PATTERN OF MATERNAL WEIGHT GAIN AND PREGNANCY OUTCOME AMONG WOMEN ATTENDING ANTENATAL CLINIC AT FEDERAL MEDICAL CENTRE BIDA, NIGER STATE, NIGERIA

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CERTIFICATION

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DEDICATION

This work is dedicated to Almighty God who ordered my path, showered me with astounding favour and encompassing mercies throughout the period of this programme.

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ABSTRACT

Malnutrition in pregnant women is of public health concern because of its associated risk both to the women and their infants. Inadequate weight gain in pregnancy is a known risk factor for poor pregnancy outcome. Limited studies have been carried out on the pattern of weight gain and pregnancy outcome in Niger State of Nigeria. This study was therefore designed to assess the pattern of weight gain and pregnancy outcome among women of childbearing age at Federal Medical Centre, Bida, Niger State of Nigeria.

A retrospective review of case notes of 1037women who obtained antenatal care and delivered at Federal Medical Centre Bida, Niger State, Nigeria from January 2005 to December 2009 was conducted. Socio-demographic and obstetric characteristics, weight at booking, second and third trimesters, and delivery were obtained. Infant birth weights were also obtained. Data were analyzed using SPSS version 15 for descriptive statistics, Chi-square test, and logistics regression at 5% level of significance.

There were 63 adolescents and 974 adult women. The age of adolescent and adult mothers ranged between 15-19 years and 20-50 years with the mean age of 17.6±1.3 years and 26.2±4.8 years respectively. Almost all (99.6%) the women were married. Majorities (80.1%) of the women were Muslims and 72.0% were urban residents. About half (49.2%) and 11.1% of adolescent women were either students or unemployed as compared with 9.6% and 37.6% of adult mothers respectively. Fewer (44.4%) adolescent compared with 46.1% of adult mothers booked at the second trimester for antenatal care. The mean weight gain at delivery of 6.4±3.1kg and 6.7±4.1kg, for the adolescent and adult mothers respectively, was significantly different ($p<0.05$). The proportion of adolescent mothers (36.5%) with packed cell volume (<30%) was higher than adult mothers (30.9%), ($p>0.05$). Adolescents were about eight times less likely to have (normal) spontaneous vaginal delivery (OR=0.120, 95%CI=0.03-0.39) and about eleven times less likely to have caesarean section (OR=0.09, 95%CI=0.02-0.34) when compared to adult mothers. Mean infant birth weight (3.0±0.4kg) among adolescent was significantly lower to that of adult mothers (3.2±0.5kg), $p<0.05$. The proportion (9.5%) of low birth weight (LBW) infants was significantly higher among adolescents compared to (7.1%) among adult mothers. Adolescent also had significantly lower mean Body Mass Index [(BMI), 20.0±3.0kg/m^2] in pregnancy compared to adult mothers (22.3±4.0kg/m^2), $p<0.05$. The proportion of the primiparous, multiparous, and grandmultiparous women were 34.7%,

41.2%, and 24.1% respectively. Underweight (BMI<18.5kg/m^2) mothers were about 27 times more likely to have LBW infants than normal weight (18.5-24.9kg/m^2) and overweight/obese (≥25kg/m^2/≥30kg/m^2) mothers (OR= 27.1, 95%CI=3.52-208.40), (p<0.05). Primiparous mothers were about 0.5 times less likely to have macrosomic infants than multiparous and grandmultiparous mothers (OR=0.5, 95%CI=0.36-0.79), (p<0.05). Women who had antenatal care visits ≤3 times were about 4times more likely to have LBW infants than those with ≥3 times antenatal care visits (OR=3.7, 95%CI=2.00-6.91), (p<0.05).

Low packed cell volume, early age at conception, low BMI, parity, late and inconsistent antenatal care visits were observed to be associated with low birth weight. Strategies to reduce incidence of adolescent pregnancies, encourage early booking and regular antenatal care visits are recommended to enhance good pregnancy outcome.

Keyword: Maternal weight gain, Pregnancy outcome, women of childbearing age.

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CHAPTER ONE

INTRODUCTION

1.0 Background

Nigeria has a population of 140 million people, and adolescent constitute about 20% or one – fifth of the total population (Rani *et. al.*, 2004, Aboghoroma *et. al.*, 1998, Oyo-Ita *et. al.*, 2004, Wang *et. al.*, 2005, Unuigbe *et. al.*, 1999). By 2005, it is projected that the number of Nigerian youth will exceed 57 million *(*World Population Prospect, 1999, UNICEF, 2000). However, lack of sexual health information and services place these increasing young people at risk of pregnancy, abortion, sexually transmitted infections (STI), and HIV/AIDS (Action Health Incorporation, 2003).

In addition, early marriage and childbearing limits educational and employment opportunities thereby recycling poverty within a generation and thereby limiting the realization of vision 2020 and the Millennium Development Goals (MDGs) especially in the developing countries like Nigeria (AHI, 2003, Aboghoroma, 1998). This has important nutritional and reproductive health implications because it means a large proportion of the future adult population needs to have the correct information about nutrition and reproductive health issues.

The term "adolescent" is often used synonymously with "teenager" who ranges between 13-19 years however the World Health Organization defines 'adolescent' as those aged 10 to 19 years while the United Nations defines "children" as up to the age of 18 years. This term in everyday speech usually refers to those who have not reached legal adulthood, which varies across the world (Byrd-Bredbenner et. al., 2009, UNFPA, 2003).

Generally, the term "adolescent" emphasizes the physiological maturation that occurs during the teenage period which is characterized by a period of rapid growth (growth spurt), development, and high nutrient needs but more frequently their nutritional intake is below recommended value. (Okpani *et. al.*, 1995; Byrd-Bredbenner *et. al*., 2009).

Pregnancy or gestation is a period from conception to birth, and for human beings, the average length of a healthy gestation is 40weeks. It is a time of great physiological changes, which may be the most sensitive and one of the most nutritionally demanding stage of life because nutrient and energy supply at this time affects pregnancy outcome (Rolfe's et. al., 2009, Sanusi et. al., 2002).

However, pregnant women needs additional energy and nutrient to support growth and development of the foetus, placental and maternal tissues as well as increase maternal metabolism than in non -pregnant woman (Byrd-Bredbenner, *et. al.*, 2009, Rolfe et. al., 2009,Scholl et. al., 1994).

Feto-maternal nutrition is a concept that explains how the feeding pattern of a pregnant mother affects the foetus negatively or positively, thus maternal nutrition plays a critical role in fetal growth and development because pregnancy imposes additional nutritional demands on the growing body and may rapidly deplete already limited reserves (www.justmommies.com, Rolfe et. al., 2009).

It is expected that pregnant women eat more energy dense foods, likewise, metabolic adjustment that allows pregnant women use some nutrient more efficiently, absorb some better also justify the need for consumption of more nutrient –dense food among this vulnerable group, more so, adequate exercise has been reported to also helps to satisfy the caloric and nutrient demands of pregnancy (Miguel *et. al.*, 2003, Clarice, 2009).

However, maternal nutrient depletion (micro and macro nutrients) may contribute to the increased reproductive complications in pregnancy such as foetal loss, foetal wastage, feotal distress, incidence of preterm births and foetal growth retardation on the foetus, obstructive (prolonged) labour, pregnancy induced hypertension (PIH), gestational diabetes mellitus (GM), gestational anaemia, preterm delivery and also increasing the risk of maternal and child mortality and morbidity (Janet, 2003, NDHS, 2006).

It is worth mentioning that the consequence of poor nutritional status and inadequate nutritional intake of women during pregnancy not only affect their health but also have a negative impact on pregnancy outcomes in terms of birth weight and development of their infants, for example, low birth weight (LBW) which is a major determinant of mortality, morbidity, and disability in infancy (congenital abnormality) and childhood, macrosomia, small –for- gestational age (SGA) among others all have long-term impact on health outcome of children in adulthood (UNICEF, 2008, WHO, 2009).

The risk factors associated with low birth weight (LBW) and preterm delivery are short inter pregnancy interval, low pre-pregnancy weight in women, insufficient gestational weight gain, multiple gestational pregnancy and young maternal age (Jacqueline 2009; State of the World's Children, 2009).

The United Nations says that 53,000 women in Nigeria dies annually due to pregnancy related illness and complications, this is one of the highest maternal mortality rates in the world and of public health concern, moreover, doctors and youths counselors in Nigeria says teenage mothers are more at risk of this because of poverty, lack of access to health care facilities and contraceptive use, poor dietary intake, religious and cultural ideology that does not like to talk about sex, that is, sex education (UNICEF, 2005, NDHS, 2006).

As 2015 deadline for the Millennium Development Goals draws closer, the challenge for improving maternal and newborn health goes beyond meeting the goals, it lies in preventing needless human tragedy, improving maternal nutritional status and reducing maternal and child mortality and morbidity, hence identifying obstacles, high risk communities and proffering solutions to this problem such as educating girls and women especially at basic educational level (Veneman, 2009).

This is one of the most powerful ways of breaking the poverty cycle and creating awareness and a supportive environment for maternal and newborn health and also identifying how to combine efforts to expand coverage of essential services and strengthen health systems with actions to empower and protect girl-child and adult women at grass root level, these are real potentials to accelerate progress (Veneman, 2009).

1.1 Problem Statement

The rate and pattern of weight gain during pregnancy is a major indicator of maternal nutritional status (McGuire and Popkin, 1990, Veneman, 2009). However, studies have shown that pregnancy in malnourished women (with suboptimal weight gain, overweight) can be associated with low birth weight, macrosomic babies, foetal death, preterm delivery, foetal growth retardation, congenital malformation, maternal morbidity and mortality in the mothers especially adolescent women (Janet, 2003 and Quinlivan, 2006).

Yearly, above half a million women (adolescents inclusive) in low income countries die from complications associated with malnutrition and childbearing while millions more suffers pregnancy-related morbidities (NCHS, 2009). For instance, in Nigeria neonatal death in 2004 stood at 249,000 with 76 percent occurring in early neonatal due to poor maternal nutrition especially during pregnancy, also resistance of some population to modern health care services, low education status especially among girl-child, lack of women empowerment to

make informed decisions especially on contraceptive utilization and family size among others has led to this alarming rate (State of the World's Children, 2009, Odu et al., 2007).

Likewise, the rural infant mortality rate (121 per 1,000) is far higher than urban mortality rate (81 per 1,000), due to low maternal education, low family wealth index, inadequate food intake and short birth intervals (NDHS, 2008, FOS&UNICEF, 2000). Also, the current maternal mortality rate is 630 per 100,000 live births while infant mortality rate is 74.36 per 1000 live birth (NDHS, 2010), this is quite alarming.

Maternal micronutrient deficiencies still constitute major determinants of maternal mortality with iron deficiency anemia (IDA) being the most common micronutrient malnutrition problem in the world, affecting more than two billion people while in Nigeria 24.3% of women and 35.3% of pregnant women are at different stages of iron deficiencies (Maziya-Dixon *et. al.*, 2003).

Although, considerable efforts has been directed towards defining nutrient requirements of mothers, suboptimal nutrition during gestation remains a significant problem for many mothers worldwide and despite advanced prenatal care for mothers and their foetus, a lot of children, that is, about 30% suffered from intrauterine growth restriction(IUGR) due to iron deficiency anaemia over the past decades (*www.justmommies.com*, NDHS, 2009).

National Demographic and Health Survey 2008 report that in Niger State only 37% of pregnant women received ANC from skilled providers out of which only 17% eventually received delivery care from a skilled provider, this is very low compared with other north-central States.

Despite this appalling trend, few studies have explicitly focused on identifying the pattern and factors that predict weight gain in pregnancy which is an indicator of the nutritional status of pregnant women in Nigeria, particularly in the north-central where available data is limited and inadequate.

1.2 Justification

In Northern part of Nigeria, women continue to follow the traditional pattern of early marriage at a median age of 15 years, thus, adolescent girls in the North have birth rate at twice those from the South (20 births per 100 women for those within 15-19 years as compared to 10 births per 100 women in the South), Total fertility rate in Nigeria is 5.7 births per woman, north-central is 5.4 birth per woman, while Niger State has TFR of 7.5 births per woman which is too high when compared with other north-central States (NDHS, 2008, CDC, 2008).

Likewise, women in the Southern part of the country have one child less than women in the North (NDHS, 2008) this could be due to much awareness on the importance of educating girl-child as it affects women's reproductive health issues and empowerment.

There are indications that in malnourished women and young girls, incidence of complications such as cephalopelvic disproportion, gestational anaemia, pre-eclampsia, placental previa, obstructed labour, incompetent cervix and other obstetric complications such as vesico-vaginal fistulas are higher as shown in a study conducted in Nigeria by Harrison *et. al.*, (1985) and Pickett *et. al.*, (2000)

It was been established that a relationship exist between maternal nutritional status, age and height, and the incidence of contracted pelvis and cephalopelvic disproportion among women, he observed that there was an increased incidence of contracted pelvis in young (<16 years of age) and short statured (<1.50m) adolescent women than adult women which could have been as a result of long-term consequence of malnutrition especially during infancy and childhood (Pickett *et. al.*, 2000, Phaneendra *et. al.*, 2001).

More so, in a recent study conducted in Camden, it was demonstrated that a large proportion of pregnant adolescent women were still growing (using knee height changes as a measure of growth) unlike adult women, reflecting continuing growth in stature during and following pregnancy (Scholl *et. al.*, 1990).

This finding may be particularly relevant to malnourished women (adolescent girls) in developing countries whose physical growth period is extended and in whom pregnancy occurs at an early age due to the growth spurt and onset of fertility that occurs during puberty in adolescents with an increased nutrient demand, there is the need for more information about the nutrient intake and reproductive health issues of women and adolescents and also

answer many nutrition-related questions associated with pregnancy and it outcomes in women(Beers, *et. al.*, 2004, Locoh, 2000).

Also, the late onset of puberty, followed by an early pregnancy (at a low gynaecological age) might also play a role on pregnancy outcomes and complication as it is obtainable in the northern part of the country where cultural beliefs and religious bigotry are held in high esteem above civilization and western education thus predisposing women to avoidable complications and mortality associated with pregnancy more than what is obtainable in the sourthern part of the country where civilization and western education is well-accepted especially with high priority on education of girl-child (NCHS, 2009, UNFPA, 2003, Locoh, 2000).

Thus, empowering women and enhancing their abilities to make informed decisions on contraceptive use, family size, food choices, physique, and assessment of available health care facilities thereby reducing the incidence of pregnancy-related complications when compared with what is often obtained in the northern part of the country (Quinlivan, 2006 & NCHS, 2009).

Furthermore, it has also been reported that the vicious cycle of poverty for women of childbearing age and their children begins with early parenting especially among poor and less privileged ones, thus one of the determinants of poverty and poor nutritional status of women may be the fact that in many developing countries like Nigeria, adolescent childbearing and parenting is usually associated with premature termination of education (Janet *et.al.*, 2003, NPC, 2006).

This has enormous impact on social, economic and health status of the women thus, negatively affecting their informed choices on dietary intake and weight gain in pregnancy which invariably affect their nutritional status therefore, there is the need study the pattern of weight gain and pregnancy outcome among minority tribe 'Nupes' and compare with what is obtainable in the southern part of the country so as to help stakeholders embark on policies that will foster intensive and effective awareness on the importance of the nutrient intake of women before, during and after pregnancy and also on reproductive health issues as it affect women and adolescent girl-child (Quinlivan, 2006, Ojofeitimi *et. al.*, 1992).

