STUDY OF THE RELATIONSHIP BETWEEN MATERNAL AND NEONATAL ANTHROPOMETRIC PARAMETERS AMONG HAUSAS IN KANO, NIGERIA

BY

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DECLARATION

I declare that the work in this project thesis entitled **‘‘Study of the relationship between Maternal and Neonatal anthropometric parameters among Hausas in Kano’’** has been performed by me in the Department of Human Anatomy, Faculty of Medicine, A.B.U, Zaria, under the supervision of Prof. S.S. Adebisi and Dr. J.N. Alawa. The information derived from the literatures has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

______________________ ______________________

SA’ADU DATTI **Date**

CERTIFICATION

This project thesis entitled **''Study of the Relationship between Maternal and Neonatal Anthropometric Parameters among Hausas in Kano ''** by Sa'adu DATTI meets the regulation governing the award of Master of Science (M.Sc) degree in Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria, under the supervision of **Prof. S.S. Adebisi** and **Dr. J.N. Alawa**. It is therefore approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to Almighty **ALLAH**, His mercy, love and comfort is incomparable. Also to our noble prophet **MUHAMMAD** (SAW), his companions and those who fallows his right path to the day of resurrection

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ABSTRACT

The study was designed to determine the relationship between maternal and neonatal anthropometric parameters among Hausas in Kano. Five hundred and twenty one subjects participated in the study. The anthropometric variables were measured using standard procedures. Pearson's correlation and regression analyses were used to analyze the data using SPSS (IMB, corporation, NY) version 20**.** Statistical significance was declared at $p<0.05$. The result shown that the Hausa neonate had mean birth weight (BW) of 3.37kg ± 0.5cm and birth length (BL) of 49.17±2.06 cm, whereas the mean value for head circumference (HC), chest circumference (CC), mid upper arm circumference (MUAC), hand length, hand breadth, foot length and foot breadth were 35.39 ± 1.80cm, 34.28 ± 2.40cm, 11.02 ± 0.80cm, 6.55 ± 0.65cm, 3.86 ± 0.39cm, 7.96 ± 0.74, 3.82 ± 0.42 respectively. For the maternal parameters: the subjects had mean weight (W), height (H), body mass index (BMI), mid upper arm circumference (MUAC), hand length, hand breadth foot length, foot breadth of 58.49kg ± 10.78, 155.57cm ± 5.22, 24.15 cm ± 3.99, 24.88cm ± 2.87, 17.88 ± 1.138.53 ± 0.67, 23.72 ± 1.62, 9.88 ± 0.82 respectively. The neonatal variable indicated gender differences with exception of BL, CC and MUAC. In term of relationship, maternal parameter correlate with that of neonate, with higher level of significance noted between MA and BW. A regression models generated indicated that BW and BL can be predicted from maternal parameters. Based on the parity, it was noted that the mothers within the 1st category of parity show significant differences ($p < 0.001$) in the BW and TC of their neonate when compared with 2nd, 3rd and 4th. However, in BL, HC and CC of the neonate the differences ($p < 0.001$) were observed only between 1st and 2nd category of parity. Moreover, the MUAC has similar pattern with addition to 3rd categories. In conclusion, the maternal age showed highest correlation value ($r=0.341$) with the birth weight, its potential variable that can be used in determining the size of a newborn.

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LIST OF ABBREVIATIONS

ABU: Ahmadu Bello University

BL: Birth length

BMI: Body mass index

BW: Birth weight

CC: Chest circumference

FB: Foot breadth

FL: Foot length

H: Height

HB: Hand breadth

HC: Head circumference

HL: Hand length

IQ: Intelligence quotient

LBW: Low birth weight

MA: Maternal age

MH: Maternal height

MW: Maternal weight

MHL: Maternal hand length

MHB: Maternal hand breadth

MFL: Maternal foot length

MFB: Maternal foot breadth

MUAC: Mid upper arm circumference

MMUAC: Maternal mid upper arm circumference

NMUAC: Neonatal mid upper arm circumference

NHL: Neonatal hand length

NHB: Neonatal hand breadth

NFL: Neonatal foot length

NFB: Neonatal foot breadth

CHAPTER ONE

INTRODUCTION

1.1 Background

Numerous studies have shown the significant effects of various maternal factors on the anthropometric characteristics of the newborns (Feleke and Enquoselassie, 1999; Kirchengast *et al.,* 1998; Malik *et al.,* 1997; MacLeod and Kiely, 1988). It was reported that maternal body dimensions are first determinants of neonate biometrics; predominantly their birth weight and length, which are closely related to perinatal morbidity and mortality, and among the nonbiometric maternal factor, two factors known to play a decisive role in foetal growth are maternal age and parity (Guihard-Costa *et al.,* 2004). It was revealed that mother's nutritional status is also known to be a key indicator of infant's body dimensions and its early growth features. Birth weight and length are clearly based on mother's nutritional (Muthayya, 2009) and anthropometric factors (Witter and Luke, 1991), respectively, showing a striking genetic influence (Veena *et al.*, 2009).The anthropometric measurements that are commonly used as indices of growth and development are height, weight, body circumferences among others (Harrison *et al.,* 2001). The growth of neonate was reported to be influenced by some maternal variables such as age, parity, social class and ethnicity (Wildschut, 1999). Other anthropometric parameters such as maternal height were reported to be associated with birth size and childhood stunting **(**Ozaltin *et al.,* 2010; Subramanian *et al.,* 2009; Victora *et al.,* 2008; Ramakrishnan *et al.,* 1999). It was reported that maternal anthropometry is a potentially valuable tool in the evaluation of pregnancy status and prediction of birth weight (Benjumea, 2007). Several maternal factors such as age, body height, pre-gestational body weight, gestational weight gain, parity, gestational age, smoking during pregnancy, ethnicity, general health state, and dietary habits during pregnancy may influence the foetal growth which manifested in birth height and birth weight (Dhall and Bagga, 1995).

Previous studies revealed the causes of low birth weight which include hard manual labour, maternal nutrition, economic condition, maternal height, maternal weight, and most importantly are mother's age and parity (Cramer, 1995; Mavalankar *et al.*, 1994;Kamaladoss *et al.*, 1992;Makhija and Murthy, 1990; Pakrasi *et al.*, 1985; Fedrick and Adelstein, 1978; Ghosh *et al.*, 1977). Maternal anthropometric measurements provide a simple, cheap and available means of predicting birth weight with a variable degree of reliability. Factors that determine birth weight, maternal height, maternal pregnancy weight gain, parity, foetal sex, ambient attitude, maternal haemoglobin concentration, paternal height, cigarette smoking and glucose intolerance. In third‑world countries where poverty among women of reproductive age is prevalent, malnutrition is a common factor that can substantially affect the size of neonate at all gestational ages (Shittu *et al.*, 2007).

Mothers who have not suffered ill health or nutritional deprivation in childhood and who enter pregnancy in good health maintaining sound reproductive physiology will have larger and healthier infants than mothers who do not have such (Ebrahim, 1983). Birth weight is the most sensitive and reliable indicator of the health in a community. It is universally acknowledged that size at birth is an important indicator of foetal and neonatal health in the context of both individual and population. Birth weight in particular is strongly associated with neonatal and post-neonatal mortality and with infant and child morbidity (WHO, 1995).

It was also reported that the relationship between maternal and neonatal anthropometric measurements in both sexes shows that, maternal weight and height had a significant positive correlation with neonatal birth weight, birth length, body mass index (BMI) and head circumference (HC), while maternal BMI showed a significant positive correlation only with birth weight, length and BMI (Hassan *et al.*, 2009).

1.2 Statement of the research problem

Midwives usually performed the measurements of basic neonatal and maternal anthropometric parameters for both mother and new born for years but yet the data has not been properly documented in our locality. It is in this view that, there is a need for documentation as well as establishing a relationship between these anthropometric parameters of the Hausa ethnic group in Kano, Nigeria**.** Based on the literature search there is paucity of information on relationship between maternal and neonatal parameters among Hausas in Kano State, Nigeria.

