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Anthropometric Correlates of Maternal Height, Weight and BMI to Birth Weight in the University of Calabar Teaching Hospital (UCTH), Calabar, Nigeria (2012-2014)

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Abstract: ***Anthropometry reflects both health and nutritional status of living humans. As to estimate the health and maturity of the neonate, birth weight is one of the important and significant indices of estimation. The purpose of this study was to determine the clinical correlates of maternal height, weight and body mass index (BMI) to birth weight of Nigerians in the University of Calabar Teaching Hospital (UCTH). Descriptive analysis was carried out on maternal anthropometric measurements and neonatal data for 500 women collected from maternal folders at the medical record unit of ante natal clinic in UCTH Calabar, Cross Rivers State, Nigeria. Male and female neonate subjects were 247 (49.4%) and 253 (50.6%) respectively. Maternal age, weight and BMI were presented as 3.19±0.03, 27.95±0.20, 77.63±0.64, 1.64±0.003 and 29.71±0.23 respectively. A positive correlation was established between maternal weight and birth weight, maternal height and birth weight as well as maternal BMI and birth weight. There was strong positive correlation between maternal BMI and maternal weight with r=0.902, maternal weight and BMI with an indication of a weak negative correlation of r=-0.044. In conclusion, maternal anthropometric parameters were associated with neonatal birth weight and obviously there was no significant difference between male and female neonatal birth weight. Educating antenatal women on good nutrition is recommended.***

Keywords: Anthropometry, maternal weight, maternal height, maternal BMI and birth weight

1. Introduction

Anthropometry as a scientific study of the measurements and proportions of the human body is a standard technique in physical anthropology for measurement of living human individuals for the purposes of understanding human physical variation. One of the fathers of anthropometry Alphonse Bertillon through patients' inquiry found that several features and dimensions of certain bony structures within the human body remains considerably unchanged throughout adulthood and with time the systematic measurements differentiate one individual from another. This discovery plays a great role in forensic investigations, especially in personal identification.

To describe individuals or populations and to investigate the public health and nutrition survey, anthropometric measurements play a key role (Kipper, 1996). In epidemiology and medical anthropology, anthropometric measurements is used to determine the relationship between various body measurement (percentage of body fat, height and weight) and medical outcomes as well as used to diagnose malnutrition in resource-poor clinical settings. The increase in body mass index (BMI) among pregnant women globally has been one of the most important public health concerns (Yazdani *et al.*, 2012; WHO, 1995). Birth weight is one of the important indices to estimate the health and maturity of the neonate that are influenced by maternal factors as well as related environmental factors (Ojha and Malla, 2007). Extreme birth weight is of great concern in obstetrics as well as pediatrics and also it is a well-recognized factor for evaluating intrauterine growth development (Afrin, 2002). Birth weight is closely associated with the health and survival of the newborn and the incidence of low birth weight are associated with high mortality and morbidity, which continues to be a major public health concern (Kramer, 1987). Neonatal birth weight is an important determinant of infant's well-being and maternal body mass index (BMI) during pregnancy is one modifiable factor capable of influencing neonatal birth weight outcome and as such, an indication of the quality or level of maternal health care and the socio-economic development of that society (Kelly *et al.*, 1996).

Anthropometric measurement is one of the various methods used to access the maternal nutritional status. Thus, an important and significant purpose of ante natal care is the assessment of pregnant and expectant mothers for risk of developing complications or minimizing their impact. Factors such as mother's genetic characteristics, socio-cultural, demography, behavioral factors, pre-pregnancy body mass index (BMI) and gestational weight gain contributed to total weight gain (Afrin, 2002).

