Anthropometric measurements among new born infants delivered in Health Care Centers in Enugu State, South Eastern Nigeria.

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Background: Determination of new born growth parameters are necessary in each population from different locations for planning their subsequent children growth charts and thus detecting disease by recognizing overt deviation from normal patterns. This study aimed at finding the means of the anthropometric measurements, to assess the comparative health status of urban and rural babies and to determine sexual dimorphism among new born babies in Enugu state.
***Method*:** This was a retrospective observational study of the infants delivered in 5 primary and secondary healthcare centers in rural and urban areas in Enugu State, South Eastern Nigeria between June 2015 and December 2018.
***Result*:** The mean birth weight, head circumference and birth length of all the participants were 2.9kg, 34.8cm, and 50.0cm, respectively. Male and female do not differ significantly in their anthropometric characteristics. However, neonates born to mothers in the rural areas differed significantly when compared to those born to mothers in urban areas.
Conclusions: This study established local values for anthropometric measurements which could serve as useful references for the care of new-born in the studied population.

Key words: Anthropometry, Birth weight, length, head circumference, Enugu.

INTRODUCTION

Anthropometry is the science which deals with measurements of physical dimensions of the human body at different ages (Ali, 2018). It provides single most portable, universally applicable, inexpensive and non-

invasive technique for assessing the size, proportions and composition of human body. It reflects health, nutritional status and predicts performance, future health and survival (Shastry *et al.*, 2015).

New born anthropometry are reliable tools for prediction of survival, growth pattern, future development (Kheir *et al*., 2013) and social health of the new born (Mutihir and Pam., 2006). Though perinatal risk assessment can be done by weight percentile criteria, other anthropometric measurements such as crown heel length, head circumference, and chest circumstance help in identifying at risk new born (Neyzi and Saka, 2002; Telatar *et al.*, 2009; Shastry *et al*., 2015). There is no such measurement for universal use because it is dependent on racial, ethnic and geographic factors (Shastry *et al.*, 2015).

Birth weight is one of the important indices in estimating the maturity of the new born. It is a well-recognized factor for evaluation of intrauterine growth and development (Haram, 2013). It is the most important indicator of maturity of the neonate and health status of the mother during pregnancy. It is strongly associated with foetal, neonatal and postnatal mortality and morbidity (Adimora *et al*., 2004; Adiele and Elem., 2013; Affusim *et al.*, 2018).

Length measurement at birth is also of prognostic significance (Oluwafemi *et al.*, 2013). An infant who is underweight but of normal length has normal growth potential, while a small infant with short body length is likely to have impaired growth potential because of genetic factors, infections or other insults in early foetal life (Oluwafemi *et al.*, 2013). A recent study has shown that body length is also a predictor of perinatal mortality, with long infants being at higher risk of perinatal death.

Measuring head circumference (HC) is a quick, non-invasive method of determining if an infant head size is too large or too small (Holden, 2014). The procedure has been described as “the simplest, inexpensive tool to assess the development of the central nervous system and identify neonatal risk of neurodevelopmental disorders (García-Alix *et al*., 2004; Harris., 2015).

Geographical distribution, ethnicity, and other socioeconomic factors may affect anthropometric measurements. Rural residents in Africa and Nigeria in particular, experience health challenges related to geographic barriers to care in addition to other indices of social disadvantage. Healthcare services are not sufficiently available, accessible and affordable to the most socially and economically disadvantaged rural

population. This is usually due to physician shortages, poorly equipped health facility, generalized poverty, lower educational attainment, and other demographic factors thus leading to higher maternal mortality, higher incidence of infant and child mortality, high fertility and low maternal and child healthcare utilization in rural areas as compared to the urban areas. Thus every single society should determine their own standard measurements (Hall, 2007; Siyah Bilgin *et al*., 2018). In the present study, we aimed to determine the mean anthropometric measurements and establish sexual dimorphism among new born infants delivered in primary and secondary health care centres in Enugu state, south eastern Nigeria.

MATERIALS AND METHODS

This was a retrospective observational study. Data was obtained from routinely collected hospital birth records in 5 (3 primary and 2 secondary) healthcare centres in rural and urban areas in Enugu State, South eastern Nigeria between June 2015 and December 2018 were included in the study. The age of the mothers in years, and parity were obtained from case notes. The birth weight in kilograms, head (occipito-frontal) circumference, birth (crown-heel) length, were also obtained from the records. All consecutive registered deliveries of all singleton live births excluding all babies that were pre-term (less than 37 completed weeks gestation at birth) over the three-year period were included in the study. Babies of multiple gestation were also included provided they were term deliveries and their anthropometric indices (weight, length and head circumference) registered individually.

