Global Advanced Research Journal of Medicine and Medical Sciences (ISSN: 2315-5159) Vol. 5(4) pp. 109-115, April, 2016
Available online http://garj.org/garjmms

Full Length Research Paper

Anthropometric Study of Cephalic Index of adult *Tiv* and *Idoma* ethnic groups of North Central Nigeria

Terkula Kpela[1]*, B. Danborno[2], S.S. Adebisi[2], S.A. Ojo[3]

[1]Department of Anatomy, College of Health Sciences, Benue State University, Makurdi, Nigeria.
[2]Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria, Nigeria.
[3]Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.

Accepted 15 April, 2016

Cephalic index is useful in establishing ethnic differences and affiliations. The aim of this study was to calculate cephalic index from head measurements and determine the predominant anatomical head forms of *Tiv* and *Idoma* ethnic groups with inter-ethnic comparison. The sample consisted of 828 volunteers aged 18-32 years drawn from the two ethnic groups, out of whom 418 were *Tiv* (218 male, 200 female) and 410 were *Idoma* (222 male, 188 female). The protocol was approved by Ahmadu Bello University Teaching Hospital, Zaria and participants gave informed consent. Demographic data was collected through self-administered questionnaire and head length and head breadth was measured to calculate cephalic index. Data was analyzed using statistical package SPSS for windows version 20 (IBM Corporation, New York, USA). Descriptive statistics and independent sample t-test for comparison of mean in two groups were used. Statistical significance was considered at $p<0.05$. The mean cephalic index in male and female *Tiv* subjects was 85.0±4.94 and 83.8±6.40 while that in male and female *Idoma* subjects was 84.5±5.28 and 82.7±6.58 respectively. The two ethnic groups exhibited sexual dimorphism with respect to cephalic index with males having significantly higher values than females ($p<0.05$). When cephalic indices of both ethnic groups were compared, there was no statistically significant difference ($p>0.05$). In both ethnic groups, brachycephalic head type was the most prevalent (47.4% and 41.7%) and dolichocephalic type was the least prevalent (0.7% and 2.9%) for *Tiv* and *Idoma* respectively. The result showed that on the basis of cephalic index and the predominant anatomical head type, there was similarity between the two ethnic groups. There is need to conduct genetic studies to backup these observed morphometric similarities.

Keywords: anthropometric, cephalic index, brachycephalic, *Tiv*, *Idoma.*

INTRODUCTION

Cephalometrical techniques summarize the anatomical complexes of the head of persons living within a similar geography for objective deductions rather than subjective impressions. These recordings yield a numerical expression which is important in evaluating population by comparison of head form (Shah *et al.*, 2015).

The first classification based on cranial morphology is attributed to the professor of anatomy Anders Retzius (1840). Retzius described as *gentes dolichocephalae* those individuals who had an elongated skull shape, and *gentes brachycephalae* those whose skulls were short

*Corresponding Author Email: kpelaterkula@gmail.com dookpelu@yahoo.com; Mobile: +234 806 783 8483

but he never, at that time, assigned numerical values to distinguish one category from the other (Franco *et al*., 2013). An application of Retzius's measures to living individuals is known as cephalic index while application to the dry skulls is known as cranial index. Either way, the indices are calculated as ratio of maximum width and maximum length of the head or skull (Safikhani *et al*., 2007; Franco *et al*., 2013; Torres-Restrepo *et al*., 2014). The concept was subsequently enhanced with the addition of intermediate values and terms that provide a classification system which reflects more accurately the diversity found in human head morphology (Farkas *et al*., 2005). The five internationally recognized head types based on cephalic index using the Martin-Saller scale are: ultrabrachycephalic, hyperbrachycephalic, brachycephalic, mesocephalic and dolichocephalic head types (Rexhepi and Meka, 2008; Franco *et al*., 2013; Shah *et al*., 2015).

Dolicocephalic head ("Long head" type): Type of head shape that describes an individual that has a narrower cranial width and usually presents with a long, narrow shape and high mandibular plane angle. The calculated cephalic Index for this group is <74.9% (Del Sol, 2005; Williams *et al*., 1995).

