RELATIONSHIP BETWEEN DIETARY PATTERN, ANTHROPOMETRIC, BIOCHEMICAL INDICES, AND BIRTH OUTCOME AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT YUSUF DANTSOHO MEMORIAL HOSPITAL

BY

SAFIYA TIJJANI ALIYU

DEPARTMENT OF BIOCHEMISTRY
FACULTY OF LIFE SCIENCES
AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

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JULY, 2017

DECLARATION

I declare that the work in this dissertation entitled **"RELATIONSHIP BETWEEN DIETARY PATTERN, ANTHROPOMETRIC, BIOCHEMICAL INDICES, AND BIRTH OUTCOME AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT YUSUF DANTSOHO MEMORIAL HOSPITAL"**has been carried out by me in the Department of Biochemistry, Faculty of life Sciences. The information derived from the literature has been duly acknowledged in the text and a list of reference provided. No part of this dissertation has previously presented for another degree or diploma at this or any other institution.

ALIYU, TIJJANI SAFIYA

_____	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This dissertation entitled "RELATIONSHIP BETWEEN DIETARY PATTERN, ANTHROPOMETRIC, BIOCHEMICAL INDICES, AND BIRTH OUTCOME AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT YUSUF DANTSOHO MEMORIAL HOSPITAL". Meets the regulations governing the award of degree of Masters of Science in Nutrition of the Ahmadu Bello University and is approved for its contribution to knowledge in literary presentation.

Prof. K.M. Anigo

_____ _____Chairman, Supervisory Committee(Signature)Date

Dr. A.B. Sallau

_____ _____

Member, Supervisory Committee(Signature)Date

Prof. M.N. Shuaibu

_____ _____ _____

Head of Department (Signature)Date

Prof. S. Z. Abubakar

_____ _____ _____

Dean, School of Postgraduate Studies (Signature) Date

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ABSTRACT

Improper nutrition in pregnancy leads to unfavorable pregnancy outcome which can further influence maternal and newborn health status. This longitudinal study was undertaken to find out the relationship between maternal dietary pattern, anthropometric and some haematologicalindices, lipid profile with birth outcome among pregnant women in their 3rd trimester attending antenatal clinic at Yusuf Dantsoho Memorial Hospital, Tudun Wada, Kaduna. A validated semi structured questionnaire was administered to pregnant women to elicit information on maternal dietary pattern and demographic. Sixty seven mothers – baby pair participated in the study. Weight, height, and MUAC ofmothers were measured with unclothed newborn length, weight, head and chest circumference also taken. Determination of maternal serum lipid profile and some serum minerals (copper, zinc and iron) were done using standard methods. Hemoglobin and packed cell volume determination was conducted using hemoglobinometer. Data obtained was analyzed using SPSS version 20.0 statistical software with One way ANOVA, student's t-test to compare the means and Pearson correlation coefficients to know the relation between parameters. Results obtained shows mean maternal age, weight, height, and MUAC of31.20±8.40years, 70.37±12.73kg, 1.620±0.07m, 26.65±4.08cm, and 26.63±3.80kg/m^2 respectively. Majority of the pregnant women(77.60%) had good nutritional status while 16.40%, 6.00% are moderately and severely malnourished respectively. Maternal dietary pattern showed daily to weekly intake of all the food groups with less than 50% except for bread and cereals which is more than 50%. Maternal mean intake of total protein and total calories was close to the recommended daily intake of 60- 75 kg/day, and 2500 – 3000 kcal respectively. Maternal Heamatological level indicates 34.3% mildly anemic. Maternal reference range of serum total cholesterol (5.67 - 9.04 mmol/l), Low density cholesterol (2.62 - 5.80 mmol/l) and triglycerides (3.39 - 5.10mmol/l), zinc (7.7 – 11.8µmol/l), and iron (5 - 35µmol/l) were comparedwith recorded respondent serum micronutrient level and found to be within reference ranges except HDL-cholesterol and serum copper which were above recommended range. Newborn anthropometric measurements indicated that61.20%were mildly stunted, 70.10% mildly underweight, and 62.70% moderately wasted neonates.Head and chest circumference are within the normal range. Maternal anthropometry and dietary pattern showed a positive

correlation with birth outcome and also maternal serum lipid profile except triglycerides that showed no relationship with birth outcome.

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LIST OF ABBREVIATIONS

ACOG American College of Obstetrician and Gynecologist

AIDS Acquire Immune Deficiency Syndrome

ANOVA Analysis of Variance

BMI Body mass Index

CARDIA Coronary Artery Risk Development in Young Adults

CDC Centre for Disease Control

DMS Degree Minutes Second

DR Dietary recall

FAO Food and Agriculture Organization

FFQ Food frequency Questionnaire

FNB Food and Nutrition Board

HDL High Density Lipoprotein

HPD Hypertensive Pregnancy Disorders

IOM TheInstitute of Medicine

IOAG Institute of ObsteracticGynecologist

IUGR Intra Uterine Growth Retardation

LBW Low birth weight

LDL Low-density lipoprotein

MUAC Mid-upper Arm Circumference

NDHS National Demographic Health Survey

NCHS National Centrefor Health Statistics

NIH National Institutes of Health

NURHI Nigerian Urban Reproductive Health Initiative

RDA Recommended Dietary allowance

TG Triglycerides

UNICEF United NationsChildren's Fund

UNU United Nation University

USDA United State Department of Agriculture

VLDL Very Low Density Lipoprotein

WHO World Health Organization

YDMH Yusuf Dantsoho Memorial Hospital

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

When a woman is expecting a baby, the quantity and quality of nourishment is of particular importance (Barker, *et al,* 2006). Nutrition during pregnancy plays a key role in well-being of the mother and newborn infant and further influences health during childhood and adulthood(Harding 2001**).** Horton (2008) reported that maternal undernutrition is a leading cause of maternal and child mortality and morbidity. Inadequate nutrition during pregnancy leads to adverse consequences like spontaneous abortion, intrauterine growth retardation, impaired learning ability and offspring behavioral problems and poor gestational weight gain (Higgins 2012). Assessment of dietary intake during pregnancy is very important because both nutrient deficiencies and excesses can have adverse effects on pregnancy outcome (Worthington-Robert*et al*., 2006).

According to Kazaura*et al.,* (2011), many risk factors influence neonatal mortality which includematernal parity,age, race, marital status, birth weight, smoking, gestation age, labour complications, antenatal care, malaria and HIV infection and poor socio-economic conditions, maternal history of pregnancy complication like stillbirth, neonatal deaths, and maternal morbidity. Dietary pattern composed of dietary behavior of a population through food and nutrient-group analyses. Therefore it is moreinclined to public health nutrition recommendations than analyses that focus on single nutrients (Ramos-colon *et a*l., 2015).

An anthropometric measurement isone of the most effective tools frequently usedfor assessing nutritional status of pregnant women. It is atool useful for prevention of prenatal mortality and morbidity, prediction of child health, and promotion of women's health (Oliveira *etal*.,

2004).Assessing pregnant women nutritionalstatus by anthropometric measurements is a promising means of improving fetal growth (Okeke*etal.*,2011).Insufficient and excessive maternal gestation weight gain are strongly related to fetal complications like pregnancy inducedhypertention,gestational diabetes, microsomia, and low birth weight (Scotland *et al*., 2005; WHO 2006).

1.2 Statement of the Problem

Malnutrition is a problem among women which poses a great challenge thatmake maternal ill-health a global burden which needs to be addressed (NDHS, 2013).Malnutrition is one of the major cause of maternal mortality and determinant of a successful pregnancy and birth outcome. The relationship between maternal nutrition and birth outcome is conflicting and intermingled by many factors like biological, socioeconomic, and demographic factors(Villar*et al.,* 2003; Blumenshine*et al.,* 2010).Consequential effect of maternal malnutrition does not just affect the pregnant woman but also has a devastating effect on the fetus (WHO 2012) Unfortunatelyin developing countries, pregnant women are nutritionally the most insecure group and many expectant mothers do not receive optimum level of essential nutrients during their gestational period (Tianan 2005).

Nearly 4 million newborns die within 28 days of birth (Population Reference Bureau 2006; WHO 2012; Addai 2010) with more millions suffering from, disease, infection,injuryand disability. Almost equal percent (98%) of the world neonatal deaths and stillbirths are from developing countries, while the highest proportion are from sub-Saharan Africa (Kazaura*et al*., 2011). According to UNICEF(2011)more than half a million women die from causes related to pregnancy and childbirth yearly. Maternal mortality rate for a woman in the developing

countries is 300 times greater than for women living in the developed countries (UNICEF2011**).**Ninety five percent(95%) of the world's maternal mortality are from Africa and Asia (WHO 2012) with precisely 50% of the global total coming from Sub-Saharan Africa and 35% from South Asia. In 2008, maternal death ratio in Kaduna city was 800/100,000 live births which is, about 1 death for every 125 pregnant women.In 2003, the North West zone has the highest proportion (27 percent) of children reported weighing less than 2.5 kg at birth, more than a third (36 percent) of children whose birth weights are known in Kaduna weighed less than 2.5 kg at births (NDHS 2013). Infant mortality rate in Kaduna city was 115 per 1,000 live births(Nigerian Urban Reproductive Health Initiative, 2014).Although, research findings on the importance of maternal nutrition to fetal development and birth outcomes has obviously been demonstrated in experimental animal studies (Northstone*et al.,* 2011), the findings of studies in humans are much less dependable, due, to secondary factors that differ from study to study like baseline maternal nutritional status, socioeconomic status of the study population, timing and methods of assessing maternal nutritional variables(Northstone*et al.,* 2011).

In addition, there is presently no data on dietary pattern, nutritional status and birth outcome among pregnant women in Kaduna, Nigeria. This study tends to investigate the relationship between dietary pattern, nutritional status and birth outcome among pregnant mothers attending antenatal clinic at Yusuf Dantsoho Memorial Hospital Kaduna.

1.3Justification

Poor maternal nutritional status is a risk factor of public health importance that can be changed and integrated into efforts to prevent adverse birth outcomes, especially among economically developing orlow-income populations (Fall*et al.,* 2011). A nutritionally adequate dietary

pattern is important throughout the trimesters to ensure a healthy pregnancy and baby (Pickel*et al.*, 2005). Pregnant women in developing country have been reported to consume diets deficient in both macro and micronutrients (Rao*et al.*, 2010). There is limited data on dietary pattern and micronutrient status of pregnant women in Kaduna, the capital city of Kaduna State, north western Nigeria.

The outcome of this study may contribute to understanding the relationship between maternal dietary pattern, anthropometric indices and birth outcomes which may provide a basis for developing nutritional interventions in order to address the problem. Therefore, the present study wascarried out among pregnant women residing in Kaduna metropolis attending Yusuf Dantsoho Memorial Hospital, Kaduna.

1.4 AIM AND OBJECTIVES

1.4.1 Aim

The aim of this study is to investigate the relationship between maternal dietary pattern, anthropometric, heamatological, and biochemical indices and birth outcome among pregnant women attending Yusuf Dantsoho Memorial Hospital, Kaduna.

1.4.2 Specific Objectives

i. To assess dietary pattern and anthropometric indices of pregnant women in third trimester of pregnancy.

ii. To determine the level of some heamotological parameters(packed cell volume,heamoglobin),lipid profile (cholesterol, triglycerides) and some serum minerals (Iron, Copper, Zinc) among pregnant women in their third trimester of pregnancy.

iii. To assess the nutritional status of neonate using anthropometry.

1.5 Research Null Hypothesis

Ho: There is no relationship between dietary patterns, anthropometric indices of pregnantwomen and birth outcome.

H_I:There is relationship between dietary patterns, anthropometric indices of pregnant women and birth outcome.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Nutrition in pregnancy

Nutrition is the provision, to cells and organisms, of the materials necessary (in the form of food) to support life (Wikipaedia 2009). Many health problems which were commonly known can be prevented or alleviated through a healthy diet. The diet of an organism is the nutrients that's its obtained from what it eats, and the body utilizes for the proper functioning of the body (Okeke *et al*., 2011).The chemical components found in food arenutrients. Six major classes of nutrients are: carbohydrates, fats, minerals, protein, vitamins and water. These classesof nutrient can be categorized as either macronutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities). Carbohydrates, fats, protein, and water are macronutrients, while micronutrients are minerals and vitamins (Berg *et al.*, 2002).Deficiency of certain nutrient can cause specific congenital abnormalities. Riboflavin deficiency has been associated with poor skeletal formation. Pyridoxine and manganese deficiencies are linked with neuro-motor problems while Vitamin A, B_{12}, Niacin and folic acid deficiency have been associated with defects in the central nervous system (Thompson *et al.*, 2011).

The subsequent weeks after conception is the time when the embryo is at its most vulnerable, it is the time when the organs and systems develop within.The mother's energy, nutrients in the circulation, and around the lining of the womb,is the energy used to create the systems. Research findings from animal studies shows that's fetal growth is most affected by maternal dietary nutrient deficiency (precisely, deficiency of protein and micronutrients) from the pre-

implantation stage to the stage of rapid placental development(Nafee*et al.*,2008) is the reason why appropriate nutrient intake during pregnancy is so vital. Thereforeresearchers need to move beyond diet therapy during pregnancy in isolation and begin focusing on maternal nutritional status throughout the pre-conception, and lactation periods as a continuum that affects maternal fetal, and infant health (Allen 2009).

A study conducted in Hungary showed that none of the2014 women who had been taken additional folic acid developed an NTD (neural tube defect), whereas 2052 who had not, 6 cases were detected (Allen 2009). Several studies have also shown that an additional intake of folic acid can prevents further anomalies such as heart malformations, lip and palate clefts and urethra malformations (Kinney, 2007). Excessive intakes of alcohol have been proven to causefetal alcohol syndromeKinney (2007) recommended that alcohol should be avoided throughout pregnancy, in view of the relatively unknown effects of even small amounts of alcohol during pregnancy

2.2 Nutritionthrough the Trimester of Pregnancy

Additional nutrients and energy are needed during pregnancy, in order to accommodate the changes in the maternal body for fetal growth. The mother's uterus and breasts grow; the placenta develops, and total body fat increase (Wardlaw 2009). The physiological changes that occur in pregnancy are necessary for the development of the foetus, regulation of maternal metabolism and preparation for labour and lactation. Pregnancy may result in discomforts such as nausea, craving and aversion,oedema, gestational goitre, anaemia and gestational diabetes (Food and Nutrition Board 2009;WHO 2012). The combined effects of these discomforts can lead to unfavorable alteration in food intake and overall nutritional habits. To ensure good

health of both infant and mother, extra nutritional needs had to be met. Multivitamin and mineral supplements are prescribed for pregnant women on their first attendance to maternal and child health centers(Hudson, 2002).

2.2.1 First Trimester

According to Wardlaw (2009), Nutritional deficiencies at the first three months of pregnancy can arrest or alter the progressing stage of development, and these effects may last a lifetime. First trimester, is the period of (fetal origin theory) rapid fetal growth that if an essential nutrient is not available or deficient, the foetus may be affected even before evidence of the deficiency appears in the mother. In respect to these, the quality of one's nutritional intake in this stage is more important than quantity. Hence pregnant women should consume nutrient dense food, even if the amount should be the same as that before conception. Even though in the first trimester, some women lose their appetite and feel nausea, they should be careful to abstain adequate nutrition (Food and Nutrition Board2009).

2.2.2 Second Trimester

Worthington-Robert*et al.,* (2011) stated that, the 4^{th} to 6^{th} month stage of gestation nutritional deficiency has a greater effect on the mother than the fetus. If the mother does not meet her nutritional requirements, ability to successfully breastfeed the infant may be affected, as fat stored during pregnancy serves as energy reserve for lactation.

2.2.3 Third Trimester

The 7^{th} to 9th month is the third trimester. At this very crucial stage, infants act as parasites due to its demands for iron, because of that they will deplete the maternal stores. Therefore if the

mother is not meeting her iron needs at this time she can end up very depleted especiallyafter delivery (Kalosa*et al.,* 2011).

2.3 Effect of Nutrients of Research Importance to Birth Outcome

The nutrients of importance in the research are copper, zinc, iron, and cholesterol. These nutrients were selected because of their nutritional importance in pregnancy and their potential mechanisms relevant to birth outcome.

2.3.1 Cholesterol

Pregnancy especially at the late gestation is associated with metabolic changes, like changes in pregnant bodies' storage of adipose tissue, in hormonal secretions and lipoproteins concentrations. One of the modifications during pregnancy is the maternal adaptation of cholesterol level to meet the maternal energy requirement and fetal growth (Rosenburg,*et al.*, 2008). Total cholesterol, High density lipoprotein(HDL),Low density lipoprotein(LDL), and triglycerides(TG) are elevated, especially, in the second and third trimester (Winkler*et. al.*, 2009). There is increase in the concentration of blood cholesterol, triglycerides, LDL cholesterol, and decreases in HDL cholesterol (Brites*et. al.,* 1999).

Winkler*et al.*, (2009) reported that, the anabolic phase occurred in the early pregnancy, characterized by increased in the production of triglycerides in the liver and enhanced removal of it is from the circulation, these leads to elevation of fat deposits in the maternal adipose tissue. However, late pregnancy is the catabolic phase; characterized by the release of free fatty

acids from the adipocytes which is facilitated by placental hormones through relative insulin resistance and stimulation of hormone-sensitive lipase (Wakatsuki*et. al.,* 1998).

Accumulation of LDL due to increased TGs during pregnancy can lead to increased risk of endothelial damage (Satta*et al.,* 2007) even though there is an excess floating HDL in third trimester. Lipid metabolism of pregnant women can be influenced by maternal dietary habit and maternal weight gain, (Di cianni*et al.,* 2003). Research findings from guinea pigs and rats recommend that manipulations of maternal dietary intake during trimesters permanently changed production of cholesterol and concentration of plasma cholesterol(Brites*et al.,* 1999,Rosemburg*et al.,* 2008).Highcholesterol levels in pregnancy have been associated with an increased risk of pre-term delivery, while high LDLlevels had increased risks of developing pre-eclampsia (Catov*et al.* 2008;Savvidou, *et al,*. 2010).