1.3 Research Hypotheses:

There is relationship between maternal and neonatal anthropometric parameters among Hausas in Kano

There is relationship between maternal parity and neonatal anthropometric parameters among Hausas in Kano

Maternal anthropometric parameters can be used to estimate birth weight of Hausa neonates in Kano

Maternal anthropometric parameters can be used to estimate birth length of Hausa neonates in Kano

1.3 Significance of study

Determination of neonatal anthropometric parameters especially birth weight is a potential tool used in the assessment of neonatal nutritional status, gestational maturity and prediction of early neonatal death (Ashraf *et al.*, 2012). And can also be used in paediatric resuscitation, it is necessary to know the birth weight in order to provide appropriate drug and fluid doses, equipment selection and ventilator settings, and there is a need for rapid and accurate methods of estimation to be able to estimate birth weight (Mackway-Jones *et al.*, 2005)

1.5 Aim

The aim of the study is to determine the relationship between maternal and neonatal anthropometric parameters among Hausas in Kano

1.6 Objectives

The objectives of this work are:

1. To form linear regression equations that can be used for birth weight estimation in neonates from maternal variables of Hausa ethnic group in Kano.
2. To determine the relationship between maternal parity and neonatal anthropometric parameters among Hausas in Kano
3. To form linear regression equations that can be used for birth length estimation in neonates from maternal variables of Hausa ethnic group in Kano
4. Provide reference data on neonatal and maternal anthropometric parameters among Hausas in Kano

CHAPTER TWO

LITERATURE REVIEW

2.1 Maternal Age and Birth Weight

It was reported that mother`s age served as an indirect factor affecting birth weight (Hoffman *et al.*, 2007). Earlier study showed that the normal age range of a mother to be given normal birth weight were 21-30 years, also the mean birth weight is normal in both male and female newborns since the normal range of birth weight was 2500gm to 3500gm (WHO, 1992). It was also reported that maternal age and other anthropometric parameters such as height, weight, body mass index (BMI), weight gain during pregnancy, nutritional status, socioeconomic status, and parity are some of the well-established determinants of the birth weight of the neonate (Shamsun *et al.,* 2007). Generally speaking aged women may have an increased risk for abnormal labour, although the mother's age by itself may be one of the factors which can have effect on the doctor's decision, patient's request or obstetric troubles (Bell *et al.*, 2001). According to Wildschut (1999) maternal age, social class and ethnicity are interrelating socio-demographic factors that influence maternal health and childbearing. Reports on complications of pregnancy in young girls are contradictory and difficult to interpret because of confounding effects of adverse social circumstances and poor attendance for antenatal care. This phenomenon is of concern because teenage mothers are reported to be disadvantaged financially, educationally and cognitively (Hanna, 2001). It is interesting that the characteristics of babies' fathers whose mothers are adolescent are also unique. These men have a lower level of education, a greater age discrepancy between themselves and the mothers, a greater unemployment rate, less financial independence, less supportive attitude toward pregnancy, poorer attendance at childbirth, less provision of postpartum care for mothers and infants (Wang and Chou, 2001). The incidence of LBW was high among mothers of age 20 years or less.

Similar observations were also reported (Negi *et al.,* 2006). It is now universally acknowledged that maternal age is an important factor influencing the incidence of LBW. Moreover, the rate of LBW decreases significantly with the increasing age of mother after 18 years of age. Earlier studies have also reported that the young (<20 years) mothers had higher incidence of LBW than older (<30 years) mothers (Begum *et al.,* 1995 and Oni, 1986).

2.2 Maternal weight and birth weight

Birth weight is now widely used as an indicator of health status of individuals and populations as it has strong associations with both childhood and adult health. It is associated with childhood growth, cognitive deficit and disability (Fairley, 2000). Birth weight plays an important role in infant mortality and morbidity, development, and future health of the child (WHO, 1995). It is also documented that the most important determinant of children's chance of survival, healthy growth and development in future (Ghai*et al.,* 2004). In recent years infant birth weight has been increasing in many countries, representing an obstetric hazard and a potential public health problem since high birth weight involves a risk of obesity later in life (Forsum, 2006). Maternal anthropometric parameters such as weight, height, body mass index (BMI), weight gain during pregnancy, nutritional status, socioeconomic status, are some of the well-established determinants of the birth weight of the neonate (Shamsun *et al.,* 2007).

2.3 Parity and birth weight

It has been reported that primipara has higher relative risk of delivering low birth weight (LBW) babies in developing countries (Lawoyin, 2007; Bisai *et al.,* 2006; Hirve *et al.,* 1994). In another study Elshibly and Schmalisch (2008) shows that primiparity is associated with an increased relative risk for LBW and that was distinctly higher when compared to the relative risk for LBW of other maternal characteristics. Several studies relating the effect of mother's age and parity on birth weight indicate that parity is the most important factor of the two (Millis and Seng, 1954).

2.4 Maternal height and birth size

Maternal height is one of the most important parameter which influences the birth weight with cut-off point of 156 cm which agrees well with investigators in Bangladesh (Baqui *et al.,* 1994). Several studies from developing countries observed the relationship between mother's height and infant birth size, most importantly; this study provides strong evidence that maternal height had the strongest significant impact on new-born size (Deshmukh *et al.,* 1998; Gopalan, 1991). Likewise the study conducted by Pachauri *et al.* (1971) showed that, the taller the mothers the heavier the babies and similarly, Bhatia *et al.* (1985) noticed birth weight increased as maternal height increased.It is well established that socio-economic status and ethnicity influences height as stunting is a consequence of long-term poor nutritional intake and is the best indicator of decreased growth in children over an extended period. Stunting has been associated with poorer cognition and school achievement in later childhood (Chang *et al.,* 2002). Stunting has also been linked to the perpetuation of the cycle of under nutrition by causing low birth weight among offspring of the stunted mother (Kramer *et* *al.,* 1990). A study from other developing countries reported high incidence of low birth weight of infants in mothers with height less than145cm than the mothers with greater than 145cm (Kamaladoss *et al.,* 1992). Several other studies have reported that short stature mother had greater risk for adverse pregnancy outcome (Pickett *et al.,* 2000; Gopalan, 1992). Earlier studies in India reported that mothers who are less than 140 cm in height were more prone to have LBW babies (Deshmukh *et al.,* 1998) these studies also found association of anemia, low socio-economic status and inadequate pregnancy weight gain with low birth weight (Dhar *et al.,* 1991). Short women gain on average approximately 1kg less during pregnancy than taller women (Kleinman, 1990).

2.5 Maternal social status and birth weight

Maternal education and household income, poverty and poor nutritional status were found to be associated with neonatal birth weight in rural areas in developing countries leading to increased risk of adverse reproductive outcomes including LBW and preterm birth (Wasunna *et al.,* 2002). Maternal nutritional status is considered to be an important factor that affects the successful completion of pregnancy (Abrams and Selvin, 1995). It has been reported that level of education did not have a significant effect on birth weight but illiterate subjects were more at risk for poor weight gain. Similarly, in the present study, different levels of education in pregnant women showed no significant influence on birth weight of babies. While it is true that healthcare providers cannot alter the mother’s education, these conditions may provide valuable clues regarding the likelihood of babies being born with low birth weight and assist in designing a comprehensive care plan (Yekta *et al.,* 2006). Other factors that determine neonatal birth weight include maternal factors such as race, stature and genetics (Moore and Devies, 2002). Environmental factors that determine neonatal birth weight are attitude, nutrition and physical activities (Lindsay *et al.,* 1989) Altered glucose metabolism, haemoglobin concentration and micro vascular integrity are physiological factors known to affect birth weight. Pathological factors such as hypertension and uterine malformations, and complications of pregnancy such as gestational diabetes mellitus and pre‑eclampsia are also important determinants of birth weight (Shah, 2010). Others workers have shown that gestational age at delivery is a significant determinant of newborn weight (Voigt *et al.,* 2004). Maternal illnesses and complications of pregnancy also affect birth weight the most common are chronic hypertension and pre‑eclampsia both of which cause low birth weight (Langer *et al.,* 1991). Evaluation of maternal nutritional status relies on measures such as pre‑pregnancy weight, height, body mass index (BMI) and weight gain at different trimesters, weight gain during pregnancy and skinfold thickness. Numerous research projects have studied maternal anthropometric characteristics as predictors of birth weight (Ayoola *et al.,* 2008). Many studies have shown that low birth weight babies that are less than 2.5 kg have deficits in average intelligence test scores at school, and within the low birth weight range, children who are smaller at birth have larger deficit than those closer to normal birth weight, the effect seems to be similar to both performance and verbal IQ (Breslau, 1995). It has been postulated that sex differences in foetal growth rates with growth generally being slower among girls could lead to different responses to foetal under nutrition (Adebisi, 2003).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Equipment

Measuring tape (to nearest 0.1cm), questionnaire, Stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured using digital standing scales (Model DS-410, Seiko, Tokyo, Japan), to the nearest 0.1 kg, Vanier caliper (Starrett, 123 Series, U.S.A.).