The data obtained were processed and analyzed using Statistical Package for Social Sciences (SPSS, version 22.0, 2013, IBM corp) program for mean, standard deviation, range, and p-value.

The study protocol was reviewed and approved by the Enugu State Ministry of Health Research Ethics Committee and prior informed consent obtained from the chief nursing officers of the facilities used for this study.

RESULTS

A total of 2,361 live births were recorded in health centres between June 2015 and December 2018. The age of mothers ranged from 18 - 45 years with a mean age of 28.0 ± 5.1 years, and parity ranged from 1-9 with a mean of 2.8 ± 1.3. They were of the reproductive age group.

Table 1 is a description of the anthropometric characteristics of the participants. The table showed that the mean weight, head circumference and birth length of all the participants were 2.9kg, 34.8cm, and 50.0cm, respectively. Male and female did not differ significantly in their anthropometric characteristics as shown in table 2. However, neonates born to mothers in the rural areas differed significantly when compared to those born to mothers in urban areas with regards to birth weight (2.8kg versus 3.0kg, $p<0.001$), head circumference (34.0cm versus 35.0cm, $p<0.001$) but not in birth length ($p=0.06$). This is shown in table 3.

The correlations between maternal age, parity and neonate anthropometrics are presented in Tables 4 and 5. Birthweight is significantly positively associated with birth length and head circumference ($r = 0.07$, $P <0.001$) and ($r = 0.13$, $P <0.001$) respectively. Similarly, head circumference was significantly positively correlated with birth length ($r = 0.27$, $P <0.001$). With respect to the impact of maternal age and parity on new-born anthropometrics, maternal age and parity were significantly negatively associated with birthweight ($r = -0.08$ vs $r = -0.15$, $P <0.001$). In contrast, birth length and head circumference were insignificantly associated with maternal age and parity ($P >0.05$).

Table 1: Summary of anthropometric measurements of the new born babies

Parameter	Mean ± SD	Median	Range
Birth weight	2.9±0.6	2.9	1.5-5.0
Head circumference	34.8±1.8	35	30-35
Birth (CRL) Length	50±2.9	50	36-58

SD: Standard deviation, CHL: crown-heel length

Table 2: Relationship between gender and anthropometry

Anthropometry	**Gender**		**t-test**	**df**	**p-value**
	Male	**Female**			
Mean Birthweight (kg)	2.94±0.55	2.94±0.56	0.17	2629	0.87
Mean Length (cm)	50.14±2.88	50.12±2.89	0.17	2629	0.86
Mean OFC (cm)	34.77±1.77	34.76±1.77	0.20	2629	0.84

Table 3: Socio-demographic and anthropometric characteristics of the study participants based on place of birth. location

Variables	**Urban (n=1618)**	**Rural (n=1013)**	**Test stat**	**p-value**
Gender			0.32	0.57
Male	809 (50.0%)	495 (48.9%)		
Female	809 (50.0%)	518 (51.1%)		
Mean Parity (SD)	2.8 (1.3)	2.9 (1.3)	-3.11	0.002
Mean Birth weight (kg)	3.0 (0.6)	2.8 (0.5)	12.94	<0.001
Mean birth length (cm)	50.0 (2.9)	50.3 (2.9)	-1.88	0.06
Mean HC (cm)	35.0 (1.9)	34.4 (1.5)	9.04	<0.001

DISCUSSION

Anthropometric variables at birth are not only critical determinants of survival, growth and development of a baby but also a valuable indicator of health, nutrition and quality of antenatal services (Adiele and Elem, 2013; Shastry *et al*. 2015). The importance of developing empirical standard for growth parameters at birth for individual population has been stressed in the literature. So in this study we have tried to establish norms for our population.

The mean birth weight of the babies delivered during the period of review is 2.9 ± 1.3 kg irrespective of sex. Similar studies in Nigeria showed mean birth weight of 3.060 ± 0.69kg (Achebe *et al*., 2014), 3.17± 0.074 kg, (Adimora *et al*.,2004), 3.08 ± 0.63 Kg (Swende, 2011), 3.167 ± 0.45, (Lawoyin, 1991), 3.1 ± 0.8 kg (Mutihir and Pam 2006) which are higher than that observed in our study. These studies were however reported from birth records obtained mostly from tertiary hospitals within Nigeria. The mean birth weight observed in our studies is higher than the mean birth weight reported in India 2.68 ± 0.45kg, 2.35 ± 0.51 (Nair *et al.*, 2016; Kumar *et al*., 2012) and Bangladesh 2.89 ±0.47 kg (Dhar *et al*., 2002) respectively. As we have not controlled for maternal factors affecting birth weight like socioeconomic status, consanguinity, and paternal factors, it would be difficult to explain the difference in mean birth weights between studies. However, lower values in our study could be due to maternal malnutrition, poor obstetric care which is one of the important determinants of birth-weight occurring in later part of pregnancy (Oluwafemi *et al*., 2013; Shastry *et al*., 2015).