Also, intake of nutrients and weight gain during pregnancy are the two major factors influencing maternal and neonatal outcome (Kelly *et al.*, 1996). In clinical medicine, neonatal birth weight is also of considerable significance as an indicator of perinatal survival and a predictor of health in infancy and later in life. It has been shown that birth weight is related to wide range of health variables or parameters such as later blood pressure (Ijzerman *et al.*, 2000), grip strength (Sayer *et al.*, 2002), social adjustment (Brooks-Gunn *et al.*, 1993) including intelligence. Report has it that

high birth weight has been identified as a risk factor for childhood leukemia and certain cancers that develop in adulthood and low birth weight is also related to an increase of coronary heart disease and intellectual impairment later in life (Mc Cormack *et al.*, 2005; Ahlgren *et al.*, 2007). Again, another investigation opined that mothers of babies with high birth weight are also at risk of leukemia (Paitel *et al.*, 2008). Maternal height and weight have been related to neonatal length and weight at birth whereby short maternal stature is of high connection with lower uterine volume and blood flow and is also directly associated with risks of fetal growth restrictions, caesarian delivery and cephalopelvic disproportion. Body mass index (BMI) is a measure of the body relative weight based on the mass and square of height of an individual that has a unit of kg/m2

$$\text{BMI}= \frac{mass\ (kg)}{Height\ (m^2)}$$

There are several BMI categories; underweight, overweight or obese as classified by the WHO. And it is a well-established fact that genetic and environmental factors play important roles in determining birth weight (Hur *et al.*, 2005). However, there are still some differential parental and maternal contributions to birth weight. It has been reported that parental birth weight has a greater influence on off springs. On the other hand, Griffith *et al. (*2007) reported that maternal weight contributed more significantly to birth weight compared to parental weight. Such discrepancies could be a reflection of considerable inter-population and the intra-population inherited traits and environmental influence on birth weight (Taiwo and Akinde, 2012). Literature search revealed that while there were many reports on maternal contribution, heredity and predictability of birth weight in many populations, little or no reports were found on most African populations especially on Nigerian populations. There is a gap in knowledge with regards to maternal anthropometry (maternal height, weight and body mass index) of Nigerians and its crucial role in the determination of neonatal birth weight. Hence the aim of this study was to determine the anthropometric correlates of maternal height, weight and body mass index to birth weight of Nigerians in University of Calabar Teaching Hospital (UCTH).

2. Methodology

The data for this research were collected from maternal folders of 500 registered pregnant women at the medical records unit of ante natal clinic of the University of Calabar teaching hospital (UCTH) Cross Rivers State, Nigeria between 1st of January, 2012 to 31st of December, 2014. Each of the folders contains ante natal note which has obstetric records of age, ethnic background, occupation, weight and height recorded during booking and weight before delivery. The maternal folders which were recorded by the midwives also contained partographs with summary of labour ward record showing the birth weight of the newborn. The weight and height of all the registered expectant mothers were taken during first ante natal checkups and in subsequent time of checkups by using a weighing balance graduated in kilogram as the unit with minimum clothing while taking readings. The height was measured crown-heel keeping the women standing erect on a metre scale without footwear.

Again, newborns to the registered mothers were weighed immediately after delivery using baby weighing scale and length measured using a calibrated nylon tape. Some data that have patient's incomplete information, premature babies with gestational age less than 37 weeks, multiple pregnancies and mothers who delivered babies with congenital abnormalities were excluded.

3. Results and Analysis

The data obtained from the research were analyzed statistically using a computer package called statistical package for social sciences (SPSS) software version 20 installed on a computer. Descriptive analysis was carried out on maternal anthropometric measurements and neonatal data. Pearson correlations were calculated to estimate correlation between maternal weight, height, BMI and birth weight.

Table 1: Descriptive of Birth weight and Sex Distribution

Parameter	Male N= 247	Female N=253
Birth weight	3.24±0.04	3.15±0.04

P>0.05

From the data obtained, male neonate subjects N=247 which is 49.4% of the total sample and the female neonate subjects N= 253 has the remaining percentage of 50.6%. Mean birth weight for male neonate was 3.24±0.04 while female neonate had 3.15±0.04. From the result, the mean birth weight of male neonate was slightly higher than that of the female neonate and there was no significant difference between male and female neonates birth weight (p>0.05) as shown in table 1.

