

Anthropometric Comparison of Cephalic Indices Between Fulani and Hausa Ethnic Groups in Ringim Local Government Area of Jigawa State Nigeria

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Abstract

The Fulani and Hausa are two prominent ethnic groups in West Africa, each with distinct cultural and historical backgrounds. The aim of this study is to compare the cephalic index between two ethnic groups Hausa and Fulani in order to gain a better understanding of the diversity of cranial shapes and sizes. The participants were visited in their various homes and workshops by the principal investigator. A consent form was filled by each of the participants before their measurements were taken. The research instrumentation was carried out by measuring the Bi-Parietal and Occipitofrontal diameters by placing the flexible metal tape snugly around the head, above the ears and eyebrows from the most posterior aspect of the head to the most frontal aspect of the head and the protuberances of the parietal bones. All measurement was taken with the subject sitting on a chair, in a relaxed mood and the head in the anatomical position. Cephalic index was calculated as biparietal diameter/length of cranium X 100. The data was subjected to statistical analysis using a t-test. The result suggest that there is a significant difference in the cranial morphology of the Hausa and Fulani, with the Hausa's having longer head length and more rounded cranial shape compared to the Fulani's. Conclusion: The study found significant differences in cranial morphology between the Hausa and Fulani ethnic groups in Ringim Local Government Area of Jigawa State, Nigeria. The Fulani ethnic group had significantly higher mean values for head length, head breadth, and cranial capacity compared to the Hausa ethnic group. These differences may have implications for healthcare delivery and resource allocation, as well as for our understanding of cranial morphology in relation to other areas of human biology and behavior.

Keywords: *cephalic index, Fulani, Hausa, West Africa, anthropometry, population diversity*

Introduction

Measurements are important tools for comparison. In order to achieve a more objective racial assessment, metric studies have long been practiced. Internationally accepted techniques of craniometry/cephalometry have promoted a large number of comparable data for male and female.¹ Anthropometry involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptions of body size and shape, it is the study of the

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measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. Actual stature, weight, and body measurements (including skinfolds and circumferences) will be collected for purposes of assessing growth, body fat distribution, and for the provision of reference data. Cephalic index is a useful anthropometric parameter utilized in the determination of racial variations. It is also used to determine sexual differences especially in individuals whose identities are unknown. It is one of the clinical anthropometric parameters recognized in the investigation of craniofacial skeletal deformities and brain development because of its validity and practicality.²

A study has shown that the people of Gurung community of Nepal of India are brachycephalic with cephalic index of 80.42. Bhils and Barelals are mesocephalic (76.98 & 79.80).³ The mean cephalic index of 79.68 has been reported for Bhils race.⁴ Cephalic index is an important parameter useful in establishing racial and sexual dimorphism, data obtained from such measurements have been very useful in differentiating people of different ethnic backgrounds, nutritional status, and gender. Several measurable anthropometric parameters or variables have been developed over the years for establishing possible differences amongst different groups. Cephalic index is one of such very useful measurable anthropometric variables used in physical anthropology to determine geographical gender, age, and racial and ethnic variations. Comparison of changes in cephalic index between parents, offspring, and siblings gives clues to genetic transmission of inherited characters or traits which play a role in forensic science.⁵

Materials and Methods

Study Location

This study was conducted in Ringim Local Government area which is a Village in Jigawa state, Nigeria.

Study Population

This study is focused on the youths of the Hausa and Fulani ethnic groups residing in Ringim, local government, Jigawa State. Data for the study was collected from 400 subjects (200 Males and 200 Females) aged 25-40 years.

Ethical Consideration

Ethical approval was obtained from Department of Human Anatomy, Federal University Dutse Research Ethics Committee and permission to conduct the study was obtained from the authorities of participating areas within Ringim town. Permission was obtained from district heads and subjects volunteered to participate in the study. Only subjects who gave informed consent to participate with the research were included in this study.

Study Design and Sampling Technique

A cross-sectional study design was adopted in this research. Simple random sampling was employed to select samples.

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Sample Size Determination

The total number of subjects to be included in the study was calculated from the formula below:

$$n = z^2 pq / d^2 \quad (\text{Naing and Rusli, 2006})$$

where

n = the desired sample size

z = the standard normal deviate, usually set at 1.96 (≈ 2.0)

p = the proportion in the target population having the particular trait (when no estimate 50% is used; i.e 0.50)

$$q = 1.0 - p$$

d = degree of accuracy desired, usually set at 0.05

$$\text{Thus } (1.96)^2 (0.5)(0.5) / (0.05)^2 = 384$$

Thus, a minimum number of 384 participant have been used in this study in order to draw valid conclusions from it. However, a total of 400 males and females participants were recruited for the purpose of this study.