The mean head circumference of 34.8cm in the current study is within the normal range of 33.1 – 35.2 in head circumference for foetuses at term earlier reported in Nigeria (Ayinde and Omigbodun, 2004; Oluwafemi *et al* 2013). The mean occipito-frontal circumference in this study was 34.8 ± 1.8 cm. This was similar to 34.6 cm Oluwafemi *et al*., 2013), 34.8 ± 2.9cm (Ayinde and Omigbodun, 2004), but a little higher than the mean head circumference of 33.8 cm (Mutihir and Pam, 2006). The reason for the difference may be related to gestational age at birth and ethnicity (Janssen *et al*., 2007)

The mean birth length of the new born babies delivered during the period of review (50 ± 2.9cm) falls within a narrow range of 49 - 51 cm reported in other studies done in Nigeria (Adebami *et al.*, 2007; Sadoh *et al*., 2007; Oluwafemi *et al*., 2013). Studies from other countries revealed 49.8 cm in UK, 50.1 cm in China (Oluwafemi *et al.*, 2013) and 51.0 cm in India (Mutihir and Pam 2006).

It was observed in our study that the difference in the mean birth weight between male and female newborns was not significant (P > 0.05). This is in conformity with studies by (Adimora *et al*., 2004; Kadam *et al.*, 2005; Janssen *et al.*, 2007 and Nair *et al.*, 2016). The lack of statistically significant gender difference in the new born anthropometric measurements observed in this study is in accord with previous studies (Nair

et al., 2016). However, our study revealed a statistical significant difference in the mean birth weight and head circumference between rural and urban areas ($P < 0.01$). This may be due to the differences in socio economic status, socio cultural practices and availability of maternal and child care in urban areas compared to rural.

CONCLUSIONS

The results of anthropometric parameters studied provide references for the epidemiological and clinical care of the new born within the studied environment. The comparison of charts referring to difference in a defined population living in the same geopolitical and cultural environment could serve as a means of measuring the extent of inequalities in health (especially in relation to maternal and child health) between populations or to monitor trends over time in response to public health policies.

The potential limitations of this present study can be listed as the collection of data from medical records in the hospitals were incomplete (due to poor handwriting, lack of documentation of all required information and missing pages), the possibility of measurement errors in neonates and the use of a cross-sectional method which limits the monitoring of the actual growth pattern. However, this study provides a quite large sample size and detailed information. We believe that these data will be of use both in clinical practice and for research purposes until more comprehensive, reliable and accessible national data pertaining to the anthropometric variables of new born in South-eastern Nigeria are produced.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests that could be perceived as prejudicing the impartiality of the research reported.

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Authors' Contributions

CJ Okamkpa conceived and collected data for the study, Elizabeth Finbarrs-Bello wrote the first draft of the manuscript. Authors Ozor I, Umeh C and Inyiama V managed the literature searches. Okamkpa C was involved from inception to design of the study.
All authors read and approved the final manuscript.

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References:

1. Achebe C, Ugochukwu EF., Adogu POU., Ubajaka C. (2014). Prediction of low birth weight from other anthropometric parameters in Nnewi, south eastern Nigeria. Nigerian Journal of Paediatrics; 41 (1):59 – 63

2. Adiele David F. And Elem Uche O. (2013). Biostatistical analysis of birth weight and head circumference of babies a case study of Nigeria. Global journal of mathematical sciences vol. 12: 5-12

3. Adimora G.N., Chukwudi N.K., Ejike O. (2004). Birth Weights of full term newborn babies among the igbos of eastern Nigeria. Nigerian Journal of Clinical Practice. Vol.7(1); 33-36

4. Affusim C. C., Erah F., Eromon P and Fuh N.F (2018). Birth Weight and Maternal Socio-Demographic Characteristics in a Rural Tertiary Hospital. International Journal of Advances in Scientific Research and Engineering (ijasre) Vol 4 (5)

5. Ali zgher hameed (2018). The normal anthropometric measurements for healthy full term Newborns in najaf city. International Journal of Advanced Research. 6(5), 452-467

6. Ayinde O. A. And Omigbodun A. O (2004). Head Circumference at Time of Birth: A Possible Predictor of Labour Outcome in Singleton Cephalic Deliveries At Term? Annals of African Medicine, Vol. 3, No. 3; 126 – 129

7. Dhar B, Mowlah G, Nahar S, Islam N (2002). Birth-weight status of newborns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh. Journal of Health, Population and Nutrition.;20:36–41.