3.2 Location of the study

The study was conducted in the Murtala Muhammad Specialist Hospital Kano, Kano State, Nigeria, for period of two month.

3.3 Study population and sample size

Sample was randomly collected from Murtala Muhammad Specialist Hospital, Kano, Department of Obstetrics and Gynaecology.

The sample size was 384 subjects comprising both mothers and neonates calculated using a formula below;

$$n = \frac{Z^2 \quad pq}{d^2}$$

Where n= desire sample size, Z= standard normal deviation 1.96 at 95% confidence level, q= 1 – p, d= degree of precision, p= proportion =0.5 (50%) (Nainge *et al.*, 2006)

The sample size for the study is 521

3.4 Inclusion criteria

The mothers and neonates are of Hausa ethnic group of Kano state origin. Grand parentage criteria were used.

Full term neonates, singleton and delivered through spontaneous vaginal delivery (SVD)

Healthy mothers and neonates

3.5 Exclusion criteria

Caesarean section cases, twins, babies with major congenital malformations, infants born to diabetic mothers and mothers with pregnancy induced hypertension were excluded.

3.6 Anthropometry

Height (H) in cm: A movable horizontal bar which could be adjusted to touch the vertex of the participant's head was used to measure the height of the participants

Birth Weight (BW) in Kg: Way Master weighing scale was used to measure the birth weight with the capacity of 13kg × 50g.

Head circumference (HC) in cm: Head circumference was measured at the largest frontal occipital plane between glabella anteriorly and along the most prominent point posteriorly using a measurement tape to the nearest 0.1 cm

Chest circumference (CC) in cm: was measured using an inelastic tape as horizontal circumference of the chest at the level of the nipples at the end phase of expiration

Mid upper arm circumference (MUAC) in cm: Was measured at the midpoint between the tip of acromion process and olecranon process of the left upper arm using inelastic tape.

Birth length (BL) in cm: Measured as the projective distance between the highest point on the head (vertex), and the most posterior projecting point of the heel, using infant measuring mat in supine position.

Body mass index (BMI): weight and height was used to calculate the BMI as kilograms per meter square (kg/m^2)

Hand length (HL) in cm: Measured from the midpoint of the distal wrist crease, to the tip of the middle finger using a plastic measuring tape (palmer surface of the hand in supine position).

Hand breadth (HB) in cm: Measured from the head of the 5th to 2nd metacarpal using a sliding vernier caliper (palmer surface of the hand in supine position).

Foot length (FL) in cm: Measured as a straight distance between the most posterior projecting point of the heel and anterior projecting point (the end of 1st or 2nd toe) using a plastic measuring tape (Planter view of the sole of the foot in supine position).

Foot breadth (FB) in cm: Measured at the widest point of the sole, which is from the metatarsophalangeal joint of the 1st metatarsal and that of the 5th metatarsal of the foot using a sliding vernier calliper

3.7 Data analysis

The data was expressed as mean ± standard deviation. The relationship was determined using Pearson's correlation.

The regression analysis was performed to provide a model for prediction of one variable from another.

For sexual dimorphism the independent t test was used. All the analysis was carried out using SPSS (Statistical Package for Social Science) version 20 and $p<0.05$ was considered as level of significance.

CHAPTER FOUR

4.0 RESULTS

Table 4.1 shows the mean ± standard deviation (S.D) for the measured neonatal parameters among the Hausa neonates in Kano. The subjects had mean birth weight (BW) of 3.37kg ± 0.51. Mean birth length (BL) among the Hausa neonates was found to be 49.17 cm ± 2.06. The mean value for head circumference (HC) was 35.39 cm ± 1.80. For chest circumference (CC), the mean value was found to be 34.28cm ± 2.40while the mid upper arm circumference had mean value of 11.02 ± 0.80. The hand length had mean value of 6.55 ± 0.65 while hand breadth had mean value of 3.86 ± 0.39. The foot length had mean value of 7.96 ± 0.74. Foot breadth had mean value of 3.82 ± 0.42.

Table 4.1: Descriptive statistics of the measured variables among Hausa neonates in Kano (n = 521)

Variables	Mean ± SD
Birth weight	3.37 ± 0.51
Birth length	49.17 ± 2.06
Head circumference	35.39 ± 1.81
Chest circumference	34.28 ± 2.40
Thigh circumference	14.70 ± 1.85
MUAC	11.02 ± 0.80
Hand length	6.55 ± 0.65
Hand breadth	3.86 ± 0.39
Foot length	7.96 ± 0.74
Foot breadth	3.82 ± 0.42

MUAC=mid upper arm circumference

Table 4.2 presents the mean ± standard deviation (S.D) for the measured maternal parameters among the Hausas in Kano. The subjects had mean maternal weight (MW) of 58.49kg ± 10.78 S.D. Mean maternal height (MH) was found to be 155.57cm ± 5.22. The mean value for body mass index (BMI) was 24.15 cm ± 3.99 S.D. For mid upper arm circumference (MUAC), the mean value was found to be 24.88cm ± 2.87 while the hand length had mean value of 17.88 ± 1.13. The hand breadth had mean value of 8.53 ± 0.67. The foot length had mean value of 23.72 ± 1.62. Foot breadth had mean value of 9.88 ± 0.82.

Table 4.2: Descriptive statistics of the measured maternal variables among Hausas in Kano (n=521)

Variables	Mean ± SD
Weight	58.49 ± 10.78
Height	155.5 ± 5.22
BMI	24.15 ± 3.98

MUAC	24.88 ± 2.87
Age	23.69 ± 5.89
Hand length	17.88 ± 1.13
Hand breadth	8.53 ± 0.67
Foot length	23.72 ± 1.62
Foot breadth	9.88 ± 0.82

MUAC=mid upper arm circumference, BMI=body mass index

In table 4.3 the mean ± standard deviation (S.D) for the measured anthropometric parameters for male Hausa neonates in Kano (268). The subjects had mean values of birth weight (BW), birth length (BL), head circumference (HC), chest circumference (CC), thigh circumference (TC),mid upper arm circumference(MUAC), hand length, hand breadth, foot length, and foot breadth of 3.46kg ± 0.52, 49.22 cm ± 2.00, 35.67 cm ± 1.62, be 34.39cm ± 2.30,14.97 ± 1.85, 11.02 ± 0.80, 6.52 ± 0.62, 3.90 ± 0.34, 8.01 ± 0.72, 3.87 ± 0.36 respectively.

Table 4.3: Descriptive statistics of the measured anthropometric parameters for male neonates of Hausa in Kano (n=268)

Variables	Mean ± S.D
Birth weight	3.46 ± 0.52
Birth length	49.22 ± 2.00
Head circumference	35.67 ± 1.62
Chest circumference	34.39 ± 2.30
Thigh circumference	14.97 ± 1.85
MUAC	11.11 ± 0.75
Hand length	6.52 ± 0.62
Hand breadth	3.90 ± 0.34

Foot length	8.01 ± 0.72
Foot breadth	3.87 ± 0.36

MUAC=mid upper arm circumference

From table 4.4mean ± standard deviation (S.D) for the measured anthropometric parameters for female Hausa neonates in Kano (n=253) of birth weight (BW), birth length (BL), head circumference (HC), chest circumference (CC), thigh circumference (TC), mid upper arm circumference(MUAC), hand length, hand breadth, foot length, and foot breadth are 3.29 ± 0.49, 49.12 ± 2.12, 35.10 ± 1.94, 34.16 ± 2.50, 14.42 ± 1.81, 10.93± 0.85, 6.58 ± 0.68, 3.83 ± 0.44, 7.91 ± 0.76 and 3.76 ± 0.48 respectively.

Table 4.4: Descriptive statistics of the measured anthropometric parameters for female neonates of Hausa in Kano (n=253)

Variables	Mean ± S.D
Birth weight	3.29 ± 0.49
Birth length	49.12 ± 2.12
Head circumference	35.10 ± 1.94
Chest circumference	34.16 ± 2.50
Thigh circumference	14.42 ± 1.81
MUAC	10.93± 0.85
Hand length	6.58 ± 0.68
Hand breadth	3.83 ± 0.44
Foot length	7.91 ± 0.76
Foot breadth	3.76 ± 0.48

MUAC=mid upper arm circumference

Figure 1, 2 and 3 presents gender differences in neonatal anthropometric parameters. Birth weight, birth length, head circumference, chest circumference, thigh circumference, mid upper arm circumference, hand breadth and foot breadth had significant value of $p < 0.05$.

