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ESTIMATION OF CRANIAL CAPACITY OF STUDENTS OF NNAMDI AZIKIWE UNIVERSITY, NNEWI CAMPUS, ANAMBRA STATE, NIGERIA

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ABSTRACT

This research was carried out to study the cranial capacity of students of Nnamdi Azikiwe University, Nnewi campus, Anambra state. The study was conducted on 500 students aged between 18 to 30 years (257 males and 243 females). The parameters required for the study such as cranial length, cranial breadth, auricular height, weight and height, were all obtained using standard anthropometric tools needed for the data collection. The collected data was recorded and analyzed using statistical package for social sciences (SPSS) version 16.0 and the results shown as scatter plots and regression lines. The cranial capacity was calculated using Lee and Pearson's equation. The mean cranial capacity for males and females were 1636.33 ± 109.94 and 1632.59 ± 149.44 respectively. Positive correlations between cranial capacity and cranial dimensions were obtained. Linear regression model for the prediction of cranial capacity were formulated for both sexes. The result of the study showed that the value of cranial capacity with respect to the obtained cranial dimensions (cranial length, cranial width and auricular height) in males were all larger than that of the females with significant difference ($P<0.05$) only to that of the cranial lengths. There is increase in cranial capacity with increase in age. The cranial capacity of males is larger than that of the females.

KEY WORDS

Cranial, Cranial length, Cranial breadth, Auricular height, Body weight and Body height.

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INTRODUCTION[1]

Cranial capacity is a measure of the volume of the interior of the cranium (also called the braincase or brainpan or skull) of those vertebrates who have both a cranium and a brain. The most commonly used unit of measure is the 'cubic centimeter' or cc. The volume of the cranium is used as a rough indicator of the size of the brain, and this in turn is used as a

rough indicator of the potential intelligence of the organism. However, larger cranial capacity is not always indicative of a more intelligent organism, since larger capacities are required for controlling a larger body, or in some cases are adaptive features for life in a colder environment[1].

Neurological functions are determined more by the organization of the brain rather than the volume. Individual variability is also important when considering cranial capacity, for example the average Neanderthal cranial capacity for females is 1300 cc and 1600 for males[2]. In an attempt to use cranial capacity as an objective indicator of brain size, the encephilization quotient (EQ) was developed by Jerison in 1973. It compares the size of the brain of the specimen to the expected brain size of animals with roughly the same weight[3]. This way more objective judgments can be made on the cranial capacity of an individual animal[1].

Cranial capacity which is in close correlation with brain volume reflects racial characteristics. This was thought to be one of the most presenting situations in human physical anthropological studies[4]. Diverse methodologies have been employed in estimating the cranial capacity of different populations both in the past and present. Most of the studies have been made on dry skull using mustard seeds, linear dimensions, packing methods or occasionally, radiological methods. There are very few documentations of measurement of cranial capacity of living subjects[5].

Knowledge of the volume of the cranial cavity of either the dry skull or of a living being may be important to the study and comparison of the crania of populations with various fundamental differences like geographical, racial, ethnic, etc[12].

This information is useful in correlating cranial capacity with other cranial measurements and in studies of primate phylogeny. Medically an analysis of cranial capacity exposes another aspect of growth and development[7]. In clinical practices, it can also be used as reference in the study of abnormalities of cranium with respect to size and shape.

The measurement of cranial capacity can be estimated by obtaining the values of the head length, head width and auricular height. Its unit of measurement is cubic centimeter[1].

Due to specific differences in body build and characteristics within different individuals, population of different areas of the world should have their own biomedical data as a reference value.

Since there is no standard normogram for cranial capacity among the students of Nnamdi Azikiwe University in Nnewi, this present study will aim to estimate the cranial capacity of students of Nnamdi Azikiwe University in Nnewi, using anthropometric measurement of linear dimensions of the head and other anthropometric method in correlation with sex, height and body weight.