Mesocephalic head ("Medium head" type): Type of head shape describing an individual that falls between the brachycephalic and dolicocephalic types and has an average cranial width. The calculated Cephalic Index is usually between 75-79.9% (Del Sol, 2005; Williams *et al*., 1995).

Brachycephalic head ("Short broad head" type): This describes an individual with a larger than average cranial width and usually presents with a broad, square head shape and low mandibular plane angle. The calculated Cephalic Index ranges between 80-84.9% (Williams *et al*., 1995).

Hyperbrachycephalic head ("Very short broad head" type): Sometimes is also considered to be part of brachycephaly. This describes a larger than average cranial width. Also presents with a broader, square head shape than in brachycephaly. Here the calculated cephalic index is above 85% (Del Sol, 2005; Williams *et al*., 1995).

Ultrabrachycephalic head ("extremely short and unusually broad head" type): it is an extreme form of brachycephaly with calculated cephalic index above 90% (Shah *et al.,* 2015).

Nigeria is a nation with such a complex and varied ethnic composition of its population. Ethnic differences in cephalic indices among many populations have been demonstrated in Nigeria (Odokuma *et al*., 2010; Umar *et al*., 2011; Maina *et al*., 2011; Eliakim-Ikechukwu *et al*., 2012; Esomonu and Badamasi, 2012). Similarly, many reported works have been published on cephalic index of various ethnic populations around the world (Alves *et al*., 2011; Jadav *et al*., 2011; Maria and Manjunath, 2011; Salve *et al*., 2011; Kiran *et al*., 2012; Yagain *et al*., 2012; Doni, 2013; Kanan *et al*., 2013; Khair *et al*., 2013; Mehta *et al*., 2014; Patro *et al*., 2014). Cephalic index has been used in determination of racial affinity (Ilayperuma, 2011) and sexual differences (Ilayperuma, 2011; Maina *et al*., 2011; Kumar and Lone, 2013) and cephalic index in various pathological conditions has also been studied (Fawehinmi and Ligha, 2011; Maria and Manjunath, 2011; Musa *et al*., 2014).

The need for the study of morphological head forms and cephalic indices of *Tiv* and *Idoma* ethnic groups of Central Nigeria has not come under much attention so far. The *Tiv* people, numbering about 2.5 million individuals according to 1991 census, are said to be of Bantu origin from the Central African continent, in the *Shaba* area of the present Democratic Republic of Congo (Shii, 2011). The *Idoma* people, numbering slightly over one million by the 1991 census figures, reportedly migrated from *Apa* in Kwararafa Kingdom after its disintegration (Udo, 1970). In view of the paucity of anthropometrical research on these ethnic groups, this study was carried out to calculate cephalic indices from head measurements and determine the predominant head forms of these ethnic groups with inter-ethnic comparison. The result would provide anthropometric data on *Tiv* and *Idoma* adults which could be useful in forensic medicine, plastic surgery, orthodontics, clinical diagnosis and treatment planning. The observations and findings of this study would provide platforms for similar extended studies in other ethnic groups for comparison and categorization.

MATERIALS AND METHODS

This cross-sectional study was conducted on 828 subjects out of whom 418 were *Tiv* (218 males and 200 females) while 410 were *Idoma* (222 males and 188 females). The subjects considered for this study all belonged to either *Tiv* or *Idoma* ethnic group with two generations of indigenization between the ages of 18-32 years. They were born and brought up in Nigeria to harmonize effects of environmental factors. The subjects were healthy individuals free from any apparent skeletal deformity. Subjects with physical deformity, those with craniofacial trauma and those with obstructive hairstyle were excluded from the study. Approval for this study was obtained from Ahmadu Bello University Teaching Hospital's ethical committee and consent was obtained from each respondent. A set of questionnaire comprising the demographic profile, ancestral background and other necessary information were verified before considering volunteers for inclusion. Measurements on the subjects were taken by locating appropriate anatomical landmarks. All the measurements were taken thrice and mean was calculated to ensure accuracy of the measurements. All the measurements were taken following the techniques of Singh and Bhasin (1989).