Gestational diabetes mellitus and pre-eclampsiahavebeen linked topregnancy-related hyperlipidemia (Gonzalez*et al*., 2007). In the Coronary Artery Risk Development in Young Adults(CARDIA) study predicted that, gestational diabetes mellitus is directly associated with low HDL levels (Savvidou*et al.,*2010), while women with impaired glucose tolerance have increased LDLlevels months after delivery (Savvidou*et al*., 2010;Retnakaran*et al.,* 2010).

2.3.2 Micronutrients Needs in Pregnancy

The needs for minerals generally increase during pregnancy, precisely that for iron, calcium, copper and zinc. Micronutrient deficiencies are common duringpregnancy, most especially in pregnant women from poverty ridden communities where diets withlow content of minerals and vitamins are consumed(Institute of Medicine2006).

2.3.2.1 Iron

Pregnant women needs for iron increasesespecially if they do not consume iron fortified foods. It is very important for women to be taking an iron supplement (30mg/d) during the last two trimesters for synthesis of a greater amount ofhaemoglobin needed during pregnancy and to provide iron stores for the foetus (Wardlaw 2009). For proper absorption of iron supplements Latham (2007) recommended that, taking iron supplements in between meals or best before bed, because they can decrease appetite and cause nausea, and constipation. For better absorption of iron, iron supplements should not be taken with milk, coffee or tea and vitamin C rich foods should be taken along with iron rich foods (Horton 2008).

The growth of the fetal-placental unit and increased in red cell mass during Pregnancy elevate pregnant women need for iron, thereby, rendered them vulnerable to Iron deficiency anemia, even though the absorption of iron increases in pregnancy (American Society for Clinical Nutrition2009). In the first trimester the iron absorption efficiencyis similar to that of non-pregnant females(WHO 2011), however in the second and third trimesters absorption efficiency increased to 25% due to the high demand for iron being part of the physiological regulation of iron flux (Boyle*et al*,.2007).Dietary deficiency in developing world is aggravated by gastrointestinal parasites such as hookworm and infections caused by helicobacter pylori which increased blood loss (American Society for Clinical Nutrition2009).

Anaemia is a disease condition characterized by deficiency of nutrients needed for haemoglobin synthesis. This manifestation is because of inadequate supply of nutrients like iron, folic acid and vitamin A, proteins, amino acids, vitamins B_{12}, C and other groups of B-complex vitamins like niacin and pantothenic acid which are required by the body for maintenance of haemoglobin level (Horton 2008).

Severe iron deficiency anaemia in pregnancy may lead to consequences such as preterm delivery, low birth weight, poor quality of life and cognition, like memory and impaired learning which leads toincreased risk for fetal death in the first weeks after birth. An inadequateiron intake may actually be more harmful to the mother than the infant (Worthington *etal.,* 2006). The risk of severe anemia increased maternal morbidity and mortality (Khan *et al.*, 2006).

2.3.2.2 Zinc

The Recommended Daily Allowances for zinc increases by about 25% for pregnant women. Maternal dietary protein intake foods should be able to provide the recommended amount of zinc. Deficiency of zinc in pregnancy increases the risk for having a low birth weight infant (Worthington –Robert *et al.,*2006).

Zinc is an essential trace element whose functions in the body include the synthesis of enzymes,nucleic acid, brain development and nervous system of the baby (WHO 2006). Studies carried out on pregnantwomen in African countries like Nigeria, Egypt, Zaireand Malawi have shown lower plasma or serum hair zinc concentrations compared to pregnant women from developedcountries (Gibson2008).Several studies from Perveen*et al*., (2002);Izquierdo*et al*., (2007) have also reported that, maternalplasma zinc decreases during pregnancy from 24-33week of gestation.However, Meran*et al*., (2009) while reporting on findings comparing plasma zinc in pregnant and non-pregnant women showed decreased plasma zinc in pregnant womengreater than 35 years old.

2.3.2.3Copper

Copper plays a role in the mobilization of iron toplasma from the tissue stores (Raman *et al.*, 1992)It is involved in the functions of severalcuproenzymes that are essential for life processes (Goel*et al.*, 2002). Deficiency of copper in the phase of embryonic and foetaldevelopment has been found to cause several biochemical andstructuralabnormalities. Copper is associated with infertility, Ebbs *et al.*, (2004)reported that due to copper deficiency, more than 50% of human conception failed to implant while those implanted, approximately 30% failto reach term. Research conducted in Nigeria shows that higher mean serum copper hadbeen reported in healthy pregnant women compared with their non-pregnant counterparts (Ajose*et al*., 2002). Similar incidence was reported inSpanish (Izquierdo*et al.*, 2007) and Turkish women(Meran*et al*., 2009).

Generally, low status of copper and zinc have been linked with various reproductive events like infertility, miscarriages, congenital abnormalities (Black, 2008), pregnancy induced hypertension, abruption of the placenta, rupture of membrane prematurely,still birth and low birth weight (Pathak*et al.*, 2008).

2.4 Other Essential Nutrients Required During Pregnancy

Wu*et al.*, (2008) stated that, optimal maternal and fetal pregnancy outcomes dependon the intake of sufficient nutrients to meet maternal and fetal needs. Malnutrition is synonymous with growth failure, and was conventionally attributed to protein-energy malnutrition generally, especially during the rapid growth phases in the life cycle, such as gestation. It was evidently recognized that poor fetal growth results if there is deficiency of protein and energy

and also inadequate intake of micronutrients that are essentially needed during rapid growth phases (Wu*et. al*.2008, Ramachandran 2009).

2.4.1 Calories

An additional 300 calories per day for second and third trimester are the recommended dietary allowance (RDA) for energy intake during pregnancy.The main source of energy should come from complex carbohydrates such as fruits, whole grains, starches, cereal, pasta, rice, potatoes, corn and legumes. A diet containing only 100kcal per day has been linked with fetal growth retardation and development (Wardlaw 2009). Protein increases by 10 to 15kcal daily (Wardlaw 2009). Approximately 925g of protein are retained during pregnancy. The rate of protein retention increases approximately fivefold from the first to the second trimester and approximately 80% from the second to the third. Research findings indicate that there are large increases in protein turnover in pregnancy (Thompson *et al.*,2011).

2.4.2 Vitamins

Generally, during pregnancyneed for vitamins increase, especially vitamin D and folate. The maternalneeds for vitamin D are to help in calcium absorption.Calcium metabolism in the body of pregnant women increases in order to absorb and distribute extra calcium for fetal bones formation.Most studies indicate that the placental transfer of vitamin D to the infant is particularly important because of low vitamin D concentrations in maternal milk (Savvidou*et. al*.,2010).

Maternal osteomalacia,hypocalcaemia of neonate,low birth weight, and tetany has been linked with Vitamin D deficiency(Institute of Gynecology, IOG 2013). People living in the northern

latitude, dark skin, and low sun exposure are at risk factors for vitamin D deficiency. Kalosa*et. al.,* (2011) recommend sun exposure to face, arms and hands for an approximately 20 to 30 minutes for several times a week to provide the expectant mothers adequate amounts of vitamin D.

Vitamin E requirement during pregnancy increases due to its essentiality for fetal growth. The transfer of vitamin E from mother to fetus occurs mostly in the third trimester, to allow the premature infants to be born with adequate stores. Deficiency of vitamin E in premature infants had been linked to broncho- pulmonary dysplasia, retinopathy and intraventricularhaemorrage (Latham 2007).

Having essential intake of Vitamin K during pregnancy (Latham 2007) can help in the prevention of haemorrhagic disease of the newborn, which commonly results in fatal intracranial haemorrhage. Studies carried out by Catov*et al*.,(2008)indicate that intake of vitamin K supplements by expected mothers for a period of time before delivery can preventhaemrrhagic diseases of the newborn. Subsequent findings indicate that this improves measures of vitamin K status and coagulation function on baby (Allen*et al*., 2009).

Night blindness is a disease condition that occurs due to Vitamin A deficiency.The disease weakened the immune system, and increases the risk of infections(Katz *et al.*,1995) and increased rates of intrauterine growth retardation and premature birth in pregnancy (Rajalakshmi*et al.,* 2004). Beta- carotene is a provitamin A from vegetables.This source of vitamin may not provide as much retinol as previously thought due to bioavailabity challenges but supplements can be taken in a case of deficiency (Kalosa*et al*.,2007).

Worthington-Robert*et al*., (2006) emphasized on the importance of folate during pregnancy to both maternal and fetal growth whereby an insufficient supply is especially crucial, because of the synthesis of DNA requires folate.The need for folic acid is higher in the first few weeks of pregnancy, those needs includes uterus enlargement, an increase in red blood cell mass,the placenta and fetal growth (Bailey 2007). Inadequate maternalintake offolate has been connected with intra uterine growth retardation, preterm delivery and low birth weight(Scholl *et al.*,2011).Congenital defect like spina bifida aneural tube defect has been linked with deficiency of folate (Wardlaw 2009). Recommended Dietary Allowance (RDA) for folate during pregnancy increases to 400– 600µg per day. Prenatal supplementation may be used to meet the RDAin order to ensure adequacy most especially for women with histories of inadequate intake of folate, and those with folate deficiency due to folate related anaemia, or use of folate dependents medications,and frequent multiple births(2Institute Of Obstetrician And Gynecologists 2013).

2.4.3 Calcium

In the course of pregnancy 1000mg of calcium is required (Wardlaw 2009).This helps to promote adequate mineralization of the skeleton and teeth of the developing fetus. Theseneeds of calcium increases in the third trimester, becauseit is the phase of the formation of teeth and rapid growth of the skeletal bones(Institute Of Obstetrician And gynecologists2013).

2.4.4 Fatty Acids

Certain polyunsaturated fatty acidsthat cannot be produced by the body but can be obtained in maternal diet like omega-6 and omega-3 fattyacids are essential for human development and health. (Hornstra2000; McGregor *et al.,* 2001). These fatty acids are very crucial for structural

elements of cell membranes and brain, essential for the formationof fetal new tissues (Hornstra 2000; McGregor *et al.,* 2001).Van Eijsden*et al.,*(2008) showed some evidence from biochemical studies among populationswith high marine-food consumption, which led to higher intakesof omega-3 fatty acids henceresultin reduced incidence of preterm delivery and also improved fetalgrowth.

2.4.5 Water

The Institute of Medicine ((NAS – IOM 2010) recommends that averagely, women consume 2.2 litres and men 3.0 litres of water daily. For pregnant women 2.4 litres (approx. 9 cups) of water is recommendedbecause pregnant and breastfeeding women need additional fluids to stay hydrated.Also The United States National Research Council (NRC) has recommended that, women should consumed 2.4 liters (10 cups) of water per day, breastfeeding women 3 liters (12 cups) and 3.7 liters for men**(**IOM 2005**).**

2.5 Adverse Birth Outcome and Their Consequences

In both developed and developing countries, low birth weight is an important secondary factor to 40%–80% of neonatal deaths. Whereby 98% occurred in developing countries (Uplinger2009). Low birth weight can be due to premature delivery, intrauterine growth failure, or a combination of the two (Goldenberg*et al.,* 2012). These conditionsare strongly associated with perinatal morbidity and increased risk of long-term disability that can affect lifelong consequences for development, quality of life, and health care cost (Goldenberg *et al.,*2012).

Preterm birth is defined as a gestational age less than 37 completed weeks, contributes to the incidence of low birth weight and the leading underlying cause of infant mortality among infants with non-lethal congenital anomalies (Scholl and Johnson 2011). The costs of postpartum hospitalization and treatment are extremely high for low birth weight and preterm infants. Studies conducted in countries that have advancement inmedical system technology indicate that average hospitalization costs of the neonates per low-birth-weight and preterm infant rise significantly as birth weight and gestational age at delivery decrease (Pestrous 2008, Pestrous 2010).

In a large, population-based study conducted in California, the total costs of hospitalization during the neonatal first 4 weeks of life for the 266 infants having a birth weight of 500–750g were almost the same with the total costs of neonatal hospitalization for the 48,610 infants with a birth weight of 2,750–3,000g, a larger group with over 182 times weight increase (Uplinger 2009). Hospitalization costs during the first 10 years of low birth weight and preterm infants life, continue to be 4–10 times higher than for normal-birth-weight and term infants (Pestrous 2008). Similarly, the costs for physical care, educational, and social developmental services to children born with low birth weight or preterm are 2–10 times higher than those for their normal-birth-weight and full-term counterparts (Pestrous*et al.*, 2010).

Intra uterine growth retardation increasedthe risks of short term and long term consequences of perinatal and infant mortality and morbidity early in life and increased risks of disorders or disruptions of child growth and development such as neurologic disorders, learning disabilities, childhood psychiatric disorders, mental retardation later in life (Scholl and Johnson 2011;Goldenburg 2012).

Infants with birth weights below the 10th percentile for their gestational age are classified as small for gestational age, and research shows that, even if they are born at term, these infants are at increased risk of neonatal mortality (Goldenbug 2012). Several major adult diseases, such as coronary heart disease, hypertension, and type 2 diabetes, originate in impaired intrauterine growth and development, especially when combined with rapid or excessive growth weight gain in childhood or adulthood, and may even have trans generational effects (Barker 2006;Jaddoe 2008).

A review of the evidence for developmental origins of hypertension show a fairly consistent association between fetal undernutrition (as measured by low birth weight) and elevated risk of adult hypertension(Uplinger 2009), even though very few of the studies were conducted in non-Western, developing transitional populations (Jaddoe 2008). Such developing transitional contexts theoretically provide the optimal conditions for expression of the developmental-origins-of-adult-disease phenomenon, if they are characterized by a high prevalence of inadequate prenatal nutrition, followed by exposure to improving nutritional conditions that facilitate overnutrition in childhood and adulthood(Black 2001).

2.6Assessment of Nutritional Status

To a great extent, before and during pregnancy the maternal nutritional status determines the birth weight outcome. Well-nourishedexpectant mothers have lower risks during pregnancy andchildbirth. While a severely malnourished pregnant woman will give birth toa baby likely to be undernourished, hence causing the cycleof poverty and poor health (Higgins *et al.*, 2012).The assessment of maternal nutritional status involveddietary survey, anthropometry measurement, and laboratory tests.

2.6.1. Dietary Pattern Assessment

To assess the dietary intake of pregnant women iscomplicated because conception signals a series of complex and sequential physiological changes that affect appetite, meal patterns, nutrient needs, absorption and metabolism, energy needs of pregnant women, (Fareeha*et al*, 2014). Physiologic and behavioral responses of Individual differ widely due to the stress of reproduction (Higgins *et al.,* 2012), depending on the period of pregnancy both the type and amount of food consumed may fluctuate. Fareeha*et al.*, (2014) estimated that nausea occurs in 50-80% of many pregnant women begin as early as 4 to 6 weeks gestation, usually excalate around 8 to 12 weeks, and then drop dawn thereafter. Heartburn and constipation are the most common ailment in pregnancy that may trigger changes in habitual food intake(Okeke 2011).

Healthy food consumption and eating pattern during pregnancy promotes fetal development (Fowles2010). Therefore, increased consumption of nutrient-rich foods from natural sources such as milk and dairy products, green leafy vegetables and fresh fruits, would promote fetal growth(Fareeha*et al.*, 2014). In contrast, increased consumption of high sugar and sodium foods such as confectioneries and condiments, and orcravings of Pica, an eating disorder affects more than half of pregnant women (Higgins *et al.,* 2012), would reduce fetal growth(Fowles 2010).

2.6.2 Anthropometry Measurement

The World Health Organization (2006) cites maternal anthropometric and intake of adequate nutrients as determinants of fetal growth, demonstrating a close association of these parameters

withmaternal weight and gestational age at birth(WHO 2002). Anthropometric measurements, are among the most frequently used methods for assessing maternal nutritional status (WHO2006).They are recognized as effective tools in the prevention of perinatal morbidity and mortality, the prognosis of child health, and the promotion of women's health (Oliveira *et al.,* 2004), and have undergone considerable improvement over the past five decades (Coelho *et al.,* 2002).Both insufficient and excessive gestational weight gain are strongly associated with maternal- fetal complications such as gestational diabetes, hypertensive pregnancy disorders (HPD), macrosomia, and low birth weight (WHO 2009; Fareeha*et al*., 2014). Hence adequate weight gain is essential during pregnancy.

Coelho *et al*.,(2002),stated that a series of research were conducted by national and international health organization and non-governmentalorganizations on the best methodology for anthropometric assessment as a means of ensuring adequate anthropometric assessment of the nutritional status of pregnant women. Measurement of the body such as weight, height, and mid-upper arm circumference (MUAC) are among the recommended. Head and chest circumference is for the newborn (Corgill 2003).

2.6.2.1 Weight

In pregnancy, weight measurements are very essential as a means of ensuring good health of the mother.The weight of a person is the one of the most important single anthropometric measurement that can be taken (Latham 2007). Weight should be done using a good, balanced scale for accurate measurement. Individual to be weighed should be wearing the minimum of clothing (light dress for females), and footwear removed(Fareeha2014).A total of 1.2kg of weight gain is required during the first trimester of pregnancy). Weight gain is most critical in

the 2nd and 3rd trimesters. World health organization recommends during pregnancy that anexpectant mother should gain an additional 0.5kg per week during the last two trimesters (WHO 2006). Lack of weight gain or weight loss at these periods can have adverse effect to the fetus. The proportion of the total weight gain during pregnancy can be attributed to components like the fetus 25 – 27%, placenta 5%, breast and uterus growth 11%, increased maternal fat stores 25 – 27%, extracellular fluid 13% and expanded blood volume 10%(WHO 2008).To meet the needs of the child a high quality diet is recommended especially for protein, calcium, folate,zinc and iron(Worthington-Roberts 2009).