Table 2: Shows the Mean, Minimum and Maximum values of the studied variables

Parameters	Mean±SE	Minimum	Maximum
Birth weight (kg)	3.19±0.03	0.50	5.20
Maternal age (yrs)	27.95±0.20	15.00	42.00
Maternal weight (kg)	77.63±0.64	47.00	120.00
Maternal height (kg)	1.62±0.003	1.40	1.96
BMI (Kg/m2)	29.71±0.23	18.79	51.94

From table 2, the mean values of birth weight, maternal age, maternal weight, maternal height and mass body index (BMI) were obtained as 3.19±0.03, 27.95±0.20, 77.63±0.64, 1.62±0.003 and 29.71±0.23 respectively. The maximum and minimum values of all the parameters mentioned above were as well taken into consideration. The mean birth weight of the newborns was found to be within the WHO stipulated normal birth weight range of 2.5 to 3.5kg.

Table 3: Comparison between present study and previous in other populations

Author	Population	N	Birth weight (kg)	Maternal weight (kg)	Maternal height (m)	Maternal BMI (Kg/m2)
Upadhyay *et al.*, 2011	Sherp/Tamag, Nepal	206	3.46±0.41	-	-	23.53±2.28
	Brahmin/Chetri, Nepal	206	2.96±0.34	-	-	21.6±2.32
Jananthan *et al.*,2009	Jaffna Sri Lanka	563	3.04±4.4	53.3±10.6	1.5±6.2	22
Taiwo & Akinde, 2012	Lagos, Nigeria	300	3.17±0.43	68.10±8.52	1.68±8.8	24.28±3.80
Ahmadu *et al.*, 2012	Maiduguri, Nigeria	104	3.02±0.58	63.39±12.59	1.63±0.05	23.69±4.33
Present study	Nigerians UCTH	500	3.19±0.03	77.63±0.64	1.62±0.002	29.71±0.23

In table 3, a comparison of the results obtained in terms of sample size, birth weight, maternal weight and maternal body mass index (BMI) of this research with other previous studies in other populations were done. The results were within the limit. Maternal weight of the present research 77.63±0.64 seemed to be highest while that of Jaffna Sri Lanka was the lowest-53.3±10.6. Neonatal birth weight of 3.46±0.41 was observed to be higher in Sherp/Tamang population in Nepal and lowest-2.96±0.3 in Brahmin/Chetri population also in Nepal. The maternal BMI was found to be lowest in Brahmin/Chetri with a value of 21.6±2.32 and the incumbent research had the highest value of 29.71±0.23.

The difference in the mean maternal height among the populations of comparison is very negligible. Though mean maternal height in Lagos Nigeria population was the highest and that of Jaffna Sri Lanka population was lowest.

Table 4: Shows the correlation between the variables in the present study

	Fetal Weight (Kg)	Maternal weight (kg)	Maternal height (m)	BMI (Kg/m2)
Fetal weight (Kg)	1	.285	.174	.224
Maternal weight (Kg)	.285	1	.385	.902
Maternal height (m)	.174	.385	1	- 0.044
BMI (Kg/m2)	.224	.902	- 0.044	1

With regards to the correlations between the variables in this present research-maternal weight, height, BMI and birth weight, some positive results were observed. Positive correlations were obtained between maternal weight and fetal weight and also between maternal BMI and fetal birth weight with r=0.174 and 0.234 respectively. There was a weak positive correlation of 0.285 between maternal weight and fetal birth weight whereas maternal BMI and maternal height indicated a strong negative correlation as r=-0.044, maternal BMI and maternal weight revealed a strong positive correlation as r=0.902.

