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Original Article

Evaluation of Cephalic Index and Students' Performance among Hausa Children in Azare, North-Eastern Nigeria

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ABSTRACT

Background: One of the most frequently used parameters for studying racial differences amongst the populace is cephalometry. There is paucity of baseline information in the North-Eastern part of Nigeria on population classification using cephalic index. Our aim was to assess the cephalic index and correlate performance. **Method:** Cross sectional study was performed on 200 male secondary school students selected randomly for the study. Demographic data was collected through self-administered questionnaire, the head and breath were measured using a spreading caliper from standard body landmarks to determine the cephalic index, and an Intelligent Quotient (IQ) test was administered to test the students' performance. Descriptive statistics and Pearson's Correlation performed using SPSS version 22, and the results were expressed as a mean ±SEM with statistically significant set at $p< 0.05$. **Results:** The results indicated a significant correlation between the cephalic index and IQ test performance (r value = Dolichocephalic (<74) 12.24 ± 0.04; Mesocephalic (75 – 79) 14.73 ± 0.47 and Brachycephalic (80 – 85) 18.50 ± 0.05, values were significant ($p < 0.05$). The two variables were related by the simple linear regression (SLR) equation as **y= 62.91 + 0.5*x.** On the other hand, there was no significant relationship between age and cephalic index as well as age and IQ ($p< 0.05$). **Conclusion:** Our finding established a relationship between cephalic index and students' performance among children of Hausa ethnic group in Azare, Nigeria. However, further study needs to be carried out to have comprehensive information relating to cephalic index and student's performance, particularly in the North-Eastern part of Nigeria.

Keywords: Cephalic index; Intelligent Quotient; Students' performance; Hausa

INTRODUCTION

Cephalometry is employed in the measuring of human heads, forensic medicine, orthodontics, plastic surgery, and the assessment of race and cultural distinctions.[1] The most essential cephalometric parameters are head height and breadth, which are used to calculate the cephalic index. There is a distinct racial tendency in cranial dimensions and cephalic indices among different ethnicities and races in various regions of the world, according to studies.[1,2] Cranial morphometry is useful in primate phylogeny, as well as in the study and comparison of the crania of any population, racial differences, regional and nutritional histories. Cephalic indices data, both population and age specific, is a vital tool for determining an individual's growth and development, as well as any anomalies in cranial size and form.[3]

According to Retzius[4], the cephalic index is the ratio of the head's greatest breadth to its maximum length, commonly multiplied by 100 for simplicity. Anthropologists utilized the index to characterize human populations in the twentieth century. In addition to its relevance as an anthropological tool for analyzing racial

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differences in a population, the cephalic index is used to determine sexual dimorphism and gives a better knowledge of human morphologies in terms of frequency distribution and comparison of various races.[5] Ultrabrachycephalic, Hyperbrachycephalic, Brachycephalic, Mesocephalic, and Dolichocephalic are the five globally recognized head types based on cephalic index using the Martin-Saller scale.[6]

Intelligence Quotient IQ

Intelligence is defined as a person's ability to reason logically, think abstractly, be self-aware, communicate, learn, and remember things.[7] Human intelligence allows them to have cognitive talents such as pattern recognition, idea understanding, and problem-solving abilities, as well as the capacity to remember information and communicate via the use of language.[8] Despite the fact that many studies used IQ scores as a measure of intelligence, human intelligence outperforms all types of assessment methods used by academics.[9] Both genetic and environmental variables have been demonstrated to influence the intelligence quotient.[10] It's also been linked to things like life expectancy, fertility, maternal and newborn mortality rates, and psychiatric illnesses like rape and attacks.[11] Race and ethnicity, as well as genetic characteristics, are thought to have a role in IQ determination.[12]