Inclusion Criteria

1. Subjects of age >20 years
2. Subjects with no history of craniofacial trauma
3. Subjects with no cranial deformity

Exclusion Criteria

1. Individuals of age < 20
2. Subjects with no history of craniofacial trauma
3. Subjects with cranial deformity and congenital defect

Method of Data Collection

The participants were visited in their various homes and workshops by the principal investigator. A consent form was filled by each of the participants before their measurements were taken. Anthropometric data included the Biparietal diameter (BPD) and Occipitofrontal diameter (OFD) of the skull. The research instrumentation was carried out by measuring the Biparietal and Occipito-frontal diameters by placing the flexible metal tape snugly around the head, above the ears and eyebrows from the most posterior aspect of the head (external occipital protuberance) to the most frontal aspect of the head (glabella of the frontal bone) and the protuberances of the parietal bones. All measurement was taken with the subject sitting on a chair, in a relaxed mood and the head in the anatomical position. Cephalic index was calculated as bi-parietal diameter/length of cranium X 100. The data was subjected to statistical analysis using a z-test,

Data and Statistical Analysis

Data was collected and sorted out in Microsoft Excel before analysis. All analyses were done by appropriate statistical methods. IBM Statistical Package (SPSS 20.0) was used to analyze the data.

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Mean value for age, head diameter, head breadth and cephalic index was calculated, presented, analyzed and critically evaluated using suitable descriptive and inferential statistical methods. Results were presented as mean \pm standard deviation (SD). An independent sample t-test will be performed to reckon sexual dimorphism in head length, head breadth and cephalic index of male and female subjects in the study and between the ethnic groups participated for the study.

Results

The demographic characteristics of the samples as revealed from table 1 below, indicated that there were equal participants in the study with males 200 (50%) as there are females 200 (50%). Participants of age range between 20-30 years (70.5%) are more compare to the older age of 30-40 years (29.5%). The total Hausa participants were equal with the Fulani participants.

Table 1: Demographic characteristics of the participants

Characteristics	Frequency	Percentage (%)
Sex		
Male	200	50
Female	200	50
Total	400	100
Age		
20-30	282	70.5
30-40	118	29.5
Total	400	100
Ethnicity		
Hausa	200	50
Fulani	200	50
Total	400	100

Table 2 shows the mean head length, head breadth and cephalic index of the total population of Ringim town. The average maximum head length and head breadth were found to be 19.27 ± 1.25 cm and 18.66 ± 1.92 cm respectively while the mean cephalic index was found to be 103.26 ± 0.26 .

Table 2: Mean head length, head breadth and cephalic index of the subjects

Variables	N	Mean	SD
Head length	400	19.27	1.25
Head breadth	400	18.66	1.92
Cephalic index	400	96.83	0.23

Table 3 revealed the results of sexual dimorphism among the variables. The mean head length was 18.93 ± 1.28 and 16.22 ± 0.82 for males and females respectively. The head breadth result shows an average value of 19.65 ± 7.22 for male and 13.39 ± 2.18 for female. Also, the cephalic index was 103.59 ± 2.88 for males and 82.55 ± 0.31 for females. There was statistically significant difference in the mean head length of the groups ($t=4.91$, $P<0.05$) and head breadth ($t=6.28$, $P<0.05$).
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P<0.001) in both males and females' subjects. Also, there was significant difference in the mean cephalic index of males and females' subjects (t=11.37, P<0.01).

Table 3: Sexual dimorphism in head length, head breadth and cephalic index of the subjects

Variables	N	Sex	Mean	SD	t-value	P-value
Head length	200	Male	18.93	1.28	4.9	<0.05
	200	Female	16.22	0.82		
Head breadth	200	Male	19.65	7.22	6.28	<0.001
	200	Female	13.39	2.18		
Cephalic index	200	Male	103.59	2.88	10.37	<0.001
	200	Female	82.55	0.31		

The results of an independent sample t-test among the two tribes (Hausa and Fulani) show that the mean head length was 19.22 ± 6.39 for the Hausa tribe while 17.97 ± 5.22 for Fulani. The head breadth result shows an average value of 20.65 ± 7.41 and 18.52 ± 7.37 for Hausa and Fulani respectively. Also, the cephalic index was 107.44 ± 1.91 for Hausa and 103.06 ± 2.09 for Fulani. There was significant difference in the mean head length (t=3.21, P<0.05) and head breadth (t=2.93, P<0.05) of the two ethnic groups. Also, there was significant difference in the mean cephalic index of both Hausa and Fulani (t=3.94, P<0.05).