2.6.2.2Height

Maternal height as a potential indicator for low birth weight lacks a clear cut – off value for general use in developing countries to identify low birth weight risk. However, short maternal stature is strongly associated with an increased risk of obstructed labour due to cephalo-pelvic disproportion and infant underweight. Women with short stature, especially in developing countries with inadequate health care systems and high prevalence of impaired growth during childhood are also at high risk of LBW and preterm delivery and of obstetric complications during labour and delivery (WHO 2008).Thus, short maternal stature (146-157cm) can be used as to identify risk for low birth weight; furthermore it can be used to identify women with obstetric risks(Corgill 2003).

2.6.2.3Mid Upper Arm Circumference

Maternal mid upper arm circumference has been used as a potential indicator of weight were found to be positively correlated to birth weight, MUAC is insensitive to changes the gestational period and it requires only one measurement UNICEF(2009). In a situation where

there is no pre pregnant BMI, maternal MUAC is a potential alternative indicator to access women at risk of poor pregnancy outcome (UNICEF 2009).The MUAC values below which most adverse effects were identified were <22 and <23cm.In Africa and Asia countries a conservative cutoff of <23 cm is recommended to classified most pregnant women at risk of low birth weight for their newborn(Ververs 2013).

2.6.2.4Head and Chest Circumference

Head circumference is a standard measurement for serial assessment of growth in children from birth to 36 months. These measurements are used in assessing the growth of infants and very young children. It is related to brain size, brain grows faster in infancy than in other time of life and to accommodate this growth. An infant's heard must be large in proportion to the rest of the body (Okeke*et al*., 2011).

From birth till about 6month of age, the head circumference should be larger than the chest, if the child is growing normally.A normal neonatal range for head circumference was 33-35cm, while 30-33cm was for chest circumferences (CDC/NCHS 2011). From 6month till about 2years, the ratio of the two circumferences should be 1. Ratio less or more than 1 is an indication of abnormality (Okeke*et al.,* 2011).Children over 12months with head circumference larger than the chest are not growing well because this is poor growth of the chest(Latham2007) or wasting of the muscles and fat of the chest wall. However, some variations may be observed in the shape of the skulls of some children attributed to genetic factors(Sickle cell anemia, and Downs syndrome) some cultural practices and disease like Rickets characterized with big skulls(Okeke*et al.,* 2011).

2.7 Factors that can Influence Nutritional Status

2.7.1Age

According to Stewart *et al*., (2007), maternal characteristics influence pregnancy outcomes. The appropriate age range any women of reproductive age areto conceive without risks for undesirable outcomes is 20 – 35 years. Under or over-age (below 19 years and above 35 years) were at increased risk of poor pregnancy outcomes like pre-term, low birth weight,small for gestation and high neonatal mortality (Stewart *et al*., 2007).

2.7.2Educational Attainment

Maternal education level influences the food choices and feeding patterns of family members (Allen *et al*., 2009). Illiteracy or low education level has indirect effects on the understanding of nutrition and food aspects and as well as improvement of the socio-economic conditions (Walraven*et al*., 2007).

2.7.3 Maternal Health Status

The health status of an expectant mother is a powerful indicator which determinesthe probability of a pregnancy terminating in a full-term,Cita(2010)or to a healthy live birth. Poor or inadequate diet affects maternal health during pregnancy. Walraven*et al*., (2007) says that, maternal food intake can be inadequate, either due to food affordability, accessibility and availability, or her immune system is affected, which makes her vulnerable to a lot of infections and diseases.Cita (2010)reported that poor maternal health results in high rates of common diseases which may include anaemia and malaria during pregnancy a major health and nutritional problems among pregnant women in sub-Saharan Africa (Walraven*et al*.,

2007).Sexually transmitted infections such as HIV/AIDS,syphilis, gonorrhea and others have been associated withpoor pregnancy outcomes including spontaneousabortion, stillbirth, pre-term birth, low birth weight,postpartum sepsis, neonatal pneumonia, neonatalblindness and congenital infections (Msuya*etal*., 2009).

2.7.4Socio Economic Factors

Socio economic status is one of the factors that have been shown to be essential predictors of nutrient intake and diet quality (Citaet*la*.,2010). Generally Nutrient deficiencies are found in low-socio economic populations, where they are more likely toinvolve multiple rather than single deficiencies (Fall*et al*., 2003). Presently, the world has a crisis of hike in food prices, which affects access to nutritious food (WHO 2008). Food choices are highly sensitive to price, and dietary diversity, including micronutrient and protein-rich healthy foods, is the first to be dropped from the diet, as these options are usually more expensive (FAO 2008). The food crisis is thus a dual threat to the quality and quantity of the diet, resulting in malnutrition.Women are especially vulnerable, with an increased risk of malnutrition during pregnancy(Cita2010).

2.7.5Cultural Practices

Every culture has its own norms and value andmost of the times these determines the kind of foods we eat. Some culture may considered certain foods as taboosand even if such foods may be nutritionally good, it will still be unacceptable(Bentum2011).Cita (2010) completed an of available studies targeting cultural issues in maternal and child health and nutrition in most culture, bad outcomes for either mother or infant are often attributed to a failure to engage in appropriate behaviors during pregnancy. In many culture these behavior often relate to

particularly avoidance of certain foods during pregnancy. Many African culture beliefs involvemore general recommendations such as the idea that eating a lot or too much during pregnancy will result in a large baby which led to a difficult delivery (Judith *et al*., 2010).

2.7.6Birth Spacing

Time interval between pregnancies strongly influences the outcome of the subsequent pregnancies. Women with short birth spacing tend not to be able to recuperate from the nutritional burden in order to replenish their nutritional stores after each delivery; this may lead to poor pregnancy outcome (Marti*et al.,* 2001, Dewey *et al.,* 2007).Pregnancies among such women tend to be very vulnerable and have a higher risk of anaemia (Latham 2007). Low availability and poor absorption of iron, and closely spaced pregnancies lead to depleted iron stores of pregnant women(Marti *et al.,* 2001).

2.7.7 Lifestyle

During pregnancy, some women feel strong urges to eat non-food items such as clay, ice, laundry starch, or cornstarch. This is called “pica”. Pica can be harmful to pregnancy. It can affect the intake of nutrients and can lead to constipation and anemia (Cita 2010). In a study carried out by Fareeha*et al.,* (2014), at Western Kenya, it was found out that 48% of all soil samples were contaminated with eggs of the round worm- Ascarislumbricoides and most pregnant women eat soil. This increases the risk of worm infestation and the consequent anaemia(CDC 2010).Smoking is linked to preterm birth and low birth weight and appears to increase the risk of birth defects, sudden infant death, and childhood cancer. Alcohol intake and drug use are some of the lifestylebehaviors that have been reported to cause poorpregnancy outcome (Bloch *etal*., 2008). According to Wardlaw*et al*., (2002)excess alcohol intake may

lead to fetal alcohol syndrome, Alcohol can pass through the placenta to affect the developing fetus and interfere with normal prenatal development (Kinney2007). This therefore leads to spontaneous abortion, developmental defects, foetal growth retardation and malformations because the excess alcohol reaches the foetus. Other harmful effects of alcohol on the infants include small head size, low birth weight and low birth length, fetal physical malformations, brain and nervous system damage (Wardlaw*et al.,* 2009).

2.7.8 Biological Factors

Biological factors involve the nutritional status of an individual due to hereditary. For instance families of overweight people are likely to have overweight babies. An underweight mother is likely to give birth to underweight babies (short stature). Short stature and iron-deficiency anaemia among mothers increase their risk of dying during delivery, accounting for at least one of five maternal deaths (WHO 2009).

2.7.9 Physiological Changes

Most at times due to the physiological change in their bodies, pregnant women tend to have special cravingsfornon-food substances such as pica (Lovelady 2006). Reassurance and support given to pregnant women during this time, enables her to make the right food choices.Morning sickness in pregnancy causes some women to avoid food which the body actually need at such times (Lovelady 2006). They therefore need support from family and friends to ensure that they do not become malnourished.About 50% of pregnant women experience nausea during the early stages of pregnancy, which may be related to the increased sense of smell induced by the pregnancy related hormones circulating in the bloodstream (Wardlaw 2002).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

Kaduna city of crocodile with no clearly demarcated geographic boundaries located at 10.52641 latitude, and 7.43879 longitudes and situated at an elevation of 626 meters above sea level. The urban part of the city largely lies in Kaduna North, South and Chikun local government. According to the 2006 census the population of Kaduna city was 1,139578 and recently reprojected to 1,582102 people in 2015 (NURHI, 2014).

Kaduna south headquarter is in the town of Makera district, it has an area of 59 km^2 and a population of 373,516 males and female as per the 1991 census and then rises to 402,390 at the2006 census (National population commission 2006). Farming, pottery, weaving and black smiting is the major occupation of the people and main tribes are Hausa, Fulani, Bwagi, among others.

Nigerian Urban Reproductive Health Initiative (NURHI (2014) reported that TudunWada district is located in Kaduna south local government with co-ordinate 10”30’45” N and 7”24’40” E in DMS(degree minute seconds). Yusuf dantsoho memorial hospital, formerly known as AsibitinDutse was founded in 1975 and one of the largest government owned hospital situated at Tudunwada district along Polytechnic road.

3.2 Study Population

The study involves pregnant women in third trimester of pregnancy (32-40wks), and has been attending the antenatal clinicat least in their second trimester of pregnancy (16 – 28wks) with hemoglobin levels and weight recorded at Yusuf DanTsoho Memorial Hospital, Kaduna.

3.3 Inclusion Criteria

All singleton pregnant women between the ages of 16-49 years, who has no medical risk pregnancy and antenatal care either in their first or second trimester were enrolled for the study

3.4 Exclusion Criteria

Pregnant women who had first antenatal care attendance during the third trimester, with medical complications during their pregnancy, and those withmultiple pregnancies were excluded from the study.

3.5 Informed Consent

Informedverbal consent was sought fromall pregnant women in their third trimester using standard protocol (Appendix I).

3.6 Ethical Clearance

Ethicalapproval was obtained before the commencement of the research. A written permission to carry out the research was obtained from the Scientific Ethical Committee Ministry of Health, Kaduna, State which was submitted to Yusuf Dantsoho Memorial Hospital in order to carry out the study in the hospital (Appendix III).

3.7 Study Design

A descriptive longitudinal design was used following pregnant women from third trimester attending antenatal clinic at Yusuf Dantsoho Memorial Hospital to their point of delivery.

3.8Sampling Technique

Yusuf DanTsoho Hospital, a governmentowned hospitalswas purposively selected for the study, due to its affordable cost of services, popularity and high level of attendance by pregnant women, with average antenatal population of about 180 per month. Most women in the communities irrespective of their socioeconomic status residing in the area attend the hospital. Following every antenatal clinic and the inclusion criteria all eligible subject were purposively selected.

3.9 Sample Size

One hundred and six pregnant women in third trimester were enlisted for the study and at the end of fourthmonth of the study, sixty seven mothers – baby's pairs completed the study

3.10Methods

3.10.1Data Collection

Data was collected through use of validated semi-structured questionnaire (Appendix III) for socio-demographic characteristics, dietary assessment, and maternal energy intake were obtained byfood frequency questionnaires and 24hours dietary recall (Lise*et al.*, 2007). Maternal anthropometry was obtained through weight, height and Mid UpperArm Circumference (MUAC)as described by Corgill(2003).Neonatal nutritional status was assessed following the methods of Fareeha(2014) and compared with WHO (2006) Z-score standard using Anthro Software version 14.

Lipid profile determination was carried out using enzymatic methods (Festus *et al.*, 2011).Serum minerals (copper, zinc and iron) were determination by Atomic Absorption Spectrophotometry and Heamoglobin and PCV determinationwas done using heamoglobinometer**.**

3.10.2 Maternal Nutritional Status

Records of weight, and height, during the first and second trimesters of the pregnant women were obtained from the maternal health record card.UNICEFSeca scale was used to determine the maternal weight (in kg)during the study period while height was measured (cm) using height-o-meter. Following Ricaldo*etal.*,(1998), and UNICEF (2009)MUAC was also taken at every antenatal visit,using a measuring tape. MUAC reading below 21cm signifies severe malnutrition; those between 21-23cm have mildly malnutrition status or borderline nutritional status; and measurement above 23cm signifying a healthy nutritional status.

Biochemical analysis for determination of haematological parameters (cholesterol, triglyceride) serum mineral (iron, zinc and copper) was conducted in the hospital laboratory.

3.10.3 Neonatal Nutritional Status

Birth weight of the babies born to the respondent at home weremeasured by the researcher using infant pan scale, those with hospital delivery were recorded from the hospital records whereas length were taken by infant-o-meter. Head, chest and MUAC measurements was carried out using a non-stretchable measuring tape as described by Sarah (2013). The outcome was compared with the standard WHO Z-score for weight for height, head and chest circumference.

3.10.4 Dietary Assessment

Dietary assessment was carried out in a face-to-face interview with pregnant women that participated in the study, using a validated Food Frequency Questionnaire (FFQ) originally developed by national cancer institute. The FFQ(Appendix 11) consist of eight food groups adopted from Food Guide Pyramid (Song 2005) and 24 hour dietary recall (DR) in orderto assess the frequency of consumption of specific food or category of foods (Thompson 2008).

FFQ containing 36 items and 24 hours DR were designed in accordance with recommended dietary guidelines provided by the National Institutes of Health (NIH), United States Department of Agriculture (USDA) and Food and Agricultural Organization (FAO). The FFQ is modified to reflect dietary intake in the past month rather than past year and included additional indigenous foods relevant to the study population. West African Food Composition Tables (2012) was used to obtain estimates of daily intakes of total energy (FAO 2012).

Dietary assessment of pregnant women in their 3rd trimester was made during their 34 to 40 weeks of gestation(Okeke2011). Probing questions were used to help the respondent remember all foods and drinks consumed the previous day or week. Standard containers, pictures and weights were used to measure the quantity of intake of the cooked food as described by Okeke(2011).

Respondent's Information on quantity of raw food material for cooking as well as the cooked food was recorded in terms of household measures per number/kg to find out the quantity of raw food intake.

3.10.5 Hematological Parameters

3.10.5.1 Sample Collection

After cleaning with 70 % alcohol and swab, with a prick on the finger, blood sample was collected for determination of packed cell volumehemoglobin of pregnant mother using battery-operated micro centrifuge(8000-Hemofast reader, All. Diag.)and hematologicalmeter with Heamoglobin strip respectively.

3.10.5.2 Packed Cell Volume (Haematocrit)

Thehaematocrit was determined and the packed cell volumevalues automatically analyzed and these were recorded from the hematological meter(8ooo-Hemofast reader, All. Diag**.)**read out value

3.10.6 Serum Micronutrients:Zinc, Copper, and Iron (Julian 2000)

Copper, Zinc, and Iron were determined using AAS (AA5500) as described by Julian (2000).

3.10.6.1 Sample collection and preparation

Exactly 10mls of venous blood sample of each subject was collected after an overnight fast into centrifuge tubes after which it was centrifuge at 3000rpm for 5mins. at room temperature (Awoyele 2005). Serum was removed from the clotted blood using pipette. The serum was than divided into two, half for micronutrient determination and other for lipid profile determination.

Principle

Quantification is based on the measurement of light absorbed at different wavelength, by ground- state atoms iron, copper, and zinc from hollow – cathode lamp light source. Specimens, standard, and quality control samples are diluted with n-butanol in 0.05ml HCL. The diluted samples were aspirated directly into a flame and the concentration of Iron,Zinc, and Copper measured using the Atomic Absorption Spectrophotometer.

3.10.6.2Blood Sample Preparation (Digestion)

Exactly 5ml of serumwas transferred into cleanMeyer flask. Then 25ml of concentrated nitric acid (HNO_3), 4mls ofperchloric acid, and 2mls of H_2SO_4were added. The content of the flask was mixed and heated using medium heat on a hot plate gently under fume hood. The flask was allowed to cool and content was further digested by addition of 2ml of conc. HNO_3. The content was further heated for 30 seconds, then allowed to cool and 50mls of distilled water was added and allowed to boiled for 30 seconds using medium heat, then cooled and solution filtered using a filter paper into a 100ml volumetric flask. The mark was then made up by adding deionized water.

3.10.6.3 Blank Preparation

The blank solution was prepared by following the same procedure (see 3.10.6.2), omitting the active ingredients that have been added for the test sample preparation. Thereby substituting distilled water for serum for each series of determination.

3.10.7 Lipid Profile(Muyanga, 2010)

Serum lipid profile determination were done using Colorimeter multichannel analyzer (FKA 6062, Kesington limited United Kingdom) as described by Muyonga*et al.*, 2010.

3.10.7.1 Total cholesterol

Principle

Serum Cholesterol is measured enzymaticallyin a series of coupled reactions that hydrolyze cholesterol esters and oxidize the 3-OH group of cholesterol. One of the reaction byproducts, H_2O_2 is measured quantitatively in a peroxide catalyzed reaction that produces a color. Absorbance is measured at 520nm. The color intensity is proportional to cholesterol concentration.

Procedure

Three test tubes labeled test, standard, and blank were set up on a rack.To each of the test tube 1000 µl of total cholesterol working reagent was dispensed followed by 20 µl of sample was added into test tube labeled test exactly20 µl of standard reagent was added into test tube labeled standard and 20µl of distilled water was added into the blank labeledtest tube.The test tubes were incubated at 37oc for 10minutes.Absorbance of test and standard sample was measured against the blank using colorimeter at 520nm.

$$\text{Calculation} = \frac{\text{Abs. of test}}{\text{Abs. of std.}} \times \text{Conc. of std (mmol/l)}$$

Reference range (3^{rd} trimester)

5.67 – 9.04 mmol/l (Abbassi-Ghanavati*et al*., 2009).

3.10.7.2High Density Lipoprotein (HDL) cholesterol

Principles

HDL is measured directly in serum. The basic principle of the method is as follows: The apoBcontaining lipoprotein in the specimen is reacted with a blocking reagent that renders them non-reactive with the enzymatic cholesterol reagent under conditions of the assay. The apoB containing lipoproteins are thus effectively excluded from the assay and only HDL-chol is detected under the assay conditions.