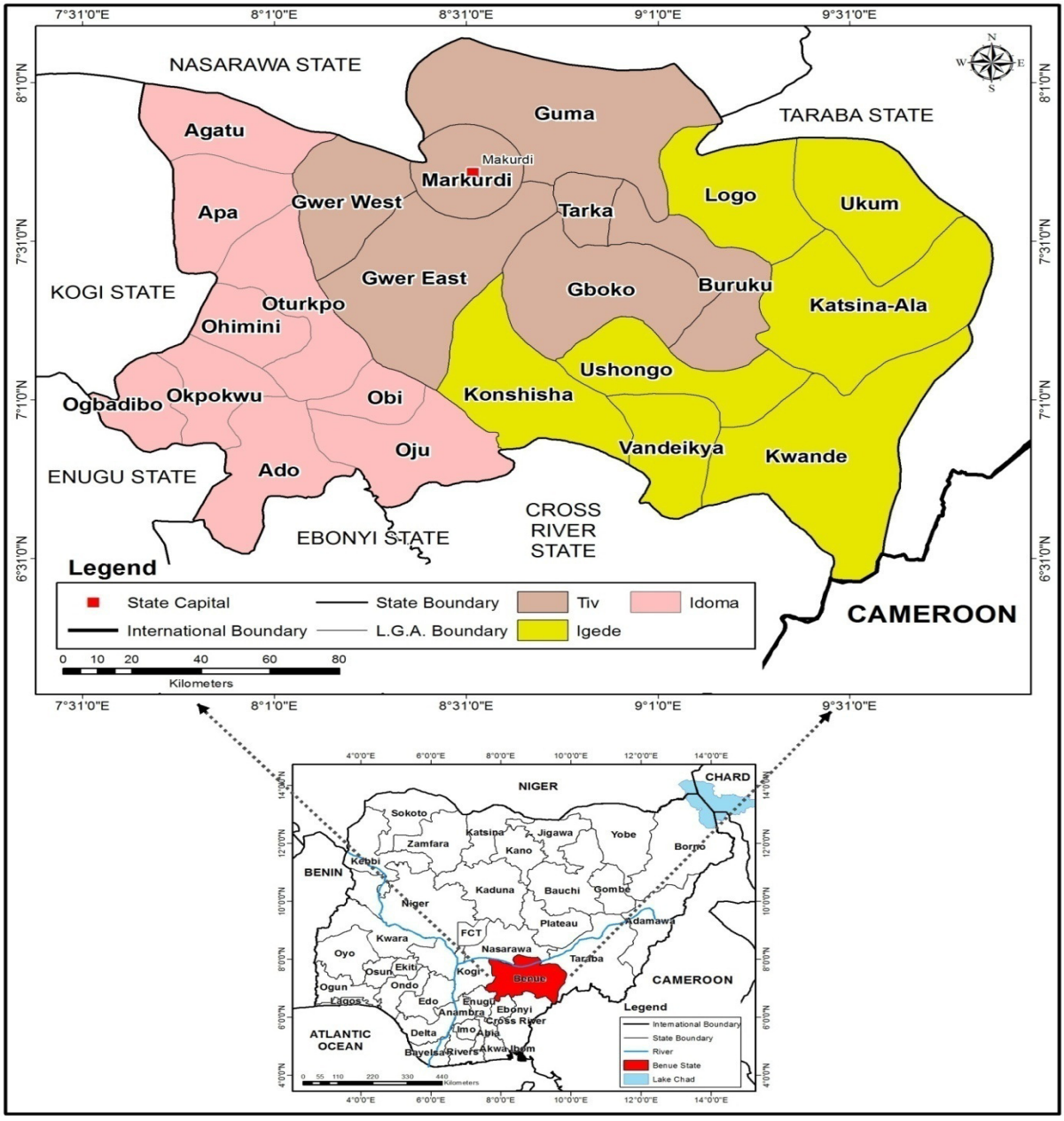

Figure 1. Map of Benue State showing the Three Major Tribes
Source: Modified from the Administrative Map of Benue State

Definitions of landmarks, measuring techniques and instrument used were according to Singh and Bhasin (1989) as follow:

Glabella: A point above the nasal root between the eyebrows and intersected by mid-saggital plane.

Opisthocranion: It is the most posterior point on the posterior protuberance of the head in the mid sagittal plane.