MATERIALS AND METHODS

Methods of Data Collection

In the present study, required data for the research such as head length, head width, stature, auricular height and weight of each individual were measured using standard anthropometric measuring instruments (such as height meter and head spanner).The data was obtained from a total of 500 students (257 males and 243 females) between the ages of 18-30 in Nnamdi Azikiwe University, Nnewi campus. A sampling technique used to select the subjects from which required information and data were to be obtained by proper assessment and interview. The study was a basic study because it was purely academic based.

Instruments for Data Collection

The materials used for the study include: height meter, spreading calipers, weighing balance and T-square rule.

Parameters in Data Collection

Prior to the data collection, the subjects gave their consent after an assurance of confidentiality was given.

The following parameters were determined and recorded:

Age (years), Sex, Height (cm), Weight (kg), Head length (mm), Head breadth (mm) and Auricular height (cm).

Inclusion Criteria

Strictly students of Nnamdi Azikiwe University, between the ages of 18-30 and individuals with no history of serious head trauma, deformities or congenital abnormality.

Exclusion Criteria

Individuals with congenital malformations of the head, individuals who had undergone serious head trauma or surgery and females with obstructive hair style.

Measurement of Stature

The statures of the subjects were obtained by measuring the vertical distance from the vertex of the skull which is the highest point on the head to the floor. The subjects were asked to stand against the height meter bare footed with feet placed together side by side, heels to the wall and standing as erect as they possibly could after which a wooden ruler was placed against the vertex along the mid sagital plane to the corresponding calibration on the height meter. The body weights of the subjects were obtained by asking them to stand erect on a weighing balance after which the reading on the calibration was recorded.

Measurement of Cephalic Dimensions

The maximum head length from G (Glabella) to I (Inion) was measured using spreading calipers. The maximum head width was measured using spread caliper. It is the distance between the eurion (eu) i.e. between the two parietal eminences. A metal T-square rule was used in place of head spanner due to availability purposes. The auricular height was obtained by placing the ‘‘T’’ end of the T-square rule vertically hanging from the vertex of the skull down against the pectoralis major muscle and the point of incidence of the external acoustic meatus on the calibrations of the T-square rule was recorded.

Data Analysis

The data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. The cranial capacity was calculated using the following formula (Lee and Pearson): Males: 0.000337(L-11) (B-11) (HT-11) + 406.01, Females: 0.000400(L-11) (B-11) (HT-11) + 206.60. Mean, standard deviation and correlation coefficient between stature and the cephalic dimensions were determined for the male and female subjects using independent student t-test.

RESULTS

The mean cranial dimensions were also summarized in Table No.1. Sexual differences with respect to mean cranial breadth and mean auricular height were found to be insignificantly different ($P>0.05$). The mean cranial length was found to be significantly different ($P<0.05$). The male parameters above were all larger than the females but were only significantly different in the mean cranial lengths shown in Table No.1 above ($P<0.05$). The cranial capacities with respect to height and weight were found to be significantly different with the males larger than that of the females ($P<0.05$).

DISCUSSION

Studies have shown that cranial capacities accompany increasing age from birth as growth progresses. Most growth is achieved in the first 5 years[2]. Between the ages of 16 - 20 the cranial capacity varies and reaches its peak at age 20. It is thought that cranial capacity does not change its size during the rest of the life[8, 9].

Diverse craniometric approaches have been proposed and utilized to estimate the cranial capacity either on dry skulls or living subjects[5]. Over the course of this study cranial capacity was estimated based on the linear dimensions of the skulls. It was interesting to note that evaluation of results of a comparative study that employed three different approaches, namely, the stereologic, planimetric and cephalometry to assess the cranial volume, have demonstrated no statistically significant differences between such results[10].

The assessment of the cranial volume using cephalometry is reliable, relatively easy and quick to apply. Furthermore this approach has the added advantage as it does not require any sophisticated techniques. Taken together, cephalometry continues to be the most versatile technique in the investigations of the craniofacial skeleton[11, 12].