The Spearman Pearson correlation between maternal weight and fetal birth weight has a linear and direct relationship. Since the slope on the graph is positive, it is obvious that the maternal weight is directly proportional to the fetal birth weight. The linear equation from the Spearman Pearson graph Y=0.0117X+ 2.2793 has Y as the fetal birth weight and X as the maternal weight.

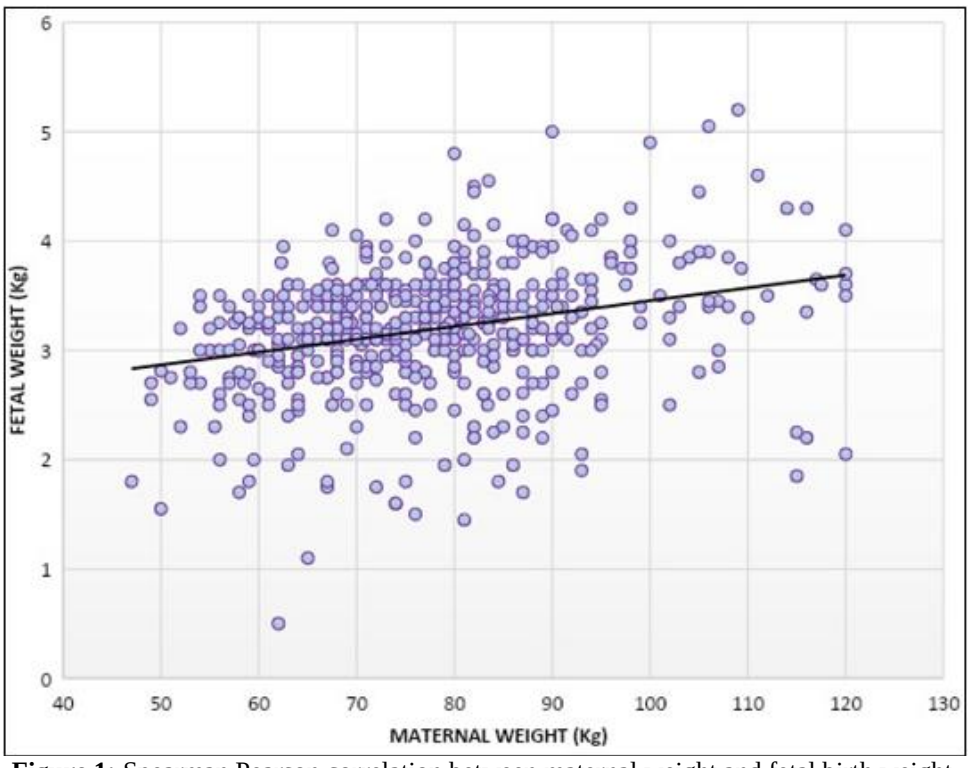

Figure 1: Spearman Pearson correlation between maternal weight and fetal birth weight

By comparing fetal weight and maternal height, a linear relationship which means increases in maternal height

equally increases the fetal birth weight. Also, there was a similar tread when plotting fetal birth weight against maternal BMI. Again, an increase in maternal BMI on the other hand increases the fetal birth weight. The above comparisons were shown in figure 2 and 3.

