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Craniofacial Dimensions in the African Neonate

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Summary

Ogunye O, Ikeji MO and Adeodu O. Craniofacial Dimensions in the African Neonate. *Nigerian Journal of Paediatrics* **1892; 9: 21.** Craniofacial measurements including head circumference (HC), anterior fontanelle (AF), posterior fontanelle (PF), inner canthal distance (IC) and outer orbital distance (OO) have been determined in 1,137 African neonates. The mean value of the head circumference was 34.2±3.5cm (2SD), the inner canthal distance was 1.9±0.7cm (2SD) while that of the outer orbital distance was 7.5±1.6cm (2SD). The average anterior fontanelle was 3.3±2.0cm (2SD). Posterior fontanelle was palpable in 45.4% of the newborns and measured 1.5±0.8cm (2SD). While the mean values for HC,OO, and IC were about the same for those obtained in American caucasian population, both the AF and PF were significantly larger and the PF more frequently palpable than in the American group. We conclude from these studies that the multifactorial determinants of fontanelle size in the African may include a "Negroid gene pool" and environmental influences. The apparent adult negroid hypertelorism is probably mostly developmental with little or no genetic influence.

Introduction

A precise description of cranial and facial structures is important in the science of dysmorphology and syndrome identification. Popich and Smith[1] and Jones, Hanson and Smith[2] have attempted to define the normal limits of neonatal fontanelles and palpebral fissures among United States caucasian children. Since these features are probably genetically determined, each genetically distinct group must have its own standards before an objective assessment of normality can be applied. Furthermore, there is ample evidence to suggest that the adult caucasian facial dimensions and structures are different from the negroid. Measurement of negroid neonatal facial and cranial dimensions will therefore afford an inference of how much of these adult differences are developmental and environmental and how much are genetic and congential.

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Materials and Methods

One thousand, one hundred and thirty-seven unselected neonates delivered at the University Teaching Hospitals Complex, Ile-Ife, Nigeria, formed the basis of this study. Three patients with hydrocephalus were excluded from the series. All babies were full-term, by dates and physical examination and were delivered vaginally with no perinatal problems. All measurements were made within the first 30 hours of birth. Measurements determined included inner canthal distance, outer orbital distance, head circumference and anterior and posterior fontanelles. All the measurements were recorded to the nearest millimetre.

Fontanelles: The lateral extents of the fontanelles were identified and marked on the skin surface with an atraumatic marker, measured with a steel or plastic tape. No significant difference was found between the anterior-posterior and the transverse dimensions. Any fontanelle which was too small to be measured accurately was for the purpose of this study, judged to be closed.

Head circumference (HC). Head circumference was measured from the occiput, through the widest diameter, to the frontal eminence.

Outer orbital distance (OO). This was determined by palpating the most lateral aspect of the orbital rim of each eye and measuring the distance between them.

Inner canthal distance (IC.) The inner canthal distance was measured as the distance between the most nasal points of the palpebral fissures.

The birthweights of the subjects were recorded and these were compared with the size of the anterior fontanelles.

Results

There were 495 males and 642 females in the series. The mean head circumference was 34.2cm ±3.5cm (2SD). The range was 27.6cm––40.0cm (Table I). This mean was not statistically different from that of 34.5cm ± 3.0cm (2SD) for the United States caucasians.[3] The anterior fontanelle (AF) was palpable in all the 1,137 subjects. The mean was 3.3cm±2.0cm (2SD) and the range, 1cm–7cm (Table II). The posterior fontanelle (PF) was palpable in 45.4% of the infants. The range was 0.5cm–4.0cm (Table III) with a mean of 1.5cm±0.8cm.

TABLE I

Head Circumference in 1,137 Neonates

Head Circumference (cm)	*No. of Cases*	*Relative Frequency*	*% Relative Frequency*
27–28	3	0.003	0.3
28–29	6	0.005	0.5
26–30	6	0.005	0.5
30–31	21	0.018	1.8
31–32	45	0.040	4.0
32–33	93	0.082	8.2
33–34	183	0.161	16.1
34–35	318	0.280	28.0
35–36	249	0.219	21.9
36–37	150	0.132	13.2
37–38	54	0.047	4.7
38–39	6	0.005	0.5
39–40	3	0.003	0.3
Total	1,137	1.000	100.0

Range: 27.6cm–40.0cm
Mean: 34.2±3.5cm. (2SD)
Standard Deviation: 1.73

TABLE II

Size of Anterior Fontanelle in 1,137 Neonates

Size of AF (cm)	*No. of cases*	*Relative Frequency*	*% Relative Frequency*
< 1.0	3	0.003	0.3
1–2	54	0.047	4.7
2–3	207	0.182	18.2
3–4	546	0.480	48.0
4–5	276	0.243	24.3
5–6	36	0.032	3.2
5–6	36	0.032	3.2
6–7	12	0.010	0.1
7–8	3	0.003	0.3
Total	1,137	1.000	100.0