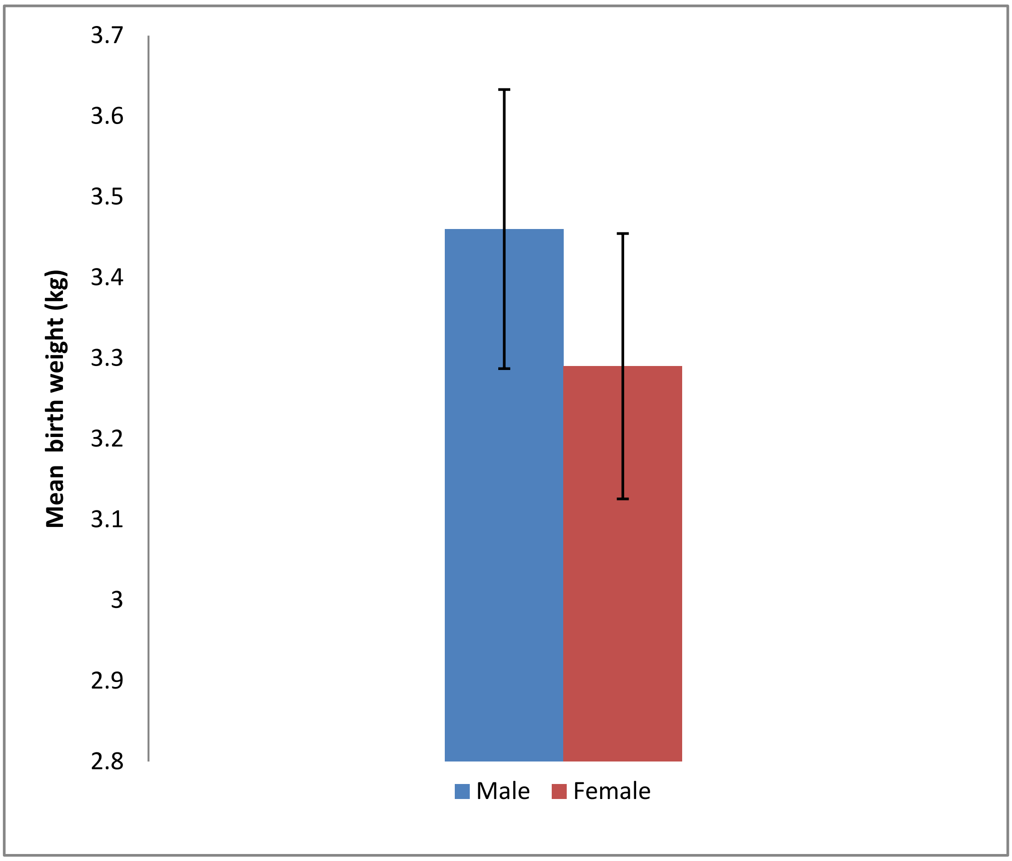

Fig 1: Gender differences in birth weight

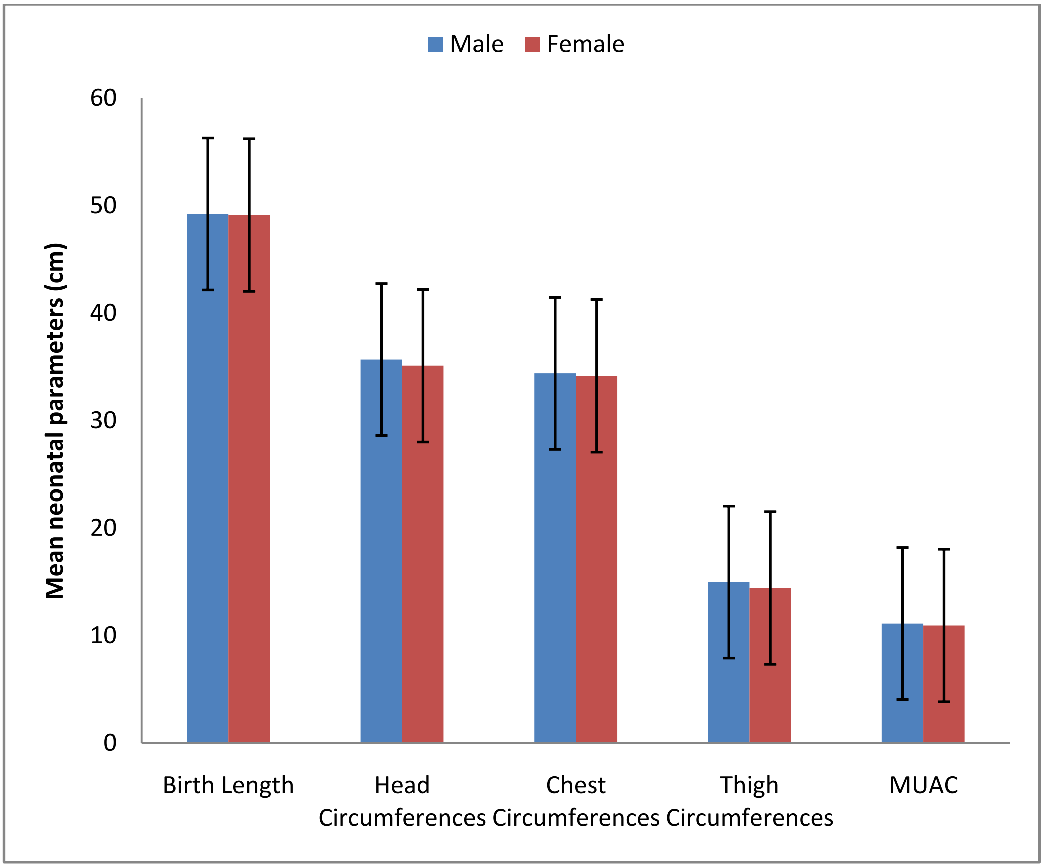

Fig 2: Gender differences in neonatal parameters

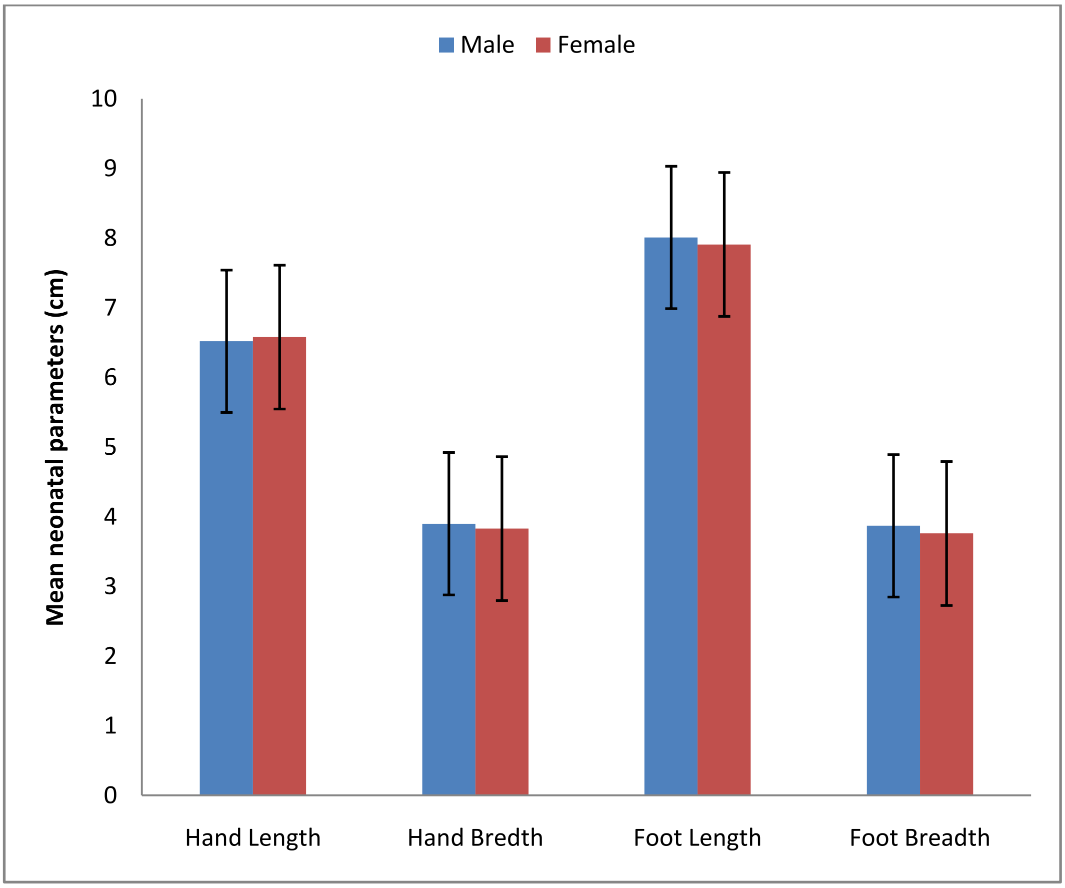

Fig 3: Gender differences in neonatal anthropometric parameters

Table 4.5 revealed correlation between maternal and neonatal anthropometric parameters among the Hausas in Kano (n=521). Maternal parameters were found to be correlated with the neonatal parameters. Maternal weight and age shows highest correlation coefficient with birth weight and thigh circumference of r=0.487 and 0.341 respectively.

Table 4.5: Pearson Correlation matrix between maternal and neonatal anthropometric parameters among Hausas in Kano-Nigeria (n=521)

Variables	MW	MH	BMI	MMUAC	BW	BL	HC	CC	TC	NMUAC
MA	0.294**	0.192**	0.256**	0.374**	**0.341****	0.130**	-0.021	0.012	0.353**	0.203**
MW		0.385**	0.921**	0.784**	0.258**	0.027	-0.103*	-0.145**	**0.487****	0.162**
MH			0.009	0.241**	0.104*	0.138**	0.014	0.037	0.138**	0.098*
BMI				0.745**	0.242**	-0.030	-0.124**	-0.180**	0.481**	0.139**
MMUAC					0.221**	0.045	0.007	-0.013	0.349**	0.152**
BW						0.290**	0.219**	0.261**	0.386**	0.386**
BL							0.399**	0.384**	-0.061	0.347**
HC								0.645**	-0.178**	0.330**
CC									-0.162**	0.369**
TC										0.277**

MA: Maternal age, MW: Maternal weight, MH: Maternal height, BMI: Body mass index, MMUAC: Maternal mid upper arm circumference, BW: Birth weight, BL: Birth length, HC: Head circumference, CC: Chest circumference, TC: Thigh circumference, NMUAC: Neonatal mid upper arm circumference* P < 0.05, ** P < 0.001

Table 4.6 presents correlation between maternal and neonatal anthropometric parameters among the Hausas in Kano (n=521). Maternal foot length and maternal hand length shows highest correlation values with thigh circumference (r=0.488 and 0.389 respectively) while maternal foot breadth had correlation coefficient of r=0.241.

Table 4.6: Pearson Correlation matrix between maternal and neonatal anthropometric parameters among Hausas in Kano (n=521)

Variables	MHB	MFL	MFB	BW	BL	HC	CC	TC	NMUAC
MHL	0.067	0.473**	0.348**	0.080	0.047	-0.109*	-0.153**	**0.389****	0.073
MHB		-0.173**	-0.119**	-0.057	0.210**	0.316**	0.373**	-0.283**	0.155**
MFL			0.455**	0.155**	-0.134**	-0.175**	-0.175**	**0.488****	-0.073
MFB				0.241**	-0.049	-0.151**	-0.257**	0.368**	0.086
BW					0.290**	0.219**	0.261**	0.386**	0.386**
BL						0.399**	0.384**	-0.061	0.347**
HC							0.645**	-0.178**	0.330**
CC								-0.162**	0.369**
TC									0.277**

MHL=maternal hand length, MHB=maternal hand breadth, MFL=maternal foot length, MFB=maternal foot breadth, BW=birth weight, BL= birth length, HC=head circumference, CC=chest circumference, TC=thigh circumference, NMUAC= neonatal mid upper arm circumference. * P < 0.05, ** P < 0.001