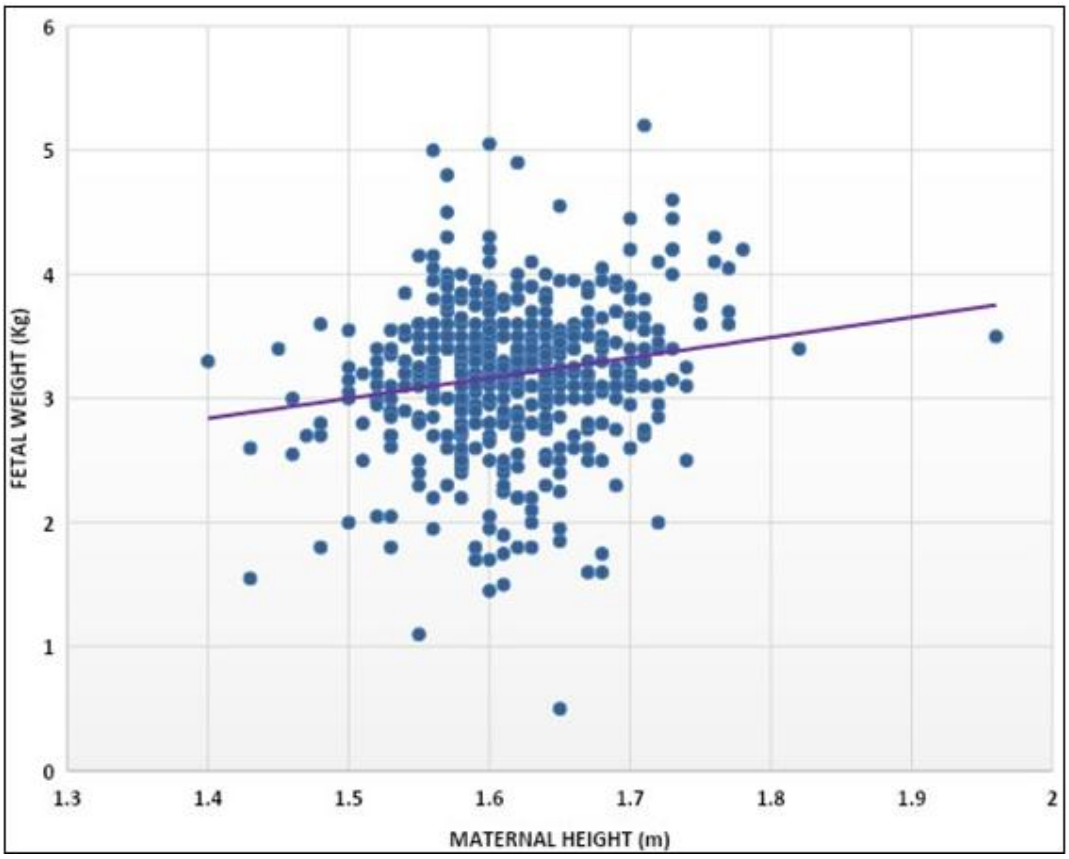

Figure 2: Spearman Pearson correlation between maternal height and fetal birth weight. r=0.17