Procedure

This involve two stages

Stage 1

Exactly 200 µl of cholesterol precipitate reagent was dispensed into a test tube.200 µl of sample was added into the test tube. The test tube was incubated at room temperature for 5minutes and centrifuge at 1000 revelation per minute for 5minute. Supernatant was separated from the deposit.

Stage 2

Three test tubes labeled test, standard and blank were set up on a test tube rack. To each of the test tube 1000 µl working reagent was dispensed. 100µl of supernatant was added into the test tube labeled test. 100 µl of standard reagent was added into test tube labeled standard. 100 µl of distilled water was added into the test tube labeled blank. The test tube were mixed and

incubated for 10minute at 37^{o}c. The absorbance of the test tube and standard were measured against the reagent blank using a colorimeter at 520nm.

$$\text{Calculation} = \frac{\text{Abs. of test}}{\text{Abs. of std.}} \times \text{Conc. of std (mmol/l)}$$

Reference range (3rd trimester)

1.24 – 2.25mmol/l (Abbassi-Ghanavati*et al*., 2009).

3.10.7.3 Low Density Lipoprotein (LDL)-cholesterol

Principle

Most of circulating cholesterol is found in three major lipoprotein fraction; Very low density lipoproteins (VLDL), Low density lipoprotein LDL and High density lipoprotein HDL. Total chol. = (VLDL-chol.) + (LDL-chol) + (HDL-chol.).

LDL-cholesterol is calculated from measured values of total cholesterol, triglycerides and HDL-cholesterol according to the relationship.

(LDL-chol) = (Total-chol) – (HDL-chol]) (TG)/5**.**

Where (TG)/5 is an estimate of VLD-cholesterol and all values are expressed inmmol/l (Fredirickson-Friedwald*et al.,* 1967)

Reference Range (3rd trimester)

2.62 -5.80mmol/l (Abbassi-Ghanavati*et al*., 2009).

3.10.7.4 Triglycerides

Principle

Triglycerides are measured enzymatically in serum using a series of coupled reactions in which triglycerides are hydrolyzed to produce glycerol through mixing and incubating for 5minutes at 37^{o}c**.** Glycerolis then oxidized using glycerol oxidase, and H_2O_2, one of the reaction produces as described above for total cholesterol. Absorbance is measured at 520nm.

$$\text{Calculation} = \frac{\text{Abs. of test}}{\text{Abs. of std.}} \times \text{Conc. of std (mmol/l)}$$

Reference range (3^{rd} trimester)

3.39 – 5.1mmol/l (Abbassi-Ghanavati*et al*., 2009).

3.11 Statistical Analysis

SPSS version 20.0 wasused to collate and analyze the data. Dietary intake was evaluated using food frequency questionnaires to assess the frequency of consumption of food groups.Food Exchange listwas used to generate estimate of daily intake of total energy of pregnant women in their thirdtrimester and Z-score calculation for nutritional status using anthropometric data was analyzed using Anthropometry software. Results are presented in Mean ± standard deviation except if stated otherwise. Result with $p<0.05$ or $p<0.001$considered significant were applicable.

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic Characteristics of Pregnant Women

Table 4.1 shows the pregnant women characteristics with mean age of 31.2±8.40years and age range of 15-49years. Majority of the pregnant women falls within the age group of 20 -44years old and higher percent (32.80 %) were Hausa by tribe, while 38.8% of the pregnant women are fulltime housewives.On level of formal education, 28.40 % of the respondents attained senior secondary school certificate, 16. 40 % hadpost-secondary school certificate and 11.90 % had no formal education.Distribution of household income indicates 44.8% of the pregnant women had monthly incomes less than five thousand naira(N5000). Majority (50.80 %) of the pregnant women has five or more children while 13. 40 % are new mothers.

Presented in Table 4.2is the household care resources, the mother's uses wood (43.30 %) as their main fuel for cooking, followed by 20.90 % that used kerosene.Mothers that uses refrigerator for storage of their food were 26.90% while 41.80% have no means of storage. Borehole is the major source of drinking water (31.30%)while 22.40 % uses public wells.The women were using public tap (25.49 %), public well (17.90 %).

Table 4.3 shows the cultural believe of respondents during pregnancy. Equal proportion (19.4%) of pregnant women believed that intakes of boiled egg and beverages during pregnancy can cause stomach ache or giving birth to large babies. Followed by 14.9o% that avoids the use of monosodium glutamate (white Maggie). Candies are the main stimulants (41.8%) consumed by the pregnant women, followed by 17.9% that took kola nut. Pregnant

women thathave no complicationwere 43.3% while 34.3%suffers food aversion during pregnancy.

Figure 4.1 shows the pregnant women level of compliance to intake of antenatal drugs which indicate that 23.9% do not take their antenatal drug and 74.6% showed compliance.

Table 4.1: Socio- demographic Characteristics of the Respondents

Variables	Freq.	%	Variables	Freq.	%
Age			**Occupation**		
15 – 19	7	10.4	Civil servant	13	19.4
20 – 24	10	14.9	Trader/ hawking	12	17.9
25 – 29	12	17.9	Farming	4	6.0
30 – 34	11	16.4	Full time housewife	26	38.8
35 – 39	12	17.9	Others	12	17.9
40 – 44	12	17.9			
≥45	3	4.5	**Household Income**		
Levels of Formal Education			< N5000	30	44.8
No Formal Education	8	11.9	N5000 – 14,999	11	16.4
Uncompleted Primary	7	10.4	15,000 – 24,999	13	19.4
Completed Primary	9	13.4	25,000 – 34,999	9	13.4
JSS Uncompleted	2	3.0	35,000 – 44,999	4	6.0
JSS Completed	4	6.0	≥ 50,000	0	0.0
SS Uncompleted	5	7.5			
SS Completed	19	28.4			
Post-Secondary	11	16.4			
Other	2	3.0			

4.2 Distribution of Maternal Household Care Resources

Characteristics	Frequency	Percentage
Source of Energy		
Wood	29	43.3
Kerosene	14	20.9
Gas	14	20.9
Electricity	8	11.9
Others	2	3.0
Method of Food Storage		
Refrigerator	18	26.9
No means	28	41.8
0ther means	21	31.3
Source of Drinking Water		
Public tap	17	25.4
Public well	15	22.4
Private well	12	17.9
Borehole	21	31.3
Others	02	3.0

Table 4.3: Distribution of Maternal Cultural Factors and Lifestyle

Cultural Beliefs (taboos)	Frequency	Percentages
Common Food and Additives Avoided		
Sugar	11	6.4
Snails	06	9.0
Monosodium glutamate	10	14.9
Beverages(eg. Milo and Bournvita)	13	19.4
Boiled Eggs	13	19.4
Sugar Cane	08	11.9
Potash	05	7.5
None	01	1.5
Intake of Stimulant		
Kolanut	12	17.9
Cigarette	03	4.5
Bitter Kola	07	10.3
Candies	28	41.8
None	17	25.5
Physiological Changes		
Cravings	15	22.4
Aversion	23	34.3
None	29	43.3

n=67

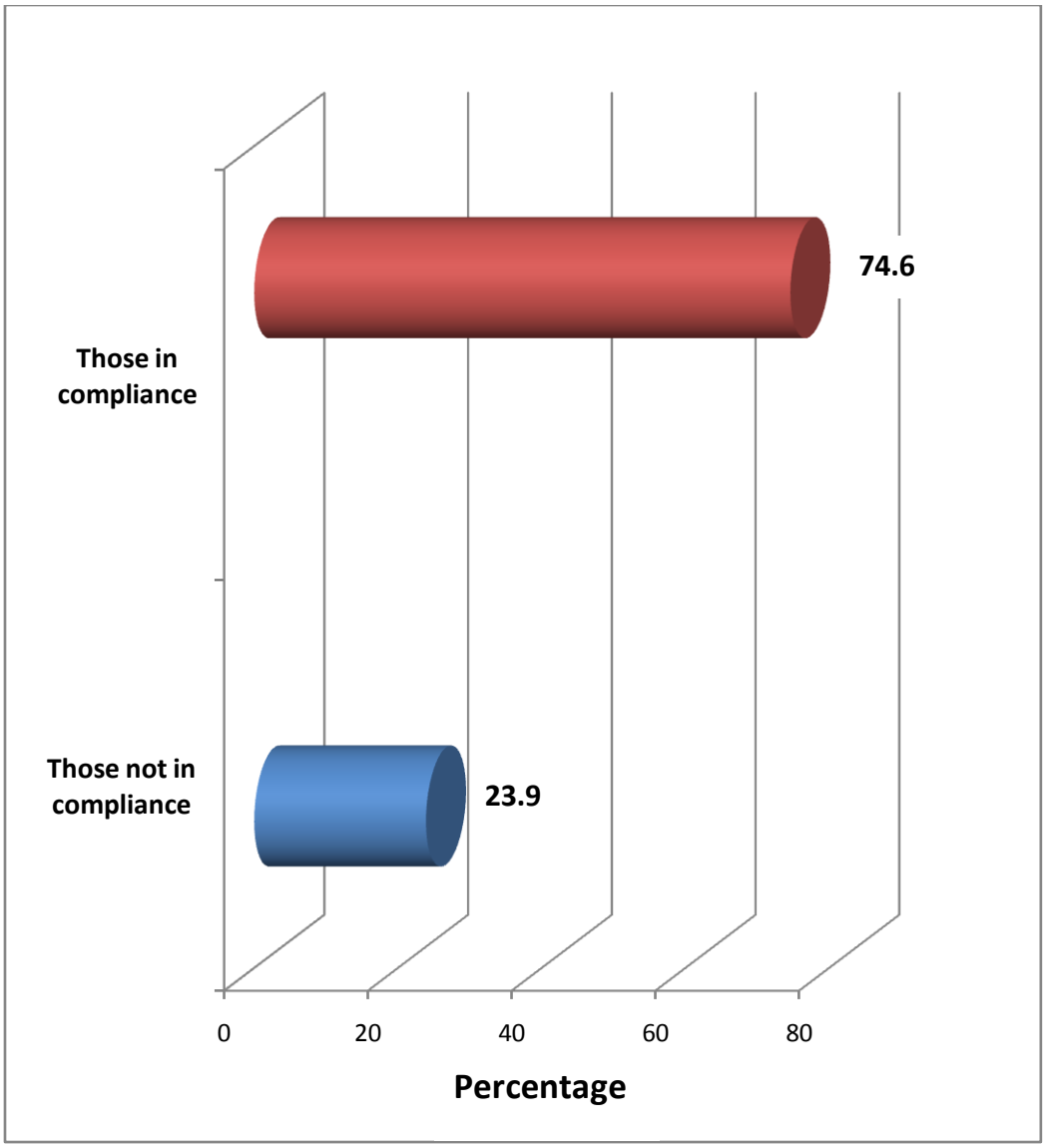


Figure 4.1: Percentage Distribution of Compliance to Intake of AntenatalDrug by Pregnant Women at Third Trimester. n = 67

4.2 Maternal Dietary Intake

Table 4.4showsdietary intakeof pregnant women using 24hrs dietary recall. Mean total carbohydrates intake is210.51±75.90g/day which was higher than the recommended daily intake of 175.00 g/day and mean protein intake is 45.05±39.00g/day which was within recommended intake (45-60g/day). Maternal fat intake 65.18 ± 39.10 was also within the reference range. Maternal mean total caloric intake was2527.51±764.90g/dayintake was within recommended daily intake range of 2500 – 3000kcal/day.

Table 4.5indicates that high mean caloric intakes of 3121.16±340.11kcal/day was obtained from mothers that gave birth to larger babies, while those mothers with lower mean caloric intake of 1485.86±723.45g/day had low birth weight babies. These values obtained based on birth weight for caloric intake were statistically different (p-<0.05).

Presented in Table 4.6 are results on the frequency of consumption of the various food groups.These shows that 43.30% of mothers consumed rice 4-5x/week, followed by 35.80% mothers who consumed rice 6x/week likewise 43.30% of pregnant women consumes millet 4-5x/week.Yam (47.90%) and sweet potatoes (40.30%) arethe most frequently (2-3x/week, 6x/week respectively) consumed food in the Root and Tubers food group in this same group locally made spaghetti has the highest percentage (44.80%) of pregnant women with high level of consumption of 6x/week. Different types of cooking oil are consumed but palm oil and animal fat("Manshanu, Kakide") are most frequently consumed by 25.40% of the mothers.Also Vegetable oil consumption was by high percent of respondent (53.70%) at 6 x/week.

Baobab leaves was the most frequently (4-5x/day) consumed vegetable soup by 35.80% of mothers, followed by fluted pumpkin leaves which was 31.30%was consumes 2-3x/week by the pregnant women.Moringa leaves wasconsumed 4-5x/week by 26.90% mothers. Fruits

wasleast consumed by the pregnant women, only 35.80%, takes orange 4-5x/week.Local drinks like tigernut was frequently consumed (4-5x/week) by 46.30% of the mothers, followed by 46.30% that consume scourrel drink 6x/week.

The Table 4.6 also indicates that 37.30% of mothers take fish once/day, while 23.90% takes chicken once/week followed by 32.50% that took egg once/day.Only 41.80% of the pregnant women takes soybeans 6x/week and more than half (53.70 %) of the mothers takes powdered milk 6x/week, while 37.30% consumes yoghurt 6x/week.

Table 4.4:Nutrient Intakes of Pregnant Women Using 24hrs Recall

Nutrients Intake	Respondent Nutrients Intake	RDI*
Total Carbohydrate(g/day)	210.51±75.90	175 - 190(+ 450)
Total Protein (g/day)	45.05±39.00	60-75 (1.02g/kg/day)
Total Fat(g/day)	65.18±39.10	45-60
TotalKcalories(kcal/day)	2527.51±764.90	2500 -3000(+452)

Values as Mean± SD.*RDI-Recommended Daily Intake (Ministry of health, Food and Nutrition Guidelines for Healthy Pregnant Women, 2006; Okeke, 2011).

Table 4.5:Maternal Mean Caloric Intake with Newborn Birth Weight

Birth Weight Classification	Maternal Mean Caloric Intakes
<2.5kg	1485.86±723.45[a]
2.5 - 3.99kg	2596.57±221.46[b]
≥4.0kg	3121.16±340.11[c]

Values are Mean± SD., Values with different superscript are considered significance different ($p<0.05$)

Table 4.6: Dietary Pattern of Pregnant Women Using Food FrequencyQuestionnaires (n=67)

Food types	Never		Once/week		2-3x/week		4-5x/week		6x/week		Once/day	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Bread,Ccereals and Grains	`											
Bread	12	17.9	16	23.9	18	26.9	21	31.3	00	0.00	000	0.0
Rice	0	00.0	0	00.0	12	17.9	29	43.3	24	35.8	203	.0
Maize	1	1.50	18	26.9	27	40.3	21	31.3	00	0.00	000	.0
Millet	6	9.00	0	00.0	27	40.3	29	43.3	05	7.50	000	.0
Roots and Tubers												
Yam	0	00.0	10	14.9	32	47.9	20	29.3	0	00.0	0	00.0
Irish potato	9	13.4	53	79.1	04	06.0	1	1.5	5	7.5	0	00.0
Potato(yellow)	2	03.0	19	28.4	23	34.3	22	32.8	1	1.5	0	00.0
Plantain	5	07.5	27	40.3	29	43.3	0	00.0	6	9.0	0	00.0
Cassava	12	17.9	29	43.3	12	17.9	8	11.9	6	9.0	0	00.0
Sweet potato	35	52.2	02	03.0	02	03.0	1	1.5	27	40.3	0	00.0
Pastas and other Processed Foods												
Pastas	0	00.0	8	11.9	36	53.7	15	22.4	7	10.4	1	1.5
Processed food	0	1.5	18	26.9	29	43.3	15	22.4	6	7.5	0	00.0
Local spaghetti	2	3.0	33	49.3	2	3.0	30	44.8	0	00.0	0	00.0
Fats and oils												
Animal fat (*kakide*)	6	9.0	21	31.3	22	32.8	17	25.4	1	1.5	0	00.0
Vegetable oil	0	00.0	1	1.5	0	00.0	26	38.8	36	53.7	1	1.5
Beverages(cocoa drinks)	0	00.0	14	20.9	10	14.9	16	23.9	27	40.3	0	00.0

Table 4.6: Dietary Pattern of Pregnant Women Using Food FrequencyQuestionnaires (continue)

Food types	Never		Once/week		2-3x/week		4-5x/week		6x/week		Once/day	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Fruits, Vegetables, soups and Sauces												
Baobab leaves	0	00.0	14	20.9	8	11.9	24	35.8	6	9.0	15	22.4
Fluted pumpkin	0	00.0	17	25.4	5	7.5	21	31.3	4	6.0	18	26.9
African sorrel	0	00.0	35	52.2	28	41.8	03	4.59	1	1.5	0	00.0
Drumstick leaves	0	00.0	28	41.8	16	23.9	18	26.9	5	7.5	0	00.0
Jute leaves	1	1.5	51	76.1	13	19.4	01	1.5	1	1.5	0	00.0
Bitter leaves, and spinach	0	00.0	19	28.4	45	67.2	03	4.5	0	00.0	0	00.0
Carrot,Cabbage,Cucumber	3	4.5	28	41.8	12	17.9	21	31.3	3	4.5	10	13.4
Sprout of fanpalm	27	40.3	30	44.8	00	00.0	00	00.0	1	1.5	0	00.0
Fruits	0	00.0	15	22.4	20	29.9	24	35.8	811.9		0	00.0
Fruits juices and drinks												
Tigernut drink	0	00.0	7	10.4	26	38.8	31	46.3	3	4.5	0	00.0
Sourrel drink (*Zobo drink*)	0	00.0	3	4.5	0	00.0	26	38.8	31	46.3	7	10.4

Table 4.6: Dietary Pattern of Pregnant Women Using Food FrequencyQuestionnaires (continue)

Food types	Never		Once/week		2-3x/week		4-5x/week		6x/week		Once/day	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Meat, Fish, and Poultry												
Beef	1	1.50	31	46.3	23	34.3	0	00.0	0	00.0	9	13.4
Egg	0	00.0	25	37.3	16	23.9	0	00.0	4	6.0	19	32.5
Chicken	0	00.0	19	28.4	13	19.4	14	20.9	16	23.9	5	7.5
Organ meat	0	00.0	22	32.8	19	28.4	17	25.4	0	00.0	9	13.4
Fish	0	00.0	38	56.7	04	06.0	02	3.00	0	00.0	25	37.3
Legumes												
Beans	0	00.0	24	35.8	23	34.3	6	9.0	14	20.9	0	00.0
Groundnut	0	00.0	33	49.3	27	40.3	3	4.5	01	1.5	3	4.5
Bambara nut	8	11.9	15	22.4	44	65.7	0	00.0	00	00.0	0	00.0
Soybeanscake	0	00.0	16	23.9	14	20.9	9	13.4	28	41.8	0	00.0
Milk and milk product												
Milk (powder, liquid)	0	0.00	1	1.5	00.00		26	38.8	36	53.7	1	1.5
Milk product(youghurt)	0	00.0	19	28.4	12	17.9	11	16.4	25	37.3	0	00.0

(n= 67)

4.3 Anthropometric Characteristics of Pregnant Women

Figure 4.2 indicates that most of the mothers (77.60%) were within the normal MUAC cut off≥23.1cmwhile 16.40% were moderately malnourished (≥ 19.00- <23.00 cm) and 6% severely malnourished (< 19.00).