More so, one of the main problems confronting women in the postpartum period is the issue of sex and the possibility of preventing future/unwanted pregnancies, thus, inadequate access

to appropriate method of contraception is also one of the most serious problems confronting mothers especially the uneducated and unexposed ones as a result of cultural and religious beliefs, poor educational status, gender inequality, poor socioeconomic status to mention but few especially among the married ones from the northern part of the country (Arendas et. al., 2008, NDHS,2003).

Some other women based on religious bigotry and cultural beliefs that planned parenthood is anti-Islamic even at the expense of their health, especially in Niger State where total fertility rate (TFR) is 7.4 births per woman, they often say 'Allah gives and takes care' thus, they deliberately would not seek counsel on child spacing and birth control techniques even when they are empowered to do so (WHO,1996, NDHS, 2008), studies have also shown that urban women are more than twice likely as rural women to use a method of contraception and give birth to twice lesser children (Dixon-Mueller, 2008, NDHS, 2003).

Likewise, a population based study in Nigeria by Igwegbe *et. al.,(* 2001) reported that most women especially young pregnant girls often did not receive antenatal care, especially if they were unmarried, girls who did not book for antenatal care confessed that high cost was the major factor while unmarried girls did not want to be seen in public whilst pregnant.

Majority of multiparous mothers depend on their experiences from previous pregnancies thus, they do not seek for medical care from qualified medical professionals at available health care facilities, while some other women due to their family fads and norms beliefs that those who seek for medical care and eventually delivers in the hospitals are weak (NDHS, 2003, NDHS, 2008).

However, most women in Nigeria do not register for antenatal care within their first trimester (first three months) of pregnancy, this is one of the attributable risk factor for the high rate of maternal and child morbidity and mortality which are preventable in the country especially in Niger State where only 37% of pregnant women access skilled providers for antenatal care and only 17% eventually receive delivery care from skilled providers (NDHS, 2008, NDHS, 2003).

In the past, attempts have been made towards decreasing teenage pregnancy rates and the number of children per woman in Nigeria, this would not necessarily mean fewer pregnancies or births per family because of polygamy, cultural and religious differences, especially among the Muslims.

Thus there is need to ascertain how pregnant women especially the teenage mothers and their children can be kept healthy through adequate food intake, weight gain and health care services (ANC) during the course of their pregnancy to enhance favourable pregnancy outcome.

The findings from this research will also enable governmental and non-governmental organisations to foster advocacy programmes through mass medias, religious leaders, clan heads, youth and women leaders, policy makers and educational institutions especially at grass-root level and embark on intervention that would be geared towards or enhance safe motherhood among this populace.

It will likewise achieve the following Millennium Development Goals (MDGs) - women empowerments, improve maternal and child health, reduce maternal and child mortality, reduce poverty and ensures basic education among women especially girl-child (NDHS, 2008, NDHS, 2003).

Therefore, the aim of this study is to investigate the pattern of maternal weight gain and pregnancy outcomes among women of childbearing age attending antenatal clinic at Federal Medical Centre, Bida, Niger State from January 2004 to December 2009.

1.3 Research Questions

1. What is the pattern of maternal weight gain in the second and third trimester among women of childbearing age who attended antenatal clinic at Federal Medical Centre Bida?
2. What are the differences in pregnancy outcomes among adolescent and adult mothers who received antenatal care at Federal Medical Centre Bida, Niger State?
3. What are the obstetric characteristics of the pregnant women?
4. What is the impact of maternal weight gain on the birth weight of the infants among the pregnant women?
5. What is the relationship between weight gain of the pregnant women and their obstetric and socio-demographic factors?

1.4 Study Objectives

The broad objective is to investigate the pattern of maternal weight gain and pregnancy outcome among women of childbearing age attending antenatal clinic at Federal Medical Centre Bida, Niger State, Nigeria.

The specific objectives are:

- To assess the pattern of maternal weight gain among women of childbearing age at the second and third trimester.
- To assess the pattern of pregnancy outcome among the pregnant women.
- To compare the pregnancy weight gain, birth weights, socio-demographic and obstetric factors in adolescents and adult pregnant women.
- To determine the relationship between gestational weight gain of the women with their socio-demographic and obstetric factors.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nigeria Fertility Rate

Total fertility rate gives a figure for the average number of children that would be born per woman if all women lived to the end of their child bearing years and bore children according to a given fertility rate at each age, (CDC, 2008, UNICEF; 2005).

Nigeria has experienced high fertility rate over the last two decades, although ,there have been modest decline in fertility rate over last two decades; a TFR of 6.3 in 1981-82 national fertility survey (NFS) to 6.0 in the NDHS of 1990 and 5.7 in 2008 (NDHS, 2008).

However, according to the Nigeria Demographic and Health Survey (NDHS) 2003, the total fertility rate (TFR) was 5.7 which are significantly higher than the fertility rate of 5.2 in 1999, showing that averagely, rural women will have one more child (TFR =6.1) than urban women (TFR=4.9). However, Niger State has TFR of 7.5 births per woman this is high when compared with other north-central state (NDHS, 2008)

Thus, the contribution of adolescent girls' (15-19 years) fertility to the overall fertility rate among women of reproductive age (15-49 years) has been increasing over time and the major contributing factor to this is early marriage and child birth in the nation especially among the northerners and less-privileged ones.

Report from NDHS (2003) showed that half of all women were married by age 17 and half had become mothers by 20 years while more than a quarter of the adolescent were either pregnant or already had children. It is worth noting that fertility varies significantly by region of residence, with lower rate in the south and higher rate in the north, also it has been reported that there exist strong negative correlation between fertility and a woman's educational attainment (NDHS, 2003).

The total number of Nigeria's fertility rate chart from 2000 – 20011.

Table 1. Nigeria fertility rate.

YEAR	PERCENTAGE (%)
2000	5.66
2001	5.57
2002	5.49
2003	5.70
2004	5.52
2005	5.53
2006	5.49
2007	5.45
2008	5.20
2009	4.91
2010	4.82
2011	4.73

This statistical chart shows that from the year of 2009 – 2011 the Nigeria's fertility rate fell to 4.73% (WHO, 2000).

2.2 Pregnancy and women

The stages of pregnancy in women are seen as a challenging period because most of them experience psychological and emotional changes. These emotional experiences of pregnancy as reported by some pregnant women are normal and healthy but challenging, however, her interest mainly centers on the perfection of her baby's health, anticipation of the exertion of labor and her contemplation of the new and expanded responsibilities of motherhood, all these intensify her emotions. (WHO, 2003, Vander *et. al.*, 2003).

Pregnancy in recent years has also experienced cardiovascular changes which increases to about 30% to 50% during pregnancy, this increase begins about the sixth (6^{th}) week of gestation and reaches maximum at about sixteenth week after delivery which makes the stroke volume of the heart to increase, and the pulse rate to approximately 80 to 90 beats/minutes, likewise, blood pressure may drop slightly after the twenty-six week of delivery, moreover, the circulation of blood to the pregnant uterus near term is about 1

liter/minutes, requiring about 20% of the total cardiac output(Rolland-Cachera and Cole, 1991, Vander *et. al.*, 2003).

In addition, the total blood volume also increase during pregnancy while plasma volume increase more than red blood cells volume and thus results in a drop in the hematocrit level usually caused by dilution hence, the number of white blood cells count in pregnancy is often above 15,000/ml (Rolland-Cachera and Cole, 1991).

Pregnancy and childbirth are generally times of joy for parents and families, but in many countries and communities, they are also periods of great risk to the health and survival of women and newborns especially in relation to adolescents, therefore, the difference between developing countries, particularly the least developed countries and the developed (industrialized) country, is perhaps the greater maternal and neonatal mortality rates obtainable in them (UNICEF, 2009).

However, based on 2005 data, the average lifetime risk of a woman in a least-developed country dying from complications related to pregnancy or childbirth is 300 times greater than for a woman living in an industrialized world while millions of women who survive childbirth invariably suffer from pregnancy-related injuries, infections, diseases and disabilities, which often result to lifelong consequences (UNICEF, 2009).

Furthermore, almost 30% of pregnancies end in abortion, giving a total of about 55 million abortions in the world each year and most of it are performed under unsafe conditions which results in about 60 thousand women per year dying of unsafe abortion (World Bank, 1993).

The World Health Organization (WHO) estimates that the risk of death following pregnancy is twice greater for women between 15 and 19 years than for those between the ages of 20 and 24 thus, the maternal mortality rate can be up to five times higher for girls between the ages of 15 and 19 in developing countries than for older women, also the highest rate of teenage pregnancy in the world is in sub-Saharan Africa, where women tend to marry at an early age (Treffers, 2003).

Teenage birth is still an obstetric risk factor, a study carried in Nnamdi Azikwe University Teaching Hospital, Nnewi, Nigeria showed the prevalence of teenage birth was 21.8 per 1000 deliveries (Igwegbe *et. al*., 2001). There is need to foster the advocacy programs on safe motherhood and reproductive health issues for teenagers and adolescents.

Nevertheless, obesity in women can also cause serious pregnancy related complications, although, past efforts based on advising women on ideal weight for pregnancy (before, during, and after) have focused little on maternal obesity, rather most of the attention has been devoted to concerns about low birth weight deliveries in addition to other maternal and infant outcomes(National Research Council, 1970 & UNFPA, 2003).

The health of adolescent girls can have severe intergenerational effects on their foetus for instance, early age of marriage and low weight of mother results in complications during pregnancy. However, low weights of adolescent girls during pregnancy results in the birth of Low birth weight babies, likewise, infant mortality is higher for children of adolescent mothers, thus, having an inter-generational consequences on adolescent health thereby necessitating the need for the development and expansion of Adolescent Reproductive Health (ARH) facilities (UNFPA, 2003).

2.3 Maternal Nutrition and the course of Pregnancy

Healthy diet and nutrition is very important and essential even before pregnancy takes place, however most people do not know how important good nutrition is during adolescent age. Sufficient amount of food taken before pregnancy prepares the mother for the stages of pregnancy, helps to stay healthy for easy conception, reduces some health risks that may arise during pregnancy, such as miscarriage (Aisein, 2003, Jacqueline, 2009).

Good nutrition helps to maintain or sustain the foetus or embryo, thus, the weight gain during pregnancy should be around 7kg to 16kg depending on the woman's pre-pregnancy weight. Good nutrition/diet during pregnancy gives a child the best possible start in life, therefore, it is important for pregnant women to take cognizance of the quality of food eaten by improving on her eating habits before and during pregnancy, because a good diet is a key to healthy pregnancy and its outcome (Miller Keane, 2003, IOM, 2009).

Women should begin to follow a healthy diet before they become pregnant; this means cutting back on high calorie, high fat, and high sugar snacks and increasing the amount of fruits, vegetables and whole grains in their diet (Gillespie, 2001). Once a woman becomes pregnant, she should make sure to get at least six to eleven servings of bread and other whole grains, three to five servings of vegetables, two to four servings of meat and proteineous food

and six to eight glasses of water and limit the use of caffeine to not more than one soft drink or cup of coffee per day (Duffy *et. al*., 2002, WHO, 1995).

However, unhealthy dietary intake at preconception and during pregnancy may lead to malnutrition, thus, healthy nutrition is very vital and essential during pregnancy, because adequate nutrition has two major components which are essential nutrients and extra energy (in form of calories), meanwhile, it is possible to consume enough calorie foods without a well-balanced selection of individual nutrients required, thus producing diseases that are noticeably different from those resulting from an overall insufficiency of nutrients and energy for human body, nevertheless, it is possible to consume adequate amount of food (Gale, 2008, WHO, 2003; WHO, 2000).

Nevertheless, few of these extra calories are needed during the first trimester (1^{st}- 12^{th} week) when the developing foetus gains little weight, in second trimester (13^{th}- 24^{th} week) a daily increase of about 350 calories is recommended while in third trimester (25^{th}- 40^{th} week) about 450 calories is recommended though women who are physically active during pregnancy may need to increase their intake above the recommended amount for each stage of the gestation (Byrd-Bredbenner *et. al.*, 2009) because it has been observed that nutritional management in pregnancy is vital and has a lot of effects on the unborn child (Jacqueline, 2009, WHO, 1995).

Importantly, there are varieties of problems that may arise at certain stages of pregnancy if proper and adequate nutrition is not taken which may cause deformities in the unborn child and often times results from the nutritional mismanagement during or before pregnancy (Gafe Encyclopedia of Medicine, 2008, Mahan *et. al.*, 2004).

However, parental care is also another factor that is vitally important during early stage of pregnancy because inadequate parental care may have some negative effects on the foetus. (Gafe Encyclopedia of Medicine, 2008).

Thus, improving nutrition also means increasing dietary intake with whole foods such as bread and brown rice, reducing the amount of sugar consumed, and cutting down on fat, though, It may not be necessary to take any special supplements if a well-balanced and adequate diet is consumed other than folic acid, which is known to help prevent spinal bifida and other neural tube defects, meanwhile, the Department of Health and Social Security

recommends 0.4mg of folic acid per day while trying to conceive and for the first three months of pregnancy. (AICR, 2007, Ransom, 2003, Rolfe's *et. al*., 2009).

Therefore, a balanced and healthy nutrition is very important and should be taken frequently most especially fruits and vegetables which supplies essential vitamins and minerals to the foetus through the placenta. (Aisien *et. al*., 2003, Latham *et.al.*, 1990).

Concisely, previous study carried out by the Department of Nutritional Sciences, University of California recommended that pregnant women(adolescents inclusive) should have their dietary habits assessed along with special dietary counseling, and also vitamin-mineral supplements should be recommended if their usual nutritional intake is below standard, more so their weight-gain pattern should be monitored to ensure that energy intakes are sufficient to support a gain of about 0.4kg per week in the second(13^{th}- 24^{th} week) and third trimester(25^{th}- 40^{th} week) (Gutierrez *et. al.*, 1993, Latham *et. al*., 1990).

2.4. The Benefits of Adequate Nutrition during Pregnancy

Here are some important reasons why what a woman eat is so vital to her and her developing baby. According to Clinton (2003). A good diet can:

- Help for easier labour and delivery. When on a good diet, the body is healthier and in better shape because certain nutrients such as protein and zinc have shown to have a direct influence on labour and the health of the uterus, the baby and placenta are also healthier. Thus, good nutrients are also building blocks of healthy developments working together for better delivery.
- Protect baby from infection because vitamins such as Vitamin C (Ascorbic acid) can strengthen the mother and child's immune systems.
- Lessen the chances of miscarriage: A good diet will enable the placenta to grow properly and better satisfy the needs of the developing baby. A healthy placenta is also less likely to detach from the uterus before labour which can also cause miscarriage in developing countries like ours, where many women are short and underweight with high proportion of low birth weight (LBW) babies.
- Make baby healthier: Diet can positively influence baby's birth weight and health after birth.

- ❖ Protect from anaemia: iron deficiency anaemia (IDA) is usually caused by a poor diet thus, low iron status often cause fatigue and can lead to other complications.

2.4.1. Essential Nutrients, Vitamins and Minerals Required during Pregnancy

According to the America Congress of Obstetricians and Gynecologists (ACOG**)** and Mahan et. al., (2004**)** pregnant women should have a diet that consists of variety of food including proteins, carbohydrate, vitamins, minerals and fats. A balanced diet is the best way to receive nutrients but vitamin supplement can also be beneficial. Pregnant women should only take vitamin supplements on a health care's provider's recommendation. Supplements do not replace a healthy diet but rather ensures that a woman is receiving enough daily nutrients (Williams, 1997). Vitamin supplements work best when taken as part of healthy diet and not as substitute for a healthy diet.