In this study it was observed that on the basis of the overall mean, the cranial capacity of both sexes was 1634.51. It was also observed that the cranial capacity of males (cc) was 1636.33 ± 109.94, while that of females was 1632.59 ± 149.44. The data obtained from this study shows to be larger than those observed by[2] of which mean cranial capacity of male skulls was found to be 1302.95 + 108.8 c.c. (range 1070 - 1560 c.c.), while in female skulls the

mean cranial capacity was found 1179.92 + 97.08 c.c. (range 1000 - 1420 c.c.).

It is also larger than that of[3,13-17] as stated respectively; males and females were 1252.857 ± 70.989 cc and 1094.441 ± 81.289 cc respectively[16], males and females were 1380.52±94.63 cc and 1188.75±91.16 cc respectively[17], in males and females were 1411.64+118.9 cm^3 and 1306.95+162.9 cm^3, respectively[18], Igbos had an average cranial volume of 1273.39 cm^3, that of the Urhobos was 1255.89 and 1310.08 cm^3 for the Edo people[14]. Also the cranial capacity of male (1334.34 cm^3) was significantly different from that of female (1204.54 cm^3) in all the studied tribes, male being larger than that of female the cranial capacity for male were 1421.12 ± 171.69 and females 1300.95 ± 158.18[15], males; 1410.832± 162.405cc and that of females; 1443.212 ± 154.283cc[13]. In the study by[13], the cranial capacity of females was slightly higher than that of the males (Table No.2).

Results in[2, 17] were classified into megacephalic, mesocephalic and microcephlic skulls. The linear regression models proposed for the prediction of cranial capacity are valid for the age group (18-30 years) of the study population. It has been clearly stated that cranial capacity varies with the age of an individual reaching its peak volume around 16-20 years of life[8, 9] (Figure No.1-6).

Table No.1: Showing Cranial dimensions of the study subject

S.No	Characteristics	Male	Female	P value	T value
1	Total number	257	243	500	500
2	Cranial capacity (cc)	1636.33 ± 109.94	1632.59 ± 149.44	0.76	-0.32
3	Cranial length (mm)	196.69 ± 7.47	193.16 ± 9.68	0.00	-4.54
4	Cranial breadth(mm)	159.97 ± 6.20	159.32 ± 7.60	0.30	-1.04
5	Auricular height(mm)	142.97 ± 8.76	142.81 ± 7.74	0.83	-1.22
6	Height	176 ± 6.06	166.54 ± 6.22	0.00	17.20
7	Weight	70.57 ± 8.48	63.36 ± 10.6	0.00	-8.29

Table No.2: Correlation coefficient between cranial dimensions and the cranial capacities

S.No	Parameters	Male	Female	Both sex	P value
1	cc and cranial length	0.507*	0.675*	0.602*	0.00
2	cc and cranial breadth	0.495*	0.681*	0.608*	0.00
3	cc and auricular height	0.719*	0.573*	0.627*	0.00