Table 4.7 revealed correlation between maternal (Under 20years) and neonatal anthropometric parameters among the Hausas in Kano (n= n=204). Maternal parameters were found to be correlated with the neonatal parameters. Maternal weight shows highest correlation value with the thigh circumference and birth weight (r=0.530, r=0.268 respectively).

Table 4.7: Pearson Correlation matrix between maternal (Under 20years) and neonatal anthropometric parameters among Hausas in Kano (n=204)

Variables	MW	MH	BMI	MMUAC	BW	BL	HC	CC	TC	MUAC
MA	0.172*	0.312**	0.048	0.230**	0.257**	-0.106	0.053	-0.127	0.365**	-0.065
MW		0.423**	0.904**	0.741**	0.268**	-0.204**	-0.178*	-0.148*	0.530**	0.093
MH			0.007	0.241**	0.085	-0.103	-0.022	0.000	0.188**	-0.013
BMI				0.703**	0.258**	-0.184**	-0.203**	-0.176*	0.511**	0.087
MMUAC					0.228**	-0.107	0.047	0.023	0.442**	0.191**
BW						0.217**	0.079	0.110	0.340**	0.328**
BL							0.337**	0.309**	-0.214**	0.327**
HC								0.672**	-0.317**	0.375**
CC									-0.337**	0.446**
TC										0.055

MA: Maternal age, MW: Maternal weight, MH: Maternal height, BMI: Body mass index, MMUAC: Maternal mid upper arm circumference, BW: Birth weight, BL: Birth length, HC: Head circumference, CC: Chest circumference, TC: Thigh circumference, NMUAC: Neonatal mid upper arm circumference* P < 0.05, ** P < 0.001

Table 4.8 shows Pearson correlation matrix between maternal (over 20 years) and neonatal anthropometric parameters of Hausas in Kano-Nigeria (n=317). Some of maternal variables that show strong correlations are: maternal age correlates with birth weight (r=0.296), and maternal height with birth length (r=0.219).

Table 4.8: Pearson Correlation matrix between maternal (over 20years) and neonatal anthropometric parameters among Hausas in Kano (n=317)

Variables	MW	MH	BMI	MMUAC	BW	BL	HC	CC	TC	NMUAC
MA	0.174**	0.015	0.195**	0.294**	0.296**	0.094	0.014	0.073	0.204**	0.156**
MW		0.314**	0.924**	0.777**	0.193**	0.077	-0.055	-0.144*	0.408**	0.135*
MH	.		-0.059	0.176**	0.041	0.219**	0.054	0.070	0.012	0.090
BMI				0.742**	0.190**	-0.004	-0.080	-0.183**	0.429**	0.118*
MMUAC					0.158**	0.057	0.010	-0.018	0.243**	0.093
BW						0.297**	0.321**	0.365**	0.343**	0.378**
BL							0.452**	0.442**	-0.054	0.338**
HC								0.626**	-0.093	0.334**
CC									-0.064	0.353**
TC										0.314**

MA: Maternal age, MW: Maternal weight, MH: Maternal height, BMI: Body mass index, MMUAC: Maternal mid upper arm circumference, BW: Birth weight, BL: Birth length, HC: Head circumference, CC: Chest circumference, TC: Thigh circumference, NMUAC: Neonatal mid upper arm circumference* $P < 0.05$, ** $P < 0.001$

Table 4.9Presents Pearson correlation matrix between maternal and male neonates anthropometric parameters of among Hausas in Kano (n=268). Some of maternal variables that show strong correlations are: maternal age correlates with birth weight and thigh circumference (r=0.460 and 0.453 respectively), maternal weight with birth weight and thigh circumference (r=0.308 and 0.494 respectively).