TABLE III

Size of Posterior Fontanelle in 1,137 Neonates

Size of PF (cm)	*No. of Cases*	*Relative Frequency*	*% Relatiue Frequency*
Closed	621	0.546	54.6
1–2	348	0.338	33.8
2–3	87	0.076	7.6
3–4	42	0.037	3.7
4–5	3	0.003	0.3
Total	1,137	1.000	100.0

TABLE IV

Outer Orbital Distance in 1,137 Neonates

Distance (cm)	*No. of Cases*	*Relative Frequency*	*% Relative Frequency*
4.5–5.0	6	0.005	0.5
4.5–5.0	6	0.005	0.5
5.0–5.5	3	0.003	0.3
5.5–6.0	6	0.005	0.5
6.0–6.5	81	0.071	7.1
6.5–7.0	63	0.055	5.5
7.0–7.5	252	0.222	22.2
7.5–8.0	264	0.232	23.2
8.0–8.5	339	0.298	29.8
8.5–9.0	96	0.085	8.5
9.0–9.5	15	0.013	1.3
9.5–10.0	12	0.011	1.1
Total	1,137	1.000	100.0

Range: 4.5cm–9.5cm.

Mean: 7.5cm ± 1.6cm (2SD)

Standard Deviation: 0.79cm.

TABLE V

Inner Canthal Distance in 1137 Neonates

Distance (cm)	*No. of Cases*	*Relative Frequency*	*% Relative Frequency*
1.0–1.5	15	0.013	1.3
1.5–2.0	405	0.356	35.6
2.0–2.5	660	0.581	58.1
2.5–3.0	51	0.045	4.1
3.0–3.5	6	0.005	0.5

Range: 1.3–3.5cm.

Mean: 1.9 ± 0.7cm (2SD)

Standard Deviation: 0.34cm

The relation between the AF and the birth-weight is shown in the Fig. It will be observed that there was no correlation between these parameters. The mean of the outer orbital distance (OO) was 7.5cm ± 1.6cm (2SD) with a range of 4.5–9.5cm. There were 15 (1.3%) of the subjects with OO less than 6.0cm (Table IV). The mean of the inner canthal distance (IC) was 1.9cm ± 0.7cm (2SD) with a range of 1.3cm–3.5cm (Table V). Neither the IC nor the OO showed any significant difference from similar values for the caucasian population.

Discussion

The present study has demonstrated significant similarities and differences between African and Caucasian neonatal craniofacial parameters. There were similarities in the head circumference, outer orbital distance and inner canthal distance, while differences existed in the frequency of the patency of posterior fontanelle, the size of the posterior fontanelle as well as that of the anterior fontanelle. The mean head circumference was not significantly different from that reported by Lubchencho, Hansman and Boyd[3] for the United States caucasian children. The outer orbital distance and the inner canthal distance for the

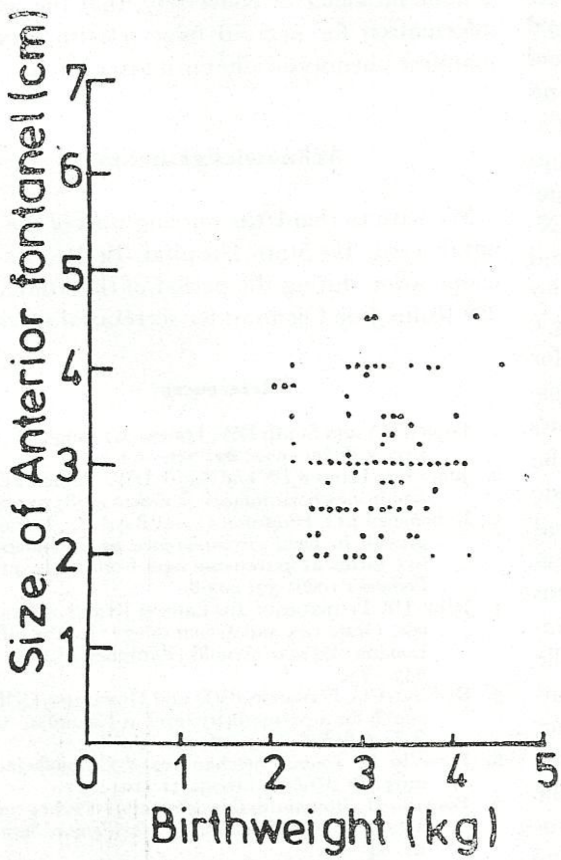

Fig. *Scatter diagram of size of anterior fontanelle and birthweight.*

Caucasians were also not different from those obtained in the present study. In the present series, the apparent adult negroid hyperteloric face was not observed and is therefore probably developmental with little or no genetic influence. The converse hypothesis is of course, that the genetic information foı negroid hypertelorism does not manifest phenotypically until after birth.