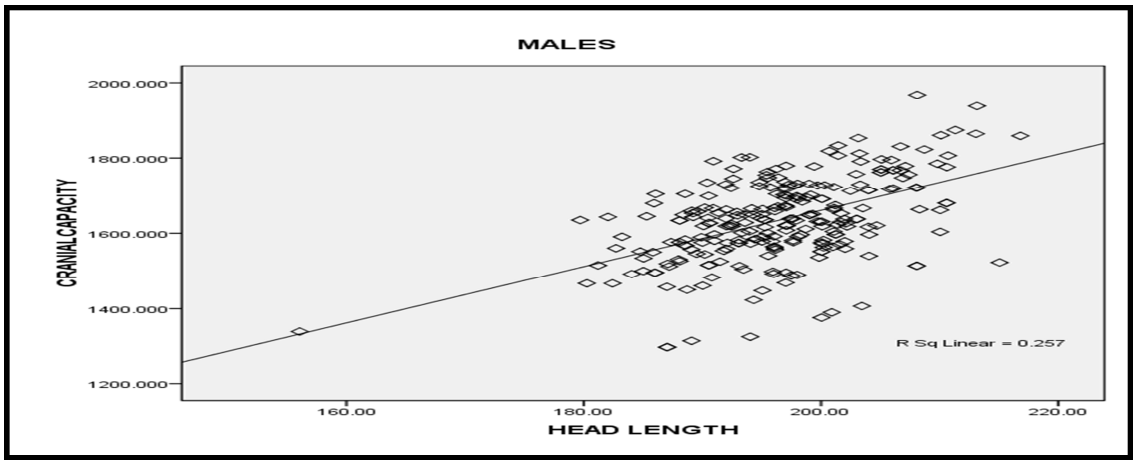

Figure No.1: Scatter plots and regression lines demonstrating the relationships between cranial capacity and head dimensions are illustrated in the figures below

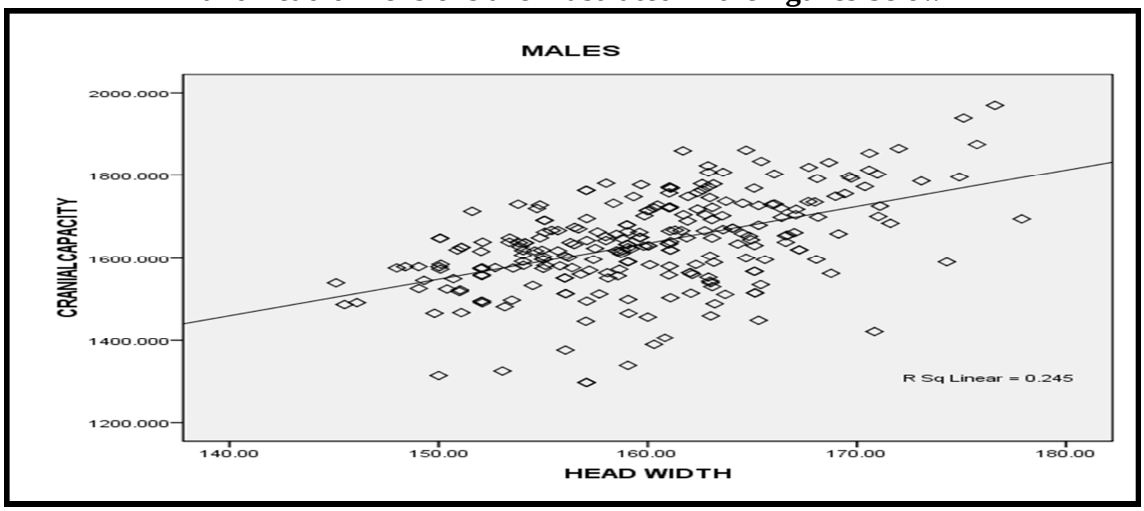

Figure No.2: Scatter plots and regression line showing relationships between cranial capacity and cranial length for males