Table 4.9: Pearson Correlation matrix between maternal and male neonates anthropometric parameters of among Hausas in Kano (n=268)

Variables	MW	MH	BMI	MUAC	BW	BL	HC	CC	TC	NMUAC
MA	0.303**	0.171**	0.262**	0.370**	0.460**	0.218**	0.034	0.088	0.453**	0.214**
MW		0.277**	0.923**	0.807**	0.308**	0.035	-0.100	-0.155*	0.494**	0.275**
MH			-0.104	0.211**	0.165**	0.114	0.069	0.142*	0.177**	0.158**
BMI				0.746**	0.263**	0.002	-0.129*	-0.211**	0.446**	0.234**
MMUAC					0.271**	0.073	0.016	-0.004	0.333**	0.211**
BW						0.281**	0.206**	0.298**	0.489**	0.370**
BL							0.278**	0.407**	0.063	0.287**
HC								0.657**	-0.136*	0.213**
CC									-0.100	0.288**
TC										0.454**

MA: Maternal age, MW: Maternal weight, MH: Maternal height, BMI: Body mass index, MMUAC: Maternal mid upper arm circumference, BW: Birth weight, BL: Birth length, HC: Head circumference, CC: Chest circumference, TC: Thigh circumference, NMUAC: Neonatal mid upper arm circumference * P < 0.05, ** P < 0.001

Table 4.10 shows Pearson correlation matrix between maternal and female neonates anthropometric parameters of among Hausas in Kano (n=253). Some of maternal variables that show strong correlations are; maternal body mass index (BMI) with birth weight and thigh circumference(r=0.192 and 0.509 respectively).

Table 4.10: Pearson Correlation matrix between maternal and female neonates anthropometric parameters of among Hausas in Kano (n=253)

Variables	MW	MH	BMI	MUAC	BW	BL	HC	CC	TC	NMUAC
MA	0.273**	0.215**	0.231**	0.364**	0.147*	0.020	-0.123	-0.092	0.197**	0.173**
MW		0.486**	0.923**	0.765**	0.185**	0.016	-0.134*	-0.145*	0.468**	0.045
MH			0.126*	0.279**	0.030	0.160*	-0.041	-0.065	0.090	0.038
BMI				0.740**	0.192**	-0.070	-0.155*	-0.159*	0.509**	0.024
MUAC					0.128*	0.007	-0.031	-0.033	0.355**	0.071
BW						0.300**	0.195**	0.214**	0.233**	0.384**
BL							0.503**	0.362**	-0.196**	0.400**
HC								0.638**	-0.272**	0.403**
CC									-0.242**	0.436**
TC										0.083

MA: Maternal age, MW: Maternal weight, MH: Maternal height, BMI: Body mass index, MMUAC: Maternal mid upper arm circumference, BW: Birth weight, BL: Birth length, HC: Head circumference, CC: Chest circumference, TC: Thigh circumference, NMUAC: Neonatal mid upper arm circumference * $P < 0.05$, ** $P < 0.001$

Table 4.11 presents predictive equations of birth weight (BW) derived from the measured maternal parameters. Maternal: age, height, weight, mid upper arm circumference, BMI, MFL, MFB can accurately use in estimating BW. Highest statistical significant observed with MA ($p < 0.001$, $r = 0.341$).

Table 4.11: Linear regression equations for birth weight (kg) estimation from the measured maternal anthropometric parameters among Hausas in Kano (n=521)

Regression equation	R	R^2	SEE	f	P
BW=2.672+0.03(MA)	0.341	0.116	0.481	68.321	0.000
BW=2.657+0.0012(MW)	0.258	0.067	0.495	37.144	0.000
BW=1.786+0.010(MH)	0.104	0.011	0.509	5.696	0.017
BW=2.625+0.031(BMI)	0.242	0.058	0.499	32.208	0.000
BW=2.396+0.039(MMUAC)	0.221	0.049	0.497	26.548	0.000
BW=2.726+0.036(MHL)	0.080	0.006	0.510	3.338	0.068
BW=3.742-0.043(MHB)	0.057	0.003	0.511	1.664	0.198
BW=2.216+0.049(MFL)	0.155	0.024	0.506	12.769	0.000
BW=1.89+0.150(MFB)	0.241	0.058	0.497	32.143	0.000

BW=Birth weight, MW=Maternal weight, MH=Maternal height, BMI=Body mass index, MMUAC=Maternal mid upper arm circumference, MHL= Maternal hand length, MHB= Maternal hand breadth, MFL= Maternal foot length, MFB= Maternal foot breadth.

Table 4.12present predictive equations of birth length (BL) from the measured maternal parameters: maternal age (MA), maternal height (MH), maternal hand breadth (MHB), maternal foot length (MFL) among Hausas in Kano. MHB shows highest r and p values of 0.210 and 0.0001 respectively.

Table 4.12: Linear regression equations for birth length (cm) estimation from the measured maternal anthropometric parameters among Hausas in Kano (n=521)

Regression equation	R	R^2	SEE	f	p
BL=48.093+0.046(MA)	0.130	0.017	2.041	8.978	0.003
BL=48.870+0.005(MW)	0.027	0.001	2.057	0.383	0.536
BL=40.690+0.055(MH)	0.138	0.019	2.038	10.133	0.002
BL=49.547-0.015(BMI)	0.030	0.001	2.057	0.468	0.494
BL=48.37+0.032(MMUAC)	0.045	0.002	2.056	1.056	0.305
BL=47.655+0.085(MHL)	0.047	0.002	2.056	1.126	0.289
BL=43.707+0.641(MHB)	0.210	0.044	2.014	23.842	0.000
BL=53.209-0.170(MFL)	0.134	0.018	2.039	9.536	0.002
BL=50.394-0.124(MFB)	0.049	0.002	2.056	1.271	0.260

BL=Birth length, MA= Maternal age, MW=Maternal weight, MH=Maternal height, BMI=Body mass index, MMUAC=Maternal mid upper arm circumference, MHL= Maternal hand length, MHB= Maternal hand breadth, MFL= Maternal foot length, MFB= Maternal foot breadth.

Table 13 shows comparison between the Actual and predictive birth weight (kg), using the derived Linear Regression Equations. Most of the maternal variables present a value similar or close to actual mean value of 3.37kg

Table 13: Comparison between the Actual and predictive birth weight (kg), using the derived Linear Regression Equations

Mean birth weight	Predictive birth weight								
	MA	**MW**	**MH**	**MUAC**	**BMI**	**MHL**	**MHB**	**MFL**	**MFB**
3.37	3.38	2.73	3.34	3.37	3.37	3.37	3.37	3.38	3.37

MA=Maternal age, MW=Maternal weight, MH= maternal height, MHL=Maternal hand length, MHB=Maternal hand breadth, MFL=Maternal foot length, MMUAC=Maternal upper arm circumference, MFB=Maternal foot breadth, BMI=Body mass index

Table 14 presents comparison between the Actual and predictive birth length, using the derived Linear Regression Equations. Only maternal weight presents a value similar to actual mean value of 49.16cm.

Table 14: Comparison between the Actual and predictive birth length, using the derived Linear Regression Equations

Mean birth length	Predictive birth length								
	MA	MW	MH	MUAC	BMI	MHL	MHB	MFL	MFB

49.16	49.18	49.16	49.23	49.18	49.17	49.18	49.21	49.17	49.18

MA=Maternal age, MW=Maternal weight, MH= maternal height, MHL=Maternal hand length, MHB=Maternal hand breadth, MFL=Maternal foot length, MMUAC=Maternal mid upper arm circumference, MFB=Maternal foot breadth, BMI=Body mass index

From figure 4, 5 and 6 the mothers within the 1st category of parity show significant differences ($p < 0.001$) in the BW and TC of their neonate when compared with 2nd, 3rd and 4th. However, in BL, HC and CC of the neonate the differences ($p < 0.001$) were observed only between 1st and 2nd category of parity. Moreover, the MUAC has similar pattern with addition to 3rd categories.

