

Pattern of Brain Weight in Three West African Populations

[Üç Batı Afrika Halkının Beyin Ağırlığı Örnekleri]

SUMMARY

AIM: The usefulness of brain weight in facilitating proper identification of skeletal remains and in emphasizing a common origin of studied populations is far reaching.

METHODS: This study involved 699 (male 361; female 338) volunteers whose age ranged 18 years and over. Respondents were selected along three ethnic groups including Urhobo (male 156; female 147), Ibo (male 141 female 145) and Edo (male 64; female 46) and it was ensured that population for the study was collected using a random stratified method.

RESULTS: The brain weight was measured using standard techniques and the mean weight was observed to be 1318g±139.71g with maximum value of 1711.00g and minimum value of 958.42g. Gender had a significant effect on brain weight (p<0.05). Male and female values were significantly different (p<0.05). Mean male values were 1386.18g and mean female values were 1251.62g. Brain weight exhibited strong sexual dimorphism and was useful in differentiating inter and intra population groups. In spite of these observations, differences which enabled intracultural differentiation commonly occurred.

CONCLUSION: Inevitably therefore, craniometric studies are most essential in the study of population dynamics especially with respect to quantitative variables.

ÖZET

AMAÇ: Beyin ağırlığının kullanımı, üzerinde çalışılan grubun iskelet kalıntılarının kimliklendirilmesinde ve nüfusun ortak kökeninin vurgulanmasında kullanılmaktadır.

METOD: Bu çalışmaya yaşları 18 ve üzerine olan 699 kişi (361 erkek, 338 kadın) katılmıştır. Katılımcılar üç farklı halktan Urhobo (erkek 156; kadın 147), Ibo (erkek 141 kadın 145) ve Edo (erkek 64; kadın 46) tabakalı örnekleme yöntemi kullanılarak seçilmiştir.

BULGULAR: Beyin ağırlığı standart teknik kullanılarak ölçülmüş, 1318g±139.71g arasında değerler aldığı, en yüksek değerin 1711.00g ve en düşük değerin 958.42g olduğu saptanmıştır. Cinsiyet beyin ağırlığı üzerinde anlamlı bir etkiye sahiptir (p<0.05). Erkek ve kadınların beyin ağırlıkları anlamlı bir şekilde farklıdır (p<0.05). Erkeklerde ortalama değerin 1386.18g, kadınlarda ortalama değerin 1251.62g olduğu tespit edilmiştir. Beyin ağırlığı güçlü cinsel dimorfizm göstermekte ve grup içi ve gruplar arası ayrımında kullanılmaktadır. Bu gözlemlere rağmen, etkin kültürlerarası farklılaşmadan kaynaklanan farklılıklar çoğunlukla oluşmuştur.

SONUÇ: Bu nedenden dolayı ve kaçınılmaz olarak, kraniyometrik çalışmalar özellikle nicel değişkenler açısından, nüfus dinamikleri çalışmalarının en önemli bileşenidir.

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INTRODUCTION

Knowledge of the cranium of either a dry skull or of a living being is of significant importance to the study and comparison of populations with various fundamental differences like racial, geographic, ethnic and dietary characteristics. Medically, an analysis of cranial capacity expresses another aspect of growth and development and permits critical evaluation of unusually large, small or misshapen crania (1).

Craniometric data is used in mainstream science to compare modern-day animal species, and to analyze the evolution of the human species in archeology. Fossil hominids are often found fragmented and are reconstructed upon a paradigm according to the law of correlation (2).

Several craniometric studies involving Caucasian, mongoloid and Americans have been conducted. As far as we know, very scant study, if any, on cranial capacity has been conducted cranial capacity in the studied populations. Forensic science involving cranial measurements is a growing science and it is gaining grounds in this area were this study was conducted and this will no doubt be very useful in facilitating proper identification of skeletal remains. More so, it will further emphasize a common origin of studied cultures and may be prove as a tunic for their development.

Attempts at explaining homogeneity of African populations have led to a number of studies (3-5) suggested that despite the general opinion that Africans did appear to be homogenous in certain morphologic characteristics, observed polymorphisms where far from homogenous. In another study, (6)

explained that the variations of craniometric characteristics were distinctly different from the previous racial categorizations of Africans (7-8). Through skull morphology, population differentiation has been explored previously by three main recent studies (3,4,6,9) showing that not only vault features but also various facial characteristics are responsible for both inter and intra-regional differences within sub-Saharan Africa (10-12) highlighted on inter- and intra-population variability in sub-Saharan Africa.

MATERIALS AND METHODS

The sample population for this study included 699 (male 361; female 338) volunteers both male and female whose age ranged from between 18 years and over. Data was obtained from persons whose parents and grand parents were of Nigerian origin and showed no obvious physical defect. Respondents were selected along three culture lines of Urhobo (male; female), Ibo (male; female) and Edo (male; female) speaking people and it was ensured that population for the study was collected using a random stratified method. Sample size for studies of this nature was determined using a standard formula (13). Finally, multivariate analyses (MANOVA), between the studied cultures were then made for assessment of differences or similarities.