Major differences between the present series and those of the caucasians were observed in the size of the fontanelles. The AF was palpable in all our subjects. The mean value was higher than the mean reported by Popich and Smith[1] in a similar study on 201 American caucasian neonates. A large variability in the size of the AF as observed by these authors was similar to our finding. While none of their 201 subjects had an AF larger than 4·5cm, 10% in the present study did. The posterior fontanelle (PF) was palpable in 45·4% of our subjects as compared with 5% in the study by Popich and Smith.[1] Our mean PF was also significantly greater than in the caucasian series.

Fontanelle size has been utilized as evidence of altered intracranial pressure or as an index of the rate of development and ossification of the calvarium which may be altered in a wide variety of disorders affecting morphogenesis. The larger fontanelle size in the present series is not associated with a concommitant increase in the head circumference as would be expected if the patency and size of the fontanelles were due to enlarged size of the ventricles. The reason for the enlarged fontanelles found in our series remains speculative. It may be due to delayed ossification of the calvarium. Delayed calvarian ossification occurs in a variety of disoders such as achondroplasia, Vit. D deficiency rickets, athyrotic hypothyroidism, malnutrition and the trisomic syndromes. The constant availability of sunshine in the tropics makes it unlikely that the enlarged African neonatal fontanelle was secondary to maternal subclinical Vit. D deficiency rickets. Similarly, although the frequency of the gene for the "genetic ricket" syndromes is not known for this population, it is unlikely that it alone can account for these findings. None of the other conditions associated with enlarged AF was present in our subjects.

The other possible explanation for the enlarged fontanelle in African neonates is intrauterine malnutrition secondary to maternal undernutrition. The incidence of prematurity[4] and small-for-dates babies is high in the tropics and this has been thought to be secondary to maternal undernutrition during pregnancy. Similarly, even within the same environment, the birthweights of babies born to mothers of lower socio-economic group are significantly lower than those from a higher socio-economic group.[5] But, as has been shown, there was no correlation between the birthweight and the size of anterior fontanelle.

Thus, it is unlikely that foetal malnutrition contributed to the fontanelle size. Finally, delayed intrauterine osseous maturation may be a negroid trait present as a "minor malformation" and therefore an expression of a negro genetic marker.

There is ample evidence to support the concept that the development of facial and cranial structures is under both single gene (autosomal and X-linked dominant or recessive inheritance) and multifactorial control.[6] It is also possible for different forces to produce the same teratologic effect in different species. For example, a model for mandibulofacial dysostosis was described by Poswillo[7] employing Wistar rats, given large amounts (75,000 to 100,000 IU) of vitamin A on the eighth day of their pregnancy. The morphologic effect produced was similar to the autosomal dominant gene responsible for the Treacher-Collins syndrome in man. It therefore seems likely that the greater frequency of patent posterior fontanelle and the large anterior fontanelle in our subjects may be of genetic and environmental aetiologies. There is the need for further neonatal measurements and other longitudinal studies in order to clarify the hypothesis that the apparent adult negroid hyperteloric face is probably mostly developmental with little or no genetic influence or conversely, that the genetic information for negroid hypertelorism does not manifest phenotypically until after birth.

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References

1. Popich GA and Smith DW. Fontanels: Range of normal size. *J Pediat* 1972; **80**: 749—52.
2. Jones KL, Hanson JW and Smith DW. Palpebral fissure size in newborn infants. *J Pedial* 1978; **92**: 787.
3. Lubchenco LO, Hansman C and Boyd E. Intrauterine growth in head circumference as estimated from live births at gestational ages from 26 to 42 weeks. *Pediatrics* 1966; **37**: 403-8.
4. Jellife DB. Prematurity. In: Lawson JB and Stewart DB. eds. Obstetrics and Gynaecology in the Tropics. London: Edward Arnold (Publishers) Ltd., 1967: 253—73.
5. De Silva CC, Fernando PVD and Gunaratne CDH. The search for a prematurity level in Colombo, Ceylon. *J Trop Pediat* 1963; **78**: 29—35.
6. Poswillo D. Causal mechanisms of Craniofacial deformity. *Br Med Bull* 1975; **31**: 101—17.
7. Poswillo D. Stomandibular deformity: Pathogenesis as a guide to reconstruction. *J Maxillofacial Surg* 1974; **2**: 64—68.

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