Euryon: It is the most laterally placed point on the sides of the head.

The maximum head length was measured with the help of spreading calliper from glabella to opisthocranion. Maximum head width was measured as the maximum transverse diameter between euryon to euryon using spreading calliper. All measurements are recorded to the nearest centimetre.

All the data were analysed using Microsoft Excel and SPSS (Statistical Package for Social Sciences) version 20.0 (IBM Corporation, New York, USA). Mean and Standard deviation were calculated followed by independent sample t-test for comparison of means for any two groups. Statistical significance was considered at $p<0.05$. Anatomical head types were classified as shown in table 1.

Table 1. Classification of head types according to Martin and Seller (1957) as reported in Shah *et al*., (2015).

Head types	Range of index	
	Male	Female
Ultrabrachycephalic	91-x	92.0-x
Hyperbrachycephalic	86-90.9	86.5-91.9
Brachycephalic	81-85.9	82.0-86.4
Mesocephalic	76-80.9	77.0-81.9
Dolichocephalic	71-75.9	72.0-76.9

Table 2. Descriptive statistics for head length, head breadth and cephalic index of *Tiv* and *Idoma* ethnic groups

Parameters	Male (n=218) Mean±SD	Min	Max	Female (n=200) Mean±SD	Min	Max	t	p
Tiv								
Head length (cm)	18.0±0.97	15.5	19.7	16.8±1.29	12.8	20.1	10.32	0.001
Head breadth	15.3±0.83	13.0	17.5	14.1±1.23	11.0	16.5	11.59	0.001
Cephalic index	85.0±4.94	74.3	103.2	83.8±6.40	62.8	100.0	2.10	0.036
Idoma	(n=222)			(n=188)				
Head length (cm)	18.3±1.19	15.3	21.4	17.1±1.34	14.0	18.6	9.20	0.001
Head breadth (cm)	15.4±1.02	13.3	18.1	14.1±1.07	12.0	16.6	6.50	0.001
Cephalic index	84.5±5.28	77.6	107.2	82.7±6.58	68.7	98.7	3.37	0.001

$p<0.05$

RESULTS

Table 2 shows the mean, standard deviation (SD) and range values of head length, head breadth and cephalic index of the studied population. The head length of *Tiv* males ranged from 15.5.5 cm to 19.7 cm (mean 18.0±0.97) while that of *Tiv* females ranged from 12.8 cm to 20.1 cm (mean 16.8±1.29) with statistically significant difference between both means ($p<0.001$). The head breadth of *Tiv* males ranged from 13.50 cm to 17.5 cm (mean 15.3±0.83) while that of *Tiv* females ranged from 11.0 cm to 16.5 cm (mean 14.1±1.23) with statistically significant difference between both means ($p<0.001$). The cephalic index of *Tiv* males ranged from 74.3 cm to 103.2 cm (mean 85.0±4.94) while that of *Tiv* females ranged from 62.8 cm to 100.0 cm (mean 83.8±6.40) with statistically significant difference between both means ($p<0.036$).

The head length of *Idoma* males ranged from 15.3 cm to 21.4 cm (mean 18.3±1.19) while that of *Idoma* females ranged from 14.0 cm to 18.6 cm (mean 17.1±1.34) with statistically significant difference between both means ($p<0.001$). The head breadth of *Idoma* males ranged from 13.3 cm to 18.1 cm (mean 15.4±1.02) while that of *Idoma* females ranged from 12.0 cm to 16.6 cm (mean 14.1±1.07) with statistically significant difference between both means ($p<0.001$). The cephalic index of *Idoma* males ranged from 77.6 cm to 107.2 cm (mean 84.5±.28) while that of *Idoma* females ranged from 68.7 cm to 98.7 cm (mean 82.7±6.58) with statistically significant difference between both means ($p<0.001$).

Table 3 shows statistical comparison of head length, head breadth and cephalic index of *Tiv and Idoma* ethnic groups. With the exception of head length, all other variables showed no statistical differences when compared in the two ethnic groups ($p>0.05$).

