for Ibibio = 349.7 approximately 350 subjects were used.

Materials Used

The materials used were measuring tape, ruler, marker, pen, data collection forms, notebook, minitab-18 statistical application software and Microsoft Excel.

Measurement of Stature

The subjects were made to stand in upright position with both hands on the sides facing a plain surface (mostly wall).

The ruler was placed on top of the subjects (the persons) vertex to indicate the upper margin and this point was marked on the wall using a marker pen, then the height of each individual was measured using a steel meter rule. It is vital to note that the distance between the vertex and the floor is the height recorded in centimeters (cm).

Measurement of Hand Length

The hand length was measured with a calibrated non stretch tape from distal crease (Lister tubercle) to the tip of the middle finger for both left and right hands in males and females. The subjects were asked to place their hand supine on flat horizontal surface with fingers extended and then adducted.

Hand Length Stature Ratio Collection

Hand length stature ratio was calculated by using the length of the hand divided by stature, multiplied by one hundred that is, 100 x length of hand / stature (height). All linear measurements were in centimeters for each parameter. Pearson's coefficients of correlation between stature and hand length were calculated using Minitab-18 statistical application software.

Inclusion Criteria

The following were the inclusion criteria for this study;

1. The subjects were selected from the fourteen (14) Local Government Areas that make up the Ibibio ethnic group.
2. The subjects were indigenes of Ibibio ethnic group.
3. The subjects included male and female of (18) and above.

Exclusion Criteria

1. Individuals with recognized deformities of leg, thigh or foot were exempted from the study.
2. Subjects below (18) years were excluded from the study.

***Source*:** Compiled by the researcher

Fig 2: Measurement of male right hand length

***Source*:** Compiled by the researcher

Fig 3: Measurement of male left hand length

3. Results

The result of the mean and standard deviation of stature, hand length, hand length stature ratio of the Ibibio ethnic group are shown in tables 1 and 2. The mean and standard deviation of height of the males and females were 167.69±6.82cm and 159.69±5.26cm respectively. It was observed that the Ibibio males had a significantly higher height than the Ibibio females ($p<0.005$). The mean and standard deviation of hand length were 21.05±1.24 and 21.24±1.26 for male right and left hands respectively; and 19.84±1.11 and 20.05±1.03 for female right and left hands respectively. It was observed that the males of the Ibibio ethnic group had a significantly larger hand length than their female counterpart ($p<0.005$). The mean Stature – hand length ratio was 12.55 and 12.67 for male right and left hand and 12.42 and 12.56 for female right and left hand respectively. It was observed that for all the parameters, the males had a significantly higher values than that of the females ($p<0.005$). Tables 5 and 6 show comparison of the correlation coefficients of stature to hand length of present study and previous studies. It was observed that, there were ethnic differences in these parameters. Table 4 and Figures 4 -7 show the Pearson correlation between the Height and hand length of the Ibibio ethnic group and their scatter plot graphical representations. The scatter plot graphs show a positive linear correlation of hand length with height as the line ascends from the root of the graph with points following a linear pattern. It was observed that, there was a positive correlation between their height and hand length ($p<0.005$).

Table 1: Showing maximum, minimum and mean values of measured parameters for males in Ibibio ethnic group.

Parameters	Male		
	Maximum value	**Minimum value**	**Mean value**
Male Height (cm)	190.00	148.50	167.69
Male Right hand length (cm)	24.80	17.20	21.05
Male Left hand length (cm)	25.00	17.50	21.24

Table 2: Showing maximum, minimum and mean values of measured parameters for females in Ibibio ethnic group.

Parameters	Female		
	Maximum value	**Minimum value**	**Mean value**
Female Height (cm)	175.00	148.00	159.69
Female Right-hand length (cm)	23.00	17.00	19.84
Female Left-hand length (cm)	22.50	17.90	20.05

Table 3: Showing sample size, mean values, standard deviation and ratio of measured parameters in Ibibio ethnic group.

Parameters	Male	Female
Sample size (N)	350	350
Sample size (n)	209	141
Mean height + Standard deviation (S.D)	167.69 + 6.82	159.69+5.26
Mean right hand length + S.D	21.05 + 1.24	19.84+ 1.11
Mean left hand length + S.D	21.24 + 1.26	20.05 + 1.03
Stature –right hand length ratio	12.55	12.42
Stature- left hand length ratio	12.67	12.56

Table 4: Showing correlation coefficient (r) values of measured parameters for males and females in Ibibio ethnic group.