Table 4.7 shows the average weight, height value among the pregnant women as 70.37±12.70kg,and 1.62±0.09 m respectively.Equal percentage (17.90%) of pregnant women from different age range 25-29, 35-39, 44-49years, had more weight with mean value as 70.20±13.3, 71.11±14.9. and 74.8±11.3kg respectively. Means in the same column with different superscript are considered significantly different (p<0.05).

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4.4 Hemoglobin and Packed Cell Volume level of Pregnant Women

Table 4.8shows the level of heamoglobin and packed cell volume, whereby 56.70% of the pregnant women had normal hemoglobin level and PCV. While 34.30% of pregnant women are classified under mildly anemic. Those moderately anemic were 9.0% whereas 43.30% had PCV below normal value.Means with the same column of same parameter with different superscript are considered significantly different (p<0. 05)

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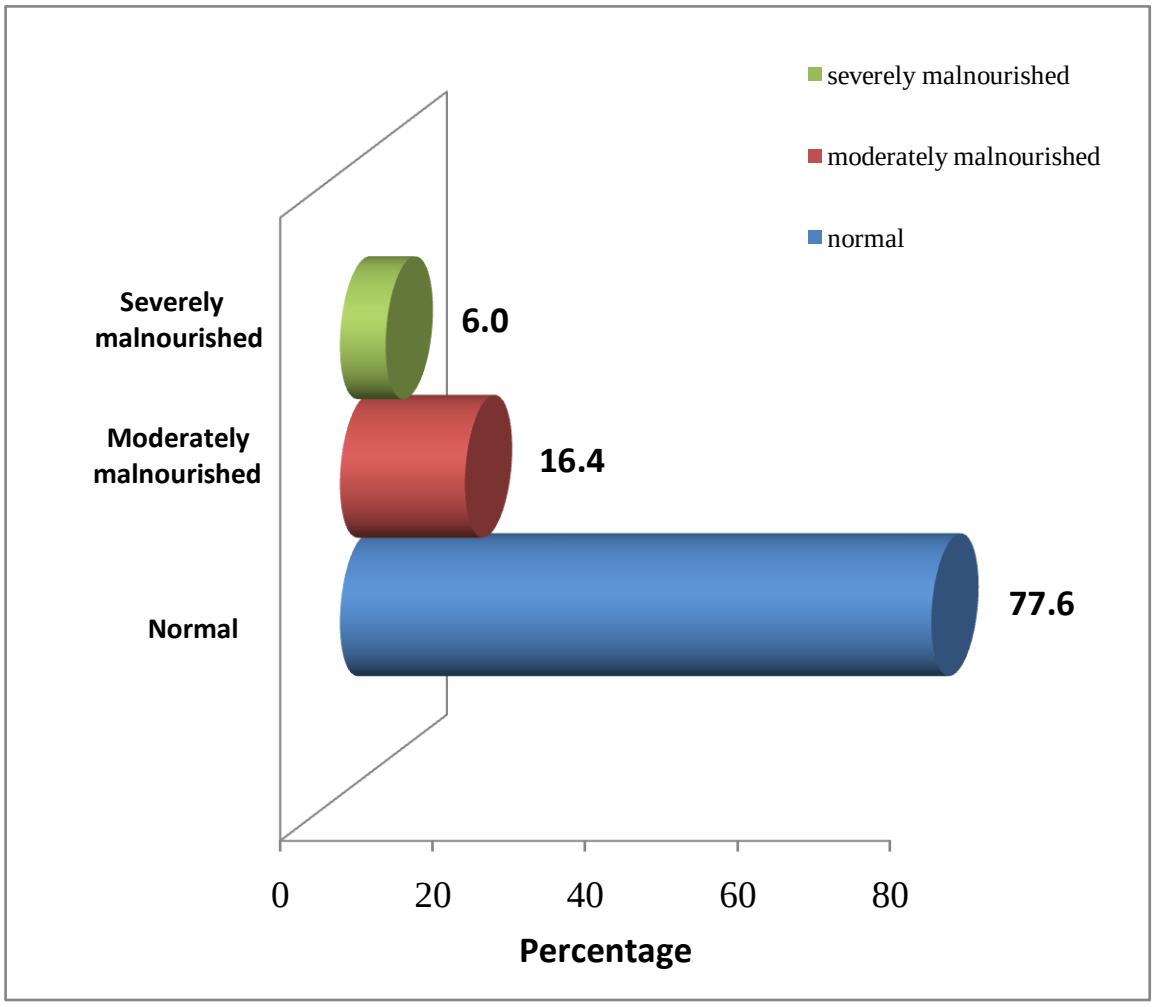


Figure 4.2: Percentage Distribution of Nutritional Status of Women Using MUAC.

Table 4.7: Distribution of Weight, and Heightaccording to Ageamong Pregnant Women in their Third Trimester.

Age Frequency (years)		Percentage (%)	Weight (kg)	Height (m)
15 – 24	7	10.4	66.94±12.71[a]	1.65±0.11[a]
20 – 24	10	14.9	66.09±11.80[a]	1.62±0.09[a]
25 – 29	12	17.9	70.20±13.31[b]	1.71±0.10[b]
30 – 34	11	16.4	68.1±09.90[a]	1.65±0.09[a]
35 – 39	12	17.9	71.11±14.91[b]	1.62±0.08[a]
40 – 44	3	17.9	74.8±11.42[c]	1.62±0.06[a]
45 – 49	3	4.5	80.8±20.01[d]	1.62±0.07[a]
Mean±SD	67	100	70.37±12.7	1.62±0.09

Values are mean± SD., Means in the same column with different superscript are considered significantly different ($p<0.05$).

Table 4.8: Maternal Heamoglobinlevel and Packed Cell Volume among Pregnant Women intheir Third Trimester

Parameters	Classification	Frequency	Percentage %	Mean±SD	*Reference Range
Hb(g/dl)	Normal	38	56.7	12.11±0.9[a]	≥ 11.0
	Mildly anemic	23	34.3	9.75±0.4[b]	9.0 – 10.9
	Moderately anemic	06	9.0	7.91±0.2[c]	7 – 8.9
PCV (%)	Normal	38	56.7	36.33±2.9[a]	≥ 33.0
	Below Normal	29	43.3	28.13±2.8[b]	< 33.0

*Classification by WHO/UNICEF/UNO.IDA (1998). Means with the same columnof same parameter with different superscript are considered significantly different ($p<0.05$)

4.5: Lipid Profile of Pregnant Women

Table 4.9 shows that the mean values of total cholesterol, LDL-cholesterol, Triglycerol are within normal range except HDL-cholesterol whichare slightly above the reference range.Figure4.3presents the percentage of pregnant women (75.00%) having normal serum total cholesterol and 20.60% of the mothers were categorized deficient. Pregnant women serum HDL-cholesterol shows 17.60% of the respondent hasnormal HDL-cholesterol value,while 55.90%had high HDL-cholesterol value and 26.5% are low. Also the distribution of pregnant women LDL-cholesterol,shows that more than half (69.10%) of the pregnant women were normal and 30.90% has high LDL-cholesterol level when compared to the normal pregnancy reference range. Distribution of pregnant women serum triglyceride level indicates that 44.10% of the pregnant women are normal and 32.40% belong to low category while 23.50% hadhypertriglyceridemia.Means that are considered to be statistically different ((p<0.05) are in the same column of same parameters with different superscript.

4.6 Serum Micronutrients level among Pregnant Women

Figure 4.4 shows the percentage distribution of pregnant women serum iron, copper and zinc which indicate that 87.00% of the pregnant women have normal level of serum iron while 11.90%, 1.80% have low and high iron level respectively. Only 14.70% of the pregnant women were categorized under normal level of copper and 85.30% of pregnant women have high copper level. Distribution of pregnant women serum zinc shows 63.20% of the pregnant women had normal level while 27.90% had high level of zinc.

Serum iron, zinc and copper concentration of the pregnant women in their third trimester was shown in Table 4.10. Mean iron and zinc serum concentration among the pregnant women were all within reference range irrespective of their age grouping except serum copper which is above the standard reference range. Means that are considered to be statistically different ((p<0.05) are in the same column with different superscript.

Table 4.9: Distribution of Maternal Serum Lipid Profile According to Age Range

Age (years)	Frequency	Percentage	Total Cholesterol (mmol/l)	HDL-Cholesterol (mmol/l)	LDL-Cholesterol (mmol/l)	Triglycerides (mmol/l)
15 – 19	7	10.4	6.92±1.90[a]	3.08±2.10[a]	5.08±1.20[a]	3.35±1.21[a]
20 – 24	10	14.9	6.47±1.41[b]	1.66±0.71[b]	4.37±1.30[b]	4.38±1.40[b]
25 – 29	12	17.9	6.60±1.91[a]	2.69±1.72[a]	5.23±1.51[a]	3.66±1.12[b]
30 – 34	11	16.9	7.03±1.92[a]	3.54±1.91[c]	5.35±1.21[a]	3.55±1.12[b]
35 – 39	12	17.9	6.80±2.20[a]	1.98±0.91[b]	5.05±1.91[a]	3.77±1.11[b]
40 – 44	12	17.9	6.88±1.41[a]	3.31±1.70[a]	5.31±1.12[a]	3.41±1.21[a]
45 – 49	3	4.5	8.59±1.41[c]	3.61±1.12[c]	5.78±0.90[c]	3.61±0.10
Mean±SD	67	100.0	6.86± 1.79	2.74± 1.66[a]	5.11± 1.40[a]	3.69± 1.17[b]
Referene Ranges**			5.67–9.04	1.24– 2.25	2.62–5.80	3.39 – 5.1

Values are Mean ±SD, (n=67),Means in the same column with different superscript are considered significantly different ($p<0.05$). T-chl -total cholesterol, HDL- high density lipoprotein, LDL- low density lipoprotein, TG-triglycerides.(**Abbassi-Ghanavati*et al*., 2009).n=67

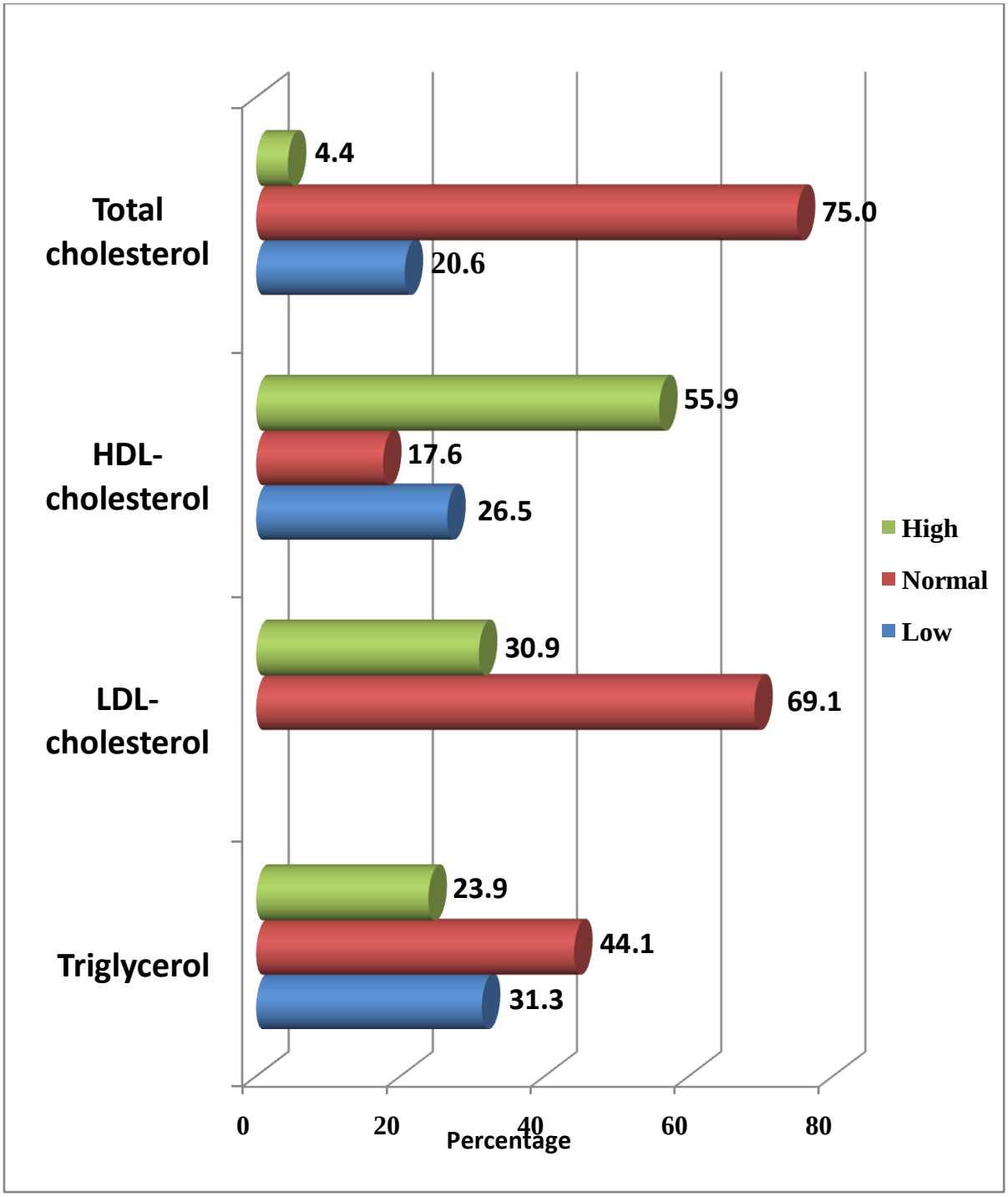


Figure 4.3: Percentage Distribution ofSerum Lipid Profile Concentration among Pregnant Women in their Third Trimester.

Table 4.10: Distribution of Some Maternal Serum Micronutrients According to Age Range

Age range (years)	Frequency	Percentage	Iron (µmol/l)	Zinc (µmol/l)	Copper (µmol/l)
15 – 19	7	10.4	20.08 ± 6.71[a]	11.36 ±2.81[a]	45.37 ± 8.61[a]
20 – 24	10	14.9	20.70 ± 5.70[b]	10.27 ± 3.30[b]	46.01± 8.32[b]
25 - 29	12	17.9	26.52± 5.12[c]	10.25 ± 1.91[b]	52.77 ±5.91[c]
30 – 34	11	16.4	23.97 ± 6.51[d]	10.67 ± 1.21[a]	53.72±7.00[c]
35 – 39	12	17.9	21.63 ± 6.71[e]	10.65 ± 2.40[a]	46.54± 8.92[d]
40 – 44	12	17.9	21.98±6.42[e]	12.43±4.72[c]	46.65 ± 8.01[d]
45 – 49	3	4.5	22.40±4.41[e]	11.80±1.71[c]	50.70±3.00[e]
Mean±SD	67	100.0	22.69 ± 6.28	10.97 ± 2.94	48.84 ± 8.09
Reference Range			5 – 35*	7.7 – 11.8*	21 – 38*

Values are mean± SD, n=67 *Abbassi*et al*., (2009), *Emily Hope (2012), (n=67).Means in the same column with different superscript are considered significantly different ($p<0.05$).