Brain size and Intelligence

The use of magnetic resonance imaging (MRI) to assess the volume of the human brain in studies,[13] indicated an overall association with IQ of more than 0.40. Rushton and Ankney (1996) discovered a 0.20 association between head size measures and IQ score. Because of the increased cranial size, the difference in average IQ was most likely related to the existence of more neurons and synapse.[14,15] Another study discovered a link between brain size and IQ both within and across families.[16,17] Fahrmeir (1975) performed a research in Nigeria on the impact of schooling on cognitive development in children aged 6 to 13 years, and found that the children's mean score on colored progressive matrices was 12 out of 36, which corresponds to the 4th percentile for 9-12 year olds on US norms, or an IQ equivalent of around 75.[18] According to Glewwe and Jacoby (1992), in a World Bank study conducted in Ghana, sample individuals ranging in age from 11 to 20 years, in a nationwide study, the mean score on the Colored Progressive Matrices was 19 out of 36, which is below the 1st percentile for 15 12-year-old on US norms, an IQ equivalent of less than 70.[19] Another research that used magnetic resonance imaging (MRI) to determine the volume of the human brain discovered a 0.40 association between IQ and intelligence.[20] Studies have also demonstrated that relationships between brain size and IQ exist both within and between families indicating that shared genetic factors are at play, implying that there are hereditary consequences that are shared. [21,22]

MATERIALS AND METHODS

Subjects

This study was carried out in Azare of Bauchi state on primary school students. Subjects were selected by stratified-random sampling technique in 5 primary schools comprising of 25 – 30 students randomly selected from each school. The inclusion criteria were being registered and studying in primary school at the time of the research data collection, and from Hausa ethnic group being within the age range of 6 – 15 years, and only male children were involved. The exclusion criteria however, were subjects with prominent abnormality affecting the physical development of the head, or any documented disorder or disease conditions like epilepsy, brain tumors, and surgical interventions on the skull that might affect the IQ of the subject were excluded from the study. A total of 200 children were recruited in the study. A written informed consent was obtained from each school managers.

The sample size was 200 subjects comprising males only from the Hausa ethnic group and the minimum sample size was calculated according to Naing.[23]

$$n = \frac{Z^{\wedge}2PQ}{d^{\wedge}2}$$

Where: n = desired sample size

Z = Standard normal deviation 1.95 at 95% confidence level

Q = 1 – p

d = degree of precision set at 0.05

p = proportion (50%)

Cephalometric Measurement

All measurements for the cephalic index were taken with the subject sitting on a chair, in a relaxed condition and head unsupported in an Anatomical position based on previously described method.[35] Vanier calipers, measuring tape, ruler and spring caliper were used for cephalometry. Measurements were performed to the nearest 1 millimeter in 3 trials, and the average was calculated and used.

Maximum head length (L) was measured as the maximum length between glabella and inion using a sliding caliper. Maximum head breath (B) was measured as the maximum length between parietal eminences.

Head height (H) was measured from the external acoustic meatus to the highest point of vertex using a sliding caliper and an auricular head spanner. Cephalic index was determined according to Williams' classification.[24]

Table 1. Craniotyping Based on Cephalic Index

Dolicocephalic	<74.9
Mesocephalic	75 – 79.9
Brachycephalic	80 – 84.9
Hyperbrachycephalic	>85

Instruments

To test IQ and its subsets, trained staff used the Wechsler Abbreviated Scale of Intelligence-second edition (WASI-II).[25,26] There are two sorts of scores provided by this questionnaire: scaled scores and composite scores. The scaled score is made up of four subtests: block design, vocabulary, matrix thinking, and similarities, while the composite score is made up of the verbal comprehension index (VCI). The perceptual reasoning index (PRI) and full-scale IQ (FSIQ) are two types of intelligence tests.[27,28] When compared to prior kinds of intelligent assessment questionnaires, WASI-II has been demonstrated to generate more consistent measurement findings as well as shorter testing times.[29] The WASI-II reliability coefficients for children and adults were originally reported to be 0.93 and 0.96, respectively.[30]

Statistical Analysis

Data obtained were expressed as mean ± SEM and were analyzed using analysis of variance (ANOVA) followed by Duncan post hoc test to compare the level of significance. The value of $p < 0.05$ were considered significant using SPSS version 22. Pearson's correlation coefficient was used to generate simple regression equation between IQ and cephalic index, as well as between age and IQ. Significance was considered as p values smaller than 0.05 and the confidence interval was considered as 95%.