8. García-Alix A, Sáenz-de Pipaón M, Martínez M, Salas-Hernández S, Quero J (2004). Ability of neonatal head circumference to predict long-term neurodevelopmental outcome. Rev Neurol.;39(6):548–54.

9. Hall JG (2007). Why measurements are useful. In: Hall JG, editor. Handbook of Normal Physical Measurements. 2nd ed. New York, NY, USA: Oxford University Press,. pp. 5-12.

10. Haram Kjell, Søfteland Eirik, and Bukowski Radek, (2013). "Intrauterine Growth Restriction: Effects of Physiological Fetal Growth Determinants on Diagnosis," Obstetrics and Gynecology International, Article ID 708126, 9 pages, https://doi.org/10.1155/2013/708126.

11. Harris S. R. (2015). Measuring head circumference: Update on infant microcephaly. Canadian family physician Medecin de famille canadien, 61(8), 680–684.

12. Holden KR (2014). Heads you win; tails you lose: measuring head circumference. Dev Med Child Neurol. ;56(8):705.

13. Janssen P. A, Thiessen P, Klein M. C, Whitfield M F, MacNab Y C, Cullis-Kuhl S. C. (2007) Standards for the measurement of birth weight, length and head circumference at term in neonates of European, Chinese and South Asian ancestry. 1(2): 74-88

14. Lawoyin T.O. (1991). Maternal weight and weight gain in Africans: its relationship to birth weight. Journal of Tropical Pediatrics; 37: 166-171

15. Mutihir J. T. and Pam S. D. (2006). Anthropometric and Other Assessment Indices of the Newborn in Jos, Nigeria. Annals of African Medicine Vol. 5, No. 4; 192 – 196

16. Kadam YR, Somaiya P, Kakade SV (2005). A study of surrogate parameters of birth weight. Indian Journal of Community Medicine; 30:89-91.

17. Kheir AE, Abozied EE, Mohamed SH, Salih AA. The pattern of anthropometric measurements among term newborn infants in Khartoum state in relation to maternal factors. Sudanese Journal of Paediatrics. 2013;13(2):31-6.

18. Kumar S, Jaiswal K, Dabral M, Malhotra AK, Verma BL (2012). Calf circumference at birth: A screening method for detection of low birth weight. Indian Journal Community Health 24:336-41.

19. Nair BT, Raju U, Mehrishi RN. (2016). Identification of a surrogate anthropometric measurement to birth weight in high-risk low birth weight newborns in a developing country. Annals of Nigerian Medicine; 10:63-7.

20. Neyzi O, Saka HN (2002). Anthropometric studies in Turkish children. Istanbul Medical Faculty journal, 65:221–8.

21. Oluwafemi O; Njokanma F, Disu E, Ogunlesi T. (2013). The current pattern of gestational age-related anthropometric parameters of term Nigerian neonates. South African journal of child health Vol. 7 No. 3 100-4

22. Sadoh WE, Sadoh AE (2007). Iduoryekemwen NJ. Newborn anthropometry: Effects of socio-demographic factors and maternal anthropometry. Nigerian Journal of Paediatrics; 34:68-78.

23. Shastry CKR and Bhat BPR (2015). Anthropometric measurements of newborns. International Journal of Contemporary Pediatrics. 2(2):85-89

24. Siyah Bilgin, B., Uygur, Ö., Terek, D., Altun Köroğlu, Ö., Yalaz, M., Akisü, M., … Kültürsay, N. (2018). Reference values of anthropometric measurements in healthy late preterm and term infants. Turkish Journal of Medical Sciences, 48(4), 862–872.

25. Swende T. Z. (2011) Term birth weight and sex ratio of offspring of a nigerian obstetric population. International Journal of Biological & Medical Research, 2(2): 531-532

26. Telatar B., Comert S., Vitrinel A. and Erginöz E. (2009). Anthropometric measurements of term neonates from a state hospital in Turkey. Eastern Mediterranean Health Journal, 15, (6). 1412-9