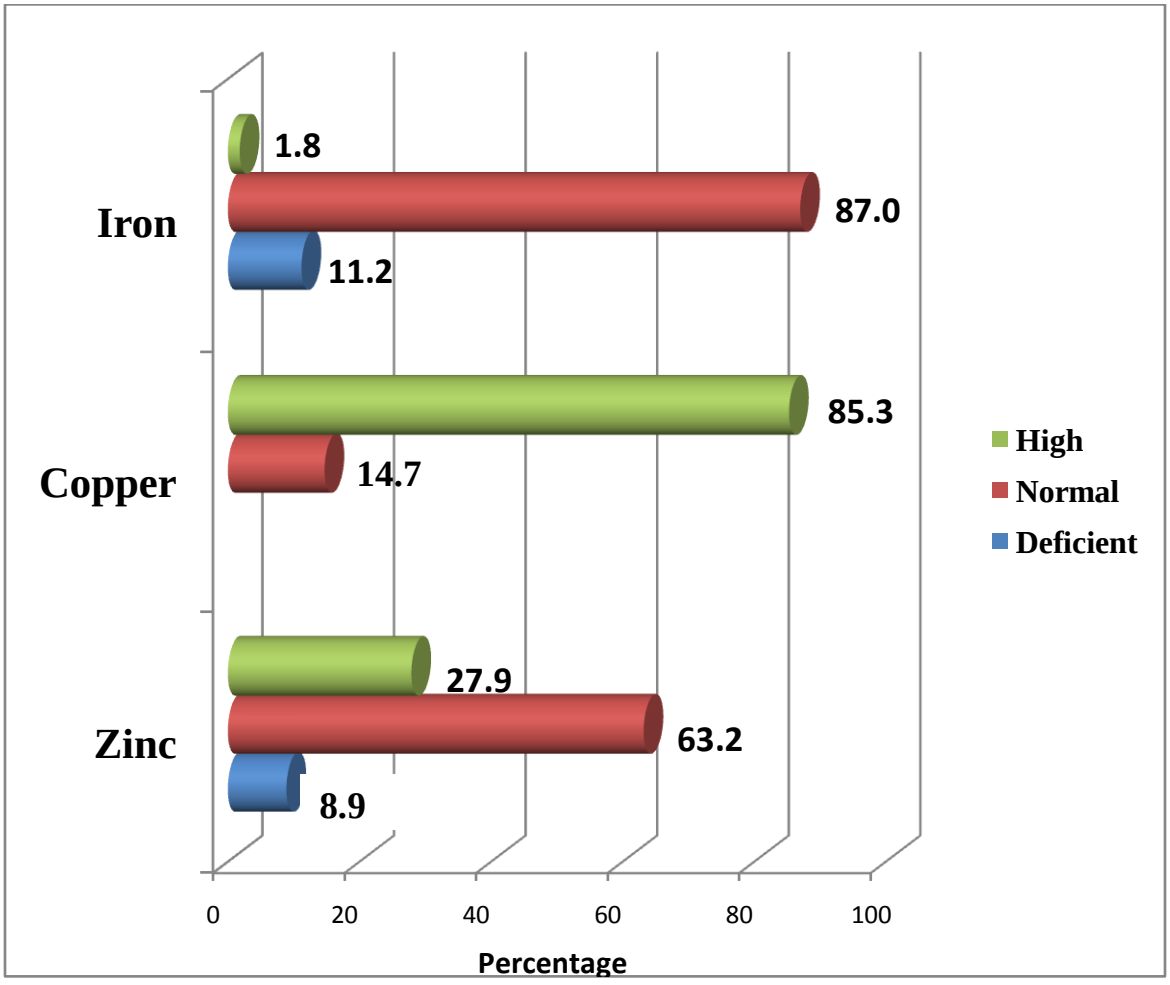


Figure 4.4: Percentage Distribution of Serum Copper and Zinc Concentration among Pregnant Women

4.7Newborn Anthropometry

Thedistribution of birth weight of the neonate was based on this classification as presented in Table 4.11. The lowest and highest birth weight of less than 2.5kg and greater than 2.5-3.99kg were reported among 10.4%, and 9.0% of the neonates, who have the lowest and highest mean value weight of 2.43 ± 0.12 kg, and 4.15 ± 0.20 kg respectively.

The average mean of head and chest circumference of newborn based on their birth weight was32.41±1.10cm for low birth weight, 33.92±1.4cm for accepted weight. The head, chest circumference average mean recorded was compared with the standard was 32.25±1.30, 33.75±1.10, 34.33±0.50cm, accepted birth weight and overweight respectively. The classification based on sex shows that male newborn have higher head and chest circumference than female with average head and chest circumference recorded as 34.02±1.20cm and 33.68±0.90cm and 33.75±1.20, 33.52±1.00cm respectively (Table 4.12).

Figure 4.5;showed Z-score classification of the neonates displayed based on frequency and percentage. Result indicate that WHO Z-score classification for weight-for-length (wasting),were more than half (61.20%) of the new born are categorized as mildly stunted. While 62.70% and 29.90% of the newborn were categorized as moderate (<-2 - >-3Z) severely (<-3Z) wasted. Weight-for-age measured prevalence of over or under weight findings showed that70.10% of the newborns were mildly underweight, 20.90% were categorized as havingsevere underweight. Length-for-age (stunting) z-score showed that 61.20% of neonates were mildly stunted while 9.00% and 6.00% were moderately and severely stunted respectively. The rest were within normal range.

Table 4.11:Percentage Distribution of Newborn Birth Weight

Classification	Frequency	Percentage	Mean± SD (kg)	Reference range
Low birth weight	07	10.4	2.43±0.12	<2.5
Accepted birth weight	54	80.6	3.37±0.30	2.5 - 3.99
Over weight	06	09.0	4.15±0.20	≥4.1

Values are mean± SD., n=67(*CDC/NCHS 2011)

Table 4.12: Distribution of Newborn Head and Chest Circumference, according to Birth Weight and Sex

Classification	Frequency	Percentage	Head Circumference(cm)	Chest Circumference(cm)
Low birth weight	07	10.4	32.41 ± 1.19	32.25 ± 1.35
Accepted birth weight	54	80.6	33.92 ± 1.04	33.75 ± 1.10
Over weight	06	9.0	34.58 ± 0.57	34.33 ± 0.50
Male	37	55.2	34.02 ± 1.2	33.75 ± 1.2
Female	30	44.8	33.68 ± 0.9	33.52 ± 1.0
*Reference range (cm)			33 – 35	30 – 33

Values are as mean± SD., (*CDC/NCHS, 2011)

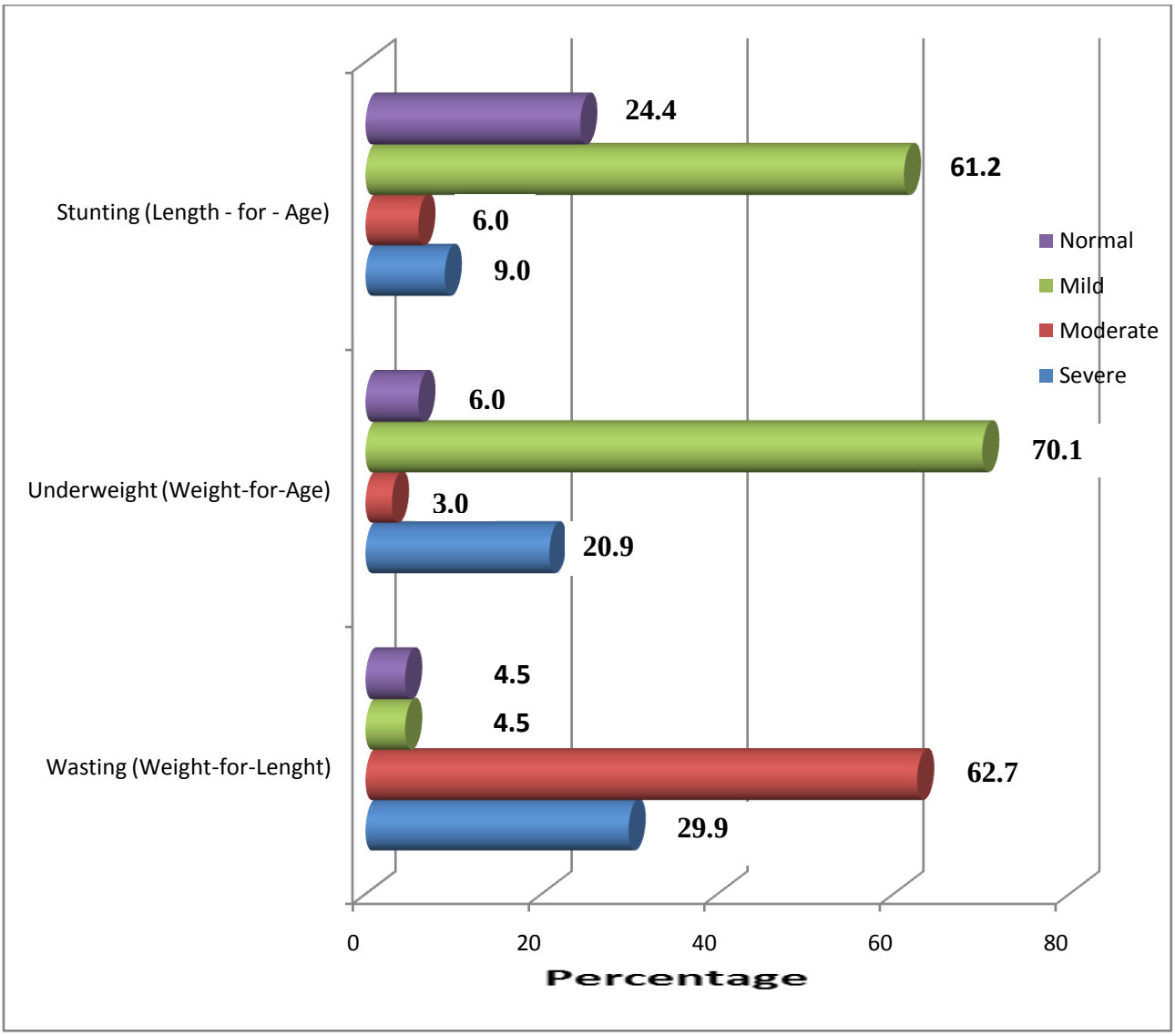


Figure 4.5: Representation of the Newborn Nutritional Status Using Z-score

4.8Relationship between Maternal Dietary Intake and Birth Outcome

Table 4.13displayed a weak positive significant (p<0.01) correlation between maternal total carbohydrate (r=0.352) total protein (r=0.635), total fat (r=0.635) and a positive significant (p<0.01) correlation with total calories (r=0.744) and birth weight. A good correlation (r=0.723) exist between maternal total calories intake in 24hours and newborn weight-for-age z-score classification. While a weak a positive significant (r=0.297,r=0.608,r=0.615) respectively with weight-for-age z-score classification.

4.9Relationship between Maternal Anthropometry Measurements and Birth Outcome

Table 4.14 shows a correlation between maternal anthropometric indices namely -Height, weight, MUAC, BMI and birth outcome. The maternal anthropometric indices measured were significantly (p<0.05) positively correlated, with aweak positive significant (p<0.05) correlation(r = 0.276)with newborn weight-for-age z-score classification. A strong significant (p<0.01) positive correlation(r = 0.818) exist between maternal MUAC and birth weight, weight-for-age z-score(r = 0.787) and a weak positive one with birth height (r=0.507). There is a statistically significant (p<0.01) relationship between maternal BMI and birth outcome especially with newborn birth weight (r = 0.546). A correlation was observed(r=0.561) between calculated maternal weight with neonate weight-for-age z-score with a statistically significant difference of p<0.01.

4.10 Relationship between Maternal Heamatological Parameters and Birth Outcome

Table 4.15 exhibit a relationship between maternal hematological parameters (hemoglobin and packed cell volume) and birth outcome. A statistically significant (p<0.05) correlation evidently occurred between maternal hemoglobin concentration and birth outcome variables especially birth weight (r=0.494, p<0.01), and head circumference(r=0.373, p<0.01). Maternal packed cell volume shows a significance (p<0.05) relationship with birth weight(r=0.495,p<0.01), calculated weight-for-age z-score (r=0.477, p<0.01) and head circumference(r= 0.373, p<0.01).

4.11 Relationship between Maternal Lipid Profile Among Pregnant Women and Birth Outcome

Table 4.16 contains information on a relationship between maternal lipid profile and birth outcome. A significantly Positive correlation exists between total cholesterol and all the birth outcome variables. A statistical significant (p<0.01) correlation exist between maternal total cholesterol (r=0.537) with neonates birth weight, maternal HDL cholesterol have asignificant (p<0.01) relationship (r=0.384) with calculated weight-for-age z-score. A statistical significant (<0.01) positive correlation exist between maternal LDL cholesterol and all the birth outcome variables, especially newborn birth weight (r=0.384).

Table 4.13:Relationship between Maternal Dietary Intake and Birth Outcome

Correlation variables	N	Total Carbonhydrate		Total Protein		Total Fat		Total calories	
		r	*p*	r	*p*	r	*p*	r	*p*
Birth weight	67	**.352****	**.004**	**.642****	**.000**	**.635****	**.000**	**.744****	**.000**
Birth length	67	.223	.070	**.430****	**.000**	**.488****	**.000**	**.458****	**.000**
Head Circumference	67	-.023.	.852	.165	.182	.155	.211	**.280***	**.022**
Chest Circumference	67	-.027	.831	.106	.393	.124	.317	.228	.064
Weight-for-length z-score	67	.123	.320	**.258***	**.035**	.195	.114	**.351****	**.004**
Weight-for-age z-score	67	**.297***	**.015**	**.608****	**.000**	**.615****	**.000**	**.723****	**.000**
Height-for-age z-score	67	.237	.054	**.433****	**.000**	**.490****	**.000**	**.472****	**.000**

Table 4.14: Relationship between Maternal Anthropometric Indices and Birth Outcome

Variable	N	Height		Weight		MUAC		BMI	
		r	*p*r	*p*			r	*p*	r	*p*
Birth weight	67		**.513****	**.000**	.165	.183	**.818****	**.000**	**.546****	**.000**
Birth length	67		**.273***	**.025**	.131	.290	**.507****	**.000**	**.255***	**.038**
Head circumference	67		**.244***	**.046**	.077	.535	**.429****	**.000**	**.275***	**.024**
Chest circumference	67		.239	.052	.060	.631	**.355****	**.003**	**.269***	**.028**
Weight-for-length-z-score	67		**.327****	**.007**	.119	.339	**.396****.001		**.360****	**.003**
Weight-for-age z-score	67		**.561****	**.000**	**.276***	**.024**	**.787.000**		**.540****	**.000**
Length-for-age z-score	67		**.300***	**.014**	.181	.143	**.467****	**.000**	**.255***	**.037**

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.15: Relationship between Maternal Heamatological Parameter and Birth Outcome.

Correlation Variables	N	Heamoglobin		Packed Cell Volume	
		r	***p***	**r**	***p***
Birth weight	67	**.494****	**.000**	**.495****	**.000**
Birth length	67	.179	.147	.179	.147
Head Circumference	67	**.373****	**.002**	**.373****	**.002**
Chest Circumference	67	**.256***	**.036**	**.257***	**.036**
Weight-for-length z-score	67	**.325****	**.007**	**.325****	**.007**
Weight-for-age z-score	67	**.479****	**.000**	**.479****	**.000**
Length-for-age z-score	67	.185	.134	.185	.134

. Correlation is significant at the 0.01 level (2-tailed)**
*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.16: Relationship between Maternal Lipid Profile and Birth Outcome

Correlation Variables	N	Total-Cholesterol		HDL-cholesterol		LDL-Cholesterol	
		r	*p*	r	*p*	r	*p*
Birth weight	67	**.537****	**.000**	**.354****	**.003**	**.392****	**.001**
Birth length	67	**.303***	**.013**	**.320****	**.008**	**.279***	**.022**
Head Circumference	67	**.408****	**.001**	.101	.418	**.247***	**.044**
Chest Circumference	67	**.424****	**.000**	.128	.302	**.341****	**.005**
Weight-for-length z-score	67	**.315****	**.009**	.067	.589	**.170**	**.169**
Weight-for-age z-score	67	**.502****	**.000**	**.384****	**.001**	**.382****	**.001**
Length-for-age z-score	67	**.294***	**.016**	**.357****	**.003**	**.309***	**.011**

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

4.12 Relationship between Some Maternal Micronutrient Serum Level and Birth Outcome

Table 4.17showed a statistically significant (p>0.05) relationship between maternal zinc and newborn birth weight, length, weight-for-age, and length-for-age (r=0.289, r=0.266, r=0.258, r=0.277) respectively. Positive correlation exists only between the maternal serum iron and newborn calculated weight-for-length Z-score with p-value <0.05.

Table 4.17 Relationship between Maternal Serum Micronutrient and Birth Outcome

Variables	N	Iron		Copper		Zinc	
		r	***p***	**r**	***p***	**r**	***p***
Birth weight	67	**-.165**	**.183**	**.002**	**.987**	**.289***	**.018**
Birth length	67	.142	.251	.061	.627	**.266***	**.030**
Head Circumference	67	-.102	.413	.065	.602	.131	.289
Chest Circumference	67	-.032	.798	.092	.458	.127	.305
Weight-for-length z-score	67	**-.255***	**.037**	-.030	.809	.019	.881
Weight-for-age z-score	67	-.074	.551	.035	.781	**.258***	**.035**
Length-for-age z-score	67	.157	.205	.073	.558	**.277***	.023

. Correlation is significant at the 0.01 level (2-tailed)**
*. Correlation is significant at the 0.05 level (2-tailed)

4.13 Relationship between Maternal Characteristics and Birth Outcome of the Malnourished Newborn

Table 4.18 shows a correlation between maternal demographic characteristics namely maternal age and maternal level of adherence to ante natal drugs intake. These characteristics showed to have a strong negative correlation with the birth outcome precisely, there is a strong significance (p<0.01) negative correlation between maternal age and the newborn's measurement of circumferences (head circumference, head circumference- for – age and chest circumference) with r=-0.967, -0.946, -0.926 respectively.

However, a significant (p<0.01) very strong positive relationship exists (r=0.837) between maternal antenatal drug intake and the weight-for-age Z-score of the malnourished neonates (Table 4.19).

4.14Relationshipbetween Maternal Physiological Changes with Birth Outcome of Malnourished Neonates.

Table 4.20 shows a negative significant correlation between pregnant women aversion to certain food and birth outcome namely birth length (r= -0.804, p<0.016) and length-for-age z-score (r=0-.714, p<0.046) classification among the malnourished neonates.

4.15 Relationship between Maternal Serum Micronutrient and of Malnourished Neonates Birth Outcome

Table 4.21 displays a correlation between maternal serum micronutrient level and birth outcome of neonates classified as malnourished. A positive significant (p<0.01 and p0.05) correlation is observed between maternal serum iron and birth length, length-for-age, and weight-for-age with r=0.840, 0.827, 0.775 respectively. Also a significant positive correlation exist with maternal serum copper and length, length-for-age, and weight-for-age (r=0.812, 0.782, and 0.833 respectively) the p-value is <0.05.