Table 4 shows frequencies of head types according to cephalic index in *Tiv* ethnic group. Brachycephalic head type was the most prevalent (47.4%) and dolichocephalic type was the least prevalent (0.7%) in *Tiv* ethnic group.

Table 5 shows frequencies of head types according to cephalic index in *Idoma* ethnic group. Brachycephalic head type was the most prevalent (41.7%) and dolichocephalic type was the least prevalent (2.9%) in *Idoma* ethnic group.

Table 3. Statistical comparison head length, head breadth and cephalic indices between *Tiv* and *Idoma* ethnic groups

Parameters	*Tiv* (n=218) Mean±SD	Min	Max	*Idoma* (n=222) Mean±SD	Min	Max	t	p
Male								
Head length (cm)	18.0±0.97	15.5	19.7	18.3±1.19	15.3	21.4	2.75	0.006
Head breadth (cm)	15.3±0.83	13.0	17.5	15.4±1.02	13.3	18.1	1.73	0.085
Cephalic index	85.0±4.94	74.3	103.2	84.5±5.28	77.6	107.2	0.96	0.335
Female	(n=200)			(n=188)				
Head length (cm)	16.8±1.29	12.8	20.1	17.1±1.34	14.0	18.6	1.73	0.085
Head breadth (cm)	14.1±1.23	11.0	16.5	14.1±1.07	12.0	16.6	0.22	0.825
Cephalic index	83.8±6.40	62.8	100.0	82.7±6.58	68.7	98.7	1.78	0.076

$p<0.05$

Table 4. Frequencies of head types according to cephalic index in *Tiv* ethnic group

Head types	Male		Female		Both	
	Frequency	%	Frequency	%	Frequency	%
Ultrabrachycephalic	7	3.2	3	1.5	10	2.4
Hyperbrachycephalic	27	12.4	21	10.5	48	11.5
Brachycephalic	102	46.8	96	48.0	198	47.4
Mesocephalic	79	36.2	80	40.0	159	38.0
Dolichocephalic	3	1.4	0	0.0	3	0.7
Total	218	100	200	100	418	100

Table 5. Frequencies of head types according to cephalic index in *Idoma* ethnic group

Head types	Male		Female		Both	
	Frequency	%	Frequency	%	Frequency	%
Ultrabrachycephalic	13	5.9	8	4.3	21	5.1
Hyperbrachycephalic	33	14.9	18	9.6	51	12.4
Brachycephalic	88	39.6	83	44.1	171	41.7
Mesocephalic	80	36.0	75	39.9	155	37.8
Dolichocephalic	8	3.6	4	2.1	12	2.9
Total	222	100	188	100	410	100

DISCUSSION

The result of this study indicated that, on the basis of maximum head length and maximum head breadth, male *Tiv* subjects had a cephalic index of 85.0 while female *Tiv* subjects had a cephalic index of 83.8. On the other hand, based on maximum head length and maximum head breadth, male *Idoma* subjects had a cephalic index of 84.5 while female *Idoma* subjects had a cephalic index of 82.7. There was no statistically significant difference between the cephalic indices of the two ethnic groups. A comparison with other ethnic groups and populations showed that the *Tiv* and the *Idoma* ethnic groups are among those with the highest values of cephalic indices in Nigeria similar to those of the Itshekiri and Urhobo. Oladipo *et al.* (2009) reported that the Urhobo and Itsekiri ethnic groups have mean cephalic indices of 82.2 and 86.8 respectively. Ijaw males have 81.0, Ijaw females have 78.2, and Igbos have 79.0 and 76.8 for males and females respectively (Oladipo and Olotu, 2006). Odokuma *et al.* (2010) reported cephalic index of 78.2 for the Edo people; 77.6 for Ibos and 78.0 for Urhobos. Umar *et al.* (2011) recorded a cephalic index of 79.5 for the Yorubas. Eliakim-Ikechukwu *et al.* (2012) recorded cephalic indices of Ibo males and females as 81.7 and 81.7 while that of Yoruba males and females as 80.4 and 78.5 respectively. Eroje *et al.* (2010) reported Cephalic indices for Obia male and female as 73.7 and 72.2 respectively. Oladipo *et al.* (2009) determined the Cephalic index for Ogu males and f emales as 74.8 and

74.8, Ikwerre males and females as 74.9 and 74.6 respectively, Efik male and females as 73.2 and 73.8, Ibibio male and female as 73.5 and 73.8 respectively. A cephalic index of 79.5 was reported for Kvangaja race; the cephalic index of 79.7 has been reported for Bhils race; cephalic index of 79.8 and 80.8 was reported for Barelias and Gujarat races of Indian respectively (Oladipo *et al*., 2009).