Table 4: Variation in head length, head breadth and cephalic index in Hausa and Fulani

Variables	N	Tribe	Mean	SD	t-value	P-value
Head length	227	Hausa	19.22	6.39	3.21	<0.05
	173	Fulani	17.97	5.22		
Head breadth	227	Hausa	20.65	7.41	2.93	<0.05
	173	Fulani	18.52	7.37		
Cephalic index	227	Hausa	107.44	1.91	3.94	<0.05
	173	Fulani	103.06	2.09		

Discussion

This study was conducted among Hausa and Fulani ethnic groups in Ringim town of Jigawa State. The study revealed that the average maximum head length and head breadth were found to be 19.27 ± 1.25 cm and 18.66 ± 1.92 cm respectively while the mean cephalic index was found to be 103.26 ± 0.26 . Based on the data presented in Table 1, it can be observed that the study population is evenly distributed in terms of sex, with 50% male and 50% female participants. This indicates that the sample is representative of both genders in the target population. Regarding age, the majority of participants (70.5%) fall within the 20-30 age range, while a smaller proportion (29.5%) are between 30-40 years old. This suggests that the study population is predominantly

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young adults. In terms of ethnicity, the study population is also evenly divided between Hausa and Fulani participants, with each group accounting for 50% of the sample. This ensures that the findings of the study are applicable to both ethnic groups and can be generalized to a wider population. Overall, the demographic characteristics of the participants appear to be representative of the target population, which increases the validity and reliability of the study's findings.

The data presented in Table 2 provides information on the mean head length, head breadth, and cephalic index of the study population. The sample size is 400, which is large enough to provide reliable estimates of the population parameters. The mean head length is 19.27 cm, with a standard deviation of 1.25 cm. This value falls within the normal range for head length in young adults, which is typically between 18 and 22 cm. The variability in head length, as measured by the standard deviation, is relatively small, indicating that the sample is homogeneous in terms of head length. The mean head breadth is 18.66 cm, with a standard deviation of 1.92 cm. Again, this value falls within the normal range for head breadth in young adults, which is typically between 17 and 21 cm. The variability in head breadth, as measured by the standard deviation, is slightly higher than that of head length, indicating that there is more variability in head breadth within the sample. The cephalic index, which is calculated by dividing head breadth by head length and multiplying by 100, is 96.83. This value falls within the normal range for cephalic index in young adults, which is typically between 75 and 95. The variability in cephalic index, as measured by the standard deviation, is very small, indicating that the sample is homogeneous in terms of cranial shape. Overall, these findings suggest that the study population has normal cranial morphology, with no significant deviations from the norm in terms of head length, head breadth, or cephalic index. This information can be useful for comparing cranial morphology between different populations or for identifying any potential abnormalities or pathologies related to cranial morphology.

Table 3 presents data on sexual dimorphism in head length, head breadth, and cephalic index among the study population. The sample size for each sex is 200, which is large enough to provide reliable estimates of the population parameters. The results show that there is a significant difference in head length between males and females (t -value = 4.9, p -value < 0.05). Males have a significantly longer head length (mean = 18.93 cm) than females (mean = 16.22 cm). This finding is consistent with previous studies that have reported a significant difference in head length between males and females.

In contrast, there is a significant difference in head breadth between males and females (t -value = 6.28, p -value < 0.001). Males have a significantly wider head breadth (mean = 19.65 cm) than females (mean = 13.39 cm). This finding is also consistent with previous studies that have reported a significant difference in head breadth between males and females. The results also show a significant difference in cephalic index between males and females (t -value = 10.37, p -value < 0.001). Males have a significantly higher cephalic index (mean = 103.59) than females (mean = 82.55). This finding suggests that male cranial shape is more rounded or brachycephalic, while female cranial shape is more elongated or dolichocephalic. Overall, these findings suggest that there are significant sexual dimorphisms in cranial morphology, with males having longer head lengths, wider head breadths, and more rounded cranial shapes compared to females. These differences may be related to genetic, hormonal, or environmental factors that influence cranial

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development during childhood and adolescence. Table 4 presents data on variation in head length, head breadth, and cephalic index between the Hausa and Fulani ethnic groups.

Overall, these findings suggest that there are significant differences in cranial morphology between the Hausa and Fulani ethnic groups, with the Hausa having longer head lengths and more rounded cranial shapes compared to the Fulani.⁶⁻⁸ These differences may be related to genetic, environmental, or cultural factors that influence cranial development during childhood and adolescence.

Conclusion

The study found significant differences in cranial morphology between the Hausa and Fulani ethnic groups in Ringim Local Government Area of Jigawa State, Nigeria. The Fulani ethnic group had significantly higher mean values for head length, head breadth, and cranial capacity compared to the Hausa ethnic group. These differences may have implications for healthcare delivery and resource allocation, as well as for our understanding of cranial morphology in relation to other areas of human biology and behavior.

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