Parameters	Male	Female
Pearson correlation coefficient between stature and right hand	0.538	0.473
Pearson correlation coefficient between stature and left hand	0.503	0.511

*probability ratio= 0.005

Table 5: Showing comparison between male and female from result of present and previous studies' correlation coefficients (r)

Researcher	Year	Ethnic group	Male	Female	Probability ratio (p)
Ibegbu *et al*	2015	Gbagyi in Abuja, Nigeria	0.706	0.703	p<0.001
Anwesa *et al*	2014	Eastern Indian population	0.583	0.487	P<0.03
Manpreet *et al*	2013	North India	0.589	0.550	P<0.001

Table 6: Showing comparison between the correlation coefficients (r) between stature and right and left hands from result of present and previous studies

Researcher	Year	Ethnic group	Right hand	Left hand	Probability ratio (p)
Amitava *et al*	2016	West Bengal (Bengalee), India	0.683	0.682	p<0.001
Nagesh *et al.* (Male)	2013	Karnataka, India	0.514	0.529	
Nagesh *et al.* (Female)	2013	Karnataka, India	0.770	0.762	
Present study (Male)	2018	Ibibio in Akwa Ibom State, Nigeria.	0.538	0.503	p<0.000
Present study (Female)	2018	Ibibio in Akwa Ibom State, Nigeria.	0.473	0.511	p<0.005

Scatter Plot Graphs for Correlations

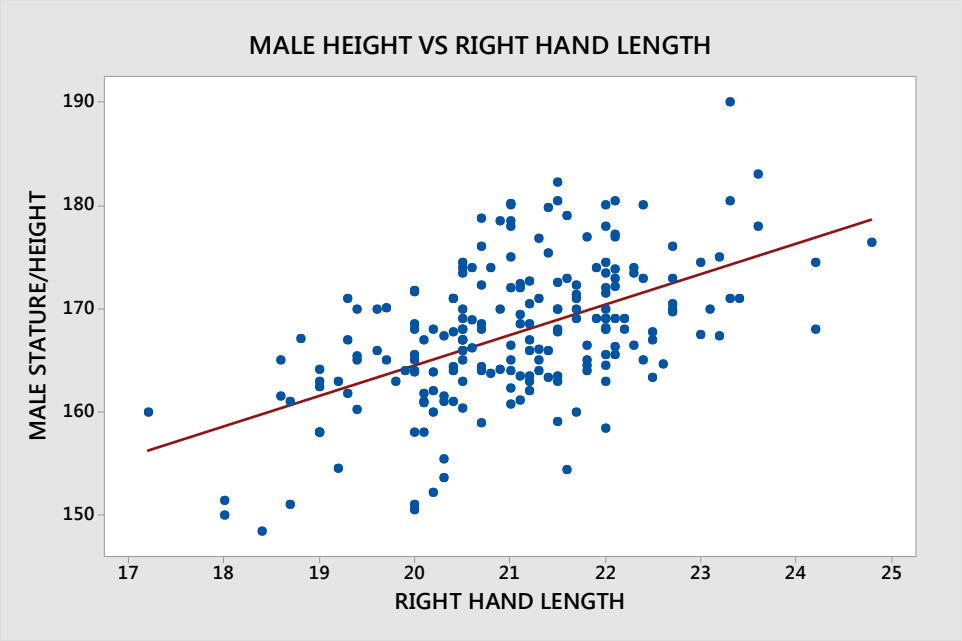

Fig 4: Scatter plot graph showing correlation coefficient between male stature and right-hand length. Pearson Correlation coefficient (r)= 0.538.