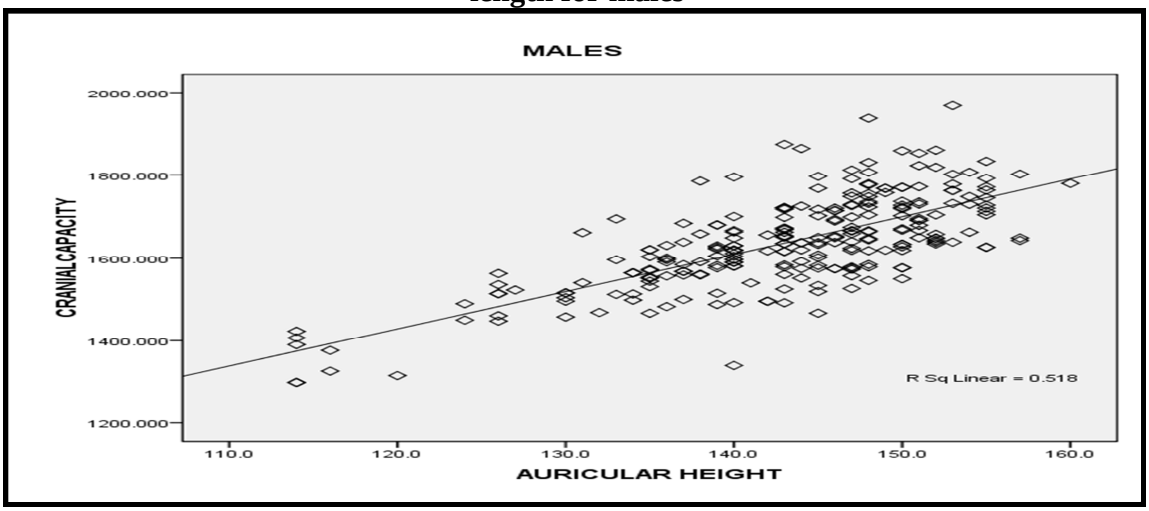

Figure No.3: Scatter plots and regression line showing relationships between cranial capacity and cranial breadth for males

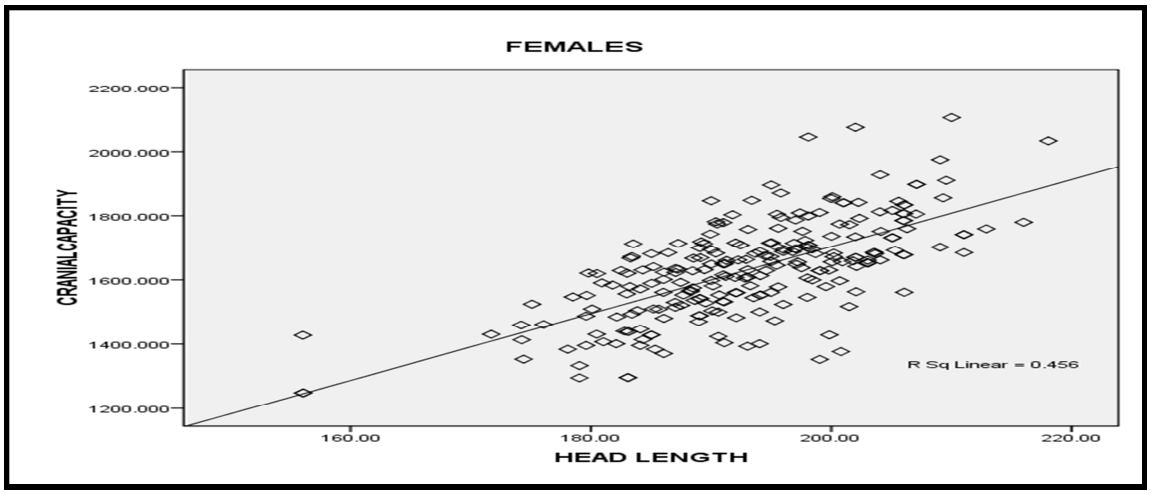

Figure No.4: Scatter plots and regression line showing relationships between cranial capacity and auricular height for males