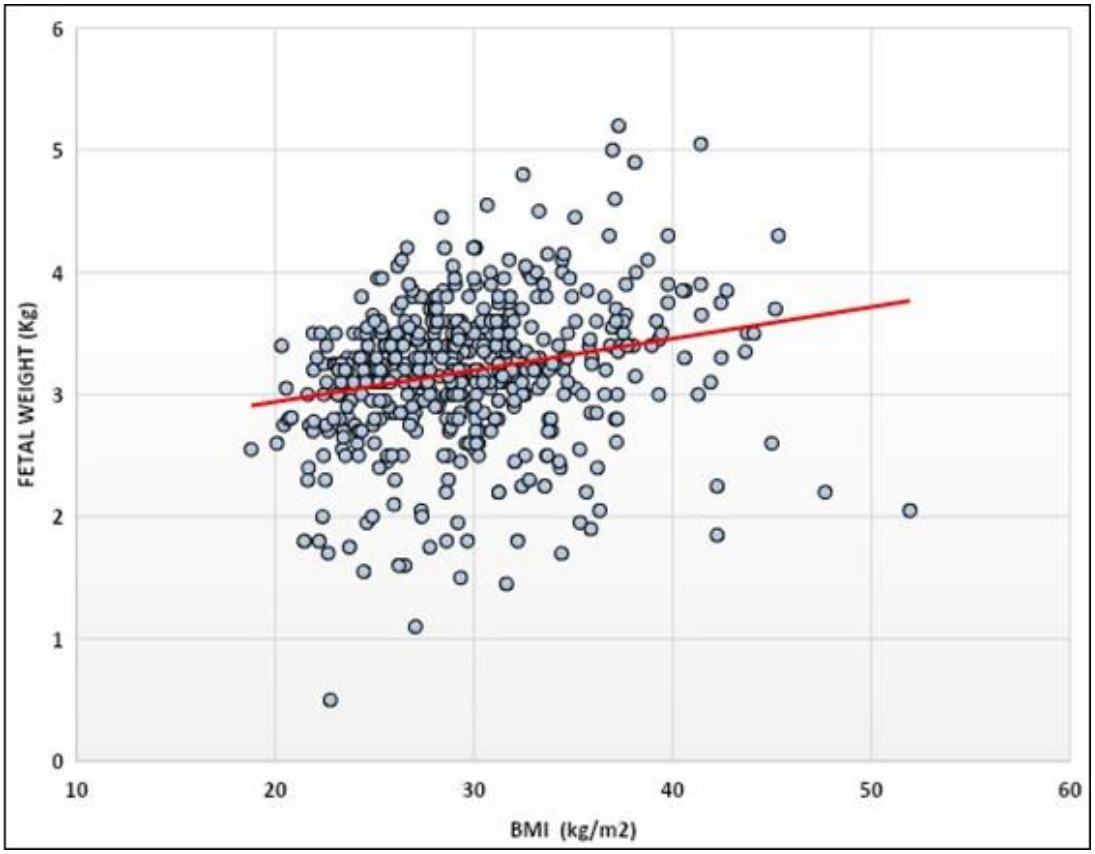

Figure 3: Spearman Pearson correlation between maternal BMI and fetal birth weight. r=0.22

Above all, there were weak positive correlations between maternal weight and fetal birth weight, maternal height and

fetal birth weight and also between maternal BMI and fetal birth weight.

4. Discussion

The values obtained from these findings with regards to birth weights of the male and female neonates was within the normal range of the WHO recommended values of 2.5kg to 3.5kg. Millis and Seng (1954) opined that male neonates were generally heavier than the female neonates, however, this was contrary to the findings in this study since there was no significant difference between the male and female neonatal birth weight. It was observed that they were within acceptable limit when compared with the work done in Maiduguri, Nigeria (Ahmadu *et al.,* 2012). From the result obtained, the maternal pregnancy BMI had a weak association with birth weight and this was in line with what was observed of previous researches (Ahmadu *et al.,* 2012 & Ushakiran *et al.,* 2005) using different population samples. In contrast, another study has it that there is strong association between maternal pregnancy BMI and birth weight of neonates in Asia (Upadhyay *et al.,* 2012). Invariably, this might be as a result of cross cultural population.

It was suggested that maternal anthropometry varies across different populations of the world. (Kelly *et al.,* 1996). Gestational weight gain is strongly associated with the risk of delivering small and large size for gestational age infants of which is reflected in the birth weight. This research finding confirmed with this as the birth weight is positively affected of maternal weight. Ay *et al.,* 2009 had a similar observation.

Genetic or environmental factors have influence on maternal height and birth weight as weak positive correlation was found in this study. Several studies (Syed and Kamanthi, 2012; Zhang *et al.,* 2010 and Witter and Luke, 1991) showed that there is a correlation in a positive direction between maternal status and the birth weight, perinatal mortality, still birth and early neonatal mortality, etc. Ay *et al., (*2009) also found weak correlations for height and birth weight ($r = 0.23$, $p < 0.01$).

Parental genetic factors influence 38%-80% birth weight variance while environmental factors have influence of 25% birth weight variance. This shows strong evidence that perinatal genetic factors contributed immensely to neonatal birth weight (Johnson *et al.,* 2002).

5. Conclusion

In conclusion, maternal anthropometric parameters which include maternal pregnancy weight, height and body mass index (BMI) are associated with neonatal birth weight. And there is no significant difference between a male and a female neonatal birth weight.

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