From this study it could be inferred that the predominant anatomical type of head among both *Tiv* and *Idoma* subjects, using the Martin-Saller scale, was brachycephalic (47.4% in *Tiv* and 41.7% in *Idoma*) while the least prevalent was dolichocephalic (0.7% in *Tiv* and 2.9% in *Idoma*) head type. This result disagreed with findings in other ethnic groups. In a previous study, the percentage distribution of cephalic index was dolichocephalic 26.7%, mesocephalic 49.0%, brachycephalic 17.6% and hyperbrachycephalic 6.7% in a sample comprising of Ibos, Edos and Urhobos (Odokuma *et al*., 2010). Umar *et al.* (2011) reported that the Yorubas, both male and female, were predominantly mesocephalic. It is in agreement, to some extent, with Eliakim-Ikechukwu *et al*. (2012) who reported that the dominant head type among Yoruba males, Ibo males and females was brachycephalic while Yoruba females were mesocephalic. We also noted some overall similarity between our findings and those of Abolhasanzadeh and Farahani (2003) who stated in his study on Iranian population that 36.6% of the individuals were brachycephalic, 29.9% hyperbrachycephalic, 24.5% mesocephalic and 9% dolichocephalic (Abolhasanzadeh and Farahani, 2003). There is a clear difference between our findings and those of Shah *et al*. (2015) who reported that the dominant head types in Gujarati males was mesocephalic (40.2%) followed by dolicocephalic (39.8%) and in females, the dominant head types was dolicocephalic (42.7%) followed by mesocephalic (42.2%).

From the foregoing, it could be seen that cephalic indices are different for different people. People with a horizontal cephalic index of less than 76 have long, narrow head, and belong to dolichocephalic type of the head. If the cephalic index is more than 80.9, the head appears to be short and broad; those people belong to brachyocephalic type of the head. People with cephalic index between 76 and 80.9 belong to mesocephalic type of the head (Rexhepi and Meka, 2008). Cephalic index is very useful anthropologically to find out racial differences. It can also be utilized to find out sexual differences. Comparison of changes in cephalic index between parents, offsprings and siblings can give a clue to genetic transmission of inherited characters (Shah and Jadhav, 2004). Sexual dimorphism is an important concern for the forensic anthropologists as it is a key to individual identification. Assessing sexual dimorphism eliminates approximately half of the population from further considerations in cases of missing persons or unknown identity. Many morphological differences are sex specific (Shah et al., 2015).

The type of head (and face) depends on many factors, such as racial and ethnical affiliation, genetic influence, traditions, nutrition, environment, and climate. Racial variations in the cranium were recorded William *et al.* (1995). Variations in cephalic indices between and within populations have been attributed to a complex interaction between genetic and environmental factors (Kasai *et al*., 1993). Although the human race must be regarded as a unit intellectually and physically, from the anthropologists' viewpoint the particular set of bones most often measured for purposes of ethno-anthropological researches are those of the head. The information collected from measurements of the cephalofacial, respectively craniofacial variables, enables a chronological study of the anthropological status of the nations and helps comparison of the anthropological features of the today's nations and previous nations too (Rexhepi and Meka, 2008). With the help of the above statistics, the sex as well as race of the deceased can be determined accurately with the head measurement. This knowledge can be of immense importance to anthropologists as well as forensic science experts (Shah and Jadhav, 2004). Standardized cephalometric records enable diagnostic comparison between patients and the normal population. Doliocephalic person have otitis media less often than brachycephalic person. It has also been reported that individuals with Apert's syndrome are hyperbrachycephalic (Oladipo *et al*., 2009). Brachycephalization is thought to be due to relative higher increase in the head breadth in comparison with the head length as a result of improvement in nutrition. Hung in 1995 mentioned that supine sleep position may promote brachycephaly and prone sleep position cause dolichocephaly (Oladipo *et al*., 2009). Even though Bharati indicated that in tropical zone dolichocephaly and in temperate zone brachycephaly were the dominant head forms respectively (Oladipo *et al*., 2009), the results of the present study matched with temperate zone forms as brachycephaly was more prevalent than other head forms.