According to Christie and Catherine (2002).

- Vitamin A (retinol and Beta Carotene(770mg).helps bones and teeth growth and can be found in liver, milk , eggs, carrots, spinach, green and yellow fruit, and cantaloupe.
- Vitamin D (calciferol) (5mg): Helps body use calcium phosphorous**;** promotes healthy teeth and strong bones formation, they are found in milk, fatty fish and sunshine.
- Vitamin E (15mg): helps body form and use red blood cells and muscles, found in vegetable oil, wheat germs, nuts, spinach, and fortified cereals.
- Vitamin C (ascorbic Acid)(80—85mg):,Antioxidant that protects tissues from damage and helps body absorb iron, build healthy immune system, can be found in citrus fruit, bell peppers, green beans, straw berries, papaya, potatoes, broccoli, tomatoes etc.
- Thiamin (B1) 1.4mg: Raises energy level and regulate nervous system, found in wheat germ, organ meats, eggs, rice, pasta, berries, nuts, legumes, pork etc.
- Riboflavin (B2)1.4mg: maintains energy, good eyesight, healthy skin found in healthy skin meats, poultry, fish, dairy products, fortified cereals, eggs etc.
- Niacin (B3)18mg promotes healthy skin, nerves and digestion. Found in high proteins food, fortified cereals and bread, meats, fish, eggs, peanut etc.

- Pyridoxine(b6)1.9mg helps form red blood cell: helps with morning sickness, chicken, fish, liver, pork, egg, soya beans, carrots, cabbage ,cantaloupe, peas, spinach, wheat germs, sunflower seed bananas, beans, broccoli, brown rice oats, bran, peanuts, walnuts etc.
- Folic Acid/Folate (600mg): helps support the placenta, and prevent spin bifida and other neutral tube defects found in orange juice, strawberries, green leafy vegetable, spinach, beefs, broccoli, cauliflower, fortified cereals, dark green leafy vegetables, canned fish with bones etc.
- Calcium (1,000—1,300mg): creates strong bones and teeth, helps prevent blood clots, helps muscles and nervous functions, found in yogurt, milk, cheddar, cheese, calcium fortified food like soy milk, juices, breads, cereals, dark green leafy vegetables, canned fish with bones etc.
- Iron (27mg): helps in the production of haemoglobin; prevent anemia, low birth weight thus foods like spinach, dried fruit, wheat germ, oat meal or grain fortified with iron should be consume.
- Protein (71mg): helps in the production of amino acid, repairs cells found in most animal foods such as meat, poultry, eggs, dairy products, veggie burgers, beans, legumes and nuts.
- Zinc (11-12mg) helps in the production of insulin and enzymes found in red meat, poultry, beans, nuts, whole grains, fortified cereals, oysters, dairy products.

2.4.1.1 Folate

Folic acid, which is the synthetic form of vitamin folate, it's extremely essential both at pre and per-conception. Deficiencies in folic acid may cause neural tube defects. Women who had 4mg of folic acid in their systems due to supplementation 3 months before child birth significantly have reduced the risk of possible deformities within the foetus. This is now highly recommended by the UK Department of Health, that 400ug per day of folic acid should be administered to pregnant women.

The development of every human cell is dependent on an adequate supply of folic acid. Folic acid governs the synthesis of the precursors of Deoxyribonucleic Acid (DNA), which is the nucleic acid that gives each cell life and character. Folic acid deficiency results in

defective cellular growth and the effects are most obvious on those tissues which grow most rapidly.

2.4.1.2 Folate and Acute Lymphoblastic Leukemia

Along with neural tube development, folate affects DNA synthesis in multiple ways. Folate is involved in the construction of purines and pyrimidines, which is the building block of nucleic acids. Folate is also necessary to make S – adenosyl methionine (SAM), which acts as a methyl donor in the synthesis of DNA. Because of its role in these important mechanisms, fetal DNA would be significantly altered if a maternal folate deficiency is present. One possible outcome is DNA mutation, which could prevent normal gene expression, for example, a tumor suppressing gene might be turned off, altering normal immune function in preventing cancer growth, (WHO, 2000).

Rolland *et. al.,* 1991, examined the relationship between maternal supplementation of folate and iron during pregnancy and incidence of Acute Lymphoblastic Leukemia (ALL) in their children and discovered that increase rates of ALL were found in children whose mothers did not take iron and folate supplements, more so, iron alone did not seem to reduce risk of developing ALL, however iron in combination with folate was shown to have a protective effect in decreasing the risk for ALL. Maternal folate supplementation throughout pregnancy plays an important role in reducing the risk for childhood Acute Lymphoblastic Leukemia (WHO, 2000).

According to WHO 2003, pregnant women are recommended to take nutrients above normal Recommended Daily Allowance (RDA) thus, maximum amount of extra nutrient required are;

- Energy – increased by 200kcal (840kj) per day in last trimester only
- Proteins – Extra 6g per day (51g) per day in total
- Thiamin – Increase in line with energy; increase by 0.1mg per day (0.9mg) in total per day.
- Niacin – Regular supplementation/diet of substance. No increased RDA required.
- Folate – Maintain plasma level, extra 100ug per day (300ug) in total
- Vitamin C – Replenish drained material stores extra 120mg per day (50mg) in total per day in RDA

- Vitamin D – Replenish plasma levels of vitamin 10ug per day RDA.
- Calcium – Needs no increase in RDA.
- Iron – Extra 3mg per day needed RDA
- Magnesium, Zinc, Copper – Normal supplementation or consumption in RDA
- Iodine – Extra 100ug per day (250ug) per day in total.

2.5 Adolescents Population Profile

Adolescents are individuals between the ages of 10 and 19 years (UNFPA, 2005,). The increase in attention towards adolescents is primarily due to recognition of the increased significance of this group as a proportion of the total population. Young people (10 – 24) years) now numbered about 1.4 billion thus, made up the 'largest youth cohort in history'. Generally, the majority of the increase in the proportion of adolescent population occurs in developing countries (NDHS, 2008, MOFHW, 1998).

Within the world of the young, adolescents are at a particularly formative stage, brimming with energy and possibilities and nearly 45 per cent of youth – 515 million – survive on less than $2 a day (UNFPA, 2005a). It is imperative to note that many adolescents are held in the grip of poverty, peril of Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS).

One in five Africans and one in every three African adolescents live in Nigeria, the most populous country in Africa (UNAIDS and WHO, 2000). Also, the youth (age 10 – 24years) constitutes about 34% of her total population (PRB, 2006).

2.5.1. Global perspective of Adolescent Pregnancy

Adolescent pregnancy means pregnancy in a woman aged 10 – 19 years or early twenties; It is also the condition where a woman under the age of 20 years old suddenly becomes pregnant, with or without a husband. (Okpani *et. al.*, 1995, Treffer et. al., 2003). However, it is worth noting that, pregnancy in women under the age of 15 years can be associated with low birth weight and suboptimal growth in the mothers as the competition for nutrients with the foetus in the adolescent women undergoing normal growth spurts can lead to a delay or failure of secondary growth spurt, while women above 15years though not up to 20years

could have delay in the full attainment of their bone density (Quinlivan, 2006, Sanusi *et.al*., 2002).

More so, adolescent pregnancy is a global concern, particularly in areas of poverty and social disadvantage. For instance, about one million teenagers become pregnant yearly in the United States of America followed by United Kingdom while Australia has the third highest rate of teenage pregnancies in the world (Odu *et. al.*, 2007).

Adolescent fact 2009, reports that approximately 750,000 teenagers between the ages of 15-19 become pregnant every year, and that between 1990 and 2004, teenage pregnancy rates decreased by 38% from 116.8 per 1,000 aged 15-19 years to 72.2 (YRBS, 2007) which is the lowest reported teen pregnancy rate since 1976 but then rose 5% from 2005 to 2007.

Despite these changes, the teen pregnancy rate in the United States is one of the highest among industrialized nations. Nearly two-thirds of women in Sub-Saharan Africa and few countries in South Asia have their first child before the age of 20 years (Bongaarts *et. al.*, 1998). It is startling that three of every four African women become mothers while they are in their teens, and 40 percent of births in Africa are to women under age 17 (Alan Guttmacher Institute, 1998, UNFPA, 1998).

Thus, teenage pregnancy occurs in all societies, though with considerable variation in magnitude and consequences among different countries and regions of the world. In each case, a variety of complex socioeconomic factors are involved, for example, in some societies girls are forced into early marriage and are expected to begin their families during adolescence. In such countries, adolescent childbearing is considered a social norm for marriage or as a proof of fertility. (WHO, 2007, Quinlivan, 2006).

According to United Nation 2002 survey, an estimated 14 million women aged 15-19 years gave birth each year from the period 1995-2000, (amounting to slightly more than 10% of all births worldwide, with 12.8 million births occurring to adolescents in developing countries). In 1995-2000, the adolescent fertility rate was 54 births per 1000 women worldwide. In developed countries it was 29 births per 1000 women, while in developing countries it was as high as 133 births per 1000 women (UNFPA, 2005, Bacci *et. al.*, 1993).

On average, adolescent childbearing is most common in Africa (115 births per 1000 women) and less common in Europe (25 births per 1000 women) because the highest rate of teenage

pregnancy in the world is in Sub-Sahara Africa, where women tend to marry at an early age and where majority of the world's young people live (Bacci *et. al.*, 1993).

A study on adolescents in Africa indicates that there are yet many unmet reproductive health Needs (such as family planning) for the African adolescents despite the many reproductive health programs which have been initiated in the last decade (Nwobodo, 2002).

The prevalence of teenage pregnancy in Nigeria is put at about 22% and 25% of Nigeria girls marry before the age of 15 years (NDHS, 2006). This contributes substantially to the high maternal and pre-natal mortality in this region of the world (Ujah *et. al.*, Fasubaa *et. al.*, 1999).

2.5.2. Prevalence of adolescent pregnancy in Nigeria

The cries of children bringing forth children are not only heard within the labour wards of our teaching hospitals, but they are also heard at the various maternity homes in Nigeria, including the rural areas. They extend to other developing countries and even to the developed countries of the world (Nnatu, 1991, Singh *et.al.*, 2004, YRBS, 2007).

Recently unplanned pregnancies among Nigeria teenagers and young women have risen despite improvements in educational levels, it was found in 2003 that 16% of pregnancies among girls and women aged 15 – 24years had been unintended as compared with 10% in 1990 also, this report showed that the proportion of adolescent women with some secondary education had Increased by 16 percentage points (from 34% to 50%) between 1990 and 2003 however, this study also noted that the population of Nigeria – Africa's most populous nation, with 150 million people was growing by 2.2% annually and at this rate would double every 32 years (WHO, 1995,UNFPA, 2003, Dixon-Mueller, 2008).

Forty-five percent of Nigeria's population is under age 15years, there is therefore need to increase health services and education concerning reproductive health for teenage students (Bulus *et. al.*, 2003).

According to the 2008 Nigeria demographic and Health survey Fact sheet, the prevalence of women age 15-19 who are mothers or now pregnant in the country is 23% with the North-central zone of the country having its prevalence at 22% (NDHS, 2008). This may be due to early marriage, which is culturally and religiously acceptable in northern Nigerian (Okpani *et. al*,. 1995, Aboghgoroma *et al*, 1998).

In developing world, teenage pregnancy and early birth is very common due to cultural differences for instance, cultural differences between the predominant Christian culture in the southern part and Muslim culture in the northern part of Nigeria has great influence on the differences in pattern of teenage marriage and parenting (Odu *et. al.*, 2007, Treffer, 2003).

The National Center for Health Statistics recently documented the sharpest rise in teenage pregnancies in 15 years, globally, the rates of teenage pregnancy range from 142 per 1000 in some sub-Saharan African countries to 2.9 per 1000 in South Korea. This contribute up to 80 % of cases of abortion related complications in hospitals, however, maternal deaths related to pregnancy and childbirth is an important cause of mortality for girls' age 15-19 worldwide, accounting for nearly 70,000 deaths each year(NCHS,2009).

Early marriage and pregnancy, HIV and AIDS, sexual violence and other gender-related abuses also increases the risk that adolescent girls will drop out of school. This, in turn, entrenches the vicious cycle of gender discrimination, poverty and high rates of maternal and neonatal mortality (Veneman, 2009).

The United Nations says 53,000 women in Nigeria die annually of pregnancy-related illness; this is one of the highest maternal mortality rates in the world more so, children born to mothers below age 18 are one and half times more likely to die before age 5 than those born to mothers age 20-34 and these children are at greater risk of lower intellectual and academic achievement, social behavior problems, and problems of self-control primarily due to the effects of single parenthood and lower maternal education (Alan Gutmacher Institute, 1998, UNFPA, 2005).

2.6 Nutritional Status of Adolescents

The effects of pregnancy during adolescence on long-term health status are not completely understood and the food choices made by adolescents affect not only their growth and development during puberty but also their reproductive capacity (pregnancy outcomes) and susceptibility to degenerative diseases when they become adults (Quilinlivan, 2006, WHO, 2003) Meanwhile, Infants born to young adolescents has been reported to range from 200 to 400 g smaller than those born to adult women in all BMI categories but this difference incrementally decreases as adolescents increase in age at the time of childbirth. The pre-conception nutritional status of a young woman sets the stage for her future offspring. In

developing countries, pregnant women with history of poor diet, anemia, short stature (<1.5m) and low body weight (< 45.4kg) are at risk for giving birth to low birth weight, intrauterine growth retarded (IUGR) infants (IOM, 1990, WHO, 2011).

A cross-sectional survey carried out by Brabin *et al.* (1997) had showed that across region 10.7% of rural adolescent girls were stunted compared to 4.7% of urban adolescent girls. In another cross-cultural comparison of contrasting populations study, 18% of girls and 50% of boys in Senegal were malnourished, while in Martinique, 19% of girls and 23% of boys were overweight or obese (Benefice *et al.*, 2003). Okesina *et al.* (1999) reported an overall prevalence of obesity to be 2% in the Maiduguri study with higher prevalence among females (3.2%) and 1.2% in males.

The NDHS (2003) reported about 3% of adolescents within the age group (15-19 years) to be severely thin, 5.5% overweight, 6.5% obese and about 1% to be grossly obese. Ekpo and Jimmy (2006) also reported that the intake of iron, folacin, calcium were most deficient in the diets of adolescent females in Akwa Ibom, Nigeria, leading to 4% of them being anaemic.

Inadequate intake of energy and calcium in diet of adolescents has also been reported by Oguntona *et al.* (1987). Vitamin A deficiency is also being described among adolescents in different parts of the world, with the prevalence up to 40% in adolescents in Nigeria (West and Darnton-Hill, 2001). A study in Nigeria also revealed that the in-school adolescents were at risk of vitamin A and C deficiencies, especially those in the boarding houses (Ene-Obong *et al.*, 2003). About 40% of Nigerian pregnant women did not take iron tablets during pregnancy (UNICEF, 2006).

It has been reported that in Nigeria, 11.6% of women suffer from chronic under-nutrition, while 14.2% of women of childbearing age are overweight and 5.7% are obese. However, 66% have their BMI within the normal range,12% are classified as thin, 14% severly thin, 22% are classified as overweight/obese (UNICEF, 2006, NDHS, 2008).