RESULTS

The result of this study indicated that on the basis of maximum length and breadth of the head, the cephalic index (C.I) correlated with intelligent quotient (IQ) having Mean ± S.E of mean as Dolicocephalic (<74) 12.24 ± 0.44; Mesocephalic (75 – 79) 14.73 ± 0.47; Brachycephalic (80 – 85) 18.50 ± 0.50. Values were significant (P < 0.05). The two variables were related by the simple linear regression (SLR) equation as **y= 62.91 + 0.5*x.** On the other hand, there was no significant

Table 2. Descriptive Statistics of Variables

			Statistic	Std. Error
Age of Participants	Mean		15.2549	.12516
	95% Confidence Interval for Mean	Lower Bound	15.0066	
		Upper Bound	15.5032	
	5% Trimmed Mean		15.2723	
	Median		15.0000	
	Variance		1.598	
	Std. Deviation		1.26402	
	Minimum		12.00	
	Maximum		18.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-.105	.239
	Kurtosis		-.448	.474
CEPHALIC INDEX	Mean		69.5794	.62311
	95% Confidence Interval for Mean	Lower Bound	68.3433	
		Upper Bound	70.8155	
	5% Trimmed Mean		69.8364	
	Median		69.6000	
	Variance		39.603	
	Std. Deviation		6.29306	
	Minimum		47.20	
	Maximum		80.00	
	Range		32.80	
	Interquartile Range		9.70	
	Skewness		-.614	.239
	Kurtosis		.423	.474
IQ SCORE	Mean		12.9706	.36399
	95% Confidence Interval for Mean	Lower Bound	12.2485	
		Upper Bound	13.6926	
	5% Trimmed Mean		13.1438	
	Median		14.0000	
	Variance		13.514	
	Std. Deviation		3.67614	
	Minimum		4.00	
	Maximum		18.00	
	Range		14.00	
	Interquartile Range		6.00	
	Skewness		-.691	.239
	Kurtosis		-.500	.474

relationship between age and cephalic index as well as age and IQ ($p < 0.05$), and the variables were related by the regression equation: **y = 13.84 + (- 0.06) *x**

Pearson's coefficient between cephalic index and IQ was 0.090, showing a weak, but significant relationship between the two variables. In the same manner, the relationship between age and IQ was represented by the Pearson's coefficient of -3.872, showing a negative correlation between the variables

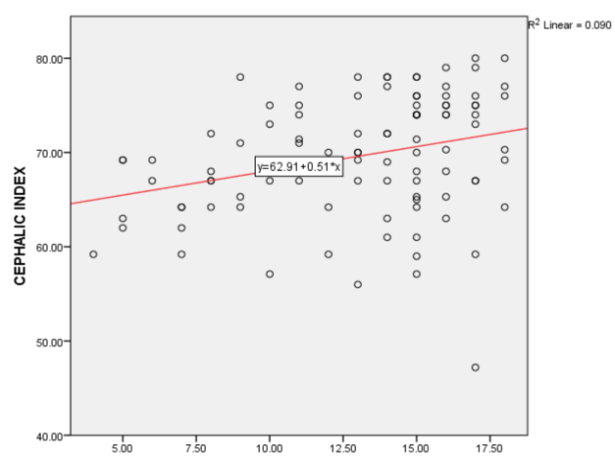

Fig. 1. Regression Equation of Cephalic Index and IQ-score

Table 3. Relationship between cephalic index (CI) and intelligent quotient (IQ)

Cephalic Index (C.I)	Intelligent Quotient (I.Q)
Dolicocephalic	12.24 ± 0.44b,c
Mesocephalic	14.73 ± 0.47a, c
Brachycephalic	18.50 ± 0.50a, b

Values were significant ($p < 0.05$); a, b and c, are statistically significant ($p < 0.05$); when compared with Dolicocephalic, Mesocephalic and Brachycephalic respectively

Table 3. Relationship between age, cephalic index (CI) and intelligent quotient (IQ)