CONCLUSION

The *Tivs*, like the *Idomas*, exhibit sexual dimorphism with respect to cephalic index with males having significantly higher value than females. The two ethnic groups are, however, similar in the sense that they both have predominantly brachycephalic head type. The reason for this close semblance may have arisen from possible environmental effects which could have resulted in shaping of the head size from medium to broader forms. When compared with other ethnic groups, the cephalic indices of *Tivs* and *Idomas* are much higher so that high cephalic index and brachycephalic head are population

defining attributes of the two ethnic groups. There is need to conduct genetic studies to backup these observed morphometric similarities.

REFERENCES

Abolhasanzadeh A, Farahani MR (2003). Standard international classification of head shapes of 22-24 years old in Tehran. *J. Res. Med.* 26(4): 281-285.

Alves AH, Santos MIMP, Melo FCL, Wellington R (2011). Comparative study of the cephalic index of the population from the regions of the north and south of Brazil. *Internet J. Morphol.* 29: 1370-1374.

Del Sol M (2005). Cephalic index in a group of mapuche individuals in the IX region of Chile. *Internet J. Morphol.* 23(3):241-246.

Doni PKR, Janaki CS, Vijayaraghavan V, Delhi RU (2013). A Study on measurement and correlation of cephalic and facial indices in males of south Indian population. *Internet J. Med. Res.* 2: 439-446.

Eliakim-Ikechukwu C, Onugh E, Bassey T, Mesembe OE (2012). cephalofacial indices of the Ibo and Yoruba ethnic groups in southern Nigeria. *J. Biol. Agric. Healthcare*. 2(11).

Esomonu UG, Badamasi MI (2012). Cephalic anthropometry of Ndi Igbo of Abia State of Nigeria. *Asian J. Sci. Res.* 5: 178-184.

Eroje MA, Fawehinmi HB, Jaja BN, Yaakor L (2010). 'Cephalic index of Ogbia tribe of Bayelsa State'. *Internet J. Morphol. 28*:389-392.

Farkas LG, Katic MJ, Forrest CR, Alt KW, Bagic I, Baltadjiev G, *et al* (2005). International anthropometric study of facial morphology in various ethnic groups/races. *J. Craniofacial Surge.* 16(4):615-646.

Fawehinmi HB, Ligha AE (2011). Canthal and cephalic indexes of children with homozygous Sickle Cell Disease in Port-Harcourt. *Niger. J. Med.* 20: 33-38.

Franco FCM, Araujo TM, Voge CJ, Quintão CCA (2013). Brachycephalic, dolichocephalic and mesocephalic: Is it appropriate to describe the face using skull patterns? *Dental Press J. Orthodontics*. 18(3):159-163.

Ilayperuma I (2011). Evaluation of cephalic indices: a clue for racial and sex diversity. *Internet J. Morphol.* 29: 112-117.

Jadav HR, Kariya VB, Kodiyatar BB, Pensi CA (2011). A Study to correlate cephalic index of various caste/races of Gujarat State. *National J. Integrated Res. Med.* 2: 18-22.

Kanan U, Gupta DS, Andani R, Kubavat DM, Nagar, *et al* (2013). Study of cephalic index in south Gujarat. *Internet o. Recent Trends in Sci. Technol.* 8: 87-89.

Kasai KLC, Richard T, Brown T (1993). Comparative study of craniofacial morphology in Japanese and Australian aboriginal population. *Hum. Biol.* 65: 821-834.

Khair S, Bhandari D, Wavhal S (2013). Study of cephalic index among the students of Mumbai region. *Ind. J. Appl. Res.* 3: 64-66.

Kiran V, Pai S, Kalthur S, Hemalatha C (2012). Study of cephalic index in Indian students. *Internet J. Morphol.* 30(1):125–129.