2.7 Factors Influencing the Nutritional Status of Pregnant Women.

Some factors influencing the nutritional status of pregnant women include;

- **Poverty:**

Poverty in its manifestation (low household income, inadequate basic infrastructure, limited access to media etc.), affects nearly 23% house hold in developing countries like ours, and is

closely intertwined with household food insecurity. However, while poverty is an important basic determinant of the nutritional status of pregnant women, it does not solely explain the high rate of malnutrition (WHO, 2003, World Bank, 2006).

- **Micronutrients Deficiencies**

This affects the health, growth and development of the newborn child and also causes harm to the mother, though, they are less obvious forms of under nutrition, it constitutes major public health problems (Van den Broek, 2003). The most common nutrients deficiencies in pregnant women and children are iodine deficiency disorder which affects the physical and mental development of children, iron, which leads to anaemia and impair cognitive developments in children, while vitamin A deficiency leads to improper functioning of the eye (xerophtalmia i.e. partial blindness), or the child will be born completely blind, it can also affect the immunity of the child to fight against diseases(Soekanjo *et. al.*, 2001).

Vitamin A deficiency affects one-third of new born babies while Iodine deficiency affects 20-50% of pregnant women (WHO, 1995, Rolfe's *et. al*., 2009). Studies have also shown in Nigeria that 19.2% of pregnant women are at risk of vitamin A deficiency (serum retinol concentration<30µg/dl), 12% of pregnant women have vitamin E deficiency, 24.3% of mothers and 35.3% of pregnant women are at different stages of iron deficiency, 43.8% of urban pregnant women are iron deficient (UNICEF, 2006, NDHS, 2008, Ugwuja, *et. al.*, 2011).

- **Diseases**

Although, the incidence of diarrhea is low and static, it continues to contribute to child under-nutrition and pregnant women (WHO, 2003). One of the reasons why the incidence of diarrhea diseases has not changed overtime is poor access to safe drinking water (portable water) and sanitation. Around the nation, one third of households in developing nations have no access to sanitation and about one quarter has no access to safe drinking water. Malaria on the other hand is due to poor and improper sewage drainage, although it's under control, acute respiratory infections make a substantial contribution to infants and pregnant women mortality and morbidity as well as malnutrition (WHO, 2003, Tanner, 1992).

- **Inappropriate Feeding Practices:**

Much emphasis has been made on the extra dietary allowance of pregnant women to consume at least 300 kcal of energy and 15 grams of protein/day over and above the

recommended daily allowance (RDA) during pregnancy. It is possible to consume a seemingly adequate amount of food, without getting the required minimum amount of energy (calorie) for example marasmus is as the result of a diet that is deficient mainly in energy, while children who get enough calories, but not enough protein have kwashiorkor(Jacqueline, 2009). This is typical in cultures with limited variety of foods, that is, those that eat mostly a single staple carbohydrate like maize or rice. These conditions overlap and are associated with multiple vitamins and minerals deficits, most of which have specific names and set of problems associated with them (WHO, 1995), therefore, evaluating the influence of socio-demographic determinant is essential because there are also other factors that contribute to poor feeding habit like unequal food distribution in the family, low gender empowerment and cultural practices where health system has no say. This shows that the healthy choices of feeding patterns of pregnant women depend on their cultural belief, locality (where they find themselves) and family size but more common problems lies within the family income, low literacy, age at first pregnancy, birth spacing, calorie and protein intake and haemoglobin levels (WHO, 2003).

2.8. Gestational Weight Gain

Maternal or gestational weight gain refers to the amount of weight gained by a pregnant woman from conception to delivery which is believed to be based on pre-pregnancy weight /nutritional status of the woman. This is calculated by subtracting pre-pregnancy weight from measured weight at delivery (IOM, 2009). It is also considered to be one of the determinants of birth weight as well as infant mortality and morbidity; thus, it plays a vital role in the health of the mother during pregnancy, labor, delivery and the postpartum period (Baker *et. al.*, 2008).

Weight gain during pregnancy has several components – the products of conception, the extra maternal tissues of the uterus, breast and blood, the increase in total body water and the increase in maternal fat stores, thus, the rate of increase in weight due to the different components of weight gain is not the same. For example, feotal growth and tissue fluid contribute to the weight gain in the last 10 weeks, whereas fat stores, which are about 4kg, contribute to the earlier increase in weight between 20 and 30 weeks (Hytten and Leitch, 1971). Therefore, about 90% of fetal growth occurs in the last 20 weeks of gestation (Bowman and Russell 2001). In addition, inadequate Feotal growth has been associated with

long term health risks, such as type-2 diabetes mellitus, hypertension, cardiovascular disease, and obesity (Godfrey and Barker, 2000).

Maternal weight gain during pregnancy influences feotal outcomes depending on the mother's pre-pregnancy nutritional status, for instance, it was reported that in long-term follow-up studies of the Dutch famine in World War II, under-nutrition during pregnancy increased the risk of chronic disease in their offspring later in life (Asbee *et. al.*, 2009).

It is therefore advised that women of reproductive or childbearing age should maintain good nutritional status through a lifestyle that optimizes maternal health and reduces the risk of birth defects, suboptimal fetal development and chronic health problems in their children, because pregnancy is a critical period during which good maternal nutrition is a key factor that can influence the health of both mother and child (American Pregnancy Association, 2006). Likewise, maternal weight gain also plays a vital role in the health status of the mother during pregnancy, labour, delivery and postpartum period. (American Pregnancy Association, 2006).

A low rate of weight gain in early pregnancy among women especially adolescents (<4.3 kg by 24 weeks) has been shown to nearly double the risk of delivering a small-for-gestational-age infant therefore, weight gain less than 0.4 kg per week after 24 weeks gestation have been associated with higher rates of preterm delivery (Carmichael and Abram, 1997), however the risk of complications during pregnancy or delivery is reduced when prenatal weight gain is adequate (Mehra, 2004).

It has also been shown that gestational weight gain appears to have a greater impact on Feotal growth in early adolescents, who require higher weight gains than late adolescents or adults to deliver an infant of optimal size (3.0-4.0 kg) (Bushman *et al.*, 2001, Leddy, et.al., 2008). A higher median weight gain and rate of gain has been observed in adolescents compared to adults (13.9-14.9 kg vs. 12.5 kg) (IOM, 2009) while, on the other hand, excessive gestational weight gain (>18kg) does not enhance fetal growth or length of gestation, but may increase the risk of postpartum weight retention and increased abdominal fat deposition, thus may contribute to the development of obesity in later adulthood (WHO, 2011).

2.9. Consequences of obesity and excessive gestational weight gain

Obesity in pregnancy which is more common among older and multiparous women than adolescent women is linked to maternal complications ranging from effects on fertility to effects on delivery and in the postpartum period, as well as many complications affecting the foetus and newborn (Arendas *et al.* 2008). Obese pregnant women are at an increased risk of gestational diabetes (Chu *et al.* 2007, Ogonowski *et al.* 2009). Elevated gestational weight gain has been shown to predict impaired glucose tolerance (Herring *et al.* 2009). Women with gestational diabetes mellitus have an increased risk of later development of type 2 diabetes; 15% to 60% will develop type 2 diabetes within 5 to 15 years after delivery (Kim *et al.* 2002). Incidences of pre-eclampsia and Caesarean section increase with maternal overweight and obesity during pregnancy(O'Brien *et al.* 2003, Diet 2005, Frederick *et al.* 2006, Leddy *et al.* 2008, Dietl 2005, Callaway *et. al*,. 2006, Vehkaoja *et. al.*, 2006, Poobalan *et. al.*, 2009). Complications due to excessive gestational weight gain also include Caesarean deliveries and Feotal macrosomia resulting in the delivery of a large-for-gestational-age infant (Abrams *et al.* 2000, Stotland *et. al.*, 2004, Helms *et. al.*, 2006).

2.10. Body Mass Index (BMI) and Gestational Weight Gain

It is worth nothing that Body mass index varies with age during adolescence until it reaches adult standards between ages 18 and 24 years (World Health Organization [WHO], 1995). The WHO indicates that the provisional cutoff for underweight is BMI for age at < 5th percentile, while BMI for age ≥ 85th percentile is the cutoff for at risk for overweight and ≥95th percentile is considered overweight for adolescents (CDC, 2000, Rolland, *et. al.*, 1991). Consequently, a BMI for age between the 5th percentile and the 85th percentile would be considered a normal weight range for adolescents.

The CDC-standardized BMI growth curves, based on national survey data with representation of racially diverse groups, represent weight gain patterns for adolescents in the United States and are currently used for all U.S. children, regardless of ethnicity. Several evidence abound that adolescents, especially early adolescents, are more likely to deliver low-birth weight (LBW) infants due to low maternal BMI in pregnancy (Singh *et. al.*, 2004, Igwegbe, 2001).

It has generally been accepted that adequate gestational weight gain affects birth weight by decreasing LBW, However, macrosomia increases with excessive gestational weight gain, especially if the weight gain is too large (Scholl & Hediger, 1994, Leddy, *et. al*., 2008).

Leddy *et. al.*, (2009) reported that higher maternal weight gains did not result in larger infants for black adolescents unlike adult women, although, additional weight gain was most beneficial for low-weight adolescents and least beneficial in overweight adolescents whose infants were within a healthy birth weight range no matter how much they gained. It has also been suggested that gaining at the upper end of the current recommendations does not improve infant outcomes for Black adolescents, which is similar to what has been observed for adult Black women (Janet *et.al*., 2003). Therefore, Women should set pregnancy weight gain goals based on their pre-pregnancy BMI as shown below;

Table 2:Pregnancy Weight Gain based on Pre-pregnancy BMI for adults

Pre-pregnancy BMI(kg/m^2) WHO	**Pre-pregnancy weight category**	**Total recommended weight gain range (kg)**	**Recommended weight (kg) in the second and third trimester**
< 18.9	Under weight	12.7-18.2	Slightly > 0.5 per week
18.5- 24.9	Normal	11.4-15.9	0.5 per week
>25.0- 29.9	Overweight	6.8-11.4	0.3 per week
≥30.0	Obese(all classes)	5.0-9.1	Aim for a steady weight gain

Source**;** *Institute of Medicine (IOM), 1990,1996*

The National Academy of science (1992) and IOM 2009 recommended maternal weight gain based on pre-pregnancy Body Mass Index (BMI). 12-18 kg weight gain in pregnancy was recommended for women with a low BMI, 11.5-16 kg weight gain in pregnancy for women with a normal body mass index, 7-11.5 kg weight gain in pregnancy for those with high (overweight) BMI and weight gain for obese women.

Table 3 Prepregnancy IOM Body Mass Index (kg/m ^{2}) for Adolescents

Adult Categories	**Prepregnancy BMI (kg/m^2)**	**Categories Using CDC BMI Percentiles for Adolescents**
Underweight:	<19.8	Underweight: <5th percentile of BMI
Normal weight:	19.9-26.0	Normal weight: 5th percentile and <85th percentile of BMI
Overweight:	> 26.0-29.0	At risk for overweight: 85thpercentile and <95th percentile of BMI
Obese:	>29.0	Overweight: 95th percentile of BMI

Note: CDC = Centers for Disease Control and Prevention; IOM = Institute of Medicine.
Source *;(Association of Women's Health, Obstetric and Neonatal Nurses, JOGNN, 2007)*

2.11 Recommended weight gain in pregnancy based on pregnancy Body Mass Index (BMI)

In 1990, the institute of Medicine (IOM) published weight gain recommendations for optimal infants' health, based on pre-pregnancy Body Mass Index (BMI). Weight gains outside the IOM's recommended ranges are associated with twice the rate of poor pregnancy outcome as weight gains within the recommended ranges. Despite the importance of weight in pregnancy, there is considerable range of prenatal weight gains that are associated with a healthy pregnancy outcome. This may be due to the fact that weight gain during pregnancy is multifaceted. Factors which may affect weight gain include low energy stores, deficiencies in micro-nutrient, a lack of plasma volume expansion and infection. (American pregnancy association, 2006, IOM, 2009).

Table 4. Institute of Medicine (IOM) range recommended for singleton pregnancy weight gain.

Pre-pregnancy BMI(kg/m^2) **WHO**	**Pre-pregnancy weight category**	**Total recommended weight gain range (kg)**	**Recommended weight (kg) in the second and third trimester**
< 18.9	Under weight	12.7-18.2	Slightly > 0.5 per week
18.5- 24.9	Normal	11.4-15.9	0.5 per week
>25.0- 29.9	Overweight	6.8-11.4	0.3 per week
≥30.0	Obese(all classes)	5.0-9.1	Aim for a steady weight gain

Source: IOM 2009

Note: adolescent pregnant women within the normal BMI category should aim to gain between 16.8-24.5kg, overweight women 14.1-22.7kg, and 11.4-19.1kg for obese (IOM, 2009).

Maternal pre-pregnancy nutritional status and pregnancy weight gain also affect the health and survival of the newborn hence it is a major determinant of feotal growth and weight at birth. Maternal dietary intake also influences the growth and nutrient transfer function of the placenta (Jacqueline, 2009).

Few studies have evaluated the patterns of weight gain and pregnancy body mass index in developing regions where malnutrition and poor weight gain and pre-pregnancy body mass index as well as maternal obesity have significant influence on the pregnancy outcome, for instance, women with lower than normal maternal body weight have been shown to be at increased risk for adverse prenatal outcomes such as prematurity (which reduces the lung function and weakens the child's immune system), intrauterine growth retardation (IUGR) and preventable risk factor for Low Birth Weight (O' Brien, 2003).

Likewise, the foetus also faces major health risk from under- nutrition during gestation and increases the likelihood of premature death (LBW infants faces 5 to 10 times risk of dying

before the age of 1year) while about 30 million infants are born each year with LBW (Byrd-Bredbenner *et. al.*, 2009).

According to the study carried out by Carmichael *et. al.*, (1997), 7002 women with good outcomes were selected (defined by factors related to maternal and infant health from the University of California, San Francisco's Perinatal Database).For each body mass index category, the compared percentiles of weight gain by trimester in women who achieved the IOM recommendations for total gain and those who did not and found out that trimester rates of gain varied by body mass index category and exceeded IOM guidelines in all groups but forty percent of these women with good outcomes had total gains within the guidelines.

In a retrospective study of 1145 pregnant women carried out by Brabin *et. al.*, (2001), he showed that trends in mean maternal weight gain from the time of booking until delivery were not linear because statistically significant lower rates of maternal weight gain were observed before 16 weeks, after 36 weeks and between 28 and 32 weeks gestation.

The average maternal weight gain was 10.71 kg, while the average weekly weight gain was 0.38kg. Wide variations in maternal weight gain were seen in women with normal outcome. The mean weight gain in heavy (greater than 68kg) and light (less than 55.4kg) women was less than that in women whose weight was in the third quartile (60-68kg) while the mean maternal weight gain was less in young (less than 20 years) women than in older women (greater than 25 years) and also less in multiparous than in primigravid women from 37 week onwards, less in smokers than in non-smokers from 20 weeks onwards, and greater in hypertensive women (BP greater than 140/90) than in non-hypertensive women from 24 weeks onwards, but the mean weight gain in women who had small for gestational age (SGA) infants was not significantly different from that in women whose babies were of appropriate size for gestational age (Arendas *et. al.*, 2008).