Formulae

Brain weight;

Brain weight=the product of cranial capacity and 1.035, where 1.035 is the mass density of the brain.

Where cranial capacity (cc)

= $(0.00037(L-11) (B-11) (HT-11)+406.01$ ---males

= $(0.000400(L-11) (B-11) (HT-11)+206.60$ --females (Lee and Pearson, 1901)

1. Maximum head length (L) (Glabellar to inion length) in (cm)

2. Maximum head breadth (B) (Distance between the two parietal eminences) in (cm)

3. Auricular Height (HT) (External acoustic meatus to the highest point of the vertex) in (cm)

4. Cranial capacity (cc)

The means obtained from the above variables were then subjected to analyses of variance (ANOVA) for comparison within cultures. Sample size for this study was determined using a standard formula; $n=(Z\Omega)^2 (P (1-P)/B)^2$, Where $Z\Omega=1.96^*$, $P=0.05$, $B=0.02=(1.96)^2 (0.05) (0.95)/(0.02)^2=456$

*Within ± 2 standard deviation's equals 0.02 (13).

Only individuals between the ages of 18 and 33 years were used for the study since little or no morphological change was expected in the skulls of such individuals normally. Sexual variation had previously been shown to affect gross cranial patterns hence the data was separated along gender lines

Guidelines for this study conformed to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000), (14).

RESULTS

Measurement of brain weight (BW) showed that the mean value was $1316.08g \pm 144.25g$ (table 1a). Tribe had a significant effect on brain weight at 0.05 levels of significance. Gender also had a significant effect on BW at 0.05, 0.01 and 0.001 levels of significance (table 1b). Mean separation showed that the brain weight of Ibo and Urhobo tribes were similar and were both significantly different from the Edo people (table 1c). Also the brain weights of male were significantly different from those of female, $p < 0.05$ (table 1d). The mean brain weight of Edo people was $1355.93 g \pm 133.27g$ (table 2a). The mean brain weight of Ibo's was 1317.96 ± 139.71 (table 2b). The mean brain weight of Urhobo's was $1299.84g \pm 149.72kg$ (table 2c).

Table 1a. Mean Brain Weight of the combined data

R-Square	Coeff Var	Root MSE	BW Mean
0.41	9.38	123.40	1316.08

Table 1b. Effect of tribe, age and gender on brain weight

Source Value	DF	Type III SS	Mean Square	F	Pr>F
Tribe	2	117187.98	58593.99	3.85	0.02
Age	48	892691.98	18597.75	1.22	0.15
Gender	1	603123.69	603123.69	39.61	<.0001

Table 1c. Mean brain weight showing variation between the three studied tribes

Grouping	Mean	N	Tribe
A	1355.93	110	Edo
B	1317.96	286	Ibo
B	1299.85	303	Urh

Means with the same letter are not significantly different.

Table 1d. Mean gender brain weight variation of the combined population

Duncan Grouping	Mean	N	Gender
A	1381.05	361	M
B	1246.70	338	F

Means with the same letter are not significantly different.

Table 2a. Mean brain weight of Edo's

R-Square	Coeff Var	Root MSE	BW Mean
0.507111	7.636123	103.5402	1355.926

Table 2b. Mean brain weight of Ibo's

R-Square	Coeff Var	Root MSE	BW Mean
0.41	9.39	123.81	1317.96

Table 2c. Mean brain weight for Urhobo's

R-Square	Coeff Var	Root MSE	BW Mean
0.370264	9.946910	129.2947	1299.847

DISCUSSION

Intercultural comparisons have also demonstrated significant variation as reported by (3-5). There was no difference between the mean brain weight of the Ibo's and Urhobo's. The brain weight of the Edo's was, however, significantly different from that of the Ibo's and the Urhobo's. This may be attributable to a common ancestral origin of the Ibo and Urhobo people or inter marriages which are very common between these cultures with interchange of physical characteristics over the years since these people were cordial neighbours. Also the brain weight of male was significantly different from that of female in all the studied tribes, male being larger than that of female $p < 0.05$. This important characteristic which was also previously observed (15) is very important in sex determination and could be explained by the generally bigger frame of the average male than the average female. Moreover, it has been shown that gender differences in brain weight could be attributed to activities in which the specific sex excelled (13). Thus brain weight has demonstrated strong gender dimorphic patterns. In this light, individuals from the studied populations can be differentiated from those of other races and perhaps African groups. Finally, for the first time as far as we know, the brain weight of the three studied tribes have been studied and this

will know doubt add to existing literature on brain weight measurements.

CONCLUSION

The values for the mean brain weight were in direct proportion with that of cranial capacity. The mean weight was observed to be $1318g \pm 139.71g$ with maximum value of 1711.00g and minimum value of 958.42g. Gender had a significant effect on brain weight ($p < 0.05$). Male and female values were significantly different ($p < 0.05$). Mean male values were 1386.18g and mean female values were 1251.62g. From this study also, it was observed that Brain weight reflected significant sexual features and may be very important in gender differentiation.

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