Age (Years)	Cephalic Index (cm)	Intelligent Quotient (I.Q)
<15	**70.93 ± 1.23**	**13.59 ± 0.64**
15 – 16	**69.46 ± 0.72**	**12.76 ± 0.53**
>16	**69.86 ± 1.82**	**12.71 ± 0.79**

Values were statistically not significant ($p < 0.05$) between age and cephalic index; also, no significant relationship between age and intelligent quotient

DISCUSSION

The result of this study indicated that on the basis of maximum length and breadth of the head, the cephalic index (C.I) correlated with intelligent quotient (IQ) having Mean ± S.E of mean as Dolicocephalic (<74) 12.24 ± 0.44; Mesocephalic (75 – 79) 14.73 ± 0.47; Brachycephalic (80 – 85) 18.50 ± 0.50. Values were significant ($P < 0.05$). The two variables were related by the simple linear regression (SLR) equation as **y= 62.91 + 0.5*x.** On the other hand, there was no significant relationship between age and cephalic index as well as age and IQ ($p< 0.05$), and the variables were related by the regression equation: **y = 13.84 + (- 0.06)*x**, the findings in this study is similar to that of previous study conducted,[31,32,33] which reported that there is small but significant correlation between head size and intelligent quotient, where racial difference in cranial capacity was estimated by measuring head dimensions between white and black Americans.

The relationship between cranial capacity and IQ in children and adolescents varies in age due to the changes in physical and brain maturation. In another studies in adolescents,[34,35] no direct relationship was found between cranial capacity and IQ. The study further indicated that the maturation of different brain regions, which might not significantly affect the cranial capacity, and may have different effects of the overall IQ score.[36] The weak correlation observed from this study might also indicate that there was no significant change in the shape of the skull which may also include that the maturation of the brain might have not yet been completed amongst the subjects of this study.

CONCLUSION

From the findings of this study, it can be concluded that significant relationship exists between cephalic index and intelligent quotient ($p< 0.05$). Also, there is no relationship between age and cephalic index, as well as, between age and intelligent quotient among Secondary school students in Azare, North Eastern Nigeria. We recommend further studies covering larger sample population including all gender.

REFERENCES

1. Abolhasanzadeh A, Farahani MR. Standard international classification of head shapes of 22–24 years old in Tehran. J Res Med. 2003;26:281-5.
2. Del Sol M. Cephalic index in a group of Mapuche individuals in the IV region of Chile. Int J Morphol. 2005;23(3):241-6.
3. Fahrmeier ED. The effect of school attendance on intellectual development in northern Nigeria. Child Dev. 1975;46:281-5.
4. Glewwe P, Jacoby H. Estimating the determinants of cognitive achievement in low-income countries. Washington DC: World Bank; 1992. p. 9-11.
5. Golalipour MJ, Jahanshahi M, Haidari K. Morphology evaluation of head in Turkman males in Gorgan, North Iran. Int J Morphol. 2007;25(1):99-102.
6. Goldstein S, Princiotta D, Naglieri JA. Handbook of intelligence: Evolutionary theory, historical perspective, and current concepts. New York, Heidelberg, Dordrecht, London: Springer; 2015. p. 3. ISBN: 978-4939-1561-3.
7. Haier RJ, Chueh D, Touchette P, Lott I, Buchsbaum M, Macmillan D. Brain size and cerebral glucose metabolic rate in nonspecific mental retardation and Down syndrome. Intelligence. 1995;20:191-210.
8. Int J Morphol. 2012;30(1):125-9.
9. Ivanovic DM, Leiva BP, Perez HT, Olivares MG, Diaz NS, Urrutia MSC, Larrain CG. Head size and intelligence, learning, nutritional status, and brain. Neuropsychologia. 2004;42(8):118-1131.
10. Jensen AR, Johnson FW. Race and sex differences in head size and IQ. Intelligence. 1994;18:309-33.
11. Jensen AR, Sinha SN. Physical correlates of human intelligence. In: Vernon PA, editor. Biological approaches to the study of human intelligence. Norwood; 1993. p. 139-242.
12. Johnson RC, McClearn GE, Yuen S, Nagoshi CT, Ahern FM, Cole RE. Galton's data a century later. Am Psychol. 1985;40:875-92.