Therefore, after taking into account infant and placental weight using multiple regression analysis, he observed that the following factors were associated with significant differences in average weekly weight gain that is parity, body mass index, smoking and high blood pressure. Dietl, *et. al.*, (2005) confirmed a strong association between weight gain during pregnancy and infant size hence, low pre-pregnancy BMI is an established risk factor for LBW. Moreover, abnormal gestational weight gain may further complicate the pregnancy as an additional risk factor for neonatal LBW (which is defined as birth weight less than 2500

grams) and it is also an important determinant of infant mortality and morbidity, thus, low maternal weight gain is considered as a preventable risk factor for LBW.

All women, regardless of their pre-pregnancy BMI may be at risk of abnormal weight gain and hence low birth weight therefore pre-pregnancy and gestation nutritional assessments should be a significant part of all prenatal visits, however, Frederick *et al.*, (2006) in his study carried out in the north-eastern part of Nigeria also concluded that Pregnancy body weight and BMI not plasma glycaemia, were important factors associated with the birth weight of babies born in Nigeria.

2.12 Factors That Influence Gestational Weight Gain

2.12.1. Socioeconomic Status:

Maternal socioeconomic status and non-modifiable, non-biological factors that affect mental and physical well-being have been associated with maternal nutrition and pregnancy outcomes. However, it is increasingly acknowledged that societal factors play a significant role in micronutrient status and pregnancy outcomes (Ugwuja *et. al.*, 2011).

Social class, despite its abstract status, is, according to Illsley (1983), an effective epidemiological concept based on the recognition that paternal occupation is a sensitive indicator, not only of working conditions, but also of income, education, housing, diet and a variety of social, economic and cultural characteristics which are often loosely described as 'lifestyle', thus the variable 'class' provides indirect evidence of the association between the social circumstances of groups in the community and their health, and therefore may influence a limited number of specific lifestyle variables which, in turn, modify the mothers' health and the outcome of pregnancy (Morgen, et. al., 2008, NDHS, 2006).

However, studies on impact of socioeconomic status on pregnancy have produced conflicting results for instance; Morgen et al.2008 found that there was no association between risk of preterm and socioeconomic status like household income and occupation. In contrast the risk of preterm birth has been reported in mothers of low socioeconomic status by Ugwuja *et. al.*, (2011), although, in recent studies**,** more specific indices such as occupational status, income and education are now used as indicators of social class, rather than occupation as defined by the British Registrars General(Soekanjo, 2001, Rani *et. al.*, 2004).

The lower socio-economic status of the mother is also associated with low birth weight babies (Chanhande, 2002, Rani *et. al*., 2004). In addition, it has also been reported that an association exist between unemployment and preterm delivery, LBW, SGA, and Perinatal mortality rate (Hanke *et. al.*, 2008, Mathur, 2003).

Conclusively, domestic responsibilities, working for livelihood, inadequate rest along with malnutrition especially when the energy demands are increased, contribute to a large number of women delivering low birth weight infants (Mehra and Agrawal, 2004).

2.12.2. Mother's Education:

Researchers have recognized that educating girls is important for improving health, reducing gender equality, and empowering women (Gillespie 2001, Chaturvedi et. al., 1996). This is in line with the Millennium Development Goals (MDG) target to increase education level of the girl child and therefore empowering women. Global commitments to girls' education have focused on primary education because primary education results in positive health outcomes that include reduced fertility and child mortality rates. Similarly, studies have shown that education is most beneficial to women in settings in which they have greater control over their mobility and greater access to services (Aisien, *et. al*., 2003).

Female secondary education is associated with high age at marriage, low fertility and mortality, good maternal care, and reduced vulnerability to HIV/AIDS. In a global review of early marriage, girls' secondary school enrolment was inversely related to the proportion of girls' married before 18 years (Mathur *et. al*., 2003, Morgen, *et. al*., 2008). Those with only primary education (7 years or less) are more likely to be married before age 18 years than girls with higher education (PRB, 2000).

Therefore, low levels of education, especially among women, and discriminatory cultural attitudes and practices are barriers to reducing high maternal mortality rates also children of young and illiterate mothers tend to face the same cycle of economic deprivation and under nutrition as experienced by their mothers for instance, a study at the Jos University Teaching Hospital in the north-central region showed that nearly three-quarter of maternal death occurred among illiterate women (Aisien and Olanrewaju, 2003,Ugwuja, *et. al.*, 2011).

In conclusion, mothers' education provides direct measure of the woman's relative socio-economic status especially in developing countries where studies have shown that more

educated women have lower perinatal mortality rates because higher education not only presumes higher economic standing but suggests a more informed approach to both self-care and the use of the health care system and birth control services(Bao-Ping,1999).

More so, better knowledge of health-related behavior is also likely to be reflected by the woman's education level. Hence, Women who fall into the lowest status group appear to manifest consistently the highest rate of low birth weight, these differences remain statistically significant after adjusting for the mothers' age, parity, marital status and weight/height (Morrison *et. al.*, 1989, PRB, 2000, Morgen, *et.al*., 2008).

2.12.3. Maternal Nutritional status:

Nutritional status of women has been considered an important prognostic indicator of pregnancy weight gain and outcomes, therefore maternal nutritional status is important for the health and quality of life in women and their growing foetus and also plays an important modifiable role in avoiding birth weight extremities and optimizes lifelong health status of the duo (State of the World Children, 2009, King, 2003).

For instance, according to Health and Well-being 2009, Low birth weight babies (less than 2500g) are often born prematurely and are about 40 times more likely to die within the first year of life while those that survive have a higher risk of autism, cerebral palsy, mental, visual and aural impairments, while high weight babies or macrosomic babies (greater than 4000g) are at increased risk of still birth, heart and neural tube defects and injuries, their mothers also have great incidence of gestational diabetes, hypertension, operative delivery, and post-partum heamorrhage. (Jacqueline, 2009).

Maternal nutrition during pregnancy has been said to affects the growth of the infant, its development and health, (Duffy & Ruberta, 2002). Additionally, deficiencies of trace elements like copper and zinc have been found to be associated with maternal morbidity such as hypertension, infections and diabetes mellitus without any adverse effect on the feotal outcome (Ugwuja et al., 2011).

2.12.4 Antenatal Care:

Much ill-health among pregnant women is preventable, detectable or treatable through adequate antenatal visits while late booking or insufficient antenatal visits account for majority of the complications experienced by women especially adolescent women, for

instance, in a population-based study in a small village in Nigeria, Igwegbe *et. al.,* (2001) reported that young pregnant girls often did not receive antenatal care, especially if they were unmarried, these girls who did not book for antenatal care said that high cost was the major reason in addition some of the unmarried girls did not want to be seen in public whilst pregnant, also, the mortality rate among women who did not receive antenatal care at all was about 20 times higher than among those who did according to a study conducted in university of Jos teaching hospital, thus previous studies stressed that around 80 per cent of maternal deaths are preventable if women have access to essential maternity and basic health-care services (Aisien *et. al.,* 2003, Veneman, 2009).

According to the 2008 Nigeria demographic and Health survey Fact sheet, the prevalence of women who gave birth in the past years who received antenatal care in the rural area from a skilled provider is 46% while those who delivered in a health facility is as low as 25% which may be as a result of cultural differences and religious beliefs associated with northerners (Odu *et. al.,* 2007, NDHS, 2008).

2.13. Pregnancy outcomes

Researchers often define favourable pregnancy outcome as a full-term gestation period (longer than 37 weeks) that results in a live, healthy infant weighing more than 2.5kg and also permits the mother to return to her pre-pregnancy health status (Bry-Bredbenner *et. al.,* 2009). Maternal nutritional status has been identified as an important determinant of pregnancy outcome such as birth weight especially before and during pregnancy, thus birth weight is an indirect mechanism of assessing maternal nutrition and it is also crucial to survival of the infants (Sanusi and Oredipe, 2002).

Despite numerous observational studies, there is no standard definition of a "good pregnancy outcome" but Institute of Medicine (IOM) Committee defined a favourable pregnancy outcome 'as delivery of a live infant with a birth weight between 3 to 4kg at 39 to 41 week of gestation (Carmichael *et. al.*, 1997, IOM, 1996).

Adverse pregnancy outcomes are low birth weight babies, macrosomia, and small for gestational age pre-term. Factors associated with increased risk for delivering a low birth weight infant include maternal age younger than 18 years or older than 35 years. High parity, history of a previous low birth weight infant, low socioeconomic status, low level of

education, late entry into prenatal care, low pregnancy weight gain or low pre-pregnant weight, and smoking and substance abuse also increase the chance of having a low birth weight baby (Locoh, 2000).

Other pregnancy outcomes are congenital abnormality, abruption placenta and Intrauterine growth restriction due to maternal malnutrition, infections including malaria, arduous workloads, teenage pregnancy, short birth intervals and excessive tobacco or alcohol consumption are believed to be the most important causal factors (YRBS, 2007).

However, age and parity are important determinants of pregnancy outcomes, thus, the best outcomes are found between ages 20-30 years while worst outcomes are found at the extremes of reproductive age, nevertheless, primigravity has been reported as high-risk pregnancy and this is increased in teenagers and elderly primigravidae with the following complications; uterine fibroid, malpresentation, operative deliveries, foetal abnormality, pregnancy induced hypertension(PIH), preterm labour, fetopelvic disproportion and poor Perinatal outcome (Onah and Eze, 2002, O' Brien, 2003).

Ugwuja et. Al., (2011) also reported that pregnancy induced hypertension was significantly high among women who were civil servant, while those who were farmers had higher incidence of anaemia, *H. pylori* infection, and other illnesses, likewise, women who were house wives and farmers had higher adverse feotal outcome than women who were civil servants and artisans.

2.13.1. Low Birth Weight:

Infants born weighing less than 2,500 grams (2.5kg) regardless of the length of pregnancy are considered to be low birth weight (LBW) (WHO, 1992). Birth weight is generally a reflection of intrauterine experience and a good indicator of not only the mother's health and nutritional status, but also of the infant's chances of survival, growth, long-term health and psychosocial development thus, these infants have a higher infant mortality rate (Odu *et. al.*, 2007, UNICEF, 2008, Arenda *et. al*., 2008) though if they survive, they are much more likely to spend an extended time in the hospital more so, they are also more likely to suffer from life-long disorders such as neurological developmental disabilities, learning disorders, behavioral problems, and respiratory problems(UNICEF, 2000 &WHO, 2004; Annan, 2001, CDC, 2008).

Infants with a low birth weight, who may have one or more of these life-long disabilities, often contribute to long-term emotional and financial strain for both the family and the community which is often caused by poor nutrition, substance use (cigarettes, alcohol, drugs) and can be an effect of sexually transmitted disease(STD), other contagious diseases, or no pre-natal care. When a baby is born pre-maturely, it stays in the hospital for up to four months. Babies who are born at a low birth weight run the risk of respiratory infections, blindness, learning disabilities, cerebral palsy, and heart infections (WHO, 2003, WHO, 2005).

Twenty to 30% of all low birth weight infants in the United States have mothers who smoked while pregnant. Recent studies show that women who use marijuana or cocaine while pregnant also have significantly smaller infants than non-users (YRBS 2007, American Pregnancy Association, 2006).

It is estimated that each year about 30million babies are born with low birth weight (LBW) worldwide, while ninety- five percent of these occur in developing countries (WHO, 2009, UNICEF, 2009). More so, LBW puts infants at greater risk of neonatal death and is a major cause of poor growth and development in later childhood resulting from under-nutrition *in-utero* which is also associated with certain chronic diseases in adult life (King, 2003, Mahan, 2004).

Although LBW can be due to a number of factors, such as a woman's small size, uterine infections, smoking and malaria infection, the most significant cause is poor maternal nutrition (Ransom *et. al.*, 2003).

However, young girls who grow poorly due to malnutrition becomes stunted women and are more likely to give birth to LBW infants and if these infants are girls, they are likely to continue the cycle by being stunted in adulthood, if nothing is not done to break the cycle thus, adolescent pregnancy heightens the risk of LBW and the difficulty of breaking the cycle moreover, teenage pregnancy is a risk factor for preterm birth and ante-partum heamorrhage (FAO, 2007, Mutihir *et. al.*, 2006, King, 2003).

Moreover, LBW of infants in developing countries are due to intra-uterine growth retardation and the major determinants are poor maternal nutritional status at conception, low gestational weight gain due to dietary inadequacy and short maternal stature (Sanusi and Oredipe, 2002, Guelinckx *et. al.*, 2008).

2.13.2. Pre-term babies:

Pre-term birth (that is infants born below 37completed weeks of gestation) is a major cause of infant mortality and morbidity that has considerable societal, medical, and economic costs, more so, the rate of pre-term birth appears to be increasing world-wide and efforts to prevent or reduce its prevalence have been largely unsuccessful (West *et. al.*, 1997, WHO, 2003). Though the cause of preterm labour is unknown, but it has been said in recent studies that about 15% of all pre-term births are multiple pregnancies though health conditions in mothers such as diabetes, heart disease, and kidney disease are potential risk factors.

More so, studies in the United States of America and the Netherlands have found that younger teenage mothers are more likely to deliver preterm babies than women in their twenties (Hoque et. al., 2010).

Moreover, gestational weight gain (both the total amount and the rate at which it is gained) are of important influence on Feotal growth, infant birth weight, and length of gestation such as low birth weight (<2.5kg) and prematurity ($\leq$ 36 weeks) of infants and these are the major determinants of Perinatal mortality and morbidity (Institute of Medicine (IOM) 1990, IOM, 2009).

2.13.3. Macrosomia:

Macrosomia is also known as large -for -gestational age is defined as weight at lies above 90th percentile for gestational age that is an infant weighing above 4kg or 4.5kg at birth regardless of gestational age, it is an indicator of high prenatal growth rate and encountered in up to 10% of pregnancies/deliveries (Leipoid *et. al.*, 2005).

Major risk factors are gestational diabetes and diabetes mellitus, gestational age (>40weeks), fetal sex, genetic factors (parental height, and weight), excessive maternal weight gain, Multiparity (>2previous pregnancies), congenital anomalies (hydrops fetalis), ethnicity, and use of some antibiotics (amoxicillin) in pregnancy with these named consequences; neonatal morbidity, injury, and obstructed labour leading to caesarean section (Leipoid *et. al.*, 2005).

2.13.4. Congenital abnormality:

According to WHO factsheet 2012, congenital anomaly/malformation is defined as structural, functional, and/or biochemical-molecular defects present in an infant at birth whether detected on time or not. It is also called birth defect and it affects approximately 1 in

33 infants, thus resulting in about 3.2million birth defect-related disabilities yearly, recently, it has been estimated that about 270,000 newborns die during the first 28days of life from congenital abnormalities. Here are some common forms of congenital abnormality; heart defects, neural tube defects, and Down syndrome. It is worth noting that congenital anomaly and preterm births are important causes of childhood death, chronic illnesses and disabilities. Moreover, approximately 50% of all congenital disorders have no known specific cause, however, according to WHO factsheet 2012, the following are potential risk factors;

- Socioeconomic factor which is due to susceptibility to macro and micronutrient malnutrition, infections, alcohol use and advanced maternal age which increases the risk of some chromosomal abnormality such as down syndrome (WHO, 2012, Rani *et. al*., 2004).
- Genetic factors could be either consanguinity(blood relation) or advanced maternal age in pregnancy which is about 25% of all congenital defects(that is women who gives birth after age 35years),both increases the prevalence of rare genetic congenital anomaly and almost doubles the risk of neonatal and childhood death, intellectual disability (Czeizel, 2005).
- Maternal infection such as syphilis and rubella are also potential risk factor.
- Poor maternal nutritional status such as iodine deficiency, diabetes mellitus, and folate insufficiency (increases the risk of having a baby with neural tube defects) also causes birth defects.
- Environmental factors for instance, maternal exposure to pesticides, medicinal and recreational drugs alcohol, tobacco, high doses of vitamin A during early pregnancy and high doses of radiation increases the risk of birth defects, also working or living near waste sites and mines contributes to the incidence of congenital birth defects (WHO, 2012).