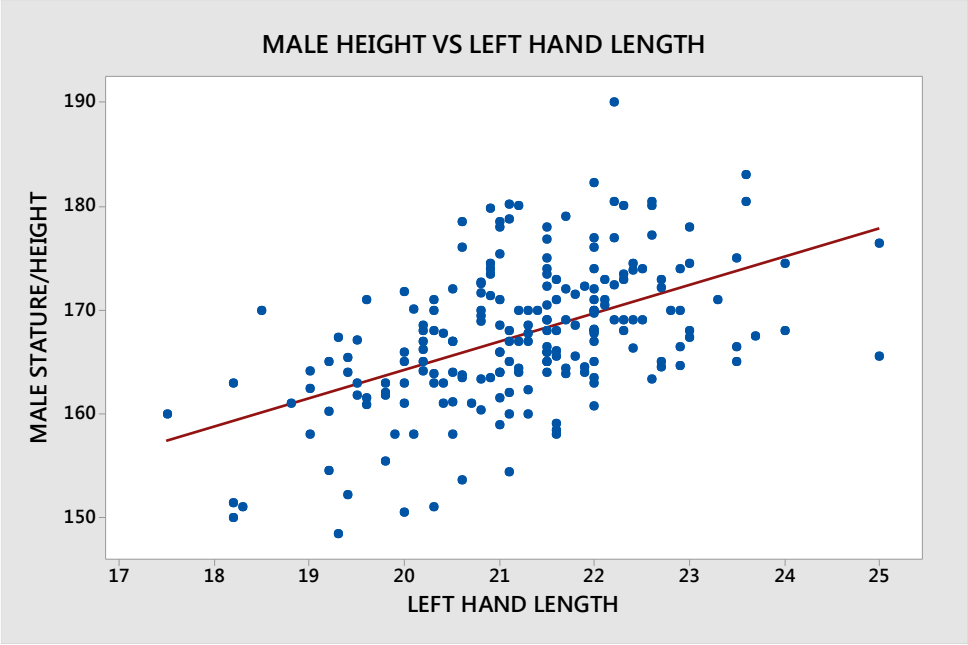

Fig 5: Scatter plot graph showing correlation coefficient between male stature and left-hand length. Pearson Correlation coefficient (r)= 0.503.

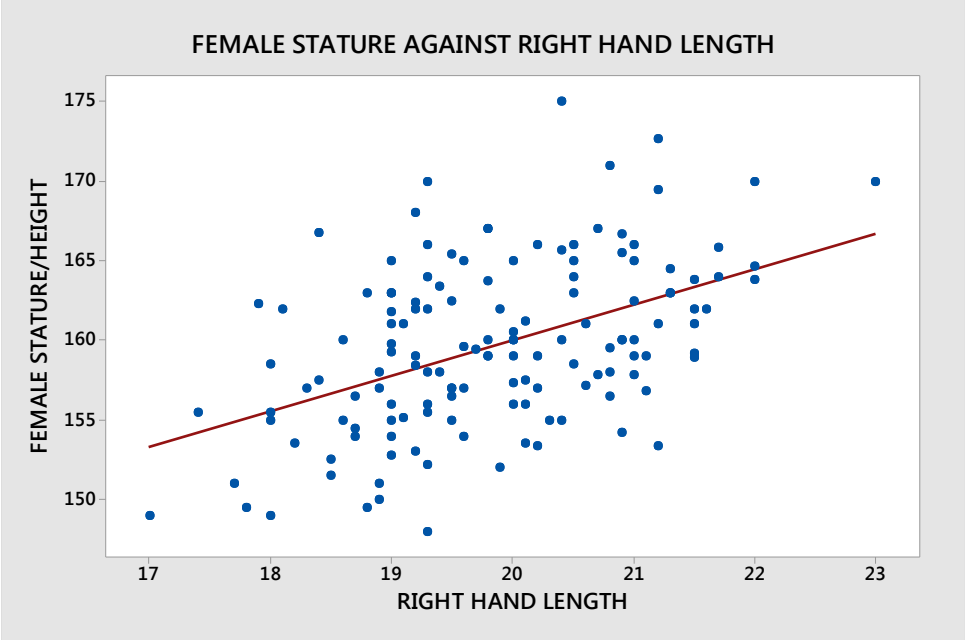

Fig 6: Scatter plot graph showing correlation coefficient between female stature and right-hand length. Pearson Correlation coefficient (r)=0.473.