Table 4.18: Relationship between Maternal Age Range with Malnourished Neonates Birth Outcome.

Correlation Variables	N	Age range	
		r	*p*
Head circumference-for-age z-score	8	**-.967****	**.000**
Head circumference	8	**-.949****	**.000**
Chest circumference	8	**-.926****	**.001**

. Correlation is significant at the 0.01 level (2-tailed)**
*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.19: Relationship between Maternal Antenatal Drug Intake and Birth Outcome of Malnourished Neonates.

Correlation Variables	N	Intake of antenatal Drugs	
		r	***p***
Weight-for-age z-score	8	**.837****	**.010**

.Correlation is significant at the 0.01 level (2-tailed)**

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.20: Relationship between Maternal Physiological Changes and Birth Outcome of Malnourished Newborn

Correlation variables	N	Maternal Aversion	
	8	**r**	***p***
Birth length		**-.804***	**.016**
Length-for-age z-score	8	**-.714***	**.046**

. Correlation is significant at the 0.01 level (2-tailed)**
*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.21: Relationship between Maternal Serum Micronutrient and Birth Outcome Of the Malnourished Newborn

Correlation variables	N	Maternal Iron		Maternal Zinc		Maternal Copper	
		r	***p***	**r**	***p***	**r**	***p***
Birth Length	8	**.840****	**.009**	.078	.855	**.812***	**.014**
Weight-for-age Z-score	8	**.827***	**.011**	-.310	.455	**.782***	**.022**
Length-for-age-Z- Score	8	**.775***	**.024**	.087	.838	**.833***	**.010**

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

CHAPTER FIVE

5.0 DISCUSSION

The reproductive performance, outcome and condition of the infant at birth,have long been known to be influenced by maternal characteristics (NDHS 2008).

This studyrevealed that half of the pregnant women were withintheir reproductive ages, while one third were either over or under age(table 4.1).This conforms to the National Demographic and Health Survey (NDHS 2008; Stewart *et al.,* 2007) report of the most fertile group. The findings showed that the appropriate age range to conceive without risks for undesirable outcomes is 20 – 35 years. Findings on the relationship (table 4.18)between maternal age and birth outcome of malnourished neonates showed a positive significant ($p<0.05$) relationship between maternal age range and birth outcome (head and chest circumference) of malnourished neonates.This indicates that maternal age has effect on the head to chest circumference of the newborn. Young mothers within low age range are likely to have babies with smaller head to chest circumference (small for gestational age) and vice versa.Under-age (below 19 years) and over-age mothers (above 35 years) were at increased risk of poor pregnancy outcomes such as pre-term, small for gestation and low birth weight babies and high neonatal mortality (Stewart *et al.,* 2007).

The study findings indicates that the highest occupational status among the pregnant women were housewives (table 4.1) and distribution of the average monthly income indicated that, close to a half of the women had incomes that were below the minimum government wage of N18, 000.00. Poor socio-economic status is one of the major contributing factors that can influence neonatal mortality. Low income adversely affects food and nutrition security, thus increasing the risk for poor pregnancy outcomes like poor gestational weight gain which can

lead to low birth weight babies. This is in agreement with Ugwa (2014) findings on pregnant women in Kano, North western part of Nigeria, which states that low income adversely affect food and nutrition security increasing the risk of poor pregnancy outcome.

Highest percentage of the women in this study had attained only secondary level of education.Low level of education can limit the pregnant women knowledge, attitude and practice on nutritional education hence leads to improper food choices.Low education level has indirect effects on the understanding of nutrition and food as well as improvement of the socio-economic conditions (Walraven*et al.*, 1997).Auger *etal.*, (2008), believes that maternal education level therefore influences the food choices and feeding patterns of family members.Yekta (2006) finding in Iran showed no significant effect on the birth outcome but believes that illiterate subjects were more at risk of adverse birth outcome.

Most pregnant womenbelievethereis a food taboo during pregnancy; however, theirbelief varies on the type of food taboos (Table 4.3). Choice of food was determined by pregnant mothers' preference of particular foods.In this study, boiled egg, beverages, and monosodium glutamate (white Maggie) were the major food seen as taboo among the pregnant women because many believed that boiled egg can cause stomach ache or discomfort while beverages results to delivering large babies. The boiled egg, and beverages are good sources of carbohydrate, protein and energy and they are accessible and available foods in the area of the study. Pregnancy imposes greater need for energy in the body, when all these easy sources of energy foods are forbidden, the women would find little to select and caloric intake will be low which leads to poor pregnancy weight gain and hence low birth weight babies. AlsoBentum (2011) beliefs that there is no special culturally unacceptable food, however,there is foodpreference during pregnancy which give way to monotonous feeding which is associated

with inadequate nutrient intake leading to higher percentage of mothers having low birth weights.

The study findings showed that few among the pregnant women in the study (23.9%) do not take the antenatal drugs given to them in the clinic.Reasons giving was due to the irregularity of antenatal visit by the pregnant mothers and failure to comply with the advice or medications recommended by healthcare providers these has increasedincidence of lowbirth weight. Inadequate or not taken antenatal drugs can leads to adverse birth outcome like neural tube defect. In the present study a significant relationship exist ($p>0.05$) between malnourished neonate anthropometry indices and their mothers compliance to antenatal drugs(Table 4.19).Women who did not take their prenatal iron,folic acid and multivitamin supplements, the risk of low birth weight neonate is higher than those in compliance. These agree with a longitudinal study conducted by Yan *et al.,* (2013) on pregnant women at Maanshan, China. Thisshowed that intake of standard folic acids supplements have a significant relationship with the neonatal birth weight. Study on 424 pregnant women in their third trimester in Delvaryanzadeh showed that 43% of newborn babies of non-compliance mothers have low birth weight. Also Singh *et al.,* (2009) observed a positive relationship between birth weight, iron supplementation, and multivitamin consumption on pregnant women in their last trimester of pregnancy; same was found in study conducted byAhmed (2014), at Shaykhol-Islam on 4883 mother-baby pair survey.

This study has shown (Table 4.5) that the mean birth weight of newborns increased with proportionate increase in the consumption of calories by the mothers during the last trimester ($P<0.05$).Mothers who consumed calories <1500 kcal/d during the last trimester delivered low birth weight neonates. Similarly, results findings have showed that mean intake of maternal

macronutrient were within recommended daily intake (2500 – 3000 kcal/day) with regard to protein and energy intake were reported by Gopalan*et. al.,* (2002). Kramer (2003) reports a study in Maryland on 300 pregnant women that show a significant relationship between energy intake and birth weight.

It was observed in Table 4.6that pregnant mothers regardless of their nutritional status were consuming less than recommended servings of various food groups. Mean intake of only bread and cereal group was more than recommended servings per day(6 – 11x/week). Rice and millet are the common meal consumed. Intake of chicken, and meat was associated with the socioeconomic status. Fish (sardines, geisha, mackerel etc) are most consumed among the pregnant women, however chicken was the least consumed. Only a few of pregnant women ate organ meat once a day. Consumption of other food groups like fruit, vegetables, milk and meat was below the recommended servings per day. This trend of food group intake among the pregnant women is reflecting the dietary habits of the study population. Women are not used to consumptions of milk and fruit in every day meal, while carbohydrates and fats are the main components of the daily cooking. This is in agreement with Pakistani report (2011) findings on eating habits of Pakistanis based on their Perceptions and preferences (Fareeha 2014).

Inadequate intake of protein rich foods cannot meet the increase demand for energy and protein in the third trimester to support both the growth of her baby and her own health to prevent anemia during pregnancy and low birth weight babies.This is similar to other studies conducted by Kemunto(2013) and studies carried out by Fatima *et al*., (2014),showing only one percent of the pregnant females taking eggs, and organ meat.In the present study (Table 4.20) a strong positive relationship was observed between craving and aversion of the pregnant women and the birth outcome of the babies born with severe malnutrition. A similar findings was observed

from a study conducted by Taheri*et al*.,(2014) on equal number (202) of low birth weight and normal weight babies this shows that changes in physiological condition of some mothers during pregnancy affect the birth length and length-for-age Z-score of the newborn neonates hence leads to stunting neonates.Taheri*et al.,* (2009) study showed that pregnant women that suffer severe cravings and aversion failed to control the health and nutritional conditions hence their increase in the possibility of delivering a low birth weight, small for gestational age and preterm babies.

Table 4.7 indicates that the average maternal weight of 70.37±12.70kg among the pregnant women was within normal weight. Majority of the women had heights (162.0±0.1 cm) above the recommended. When the maternal heightand weight is appropriate the better is the baby's growth thus the birth outcome (Sharma 2014).Majority of the pregnant women in the present study were not among women of short stature with risk of obstructed labour.Studies conducted in African countries by Mohanty*et al.,* (2005); Sen*et al.*,(2010) showed the average maternal height that has been associated with good pregnancy outcomes is >1.51 meters.A small pelvis is likely to be found in short women, which can lead to dystocia with foeto-pelvic disproportion or shoulder dystocia(Kirchengast*et al.*,2007), likely to have intrauterine growth retardation or preterm labour (Pilotto*et al.,* 1993). A study by Shirima*et al.,* (2005) also reported increased risk of caesarean sections among women of short stature. Women with a weight below 50kg, height >145cm and MUAC <22.1cm should be referred for nutritionalcounselling.

Maternal anthropometry over several years has been considered a predictor of pregnancy outcome (Watkin*et al.,* 2003, ACOG 2005; Crane *et al.,* 2009; Addo, 2010and Farrel 2010).Figure 4.2 clearly indicate the acute malnutrition status of the pregnant women with few

having moderate to severe acute malnutrition status. Mid upper arm circumference is highly recommended in this study as a good predictor of nutritional status of pregnant women where there is no information on the pre-pregnancy BMI.Table 4.14 finding showed a strong relationship between pregnant women MUAC and birth outcome which agrees with 12 longitudinal studies reported on association between low maternal MUAC and birth outcomes. Half of the studies looked at the association between low MUAC and infant LBW (Mohanty*et al.*, 2006, Rollins *et al.*, 2007, Assefa*et al.*, 2012, Sebayang*et al*., 2012), all of which found significantly increased risk of low pregnancy weight which is associated with given birth to low birth weight newborn among mothers with low MUAC during pregnancy.

The heamoglobin concentration,10.93±1.65 g/dl which is below the Hb cut-off concentration that is used to define anaemia in pregnancy is 11.0 g/l by WHO/UNICEF/ UNU (2001), About half of the pregnant women in this study have normal heamoglobin level while more than one third of the study group were mildly anemic, while only 9.0% were severely anemic, the reason for less number of severely anemic pregnant women would be due to this could be due to intake of iron supplements by most of the women(Fig. 4.1) therefore, proper intake of antenatal supplement may lessen or curtail the severityof iron deficiency anemia during pregnancy and hence reduce the rate of maternal morbidity and newborn mortality.Ramakrishnan(2004) reported several studies with evidence that iron supplementation to boost Heamoglobin level had a positive effect on birth weight.

Resultsfrom this sturdy indicated an association between third trimester haemoglobin levels and infant birth weight with a statistical significance of 0.01 for each(Table 4.15). This is in agreement with the results of work done by Sharma *et al.* (2014),Rosenberg *et*

al.,(2008)Murphy *et al.*, (1986)in China and India, on the effect of different haemoglobin level on birth outcome and their findings showed that mildanaemia was significantly associated (3^{rd} and 2^{nd} trimesters)with low birth weight, thereby conformedto the findings of this study.This result confirms with report, that anaemia is said to be significantly higher in the 3^{rd} trimester of pregnancy than the first two trimesters (WHO, 1992).

Study finding in table 4.9 showed that the high percent of the pregnant women have high HDL=cholesterol about one third were deficient of HDL-cholesterol. This can be attributed to low fat intake among the pregnant women precisely the Hausa//Fulani with highest percent. Although this study has a relatively smaller sample size when compared with a similar study on maternal serum lipid profile at Kura local government (Atiku*et al*., 2009). Over 98% of the participant both pregnant and non-pregnant women have normal cholesterol. Only some few has total cholesterol level greater than normal reference range.

Also findings showed normal level of total cholesterol which indicates that hypercholesterolemia is not common in this environment which can be due to many factors such as environment, diet, and/or genetic factors.Table 4.16 showed a positive correlation between maternal Lipid parameters, including total cholesterol, LDL-cholesterol, HDL-cholesterol, and neonatal birth outcome; these have been shown in other published reports on the relationship between maternal HDL-cholesterol, LDL-cholesterol, total cholesterol and unfavorable pregnancy outcome (Walletin*et. al.,* 1986). Hypercholesteremia during pregnancy is shown in previous study as normal due to adaptation of the mother to supply the fetal requirement; hence estrogen is increase during the gestation (Wallentin*et al.,* 1986), and at mid gestation increases the cholesterol in HDL (Knopp*et al.,* 1981).So the higherfindings is not suprising.

The most obvious changes are the pregnant women serum triglycerol, which increases among the pregnant women.Udoh*et al.,* (2002) agrees in his findings which shows serum triglycerol concentration significant increases (P<0.0001) in the third trimester of pregnancy than in the non-pregnant women, the mean value being raised almost two folds. The principle modulator of this hypertriglyceridemia is estrogen, as pregnancy is associated with hyperestrogenemia**.** This corroborates with the previous discovery of Udoh*et al,* (2002) who observed a progressive increase in serum TC, HDL, LDL, VLDL and TG at various stages of pregnancy.

Findings in Table 4.9 showed that the highest percentageof the pregnant women are reported to have increase in serum copper level above the reference range, the increase of copper is due to increase in the production of sex hormone estrogen.After delivery the copper level is expected to reduce if not it can leads to postpartum complication.The study findings inTable 4.16 evidently show a relationship between maternal serum zinc and iron with birth outcome. Correlation between the malnourished newborn and their mother's serum micronutrients characteristics shows a positive association with maternal serum iron and copper with birth outcome (Table 4.21) In a similar study by Gambling *et al.,* (2008),have demonstrated interactions between iron and zinc the fetus not only needs minerals to sustain its growth, it is also a stage when the fetal liver builds up stores for the immediate postnatal period. A reduction in mineral availability, by interactions between the nutrients in the maternal gut, liver or in the placenta itself, may result in adverse outcomes for the baby(Ramakrishnan2004).

Findings of the study (Table 4.10) showed a significant increase in serum copper was observed with onset of pregnancy; and it continued to rise and doubled by the end of pregnancy. Findings are in agreement with other studies which showed copper increased among pregnant

women in the developing world (Upadhyaya*et al*. 2004).Findings had been reported in healthy pregnant Nigerian women and their non-pregnant counterparts (Ajose*et al*., 2002). Same had been reported in Spanish (Izquierdo*et al*., 2007) and Turkish women (Meran*et al.,* 2009). Das (2009),Furthermore (Bro *et al*., 1988) noted that copper concentration increase during pregnancy and decrease after delivery. This increased of copper with progression of pregnancy could be partly related to synthesis of ceruloplasmin due to elevated level of maternal estrogen (Farzin*et al.,* 2009),increase in adrenalin hormone which increase in pregnancy(Fuchs *et al.,*1977).Given the high incidence of maternal iron deficiency anaemia during pregnancy,these results in the increase of liver copper levels which are associated with an increase of serum copper levels in the mother and in the activity of maternal serum ceruloplasmin(Jelka*et al*., 2012).

Low birth weight is defined as being less than 2.5kg at birth (UNICEF and WHO 2004).It was observed in this study that, 10.40% percentage of neonate were born with low birth weight
And with majority having acceptable birth weight (Table 4.11). Positive relationship exists in Table 4.13 between neonatal birth outcomes (birth weight, Birth length, z-score for length-for-age, weight-for-age) and maternal energy and macronutrients (total protein, Fat and Calories) intake.

Studies from various countries including Nigeria have corroborated the utility of head and chest circumference as a valuable surrogate for LBW (Ezeaka*et al.,* 2003; Sreeramareddy*et al.,* 2008). Normal neonatal accepted average range ofhead and chest circumference was 33-35cm and 30-33cm respectively (CDC/NCHS, 2009).Table 4.11shows the result of the chest and head circumference which indicate a close relationship between them, although they varies

when compared with birth weight classification. It was clearly seen that the head and chest of the underweight newborn is smaller than the newborns with accepted birth weight.The cut-off of 32.9 and 29.5cm for LBW head and chest circumference an in this study is sighted in earlier study conducted by Ezeaka*et al.*,(2003) from Nigeria, with the closest rate reported from Bangladesh (Sreeramareddy*et al.*, 2008).

Nutritional status classification showedthat majority were categorized as mildly malnourished in respective of the three z-score indices. The findings reveals that Underweight is slightly high among the newborn than other z-score classification. This agrees with the finding of NDHS, (2013) that the North West zone has the highest proportion (27%) of children reported as weighing less than 2.5 kg at birth, More than one third (36%) of children whose birth weights are known in Kaduna weighed less than 2.5 kg at birth.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

6.1 Summary

Major findings of this study can be summarized as follows

i. Almost half of the pregnant women were low income earners, with 38.8% as fulltime housewives
ii. Dietary pattern consist of high intake of rice and millet for 4-5×/week and 6×/week respectively.
iii. MUAC measurement of the pregnant women reveals the majority within normal reference range while close to one third were considered mildly malnourished.
iv. There was high concentration of serum HDL- cholesterol, and LDL- cholesterol, and copperamong pregnant women.
v. Prevalence of mild to severe anemia were recorded among the pregnant respondents.
vi. The study reveals a significant ($p > 0.05$)maternal age range, antenatal drug compliance, physiological change, serum micronutrients and between malnourished neonate anthropometrics indices.

6.2 Conclusion

Based on the findings of this study it is concluded as follows; - Half of the pregnant women were within the appropriate age to conceive without risk of undesirable outcome. Generally intake of fruits and vegetables is low among the study population.

The pregnant women anthropometry shows that most have a good nutritional status.About one third of the pregnant women were anemic. Male newborn had higher height, weight, head and chest circumference than female.Maternal anthropometry, hematological parameters shows strong association with neonatal birth weights.