2.13.5. Small for gestational age and IUGR:

Short Gestational Period, i.e. Infant born too soon and qualified to be premature (between <2500g and gestational age <37 weeks), or infant with retarded inter-uterine growth, i.e. the infant is small-for-gestational age (between 2500g and gestational age <37 weeks) also result from poor nutrition (Ransom *et. al.*, 2003).

Moreover, in developing countries like ours, inter-uterine growth retardation (IUGR) accounts for the majority of low birth weights whereas in developed countries most LBW babies are premature as opposed to growth retardation ,thus, LBW infants have less chances of survival and even when they survive, they are prone to diseases, growth retardation and impaired mental development. A good start in life is important therefore, maternal nutritional status during pregnancy has repeatedly been demonstrated to be associated with pregnancy outcomes for the infants. (Frisancho & Matos, 1985, Ransom et. al., 2003).

Poor micronutrient intake and status increase the risk of SGA births in pregnant adolescents (Baker *et. al.*, 2009). Findings from previous study carried out on maternal nutritional status and adolescent pregnancy outcome showed that young adolescent mothers had smaller and thinner newborns than those born to older women who were adjusted for nutritional status in pregnancy and at a delivery (Frisancho *et. al.*, 1983, Odu et. al.,2007).

According to WHO, 2000, a precursory study into the link between nutrition and pregnancy in 1950 showed that women who consumed minimal amount of food over a period of eight weeks had a higher mortality or disorder rate concerning their offspring than women who had regular and adequate meals, because children born to well-fed mothers had less birth restriction within the womb unlike those who are not well-fed whose infants not only had physical disorders linked with poor nutrition before and during pregnancy, but also had neurological disorders and handicapped, a condition which can also lead to the child becoming more susceptible to later degenerative diseases(Ransom *et.al*., 2003, Rani *et.al.*, 2004).

However, maternal nutrient depletion (macro and micronutrients) may contribute to the increased incidence of preterm births and fetal growth retardation, thereby increasing the risk of maternal and child mortality and morbidity (Janet, 2003, Sanusi, 2002).

2.13.6. Infant mortality/ Still birth:

The earliest days of life are the most vulnerable for a child and death of new born especially in developing country like Nigeria have received far too little attention because statistics showed that almost 40% of under-5 death occurred in 2004 according to the latest world health organization estimates, these deaths occurred in the first 28 days of life, that is the neonatal period, thus, it implied that three -quarter of the neonatal death takes place in the

first seven days of life though most of them are preventable however, being born too small for gestational age is a major predictor of neonatal mortality and morbidity, failure to grow, slow cognitive development and chronic diseases in adulthood(Janet, 2003).

The risk of mortality is greatest during the first day after birth, when it is estimated that between 25 -45% of neonatal death occurs while a child born in developing country is 14 times more likely to die during the first 28 days of life than a child born in an industrialized country (State of the World Children 2009, UNICEF, 2009).

For neonates, the risk of mortality is greatest during the first day after birth, when it is estimated that between 25 percent and 45 percent of neonatal deaths occur, thus a child born in a least developed country is almost 14 times more likely to die during the first 28 days of life than a child born in an industrialized country. (State of the World's Children, 2009, NDHS, 2008).

Nonetheless, teenage pregnancy contributes to the high incidence of infant and maternal mortality and this result from the lack of understanding of the increased needs during pregnancy and of the relations between good nutrition, fewer complications during pregnancy and a healthy infant. Most adolescents lack the knowledge of nutrition and how it affects the course of pregnancy and the unborn baby (Igwegbe *et.al*., 2001, Janet, 2003).

Some 86 per cent of newborn deaths globally are the direct result of three main causes: severe infections – including sepsis/pneumonia, tetanus and diarrhea – asphyxia and preterm births. Severe infections are estimated to account for 36 percent of newborn deaths and can largely be prevented be improved care during labour and delivery(State of the World Children, 2009).

The condition can be alleviated by a trained health worker who is able to detect its signs and resuscitate the newborn. For example, more than 1 million children who survive birth asphyxia each year end up suffering disabilities such as cerebral palsy or learning difficulties (State of the World Children, 2009 and UNICEF, 2009).

In Nigeria, neonatal deaths in 2004 stood at 249,000, according to the latest World Health Organization figures with 76 per cent taking place in the early neonatal period (first week of life). Inadequate health facilities, lack of transportation to institutional care, inability to pay for services and resistance among some populations to modern health care are key factors

behind the country's high rates of maternal, new born and child mortality and morbidity (State of the World's Children, 2009).

2.13.7 Maternal Morbidity and Mortality

Maternal mortality/maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. Maternal Mortality Ratio is the ratio of the number of maternal deaths per 100,000 live births (WHO, 2006).

Nigeria is reported to have one of the highest levels of maternal mortality in the world, with a current figure of 1,100 per 100,000 live births (UNICEF, 2008, NDHS, 2008). More than 70% of all maternal deaths are due to five major complications: hemorrhage, infection, unsafe abortion, hypertension diseases of pregnancy and obstructed labor. About 600,000 induced abortions are believed to take place in Nigeria annually (FMOH, 2003).

Airede and Ekele (2003) carried out a study on adolescent maternal mortality in Sokoto, Nigeria and found that complications from abortion account for 72 percent of all deaths in young women under age 19; moreover, half of all maternal deaths result from illegal abortions among Nigeria adolescents. Poor access and utilization of quality reproductive health services also contribute significantly to the high maternal mortality (NDHS, 2003, Dixon-Mueller, 2008).

Maternal micronutrient deficiencies still constitute major determinants of maternal mortality with iron deficiency anemia (IDA) being the most common micronutrient malnutrition problem in the world, affecting more than two billion people. In Nigeria 24.3% of women and 35.3% pregnant women are at different stages of iron deficiencies (Maziya-Dixon *et. al.*, 2003, Derbyshire, 2009).

However, socio-cultural factors, such as the stigma attached to unwed motherhood and, therefore, the prevalence of abortions only serves to increase the incidence of mortality, maternal mortality among adolescents is caused by several inter-linked factors – susceptibility to medical complications (as the body has not yet reached full maturity), lower utilization of health services such as antenatal or delivery care, poor nutrition (maternal

mortality is five times higher in anaemic women), reproductive risk factors and social factors such as stigma of unwed motherhood (Mehta, 1998, NDHS, 2008).

2.14. Factors Affecting Pregnancy Outcomes

The risk factors associated with LBW and preterm delivery are short inter-pregnancy intervals, low pre-pregnancy weight, insufficient gestational weight gain in each trimester , multi-fetal pregnancies, and young maternal age, while a high maternal body mass index (BMI) and excessive pregnancy weight gain are associated with increased incidence of stillbirth, fetal macrosomia and fetal growth restriction (Jacqueline, 2009, Cziezel *et.al.*, 2005, Herring *et. al.*, 2009).

Other factors that affect maternal weight gain and pregnancy outcome are parity, antenatal care, inter-pregnancy interval, dietary intake (maternal nutritional status), maternal age, level of physical activity, level of maternal education, anaemia ,gestational diabetes, hypertension, infections to mention but few.(Robin et.al., 2009, Janet, 2003). Higher prevalence rates of malaria and of morbidity and mortality associated with anaemia was found among pregnant women who fail to receive antenatal care during pregnancy (Okonofua, Feyisetan and Sanusi, 1992 and Abejide, 1996, NDHS, 2008) Therefore, it is imperative that nutritional advice on adequate dietary intake during pregnancy should be given to pregnant women and it must be appropriate for their age, physiological and nutritional status as at conception (Jacqueline, 2009).

2.14.1 Maternal age at marriage

Age at marriage is an important factor determining the age at which the first pregnancy occurs. Marriage generally occur earlier in developing than in developed regions (WHO, 2004a) thus, marriage among adolescent girls younger than 18years often has significant negative consequence for them and their newborns (SCN, 2006, Igwegbe *et.al.*, 2001,). Adolescent girls in rural areas are more likely to start childbearing than those living in urban areas-24% compared to 16% in developing countries respectively which is associated with early marriage (US Bureau of Census, 1996, Mehra, 2004). More than half of girls are married by the age of 18 in Bangladesh, Burkina Faso, Chad, Mozambique and Nepal, while

more than 40% married in Ethiopia, India, Malawi, Nigeria and the Yemen (Haberland *et. al.*, 2003).

Very early childbirth below the age of 16 is also associated with child marriage. In Bangladesh, Cameroon, Liberia, Malawi, Mali, Niger and Nigeria, all countries where early marriage is common, 8-15% of the girls have had a child by the age of 15 (Singh, 1998). In Bahrain 18 – 20% of the adolescents begin childbearing under the age of 16 and in Kuwait 40% of the mothers giving birth in hospitals were less than 16 years old (WHO, 1996).

The NDHS (2003) reported that half of all women were married by age 17 and half had become mothers by age 20, more than a quarter of adolescents, were pregnant or already had children. Ihejiamaizu *et. al.,* (1998) found that 26.9% of urban females and 27.4% of the rural females in Akwa Ibom State, in the Southern part of Nigeria married before attaining the age of 17. Similarly for Cross River State, 26.9% of urban females and 34.8% of their rural counterparts also married before age 17. They also found median age at first pregnancy to be 20 years for rural and urban Cross River women and 21.1 and 20.2 years for urban and rural Akwa Ibom respectively.

In Nigeria, early marriage is a challenge because many young girls are given out in marriage against their will, and mostly to men who are much older and already have many wives (UNFPA, 2005c). According to NDHS 2003, half of the female population (20-24years) were married by 17years while about one-third of adolescent (15-19) were already married in 2003, and 16% were actually married by the age of 15 years (NDHS, 2003, NDHS, 2008).

Most countries, including Nigeria, have decided 18 years as the minimum legal age of marriage, despite this child marriage still occurs which is a health issue as well as human rights violation because such marriages take place almost exclusively within the context of poverty and gender inequality, moreover, it also has social, cultural and economic dimensions (UNFPA, 2005b).

For teenagers, the physiological adjustments in pregnancy are two-fold; adolescent growth and physiological changes of pregnancy which both need to be taken into consideration (Derbyshire, 2009)

In this sense "adolescent pregnancy" means pregnancy in a woman aged 10 – 19 years or early twenties, It is also the condition where a woman under the age of 20 years old suddenly becomes pregnant, with or without a husband. (Okpani *et. al.,* 1995, NDHS, 2008).

However, it is worth noting that, pregnancy in women under the age of 15 years can be associated with low birth weight and suboptimal growth in the mothers as the competition for nutrients with the foetus in the adolescent women undergoing normal growth spurts can lead to a delay or failure of secondary growth spurt, while women above 15years could have delay in the full attainment of their bone density (Quinlivan, 2006).

Nevertheless, teenage pregnancy has long been classified as a high-risk group with increased adverse obstetric outcomes, they were found to have a higher incidence of preterm delivery, intrauterine growth restriction, anaemia, sexually transmitted disease, pregnancy-induced hypertension, pre-eclampsia, obstructed labour, Caesarean section, intrapartum complications, babies with low birth weights, low Apgar scores and thus putting them at higher risk of maternal and neonatal mortality and vesico-vaginal fistula, moreover, some studies also suggested that this was predominantly caused by the poor social, economic, and behavioural factors, and non-utilization of prenatal care (UNFPA, 2005c) .

A study conducted in South Africa by Hoque and Hoque (2010), reported that the caesarean delivery rate was the second highest mode of delivery in both teenager and older women, but was significantly higher in older women compared to teenage mothers while the assisted vaginal delivery rate was significantly higher in teenage mothers compared to older mothers.

Furthermore, emergency obstetric conditions such as eclampsia and obstructed labour occur more commonly in adolescent pregnancy thereby putting such mothers at higher risk of death (UNFPA, 2005c, Nwobodo, 2002, Quinlivan, 2006).

2.14.2 Maternal and Child Anthropometry

Anthropometric indices provide an approximate reflection of nutritional status of both mother and child and the common indicators used most often are body weight and height, in relation to the subject's age and sex while others include arm, head and thigh circumferences and skin-fold thickness but in a population study depending on the target population, the main anthropometric indices used are Body Mass Index (BMI), weight-for-height, height-for-age, and weight-for-age(Viogt et.al., 2007, WHO, 1995).

World Health Organisation (WHO) uses the United States' National Centre for Health Statistics (NCHS, 2009) data as a reference standard since many studies have shown that the

growth of normal, healthy and adequately nourished children, almost always approximate these reference values. Preferably, anthropometric data for children are quoted in terms of "Z-scores", based on standard deviations (SDs) above or below the median reference value, for a person of a given age. The level of median minus 2 SD is usually taken as the cut-off point or threshold, below which the status is considered unsatisfactorily, that is, under-nutrition, exists (WHO,1995, Viogt et. al., 2007).

2.13.3 Maternal pregnancy weight gain

The amount and pattern of weight gain during pregnancy whether over a limited number of weeks or total gain is an indicator of maternal nutritional status and thus correlates in all studies with Feotal growth which may be a critical indicator of pregnancy outcome (McGuire and Popkin, 1990, Veneman, 2009, World bank, 2006).

The most favourable outcome to pregnancy is associated with 1 to 2 kg weight gain in the first trimester and subsequently, a weight gain of 350 to 430g per week in the second and third trimesters (Taffel and Kappel, 1986, IOM, 2009).

A total weight gain of 11 to 12.5kg during pregnancy has been found to yield optimum health for both mother and foetus, producing an infant with a birth weight between 3 and 4.5 kg (IOM, 2009), however, underweight women should have total weight gain of about 13.5kg while obese women should decrease to about 7 to 8.5kg thus, achieving adequate weight gain can be done by giving nutritional advice and supplements during pregnancy. Meanwhile, the following are the components of weight gain in pregnancy;

(1) Maternal stores of nutrients = 3kg

(2) Increased body fluid = 2kg

(3) Increased blood volume = 1.5 – 2kg

(4) Breast growth = 600g

(5) Enlarged uterus = 1kg

(6) Amniotic fluid = 1kg

(7) Placenta = 600g

(8) Baby = 3,4 – 4kg

Total = 11 – 16kg

Source: *(UNICEF, 2000, IOM, 2009).*

Summarily, appropriate maternal nutritional status is imperative for ensuring a favourable pregnancy outcome especially among the vulnerable group and it is the most single important environmental factor that affects pregnancy outcome because maternal nutritional status at conception influences how nutrients are partitioned between the mother and the foetus (Janet, 2003, Scholl, *et. al*, 1990, World bank, 2006, Mathur *et. al*., 2003).