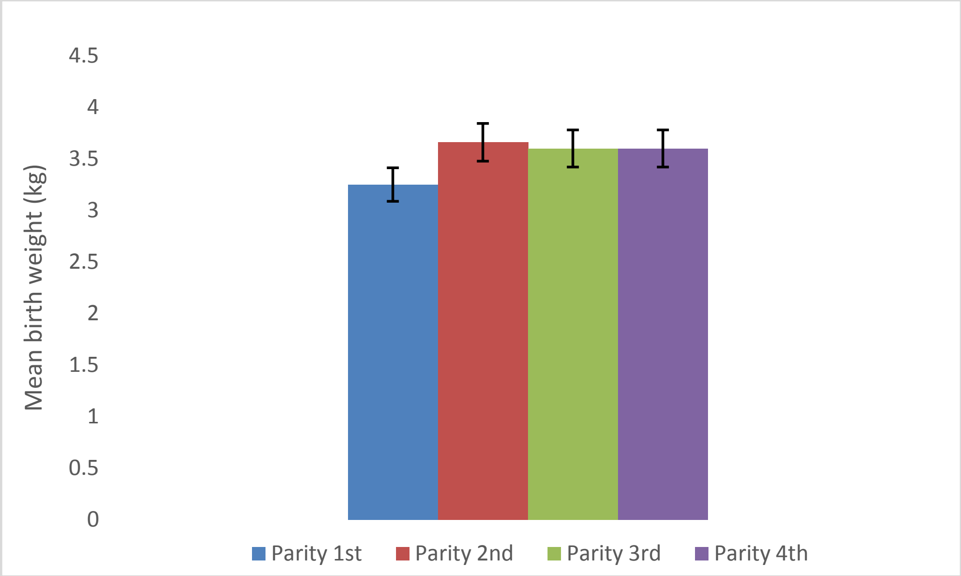

Fig 4: Maternal parities and birth weight

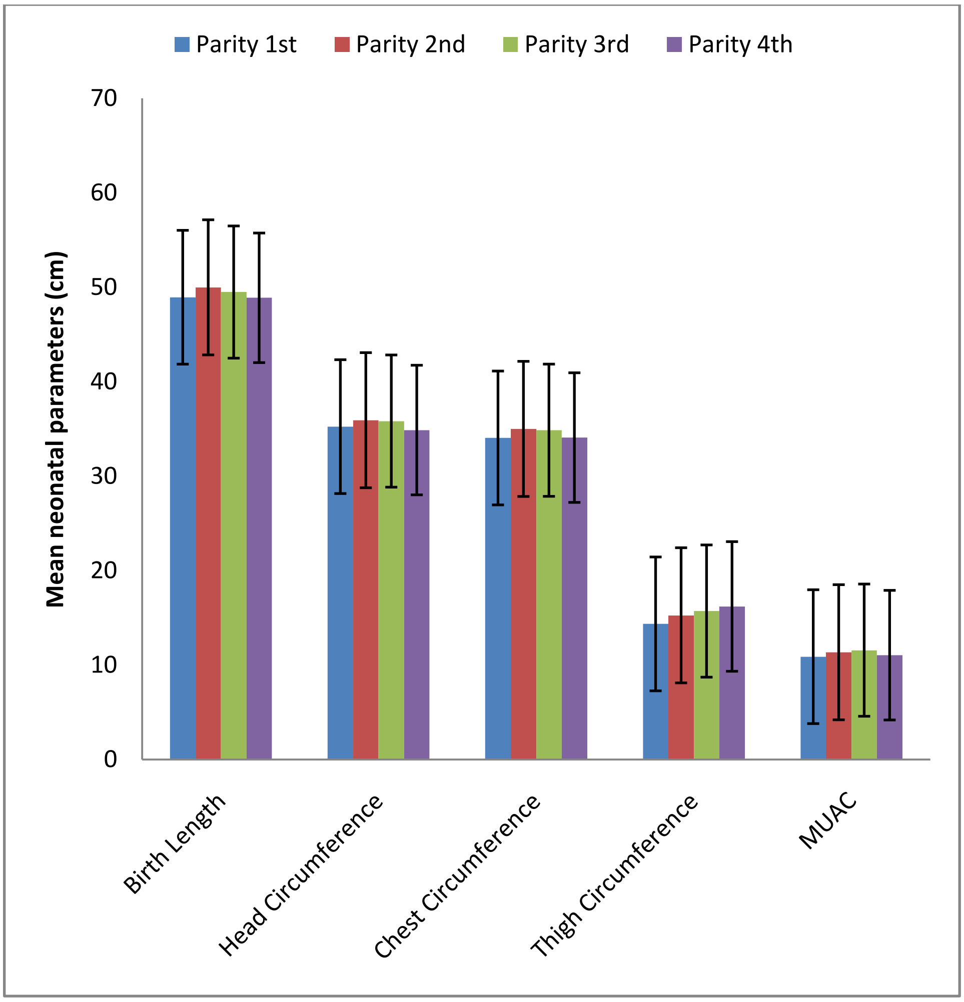

Fig 5: Maternal parities and neonatal anthropometric parameters

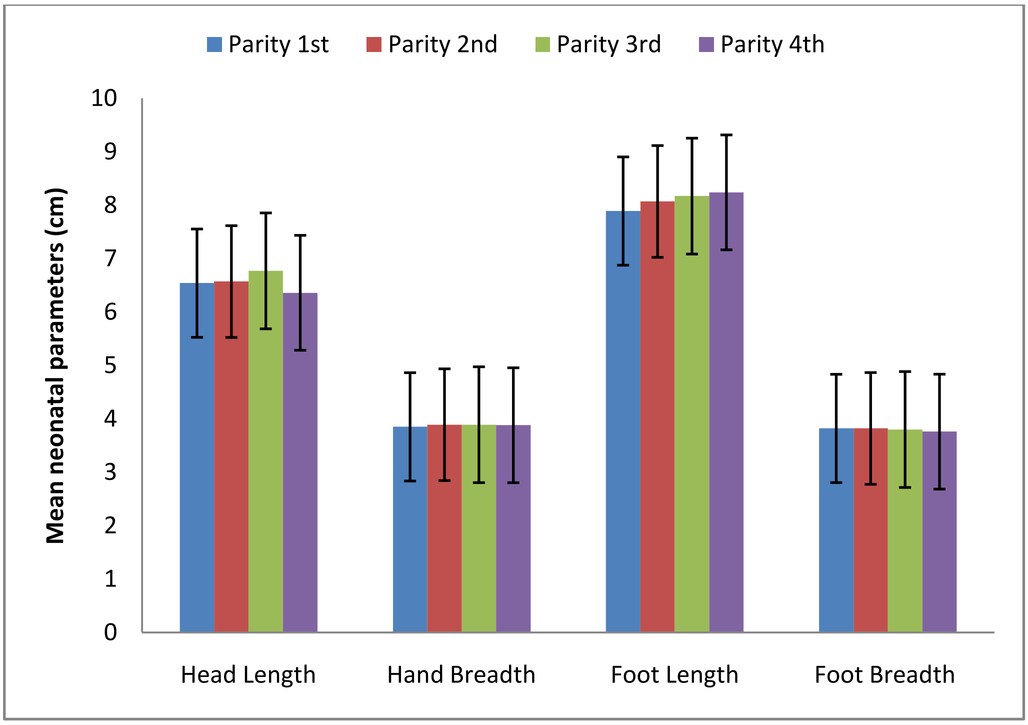

Fig 6: Maternal parities and neonatal anthropometric parameters

CHAPTER FIVE

DISCUSSION

Determination of maternal anthropometry is a potential tool in the evaluation and prediction of birth weight and other neonatal parameters (Benjumea, 2007). In the course of establishing the relationship, the present study observed a significant relationship between these parameters. The result revealed a statistically significant relationship between maternal weight and neonatal birth weight which is in agreement to what reported by Mohanty *et al.* (2006). It was also reported that birth weight and maternal weight have significant correlation value after controlling other anthropometric variables (Bhatia and Tyagi, 1984). Recent study confirms the relationship between maternal weight and other neonatal parameters by extension, as it was observed that there is strong correlation between birth weight, mid upper arm circumference, chest circumference and head circumference of the neonates (Mohsen *et al.,* 2011). According to Mandeep *et al*. (2013) birth weight has shown to have correlation with the chest circumference, mid-calf circumference, birth length and mid upper arm circumference and head circumference**.** Also reported, there is correlation between head circumference, thigh circumference and birth weight (Ezeaka *et al.,* 2003; Kadam *et al.,* 2005).Result of our study indicates that, the heavier the mother the heavier the neonate and the most likely explanation is large deposit of fat and glucose in her body which is been utilized by the foetus.

The relationship of maternal height and birth weight had indicated a significant correlation in the present study. This is in conformity with the previous report which shows that maternal height has positive correlation with the birth length and birth weight (Das and Khanam, 1997).

Positive correlation between maternal height and birth length of male newborns were observed, while the maternal weight was found to be better correlated with the birth weight of a male child than to female newborns (Das and Khanam, 1997). It has been observed that taller pregnant women (more than 155 cm) gave birth to significantly heavier and normal babies when compared to shorter women (Tabrizi and Saraswathi, 2012). In addition Morrison *et al.*(1991) from Sudan reported that maternal height had significant effect on birth weight.

Moreover, the present study revealed a positive correlation between maternal body mass index and birth weight and this is in conformity with what reported in another study in which a correlation between maternal BMI and birth weight was statistically significant (Mohanty*et al.,* 2006).