Kumar M, Lone MM (2013). The study of facial index among Haryanvi adults. *Int. J. Sci. Res.* 2: 51-53.

Maina MB, Shapu YC, Garba SH, Muhammad MA, Garba AM, Yaro AU, Omoniyi ON (2011). Assessments of cranial capacities in a north-eastern adult Nigerian population. *J. Appl. Sci.* 11: 2662-2665.

Maria SJ, Manjunath KY (2011). Cephalometry of mentally challenged subjects and correlation with intelligence quotient. *Anatomica Karnataka*, 5(2):60-65.

Mehta M, Saini V, Nath S, Patel MN, Menon SK (2014). CT scan images to determine the origin from craniofacial indices for Gujarati population. *J. Forensic Radiol. Imaging*. 2: 64-71.

Musa MA, Abdulhameed A, Bello SS, Usman JD, Bello A, Ammani T, Ahmed H (2014). Mesocephalic head shape observed in children with Neuro-Developmental Disorders (NDDS): A Comparative Study. *Research and Reviews: J. Med. Health Sci.* 3(1).

Odokuma EI, Akpuaka FC, Igbigbi PS, Otuaga PO, Ejebe D (2010). Patterns of cephalic indexes in three West African populations. *Afr. J. Biotechnol*. 9(11):. 1658-1662.

Oladipo GS, Olutu EJ, Osah T, Osunwoke EA, Hart J, Ordu K (2009). 'A comparative study of cephalic indices of Nigerian Ibibios and Efiks'. *J. Arts and Cult. 4 (1):* 62-65.

Oladipo GS, Olotu EJ.(2006). Anthropometric comparison of cephalic indices between the Ijaw and Igbo tribes. *Glo. J. Pure and Appl. Sci.* 12(1): 137-138.

Patro S, Sahu R, Rath S (2014). Study of cephalic index in Southern Odisha population. *J. Dental and Med. Sci.* 13: 41-4.

Rexhepi A, Meka V (2008). Cephalofacial morphological characteristics of Albanian Kosovo population. *Int. J. Morphol.* 26(4):935-940.

Safikhani Z, Afzali N, Bordbr H (2007). Determination of anatomical type of head and face in children under 6 years in Ahwaz. *Acta Medica Iranica*, 45 (1): 43-45.

Salve VM, Thota NR, Patibandla A (2011). The study of cephalic index of Andhra region (India). *Asian J. Med. Sci.* 2: 53-55.

Shah T, Thaker MB, Menon SK (2015). Assessment of cephalic and facial indices: a proof for ethnic and sexual dimorphism. *J. Forensic Sci. Criminol.* 3(1): 101.

Shah GV, Jadhav HR (2004). The study of cephalic index in student of Guyarat. *Biol. J. Med. College*. 153: 25-26.

Torres-Restrepo AM, Quintero-Monsalve AM, Giraldo-Mira JF, Rueda ZV, Vélez-Trujillo N, Botero-Mariaca P (2014). Agreement between cranial and facial classification through clinical observation and anthropometric measurement among envigado school children. *BMC Oral Health*, 14:50.

Shii BI (2001). *Christianity in Tivland: A History of NKST*. Oracle Business Limited, Makurdi, Benue State.

Singh IP, Bhasin MK (1989). *A laboratory Manual on Biological Anthropology*. 2nd Revised Edition, Delhi: Nazia Offset Press.

Udo RK (1970). *Geographical regions of Nigeria*. University of California Press, Los Angeles, PP. 138-147.

Umar MBT, Ojo AS, Asala SA, Hambolu JO (2011). 'Comparison of cephalometric indices between the Hausa and Yoruba ethnic groups of Nigeria'. *Res. J. Med. Sci. 5*:83-89.

Williams P, Dyson M, Dussak JE, Bannister LH, Berry, MM, Collins P, Ferguson MWJ. (1995). *Gray's Anatomy: Skeletal system*; 38th Edition; London, Elbs with Churchill Livingston, pp. 607-612.

Yagain VK, Pai SR, Kalthur CG, Chethan P, Hemalatha I (2012). Study of cephalic index in Indian students. *Int. J. Morphol.* 30(1):125-129.