Table 6. Maternal factors that increase the risk of pregnancy outcomes

FACTORS	Conditions Increasing Risk of Nutrient Deficiencies
Body weight (prepregnancy)	BMI less than 19.8 or greater than 26
Body weight (during pregnancy)	Inadequate or excess weight gain inappropriate pattern of weight gain
Age	Young age
Eating pattern	Regular omission of foods from one or more major food groups due to food fads or taboos Excessive consumption of a single type of food Fasting and weight loss diets Special diet to control maternal health condition, such as heart disease, kidney disease, diabetes, and genetic disorders Eating disorders and food cravings, aversions and pica
Health	Pregnancy spaced less than 12 to 18 months apart More than 3 previous pregnancies if under 20 years old, more than 4 if above 20. Carrying more than 1 foetus Inadequate prenatal healthcare(ANC) Diseases such as HIV/AIDS and diabetes Onset of gestational diabetes mellitus Onset of pregnancy-induced hypertension, preeclampsia, and/or eclampsia
Socio-economic factors	Low income Limited educational achievement Lack of family or social support
Food supply	Food contaminates (e.g. lead, mercury, etc.) Food borne illness pathogens High caffeine intake
Lifestyle	Use of alcohol, drugs, tobacco, or herbal and botanical products.

Source: *(Jacqueline, 2009)*

2.14.4 Interpregnancy spacing

An adequate supply of nutrient is probably the single most important environmental factor affecting pregnancy outcome, thus women with early or closely spaced pregnancies are at increased risk of entering reproductive cycle with reduced nutrient reserves thus maternal nutrient depletion may contribute to increased incidence of preterm births, foetal growth retardation maternal mortality and morbidity, although, maternal under nutrition due to an insufficient food intake places women and their feotus at risk (King, 2003, Davis,2013).

It has also been reported that women with short interpregnacy intervals(18months) may not have sufficient time to replace nutrient used during the previous pregnancy thus leading to

depletion and its associated consequences such as preterm, LBW, and SGA (Bao-Ping Zhu *et. al.*,1999 and Janet, 2003).

More so, studies have shown that women with <8month interval between pregnancy were14-47% more likely to have preterm deliveries, and maternal death at OR=2.54, 95%CI=1.22-5.38 (Janet, 2003). Also, increased or longer inter-pregnancy interval and prevention of excessive pregnancy weight gain leads to reduction in incidence of maternal obesity (Davis, 2013, King, 2003).

2.15. Relationship between Maternal Nutritional Status and Pregnancy Outcomes

Pregnancy and childbirth during the teenage years are associated with increased risk of poorer health and well-being for both the mother and the baby (Paranjothy *et. al.*, 2009, Chu *et.al.*, 2007). Adolescents are more likely than adults to consume energy-dense, micronutrient-poor diets and to experience adverse pregnancy outcomes (Baker *et. al.*, 2009). Pregnant teenage girls will need more nutritional support to meet both their needs and that of her baby because(Christie *et.al.*,2002), lack of proper nutrition can lead to problems like anemia(low iron), low weight gain, macrosomia, IUGR/SGA, and congenital abnormality to mention but few (Robin, 2009, Fadupin *et.al.*, 2011).

The nutritional needs of pregnant adolescents are the greatest at a time when it is most difficult to meet them because behavioural attitudes such as dieting, meal skipping, snacking, eating away from home, consuming fast foods, and trying unconventional diets are common eating-behaviour among adolescents, which relate to their changing lifestyles of increased independence, busy schedules and search for self-identity, peer influence, group conformity, and body image dissatisfaction(Derbyshire, 2009).

Nevertheless, the total nutritional needs of pregnant adolescents who are at least 2-year post-menarche are similar to those of pregnant adults but because of their poor dietary habits, they usually enter pregnancy with reduced nutrient stores and increased risk of nutritional deficiencies (Gutierrez *et. al.*, 1993, Duffy, 2002).That is, despite the similar nutritional status among the young adolescent mothers, the availability of nutrients for the accumulation of calories in the fetus was less than that of older women.

Furthermore, the pregnancy weight gain associated with an optimal or average newborn weight is greater for young teenagers than for older women thus, these findings support the

hypothesis that among rapidly growing teenagers, the nutritional requirements of pregnancy may be greater than those of older women, and that this increased requirement competes with the growth needs of the fetus (Frisancho *et. al.*, 1983, Czeizel *et.al*., 2005, Gutierrez *et.al.*, 1993,Jacquelin, 2009).

Micronutrient deficiency and especially iron deficiency is believed to be the main underlying cause for anaemia while recently, the role of vitamin A deficiency as a contributing factor to anaemia has also been examined (Van dan Broek *et. al.*, 2003, Idowu *et.al*., 2005). Studies have shown a high frequency of low iron stores among adolescent, therefore, it is imperative to encourage the use of iron supplementation in pregnant teenagers (Hertrampf *et. al.*, 1994, Janet, 2003).

Another study also showed that anemia, preterm delivery, and low birth weight were more prevalent among teenagers than among women who were 20-24 years old, Likewise, this buttress the need to enhance family welfare measures by delaying the age at first pregnancy, thereby reducing the multiple complications that may occur in the young mother and her newborn baby (Banerjee *et. al.*, 2009,Millan *et.al.*, 2003, ICN, 1992).

Anaemia is one of the important causes of maternal mortality (including among adolescents) and there is a scarcity of data on severity of anaemia and adolescent mortality in developing countries (Brabin *et. al.*, 2001, Idowu *et.al*., 2005). An increased prevalence of anaemia in young pregnant women was found in four of seven studies from developing countries included in the review by Scholl *et. al.*, (1994).

Generally, the cause of anaemia is not the young age of the pregnant woman rather it is often caused by nutritional deficiencies, especially of iron and folic acid while in developing countries it is mostly caused by malaria and intestinal parasites (hookworm) aside nutritional deficiency(Jacqueline, 2009, King, 2003).

Acute and chronic inflammations due to infectious diseases such as tuberculosis (as well as HIV infection) are also important causes of anaemia (Van den Broek, 1998) and vitamin-A deficiency may also play a role (Van den Broek, 1998). In some individuals, genetic factors are responsible (sickle cell diseases in people of African origin and thalassaemia in people from North Africa and South Asia).

A study carried out in Abeokuta, showed that women in the 15 – 19 years age group constituted the highest percentage of anaemic cases (80%) followed by 25 – 29 years age

group (78.1%) compared to the other age groups, this study has shown that anaemia in pregnancy is a major health problem in Nigeria (Idowu *et. al.*, 2005, Godfrey *et.al*., 2000).

For an estimated 160 million people living in iodine-deficient environments around the world, iodine deficiency is a major factor for impaired physical and men tal development. Iodine deficiency during pregnancy can cause brain damage to the fetus; with associated mental retardation and neurological disorders. The severest form is cretinism, a combination of these disorders with severe growth retardation (WHO, 1998b, Frisancho *et.al.*, 1985, FOS&UNICEF, 2000, Czeizel *et. al*., 2005). Therefore in areas with environmental iodine deficiency, adolescent girls and women in their reproductive years are especially at risk (WHO, 1997, Gale, 2008).

Vitamin D insufficiency is once again emerging as a major public health concern in the United States (Holick *et. al.*, 2008) thus; maternal vitamin D deficiency during pregnancy may limit transfer of vitamin D to the fetus and result in reductions in infant vitamin D stores. Neonatal vitamin D deficiency can result in impaired growth, delayed bone ossification, abnormal enamel formation, and perturbations in calcium homeostasis including hypocalcaemia and tetany (Mallet, 1989, Czeizel *et.al*., 2005).Unfortunately, deficiency of this vitamin during infancy may go largely undiagnosed and may not be detected until significant deficits in mobility and bone development become evident (Biser-Rohrbaugh *et. al.*, 2001, Godfrey *et.al*., 2000).

Summarily, these are the pregnancy outcomes resulting from poor nutritional status;

- Low birth weight (LBW)
- Congenital abnormality
- Macrosomic babies
- Neural tube defect
- Inter-uterine growth retardation (IUGR)/Small for Gestational Age (SGA)
- Still birth (Infant mortality)
- Delay /malformation of the vital organs at the proper stages.
- Maternal morbidity and mortality

2.16 Common Obstetric Complications in Pregnancy

The timing and causes of maternal and newborn deaths are well understood as Obstetric complications such as post-partum heamorrhage, infections, eclampsia, and prolonged or obstructed labour while complications of abortion account for most maternal deaths. Moreover, anaemia, exacerbated by malaria, HIV and other conditions also increases the risk of maternal death. (State of the World's Children, 2009, Kim *et al*., 2002, Dietl, 2005 Ogonowski *et.al.*, 2009).

2.16.1 Spontaneous abortion

The risk of spontaneous abortion is increased in obese women. Using a retrospective case–control model and a sample size of 4932, Benefice *et. al*., (2003) identified an odds ratio for spontaneous abortion of 1.2 (95% CI 1.01 to 1.46) for obese women (BMI > 30 kg/m2). The authors also identified an increased risk of recurrent early miscarriages (more than 3 successive miscarriages < 12 weeks' gestation) in the obese population, odds ratio 3.5 (95% CI 1.03 to 12.01). Similar risks have been identified in obese women undergoing in vitro fertilization therapy (Leddy 2008, ACCN, 1994).

2.16.2 Gestational diabetes

It is well documented that rising rates of obesity in North America are responsible for the concordant rise in type 2 diabetes in the general population. Pre-gestational diabetes is more prevalent in obese women. Therefore, testing in women with risk factors early in pregnancy is recommended. Obese women are also at increased risk of developing gestational diabetes. (Kim *et.al*., 2002, Arendas *et.al*., 2008) Lifestyle factors such as an inappropriate diet may play a major role in excessive weight gain during pregnancy (IOM, 1990, ICN, 1992, Jacqueline, 2009).

Smoking (Rolfe's *et.al.*, 2009, Ogonowski *et.al*., 2009) and misperceived pre-pregnancy body weight status (Herring *et. al.*, 2008) are also associated with excessive gestational weight gain. A recent study from the US indicated that an organized, consistent programme of dietary and lifestyle counseling did reduce weight gain in pregnant women (Asbee *et. al.*, 2009, Chu *et.al.*, 2007).

There is no information about the role of dietary patterns in maternal weight gain during pregnancy, though, generally, a Western dietary pattern (characterized by high intakes of red and processed meat, refined grains, sweets, desserts and potatoes), has been shown to be associated with greater weight gain in women (Scholl *et. al.*, 1994, Herring *et.al*., 2009).

2.16.3 Gestational hypertension

Hypertension was defined as systolic BP of 140 mmHg or greater and/or diastolic BP of 90mmHg or greater on at least two readings in patients who were not on regular antihypertensive therapy. Hypertension (HTN) is the most common non communicable disease in Nigeria (O'Brien *et.al.,* 2003, Banerjee *et.a*l., 2009).

The crude prevalence rate for females is 11.2%, while the age adjusted rate is 9.3%.' HTN is also the most common medical disorder of pregnancy worldwide. It has been estimated that 5-10% of all pregnancies are complicated by HTN (Oluranti et. al., 2004).

The hypertensive disorders of pregnancy fall into four main groups: chronic (pre-existing) HTN, gestational (de-novo) HTN, pre-eclampsia/eclampsia and pre-eclampsia superimposed on chronic HTN. Chronic HTN on its own is estimated to occur in about 5% of pregnant women, and it is associated with increased rates of adverse maternal and fetal outcomes in both acute and on a long-term basis (Oluranti *et. al*., 2004, O'Brien *et. al.*, 2003).

Gestational HTN and pre-eclampsia/ eclampsia may lead to development of sustained HTN and stroke in later life and also increased risk of low birth weight and preterm deliveries. It has been observed that multiparous women have a higher mortality from HTN than nulliparous women (Dietl *et. al.*, 2005, Odu *et. al*., 2007).

However, indications that the incidence of transient severe HTN, antenatal hospitalization, proteinuria at delivery and neonatal respiratory distress syndrome may be decreased by normalizing the blood pressure (BP).In addition, it has been suggested that age, parity, weight and race constitute important risk factors for both chronic HTN and pre-eclampsia/eclampsia (Oluranti *et. al.*, 2004, Herring *et. al*. 2009).

2.16.4 Gestational Anaemia

Iron deficiency is the most common widespread nutritional disorder in the world and often leads to anaemia which is defined by WHO as a heamoglobin concentration below 11g/dl and as continued to be a major health problem in many developing countries and it is associated with increased rate of maternal and prenatal mortality, premature delivery, low birth weight, and other adverse outcomes, moreover, it affects a large number of pregnant women in developing countries (at a prevalence rate between33%-75%) about 40% of preschool children, approximately half of adolescent girls in the developing world are anaemic. while anaemia accounts for only 15% prevalence in industrialized countries (Dim and Onah, 2007, Idowu, 2005).

Moreover, iron deficiency anaemia is aggravated by worm infections, malaria and other infectious diseases such as HIV and tuberculosis (WHO, 2007, Hertrampf *et. al.*, 1994). Nutritional deficiency in folic acid or iron, and infectious diseases, such as malaria and intestinal parasite all contribute to adolescent anemia. Iron deficient- anemic adolescent mothers are more likely to give birth to low birth weight babies because their developing bodies compete with the fetus for nourishment, exhausting iron and nutrient reserves(ACC/SCN, 2000, Benefice *et. al.*, 2003).

The major health consequences of anaemia deficiency are poor pregnancy outcome, impaired physical and cognitive development and risk of morbidity in children and reduced work productivity in adult hood, More so, anaemia contributes to 20% of all maternal deaths (WHO, 2007; Ransom and Elder, 2003).

Jolly *et. al.*, (2000) and Aboghoroma *et. al.* (1998) identified that less than 18 years old teenagers had an increased risk of maternal anemia in the UK while an increase prevalence of anemia in young pregnant women was found in four of seven studies from developing countries included in the review by Scholl (1994) and in two of these studies the difference was statistically significant. Onadeko *et. al.*, (1996), also observed that adolescent mothers had higher risk of anemia. Due to the high prevalence of anemia in all women in developing countries, the difference in the prevalence of anemia between adolescent and adult pregnant women, if any, may be relatively small. Nevertheless, the severity of anemia may differ between groups (WHO, 2004a).

Nutritional deficiencies (macro and micronutrients) are usually related to social and environmental circumstances. Frequently, children and female adolescents suffer most from this deprived environment and social circumstances and this is often the cause of their anaemia as pregnant adolescents often receive inadequate antenatal care, their anaemia during labour and the postpartum period may be worse than in older women. (WHO, 1998a).

In southeastern Nigeria in 1993, more than 50 percent of women and young children suffered from Iodine deficiency anaemia (IDA) with the corresponding high levels of anaemia amongst women of reproductive age. Iron deficiency is high in the Dry savannah zone and low in the moist savannah (Maxiya-Dixon *et. al.*, 2003).

Generally, the predisposing factors of anaemia include grand multiparity, low socioeconomic status, malaria infestation, late booking, HIV infection, and inadequate child spacing among others (Dim and Onah, 2007).

2.16.5 Caesarean section

The risk of Caesarean section is increased in the obese parturient. Dietz *et. al.*, analyzed 24 423 nulliparous women stratified by pre-pregnancy BMI and pregnancy complications and observed that obese women undergoing Caesarean section experience more complications, including blood loss > 1000 ml, increased operative time, increased postoperative wound infection and endometritis, and need for vertical skin incision than non-obese women. (Benefice *et. al.*, 2003).