It was observed that maternal mid upper arm circumference and neonatal mid upper arm circumference shown to have a positive correlation in the current study and this is in agreement with what obtained in other populations (Sajjadian, 2011; Naik*et al.,* 2003;Dhar*et al.,* 2002; Haque, 1991; Utley, 1990; Larson, 1985; Rowshon and Ahmad, 1978).

Similar trend has been observed in correlation between maternal and neonatal parameters as seen in the case of maternal hand length which correlates with the neonatal foot length and foot breadth. The maternal hand breadth correlates with the neonatal hand length, hand breadth, foot breadth and foot length. Maternal foot length correlates with the neonatal hand length, foot length, foot breadth and hand breadth. While maternal foot breadth shows significant correlation with the neonatal hand length and foot length. In comparison with previous literature, foot length, foot breadth hand length and hand breadth all correlates with birth weight among Hausa neonates (Modibbo and Taura, 2013). However, the presents study by extension found the inter correlation between foot length, foot breadth hand length and hand breadth between mother and their neonates. It was also reported that in some part of Nigeria, the birth weight and other neonatal parameters of the neonates depended on the size of the mother, her height and weight (Baird, 1965).

It has been observed in this study that maternal age had positive correlation with birth weight; birth weight increases with the increase in maternal age and it was found to be in line with similar work conducted in some part of Nigeria (Ahmad *et al.,* 2014). Moreover, the findings are consistent with those reported by Li and Chang (2005) in Eastern Taiwan; MacLeod and Kiely (1988) in New York. Most studies have documented a tendency of increasing birth weight with maternal age (Geeta*et al.,* 2014), and the results of the present study also confirm the findings from other studies, that male babies were generally heavier than the female babies (Millis, 1954). Similar findings have been obtained in this study.

The significant correlation can best interpreted as result of genotypic and phenotypic relationship between the mother and their offspring. Moreover, the contribution and inheritance of the mitochondrial genomic of mother to her offspring may also explain the close association in the biological parameters between the mother and her neonate more than any other individual, the father inclusive. Maturity of the mother and nutritional status during pregnancy together with the gestational maturity play a very important role in correlating the variables (maternal and neonatal variables).

With regard to regression model, in this studymaternal age equation gives a better estimate of birth weight, whereas maternal weight gives better prediction of birth length in this age group asit wasalso reported that maternal predictors for neonatal birth weight were different from those for neonatal birth length (Gonzalez-Cossio*et al.,* 1998)

Maternal nutrition is one of the most modifiable characteristics among the major environmental causes of intrauterine growth restriction (IUGR) in the developing world, and if taken care of, a substantial fraction of low birth weight could possibly be prevented. Absence of data on pre-pregnancy weight, actual gestational age, certain factors during the course of pregnancy and a small sample size are limitations of the present study.

The current study also explores the differences in the neonatal variable among different categories of parity (1^{st}, 2^{nd}, 3^{rd} and 4^{th}). The result shows significant decrease in the neonatal variable of 1^{st} parity category compared with others. The findings complement several studies relating the effect of mother's age and parity on birth weight indicate that parity is the more important factor leading to the low birth weight (Warburton and Naylor, 1971; Neel and Schull, 1956; Millis and Seng, 1954; Karn and Penrose, 1951). Celik and Younis (2007) in Turkey found out that birth order was one of the major factors affecting birth weight. Similar results were also observed in the current study. Women who were pregnant for the second and third time gave birth to neonates with higher birth weights, while women with first gravid gave birth to neonates with lower birth weights

A possible explanation of lower birth weight among first-born infants could be a consequence of biological immaturity as compared to later-born infants (Bisai*et al.,* 2006). Furthermore, other variable like BL, HC, CC and MUAC indicate similar trend as observed in the BW. This can also be linked to consequence of biological immaturity usually happened in the early born child compared to the later ones

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The present study is a preliminary one in anthropological studies of relationship between maternal and neonatal anthropometric parameters among Hausas of Kano State origin-Nigeria. The study highlighted the relationship between maternal parameters (age, weight, height, body mass index and mid upper arm circumference) and neonatal parameters (birth weight, birth length, head circumference, chest circumference, and mid upper circumference), and are found to be correlated. When dealing with both sexes maternal weight and age shows highest correlation coefficient with birth weight and thigh circumference of r=0.487 and 0.341 respectively. In male neonates it was observed that maternal age correlates with birth weight and thigh circumference (r=0.460 and 0.453 respectively), maternal weight with birth weight and thigh circumference (r=0.308 and 0.494 respectively) while for female neonates Some of the maternal variables that show strong correlations are; maternal body mass index (BMI) with birth weight and thigh circumference(r=0.192 and 0.509 respectively).

Despite some limitations, the present study establishes the association between maternal anthropometry and with those of new-born babies among Hausas of Kano State origin,

Maternal parameters can be used for estimation of birth weight and birth length in neonates. Also, the study has been successful in forming equations for the calculation of birth weight and birth length in neonates of Hausa ethnic group, with the maternal age having the highest correlation value of 0.341 in estimating birth weight while maternal hand breadth (MHB)had highest correlation value of 0.210in estimating birth length. Therefore, maternal age equation will give a better estimate of birth weight and maternal hand breadth equation will give better estimate of birth length in this age group. It should be noted that these equations cannot be used for other Nigerian ethnic groups, as anthropometry is population and sex specific.

In conclusion, Null hypothesis (H_0) is rejected, while Alternate hypothesis (H_1) is accepted, that is:

1. Maternal age shown to have higher correlation value with the birth weight of neonates among Hausas in Kano (r=0.341, $p<0.0001$)
2. Maternal anthropometric parameters can be used to estimate birth weight (BW=2.672+0.03*MA) of Hausa neonates in Kano
3. Maternal anthropometric parameters can be used to estimate birth length (BL=43.707+0.641*MHB) of Hausa neonates in Kano
1. The neonatal variable changes across different categories of parity among Hausa neonate (stable in the 3rd and 4th parities, decreases in the 1st and 2nd parities)

RECOMMENDATIONS

4. Maternal age equation can be used to estimate the birth weight of a neonates (BW=2.672+0.03*MA)
5. Maternal hand breadth equation can be used to estimate birth length (BL=43.707+0.641*MHB)
6. The concerned authorities should formulate appropriate health awareness to encourage pregnant women to have good nutritional status and to have ante natal care.

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APPENDIX l

Questionnaire for Study of the Relationship between Maternal and Neonatal Anthropometric Parameters among Hausas in Kano, Nigeria

S/No……

Bio data

Father’s tribe………………….. Mother’s tribe……………………………….

Grandfather’s tribe (paternal)………… Grandmother’s tribe (paternal)……………..

Grandfather’s tribe (maternal)…………. Grandmother’s tribe (maternal)………………

Maternal Anthropometry

Age (years)	
Educational level	
Parity	
Weight (kg)	
Height (cm)	
Mid upper arm circumference (cm)	
Hand length (cm)	
Hand breadth (cm)	
Foot length (cm)	
Foot breadth (cm)	

Neonatal Anthropometry

Sex	
Birth length (cm)	
Birth weight (kg)	
Head circumference (cm)	
Chest circumference (cm)	
Thigh circumference (cm)	
Mid upper arm circumference (cm)	
Hand length (cm)	
Hand breadth (cm)	
Foot length (cm)	
Foot breadth(cm)	

APPENDIX ll

Consent Letter and Form

Department of Human

Anatomy,

Faculty of medicine,

ABU, Zaria.

Dear respondent

I am Sa'adu DATTI, a Masters student of the Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria, conducting a research on the Study of relationship between maternal and neonatal anthropometric parameters among Hausas in Kano. Participation is voluntary. It involves taking measurement of your body variables and your newborn baby and some information about you.

I assure you that the information obtained will be kept confidential.

Yours faithfully

Sa'adu DATTI,

Department of Human Anatomy

Faculty of Medicine,

ABU, Zaria.

APPENDIX lll

Consent form for Study of the Relationship between Maternal and Neonatal Anthropometric Parameters among Hausas in Kano, Nigeria

I…………………………………………………………………………………………………
………………………, have been duly informed of the procedure, aim and objectives of the study to be carried out on me and my newborn.

Participant Name…………………. Date…………… Sign…………..

Investigator Name…………………. Date…………… Sign…………..