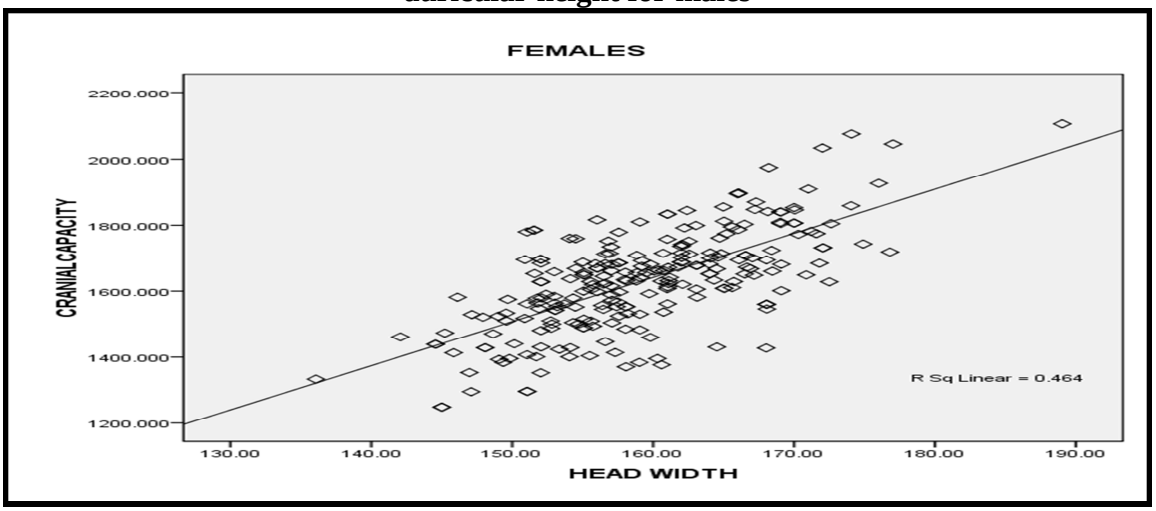

Figure No.5: Scatter plots and regression line showing relationships between cranial capacity and cranial length for females

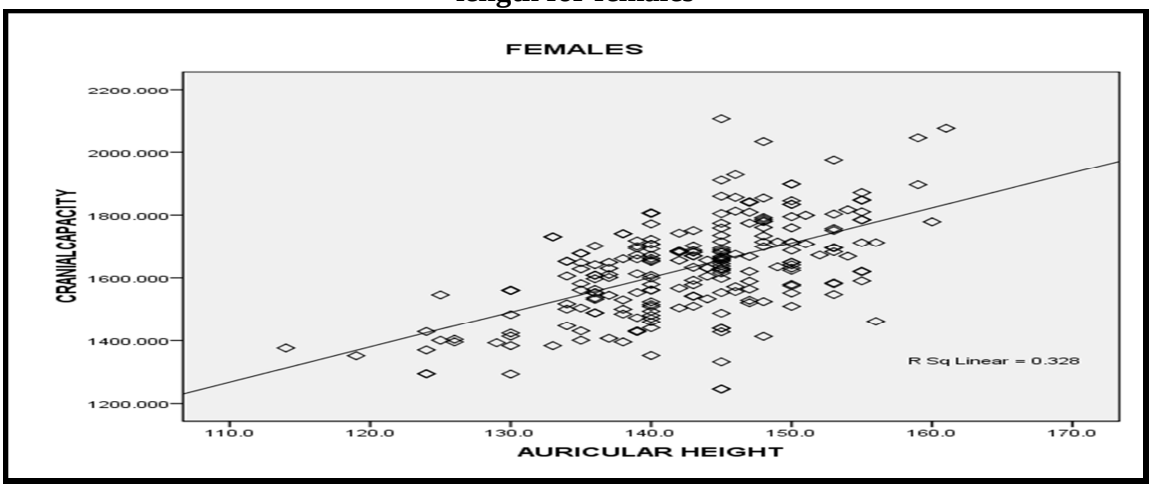

Figure No.6: Scatter plots and regression line showing relationships between cranial capacity and cranial breadth for females

CONCLUSION

Studies have shown that there are positive correlations between age and cranial capacity. Several studies have estimated that cranial capacity indirectly reflects the brain volume in different countries and is affected by gender, race, ethnic, geographical, biological and ecological factors. We also conclude that cranial capacity of the population of study is also affected by gender, race, ethnic, geographical, biological and ecological factors.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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