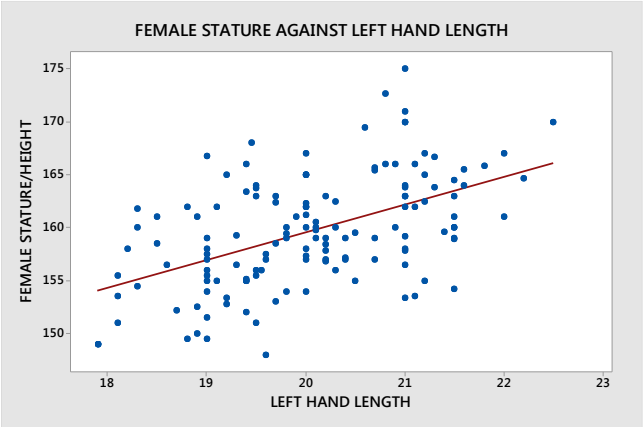

Fig 7: Scatter plot graph showing correlation coefficient between female stature and left-hand length. Pearson Correlation coefficient (r) = 0.511.

4. Discussion

When the accurate measurement for stature is unobtainable, it is estimated using other surrogates. Hand length is one of the most widely used. This study analyzes the correlation between stature and hand length of the Ibibio ethnic group in Akwa Ibom State, Nigeria among adults of 18 -50 years. Regression equations are hence developed to predict stature. The major determinants of one's height are the length of the long bones and the height of the vertebral column. At the time of fusion of long bones and completion of growth of the vertebral column the maximum stature is achieved. This skeletal growth stops at the age of 18 to 20 years [6]. After achieving maximum stature the bones are in relatively static period up to 40 years of age after which the natural process of senile degeneration takes place [20]. It is observed that the males generally have higher anthropometric measurement than that of females in the present study. Similar observations are made in many studies [21, 22, 23]. These differences may be due to gender associated genetic factors, hormonal factors and lifestyle factors [24]. Mean stature for population of adults varies from minimum values for the Efe pigmies of Africa at 144.9cm for men and 136.1cm for women [25] to the maximum values for the Dutch of Europe at 184.0cm for men and 170.6cm for women [26]. In this study, the mean stature for Ibibio adults is significantly higher than the pigmies of Africa, and higher than that of the Dutch people of Europe. In this study, the sample sizes are population-based and large enough to estimate accurately the height in Ibibio adults. The equations reported herein were obtained from large representative samples from the selected villages, thereby allowing for the possibility of their application to the Ibibio ethnic group of Nigeria. In this present study, hand length showed a moderately strong positive linear relationship with height at r= 0.538 and 0.503 for right and left hands in males and at r= 0.473 and 0.511 for right and left hands in females. Right hand in males have the highest coefficient of correlation to height at r=0.538, seconded by left hand in females at r= 0.511 then left hand in males at r=0.503. Female left hand shows a lower coefficient of correlation at r=0.473 as compared to that of the already mentioned results, all at probability levels of $p<0.005$. The present study corresponds with the study of Ibegbu *et al.*, (2011) [21] which showed a strong positive correlation of hand length with height to be r= 0.706 and 0.703 for male and female respectively at $p<0.001$. Manpreet *et al.*, (2013) [23] in North India also had a positive correlation of hand length to height of 0.589 and 0.550 for male and female at $p< 0.001$. A similar study was conducted by Anwesa *et al.*, (2014) [22] among Eastern Indian population with a positive correlation coefficient of 0.583 and 0.487 at $p<0.03$ for both male and female respectively. Similar correlations as shown in the present study too makes it clearly evident that hand length can be used as the predictor of stature, but it should be borne in mind that ethnic specific equations should be derived for a specific ethnic group [27].

5. Conclusion

The objective of this research was to determine the stature and hand length of the Ibibio ethnic group and to determine if stature

can be predicted using hand length among adult Ibibio individuals. This study was essential because there had been no work done to predict stature using hand length among the Ibibio ethnic group in Akwa Ibom State, Nigeria. The positive correlation coefficient obtained from this study shows that hand length is a good predictor of stature among Ibibio adults. As an instance, an individual with hand length within the range of 21-24cm should have a stature in cm that falls within the range of 169-182cm because from the measurements made using the values from three subjects, it was seen that stature is 7.5-8.2 times a person's hand length. Hence, hand length can be used on an average scale as a good predictor of stature in Ibibio ethnic group in Akwa Ibom state, Nigeria.

6. Competing Interests

Authors have declared that no competing interests exist

7. References

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