6.3Recommendations

i. Women should be enlightened more on pregnancy risk factors and of the importance of stating antenatal clinic early in pregnancy.

ii. Government should focus on the effective implementation of nutrition educationprograms into diversifies the dietary intake of pregnant women for optimum health and improve neonates health status.

iii. A routine test for total cholesterol during pregnancy should be conducted, in order to differentiate between a physiological increase and a pathological one. Hence the need to establish a national reference range for Nigerian population.

iv. Further studies, preferably larger one should be conducted, starting with pregnant women in their 1st trimester to investigate further on various aspects of maternal nutritional factors and their association with birth outcome.

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APPENDIX I

DEPARTMENT OF BIOCHEMISTRY, FACULTY OF SCIENCE AHMADU BELLO UNIVERSITY, SAMARU- ZARIA.

INFORMED CONSENT FORM (ICF)

The informed consent form is for pregnant mothers attending antenatal clinic in Yusuf Dantsoho memorial hospital in Kaduna state. Iam inviting you to participate in this research work titled "studies on the relationship between dietary pattern, anthropometry indices and birth outcome among pregnant women attending antenatal clinic at Yusuf DantsohoMemoriel Hospital.

Researcher : SafiyaAliyuTijjani
Supervisor(s) : Prof. K.M.Anigo& Dr. A.B. Sallau
Institution : Department of biochemistry Ahmadu Bello Zaria.
Name of sponsor : Self
Name of proposal : MSc. Nutrition.

This informed consent form has two part:

- Information sheet (to share information about the research with you)
- Certificate of Consent (for signatures if you agree to take part)

PART 1: INFORMATION SHEET

Introduction

I am SafiyaAliyuTijjani an MSc. Student of Department of Biochemistry, Faculty of ScinceAhmadu Bello Zaria, carrying out a research work under the supervision of Prof. K.M.Anigo and Dr. A.B. Sallau. We are doing a research work on "The Relationship between Dietary Pattern, Anthropometric Indices and Birth Outcome among Pregnant Women Attending Antenatal Clinic at Yusuf Dantsoho Memorial Hospital, Kaduna State Nigeria. Iam going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

Purpose of research

The purpose of this research is to find out whether there is a relationship between dietary pattern and anthropometric indices and birth outcome among pregnant women attending Yusuf Dantsoho Memorial Hospital Kaduna, Kaduna State of Nigeria.

Patispant selection

We are inviting all healthy pregnant women in their third trimester to participate in the research work on the relationship between dietary pattern and birth outcome among a Cohort of pregnant women attending Yusuf Dantsoho Memorial hospital.

Do you know why we are asking you to take part in this study? YES..... NO.....
Do you understand what this study is all about? YES..... NO....

Voluntary participation

Your participation in this research is entirely voluntary, it is your choice whether to participate or not. Whether you chose to participate or not. All the services you receive at this hospital will continue and nothing will change. If you choose not to patispate in this research project you will be offered the treatment that is routinely offered in this antenatal clinic. You may change your mind later and stop participating even if you agreed earlier.

If you decide not to take part in this research study. Do you know what your options are? YES... NO...
Do you know that you do not have to take part in this study, if yes do not wish to? YES.. NO...
Do you have any questions? YES... NO.....

Procedures and protocol

When you have agreed to participate in this research, we will need you fill this questionnaire and we will take your anthropometric indices and the anthropometric measurement of your new born baby, also we will take your blood once to carry out biochemical analysis (lipid profile and serum minerals). It will be used in comparing the relationship between dietary pattern, anthropometric indices and birth outcome among pregnant women attending antenatal clinic at Yusuf Dantsoho Memorial Hospital.

Description of the process

During the research a routine anthropometry measurement will be taken in every antenatal visit. A small amount of blood sample will be taken, this blood sample will be use to test for the level of serum lipid and mineral. We will also ask you about your question on your demographic information.

Duration

The research will take place over three to four months. During that time, it is necessary for you to be regularly be attending your antenatal clinic days.

- *How many times are we asking you to come to the hospital to participate in the research?.....*
- *Can you tell me the number of time we will take your blood sample?.....*
- *Do you have any questions?.....*
- *Doyouwantme to go through the procedures again?.....*

Risk

There is a risk that you may share some personal information or confidential information by chance, or that you may feel uncomfortable talking about some topics. However information you provided will be kept strictly confidential. You can choose not to answer any question or take part in the research if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

Benefits

If you participate in this research , you will have the following benefit:

- You will have the opportunity of having tests that others not participating in the study will not have.
- There may not be any benefit to the society at this stage of the research, but future generations are likely to benefit.
- Apart from these few benefits listed above, your participation is likely to help us to the research questions.

Reimbursements

You will not be provided with any special incentive or travel allowance for you to take part in the research. But we advice that your visit to the hospital will have to be on your normal antenatal days.

- Can you tell me if you have understood correctly the benefit that you will have if take part in the study.....
- Do you know that the study will not pay your travel costs? .....
- Do you have any other questions? .....

Confidentiality

The information that we collect from this research project will be kept confidential. Any information about you will have a number on it instead of your name which only the investigator will know your number.

Right to refuse or to withdraw

Whether you chose to participate or not. All the services you receive at this hospital will continue and nothing will change. If you choose not to participate in this research project you will be offered the treatment that is routinely offered in this antenatal clinic. You may change your mind later and stop participating even if you agreed earlier.

Who to contact

If you have any questions you may ask them later, even after the study has stated . if you wish to ask questions later you may contact the following:
SAFIYA ALIYU TIJJANI: 08037033026

This proposal has been reviewed and approved by scientific ethical committee (SEC) of the ministry of health which is a committee whose task is to make sure that research participants are protected from harm.

If you decide not to take part in this research study do you know what your options are? YES..... NO...
Do you know that you do not have to take part in these study , if yes do not wish to? YES..... NO.....
Do you have any questions? YES..... NO.....

PART II: CERTIFICATEOF CONSENT

I have read the foregoing information, or it has been read and translated to me in language that I understand. I have also talked it over with my Doctor and also my family to my satisfaction. I have had the opportunity to ask question about it and any question that I have been answered to my satisfaction. I understand that my participation is voluntary. I know enough about the purpose, methods, risk and benefits of the research study to judge that I want to take part in it.I understand that I may freely stop being part of this study at any time. I have received a copy of this consent form and additional sheet to keep for myself. I therefore consent voluntarily to participate in this research.

Name of participant: .....
Signature of participant: .....
Date: .....

Statement by witness

I have witnessed the accurate reading of the consent form to the potential partispnt, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness: .....and **thumb print**

Signature of witness: .....

Date: .....

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability make sure that the participant understands that the following will be done:

1. Blood sample will be taken

1 confirms that sufficient information, including about risks and benefits, to make an informed decisions have been fully explained to the participants. The participant was given an opportunity to ask question about the study, and all the questions asked by participant have been answered correctly and to the best of my ability. I confirm that the individual has been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Name of researcher/person taking the consent: .....

Signature of researcher/person taking the consent: .....

Date: .....

Day/month/year

APPENDIX II

DEPARTMENT OF BIOCHEMISTRY
FACULTY OF SCIENCE.
AHMADU BELLO UNIVERSITY, ZARIA

SURVEY QUESTIONNAIR

(This questionnaire is to be used on pregnant women on their third trimester and their newborn babies)

Studies on the relationship between dietary pattern, Anthropometric indices and birth outcome among pregnant women attending antenatal clinic at Yusuf Dantsoho Memorial Hospital

Informed Consent

Hello. My name is SafiyaAliyuTijjani. I am a student of ABU Zaria; conducting a research title: studies on relationship between dietary pattern , nutritional status and birth outcome among pregnant women attending antenatal clinic at Yusuf Dantsoho Memorial Hospital, Kaduna. The survey conducted to understand what needs to be done at the community level to improve the health maternal and newborns also reduce the rate of mother/child mortality and morbidity. This study has been granted approval by the school, the ministry of health and chief medical director of the Hospital. village Heads for the study period will last for four month.

I would like to ask some questions about your knowledge and experience of pregnancy, newborn and child care related information. The information receive from you will be used to inform program for women and in the community that will improve safe maternity and under five children services. Whatever information you provided will be kept strictly confidential. Participation in this survey is voluntary and you can choose not to answer any individual question or all of the questions. However, we hope that you will participate fully in this survey since your views are important.

At this time, do you want to ask any question about the survey?

May I begin the interview now?

Signature of interviewer---------- Date----------

Respondent agrees to be interviewed----------1- Continue

Respondent does not agree to be interviewed---2- End

Section 1: Background information

Date...../...../ No: ---------- Questionnaire no...../.....

Household Address.....

Interview's Name.....

Section 2: Characteristics of respondent

1. Trimester of pregnancy .....
2. Age of respondent ( ) years
3. Ethnic group:- 1=Hausa/Fulani 2=Hausa 3=Fulani 4=Gbagi 5= Jaba 6= Kataf ( )
   7= Yoruba 8= Igbo 9= Nupe 10= Others (specify) .....
4. What is your marital status?
   1 = Married 2 = single, never married 3 = Divoiced ( )
   4 = Separated 5 = widowed 6 = Declined Response ( )
5. How many children do you have?
6. What is your main occupation? ( )
   1 = civil servant 2 = Trader 3 = Farming 4 = Full-time house wife
   Others (specify) .....
7. Estimated Household monthly income ( )
   1 = < N5,000 2 = N5,000 – 14,999 3 = 15,000 – 24,999 4 = 25,000 – 34,999
   5 = 35,000 – 44,999 6 = 45,000 – 54, 999 7 = 55,000

8. What is your level of formal education? ( )
   1 = No formal Education 2 = Primary school uncompleted
   3 = Primary school completed 4 = Junior secondary school uncompleted
   5 = Junior sec. school completed 6 = Senior sec. sch. Uncompleted
   7 = Senior sec. sch. completed 8 = Post secondary school
   9 = Some post graduate Education

SECTION 3: Household Care Resources

9. What is your main source of energy for cooking? ( )
   1 = Wood 2 = Kerosene 3 = Gas 4 = Electricity 5 = Others (specify).....
10. Main source of drinking water ( )
    1 = Public tap 2 = Public well 3 = Private well 4 = River/Stream
    5 = Borehole 6 = Rain water 7 = Others (specify).....

11. How do you store drinking water? ( )
    1 = Plastic container 2 = Aluminium containers 3 = Clay pot
    4 = Others (specify).....

12. Primary method of refuse disposal ( )
    1 = Bush 2 = Refuse dump 3 = City service 4 = Others(specify).....
13. Main type of toilet ( )
    1 = Bush 2 = Pit latrine 3 = VIP latrine 4 = Water system
    5 = Rivers 6 = Others (specify).....
14. Household food storage method ( )
    1 = Refrigerator 2 = No means of storage 3 = Others (specify).....

SECTION 4: Child information

15. What is the age of you baby? ( )
    1 = 2 days 2 = 3 – 4 days 3 = 1 week 4 = 2 weeks 5 = 1month
16. What is the sex of the child? ( )

1 = Female 2 = Male

18. Birth outcome
    1 = Alive 2 = Dead ( )

17. CHILD ANTHROPOMETRY DATA
    1 = Weight.....kg 2 = Length.....cm
    3 = Chest circumference.....cm 4 = Head circumference.....cm

SECTION C: MATERNAL NUTRITION/HEALTH

18. When you were pregnant did you go for antenatal? ( )
    1 = Yes 2 = No
19. Were you giving the prenatal drugs? ( )
    1 = Yes 2 = No
20. Were you eating healthy and adequate food during the pregnancy? ( )
    1 = Yes 2 = No
21. If you or child is sick, who gives you the permission to go and seek health care services? ( )
    1 = Self 2 = Partner 3 = Mother in-law
    4 = Other relative 5 = Other (**Specify**)

22. MOTHER'S ANTHROPOMETRY DATA

TRIMESTERS	WEIGHT (kg)	HEIGHT (cm)	MUAC (cm)	BMI (cm)
FIRST				
SECOND				
THIRD				

HAEMOGLOBIN AND CHOLESTEROL ASSESSMENT

Heamoglobin level (g/dl)	PCV (%)	Total chol. (mmol/l)	HDL-chol. (mmol/l)	LDL-chol. (mmol/l)	Serum Copper (ug/l)	Serum Iron (ug/l)	Serum Zinc (ug/l)

24 HRS DIET RECALL FOR THE PREGNANT WOMAN

MEAL TIME	FOOD GROUPS	METHOD OF PREPARATION	AMOUNT EATEN	NUMBER OF EXCHANGE

Water taken per day/litres…….....**.....**

APPENDIX III

1. FOOD FREQUENCY QUESTIONNAIRES FOR PREGNANT WOMAN

FOOD GROUPS (using my pyramid)	Never	Once a week	2-3x/wk	4-5x/wk	6x/k	Once a day	2-3 times a day
A. BREAD, CEREALS AND GRAINS (6 - 11 serving/day) 1. **Bread:** white bread, wheat bread 2. **Rice:** boiled white rice, jollof rice, tuwon rice, rice cake (waina). 3. **Maize:** boiled(with or without a. cob),couscous(burabisko/tsaki) b. maize snack(funkasau) 4. **Millet:** ground millet mix(fura), pap(kunu), others							
B. FRUITS,VEGETABLE, SOUPS AND SAUCES (3 - 5 serving/day) 5. **Indigenous leaves:**Sesame leaves(miyankarkashi), baobah leaves(miyankuka), 6. fluted pumpkin leave(miyanogwu), 7. African sorrel(yakuwa/miyantaushe), 8. moringa leaves(miyanzogale/dambu), 9. corchorus(rama),pumpkin(kabewa), 10. bitter leaves, baobab leave,spinach, lansir.others. 11. Carrot, cabbage, pumpkin., cucumber.muruchi, 12. Fruits-orange,watermelon,banana,mango,paw paw Guava, apple.							

C. MEAT, FISH, AND POULTRY **(2 – 3 servings/day)** 13. **Beef:** boiled, fried, suya, kilishi 14. **Lamb:** fried, roasted 15. **Chicken:** boiled, fried, roasted 16. **Fish:** boiled, fried, roasted 17. **Egg:** boiled, fried. **18. Others form of animal protein**.							
E. ROOT AND TUBERS **(3-4 serving/day)** 19. **Yam**: boiled/porridge, roasted, fried 20. **Cocoyam:** boiled, roasted 21. **Potato:** Irish or sweet: boiled, fried, 22. **Plaintain:** roasted/fruid and boiled **23. Cassava:** fried(cassava cake), garri, **24.** Others							
F. LEGUMES **(2 serving/ day)** 25. **Beans**: boiled/ porriage, fried bean cake(kosai), beans pudding(alalale), danwake. 26. **Groundnut:** roasted/boiled,kuli-kuli, g/nut pap(kunungyada), g/nut soup(miyangyada). 27. **Bambaranut(birji):** roasted/fried or soup, others. 28. **Soybeans:**soycake(tufo), soy milk, etc							

G. PASTAS, AND OTHER PROCESSED FOOD (2 – 3 serving / day) 29. **Pasta:** spaghetti, macaroni, noodles, semovita and others, **30. Processed foods:** snacks like-meatpie, cakes, doughnut, puff-puff, kalallaba, hikima, tsatstsafa, nakiya, alkaki, dubulan,							
H. Fruit juices/drinks and other fluids **(3-4 servings/day)** 31. **Milk and milk product:** liquid or powdered milk, ice-cream, youghurt, soy milk, cow milk, ground nut or Bambara nut milk and other plant sources of milk							
I. Fat, oil and sweets **(use sparingly)** **32. Animal Fat:** man shanu, kakide. 33. **Vegetable oil:** palm oil, ground nut oil. **Fruits juices:** mango juice, guava juice, orange juice, p/apple juice, 34. **Fruits drink:**tigernut drink(kununaya), sorrel drink(zobo drink), kununzaki, others. 35. **beverages:** Tea, coffee, others.							

2. DATA ON CULTURAL FACTORS/ LIFESTYLE

Are there any cultural practices that inhibit the intake of certain foods in pregnancy ( )
1 = Yes 2 = No
If yes, what are they?
…….....
Do you take any of these as stimulant ( )
1= kola 2 = cigarette 3 = namijingoro 4 = candies 5 = alcohol 6 = none
Pregnancy complication ( )
1 = craving **2 =** aversion 3 = none
If yes, what are they…….....

THANK YOU

APPENDIX IV

MINISTRY OF HEALTH AND HUMAN SERVICES
KADUNA STATE, NIGERIA

MOH/ADM/744/VOL.1/351

17th NOV, 2015

Medical Director
Yusuf Dantsoho
Memorial Hospital

Yusuf Dantsoho Memorial Hospital
RECEIVED
DATE 9/3/16

NOTICE OF APPROVAL AFTER FULL COMMITTEE REVIEW

STUDIES ON THE RELATIONSHIP BETWEEN DIETARY PATTERN,ANTHROPOMETRY INDICES AND BIRTH OUTCOME AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT YUSUF DANTSOHO MEMORIAL HOSPITAL KADUNA.

Name of Principal Investigator:	SAFIYA ALIYU,TIJJANI
Address of Principal Investigator:	Dept. Of Biochemistry Faculty of Science, A.B.U, Zaria.
Date of receipt of Application	19th Oct, 2015
Date of Ethical Approval	13th November, 2015

This is to inform you that the Research described in the submitted Protocol, the Consent forms, advertisements and other participant information materials have been reviewed and given full approval by the Health Research Ethics Committee (HREC).

If there is delay in starting the research or any change, inform the HREC so that the dates of approval can be adjusted accordingly.

However, Researcher is kindly requested to submit a copy of his/her findings to the State Ministry of Health, please

DR. BUTAWA NUHU N.
SECRETARY
FOR: CHAIRMAN

KADUNA B... Hospital
pls treat

Independence Way, P.M.B 2014, Kaduna. Kaduna State-Nigeria