13. Naing L, Winn T, Rusli BN. Practical issues in calculating the sample size for prevalence studies. Arch Orofac Sci. 2006;1:9-14.
14. Nisbett RE, Aronson J, Blair C, Dickens W, Flynn J, Halpern DF, Turkheimer E. Intelligence: New findings and theoretical developments. Am Psychol. 2012;67:130-59.
15. Rabey GP. Craniofacial morphoanalysis. Proc R Soc Med. 1971;64:103-11.
16. Rushton JP, Ankney CD. Whole brain size and general mental ability: A review. Int J Neurosci. 2009;119(5):692-732.
17. Rushton JP, Templer DJ. National differences in intelligence, crime, income, and skin color. Intelligence. 2009;37:341-46.
18. Rushton JP, Skuy M. Performance on Raven's Matrices by African and White university students in South Africa, East Indian, and White engineering students in South Africa. Intelligence. 2000;31:123-37.
19. Rushton JP, Skuy M. Performance on Raven's Matrices by African and White university students in South Africa. Intelligence. 2003;28:251-65.
20. Shah GV, Jadhan HR. The study of cephalic index in students of Gujarat. BJ Med Coll. 2004;153:25-6.
21. Tirri N. Measuring multiple intelligences and moral sensitivities in education. Springer; 2017. ISBN: 978-94-6091-758-5.
22. Tramo MJ, Luftus WC, Stukel TA, Green RL, Weaver JB, Gazzaniga MS. Brain size, head size, and intelligence quotient in monozygotic twins. Neurology. 1998;50:1246-52.
23. Vernon PA, Wickett JC, Bazana PG, Stelmack RM. The neuropsychology and psychophysiology of human intelligence. In: Sternberg RJ, editor. Handbook of intelligence. Cambridge: Cambridge University Press; 2000. p. 245-64.
24. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE. Gray's anatomy: The anatomical basis of medicine and surgery. 38th ed. New York: Churchill Livingstone; 2000.
25. Yagain VK, Pal SR, Kalthur SG, Chethan P, Hemalatha I. Study of cephalic index in Indian students. Int J Morphol. 2012;30(1):125-9.
26. Rabey GP. Craniofacial morphoanalysis. *Proc R Soc Med.* 1971;64:103-11.
27. Rushton JP, Ankney CD. Whole brain size and general mental ability: A review. *Int J Neurosci.* 2009;119(5):692-732.
28. Rushton JP, Templer DJ. National differences in intelligence, crime, income, and skin color. *Intelligence.* 2009;37:341-6.
29. Rushton JP, Skuy M. Performance on Raven's Matrices by African and White university students in South Africa, East Indian, and White engineering students in South Africa. *Intelligence.* 2000;31:123-37.
30. Rushton JP, Skuy M. Performance on Raven's Matrices by African and White university students in South Africa. *Intelligence.* 2003;28:251-65.
31. Shah GV, Jadhan HR. The study of cephalic index in students of Gujarat. *BJ Med Coll.* 2004;153:25-6.
32. Tirri N. Measuring multiple intelligences and moral sensitivities in education. *Springer*; 2017. ISBN: 978-94-6091-758-5.
33. Tramo MJ, Luftus WC, Stukel TA, Green RL, Weaver JB, Gazzaniga MS. Brain size, head size, and intelligence quotient in monozygotic twins. *Neurology.* 1998;50:1246-52.
34. Vernon PA, Wickett JC, Bazana PG, Stelmack RM. The neuropsychology and psychophysiology of human intelligence. In: Sternberg RJ, editor. *Handbook of intelligence.* Cambridge: Cambridge University Press; 2000. p. 245-64.
35. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE. Gray's anatomy: The anatomical basis of medicine and surgery. 38th ed. New York: Churchill Livingstone; 2000.
36. Yagain VK, Pal SR, Kalthur SG, Chethan P, Hemalatha I. Study of cephalic index in Indian students. *Int J Morphol.* 2012;30(1):125-9.