2.16.6 Ectopic pregnancy:

Ectopic pregnancies can be caused by sexually transmitted disease (STD), such as Chlamydia, or an infection, such as pelvic inflammatory disease. Women who have undergone sterilization procedures or have been diagnosed with endometriosis or other female reproductive disorders are also at risk. If the fallopian tube is getting tighter, or narrow, the egg is fertilized outside the uterus or in the tube, thus the name: "Tubal pregnancy." Causes heavy bleeding, severe pelvic pain, dizziness and may result in death. Emergency surgery or Methotrexate is used for treatment (Dietl, 2005).

2.16.7 Preterm labor:

This occurs when the mother's body is trying to deliver a baby before it has reached full-term (37 weeks). There is a risk of delivering the baby too early when the contractions are closer, stronger, and longer. This often feels like menstrual cramping or a subtle backache (Dietl, 2005).

2.17 Proven interventions to ensuring maternal, newborn and child health

The essential services required to support a continuum of maternal and newborn care include enhanced nutrition: safe water, sanitation and hygiene facilities and practices; disease prevention and treatment; quality reproductive health services: adequate antenatal care; skilled assistance at delivery; basic and comprehensive emergency obstetric and newborn care; post-natal care: neonatal care; and Integrated Management of Neonatal and Childhood Illness (UNICEF, 2009).

2.17.1 Quality reproductive health services

A growing consensus is emerging on the importance of improving reproductive health services for young people in particular, and curbing the growing incidence of HIV and other sexually transmitted diseases among them. Building reproductive health capacity at the national level will necessitate identifying problems, setting priorities and formulating strategies with the participation of all stakeholders (UNICEF, 2009).

2.17.2 Enhanced nutrition

Adequate nutrition for adolescent girls and pregnant women is critical for the health and survival prospects of both mothers and newborns. The under-nutrition of young women, which is particularly prevalent in South Asia from an age, increases the health risks for both them and their babies. Programmes targeted towards improving maternal health are increasingly focused on enhancing the nutrition of girls and women. Increased food intake and supplementation with folic acid and iron are being encouraged during pre-pregnancy and pregnancy (UNICEF, 2009)..

Dietary diversification, the use of iodized salt and de-worming also support the health of pregnant women and mothers. Vitamin A supplementation is recommended for postpartum

women. Improved feeding practices for newborns, especially early and exclusive breastfeeding, helps protect them against disease (UNICEF, 2009).

2.17.3 Safe water, sanitation and hygiene facilities and practices

Clean delivery practices are vital to safeguard the health of mother and newborns from infections. Severe infections, which are often associated with unhygienic delivery practices and unsafe water and poor sanitation, accounted for 36 per cent of neonatal deaths in 2000. Promoting hygiene delivery practices and immunization has contributed to a significant reduction in the incidence of maternal and neonatal tetanus since 1980 (UNICEF, 2009).

Disease prevention and treatment: Interventions to prevent and heat infection diseases in pregnant women are essential complements to maternity services. Two key areas of prevention and treatment relate to HIV and malaria, particularly in sub-Saharan Africa. Although efforts to prevent and treat HIV and malaria have achieved some successes in recent years much more needs to be done to address the toll of these diseases (UNICEF, 2009).

2.17.4 Adequate antenatal care

UNICEF and WHO recommend a minimum of four antenatal visits and these enable women to receive key interventions, such as tetanus immunization, screening and treatment for infections, and vital information on complications during pregnancy and delivery. In the developing world as a whole, three-quarter of pregnant women received antenatal care from a skilled health provider though many do not receive the recommended four visits, Primary Health Centers (PHCs) are the closest contact and source of information and services for pregnant women (teenagers inclusive) as they are the first point of call among women accessing antenatal care in most communities. Thus, many women access PHCs than tertiary and secondary health care facilities because it is accessible and affordable to them (UNICEF, 2009)

2.17.5 Skilled assistance at delivery

No substitute exists for the assistance of skilled health personnel at delivery. There has been a marked increase in skilled attendance in all regions of the developing world over the past decade, except in sub-Saharan Africa (State of the World's Children, 2009).

During the 2000 – 2007 periods, skilled health workers attended 61 per cent of the total number of births in the developing world. The two regions with lowest coverage, South Asia (41 percent) and sub-Saharan Africa (45 percent) also have the highest incidence of maternal mortality. For the developing world as a whole, deliveries of women from the poorest fifth of households are around half and are likely to be attended by skilled health workers as those from the richest households (UNICEF, 2009).

WHO recommends that skilled birth attendants administer active management of the third stage of labour (which follows completed delivery of the newborn and lasts until the completed delivery of the placenta) for all mothers – a procedure that is the most widely accepted method to reduce post-partum heamorrhage, a leading cause of maternal death (UNICEF, 2009).

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This study is a descriptive and retrospective cohort review of the hospital records of pregnant women who delivered their babies at the Federal Medical Center Bida, Niger State between January 2005 and December 2009.

3.2 Study Location

The study was conducted in the antenatal clinic of the Department of Obstetrics and Gynaecology, Federal Medical Center, Bida, in Bida Local Government Area which is one of the twenty-five local government areas in Niger state. Bida is the headquarter of the Nupe kingdom, and Bida Local Government is the second largest local government area in Niger state with about 185,283 people of which 93,471 are males and 91,812 are female (National Population Commission, 2006).

There are 14 political wards with several healthcare facilities that are classified into primary, secondary and tertiary categories. The Federal Medical Centre Bida, is located in the heart of the town. FMC Bida was used for this study because it is the only tertiary health facility where proper medical records needed for this study was available.

3.3 Target Population

These consist of pregnant adolescent women ≤ 19 years and adult women 20-50 years who had antenatal care in and also delivered at the Federal Medical Centre, Bida, Niger state, Nigeria.

3.4 Sample size Determination

The sample size was determined using the formula below:

$$N = \frac{Z^{2}_{\alpha/2}\,\sigma^{2}}{d^{2}}$$

Desired level of Precision (d) (%) = 0.25%

$Z_{\alpha/2}$ (a standard normal deviate) = 1.96

σ = Standard deviation of maternal weight gain from previous study = 3.61 [Aisein, 2003]

Sample size = 801.024

The minimum sample size was rounded up to 900, to take care of "incomplete data" in some case files.

3.5 Inclusion Criteria

All deliveries by pregnant adolescent women ≤ 19 years and adult women ≥ 20 years with singleton pregnancy which is not less than 37 weeks of gestational age were included in the study.

3.6 Exclusion Criteria

Pregnant Adolescent women ≤ 19 years and adult women ≥ 20 years with multiple delivery, unbooked deliveries, history of diabetes, gestational age below 37 weeks, cardiac failure, kidney failure and blood transfusion in pregnancy were excluded from the study.

3.7 Sampling method and procedure

Records of pregnant women from 2005 to 2009 who satisfied the inclusion criteria were retrieved from the medical record department of the hospital. Selection of client case files and delivery data were performed using systematic random sampling.

The sum total of all deliveries from 2005 to 2009 were obtained from the records and divided by the calculated minimum sample size to determine the sampling interval K. a list of sampling units (sampling frame) was generated from the hospital records using their hospital numbers where the first case file was randomly selected by balloting and subsequent case files were selected using the sampling interval K. i.e. after every k^{th} interval.

$$K = \frac{\text{Total deliveries from 2005-2009}}{\text{Minimum sample size calculated}} = \frac{4797}{801} = 5.9$$

K = 6th term.

3.8 Data collection procedure

In this study, quantitative method of data collection was adopted using a medical record review guide to retrieve important information from the case files. The data extracted include socio-demographic, mothers' anthropometry, obstetric information, and infant characteristics.

3.9 Data management

Each medical record review guide was serially numbered for recall purposes. Data collected were cross checked for completeness and accuracy and stored in a safe and secure location for statistical analysis using SPSS version 15.0.

3.10 Data Analysis

Accurate coding of data obtained through the record review guide was done. Both descriptive characteristics such as simple percentages and inferential statistics such as Chi square, and logistic regression were used to analyze the quantitative data. For the inferential statistics analysis, a p-value less than or equal to 0.05 at 95% confidence interval was considered statistically significant in determining the relationship between nutritional status and pregnancy outcome.

3.11 Validity

Validity describes the ability of an instrument to measure what it is expected to measure. The objective opinion of the supervisor and experts in medical statistics were sought to ascertain the validity of the instrument used for data collection and analysis.

3.12 Ethical Considerations

Approval was obtained from the UI/UCH ethical review committee to conduct the study (NHREC/05/01/2008a). The medical record review guide was designed to ensure confidentiality of the cases. Informed consent of the Ethical Committee of the Federal Medical Centre, Bida was also obtained for permission to utilize their medical library to retrieve the client's hospital record (antenatal folders and case notes) because individual consent of the client's was not possible since the study was based on secondary data.

3.13 Limitation of the study:

The limitations of the study are;

- Since the study was based on hospital records it lacked detailed clinical information, pattern of dietary intake and socioeconomic status of the women therefore, only the available information was used.

- The study was to carry out a 5 year review of hospital records of the client's to show their weight gain in pregnancy, however, most of the client had no record of maternal weight at first trimester due to late booking and inconsistent antenatal visit, however, analysis was based on records of those who registered at the beginning of second trimester.
- There was no record of their pre-pregnancy weight which could have helped to calculate the total weight gain in pregnancy, thus weight gain was estimated based on differences in weight between the beginning of second trimester and the end of third trimester.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic Characteristics of the Respondents

The socio-demographic characteristics of the pregnant women are presented in figures 4.0, 4.1, 4.2, 4.3 and table 4.1a. A total of one thousand and thirty-seven hospital records of pregnant women received antenatal care at FMC Bida were reviewed. The largest proportions (93.9%) of the pregnant women were adults (20-50 years) while a small proportion accounting for 6.1% were adolescent (15-19 years) as shown in figure 4.0.

Figures 4.1 and 4.2 indicate the age distribution of the pregnant women. The age of the adolescent pregnant women ranged from 15-19 years while the age of the adult pregnant women ranged from 20-50 years. It is obvious in figure 4.1 that the highest proportion (44.4%) of the adolescent pregnant women were 18 years old while 23.8%, 14.3%, 11.1% and 6.3% were 19years, 15 years, 17 years, and 16 years respectively. Among the adult pregnant women (figure 4.2), those within the ages of 20-29 years had the highest proportion (76.1%) while 23%, 0.8%, and 0.2% were those within 30-39 years, 40-49 years, and 50-59 years respectively. Thus most of the adult pregnant women were below 30 years.

The majority (99.6%) of the pregnant women were married while the mean age at marriage was 17.6 ± 1.3 years and 26.2 ± 4.8 years for adolescent and the adult women respectively. One hundred percent (100.0%) of the adolescent women and 99.6% of the adult women were married. High proportions (80.1%) of these women were Muslims while 19.9% were Christian. The women were predominantly Nupe (61.2%), others were either Yoruba (13.6%), Ibo (8.7%), Hausa (8.2%), or Gwari (0.9%). Majority (72.0%) of the pregnant women were urban dwellers while 28.0% were rural dwellers as shown in table 4.1.

Figure 4.3 showed that most (36.9%) of the pregnant women were unemployed, 19.0% were petty traders, 18.4% were artisans, 14.7% were civil servants and 11.9% were students. Almost half (49.2%) of the adolescent pregnant women were student as compared with 9.6% of adult pregnant women. About 50.8% of the adolescent women were unemployed, petty traders, or artisans as compared with majority (90.4%) of the adult women who were either unemployed, petty traders or artisans ($p<0.05$). None of the adolescent pregnant women were civil servant. More than a third (37.6%) of the adult pregnant women were unemployed, 15.6% were civil servants while 46.9% were students, artisans, or petty traders ($p<0.05$).

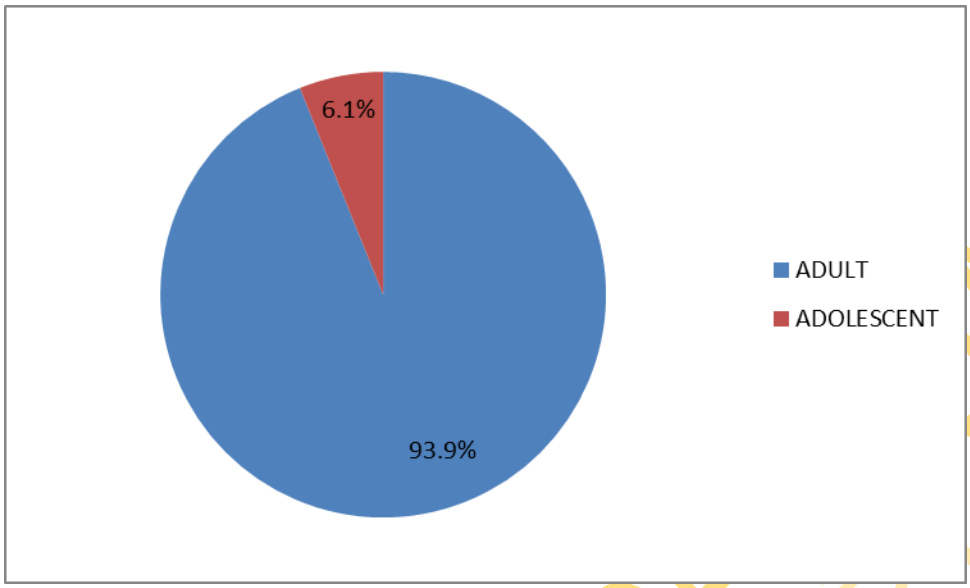


Figure 4.0 Proportion of the pregnant women studied

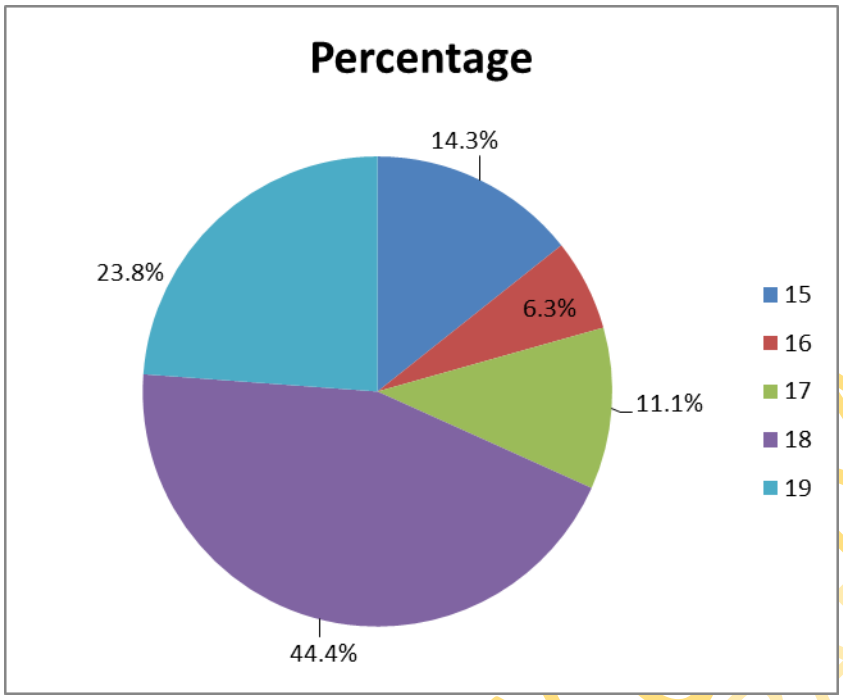


Fig 4.1: The Age (Years) Distribution of Adolescent Pregnant Women

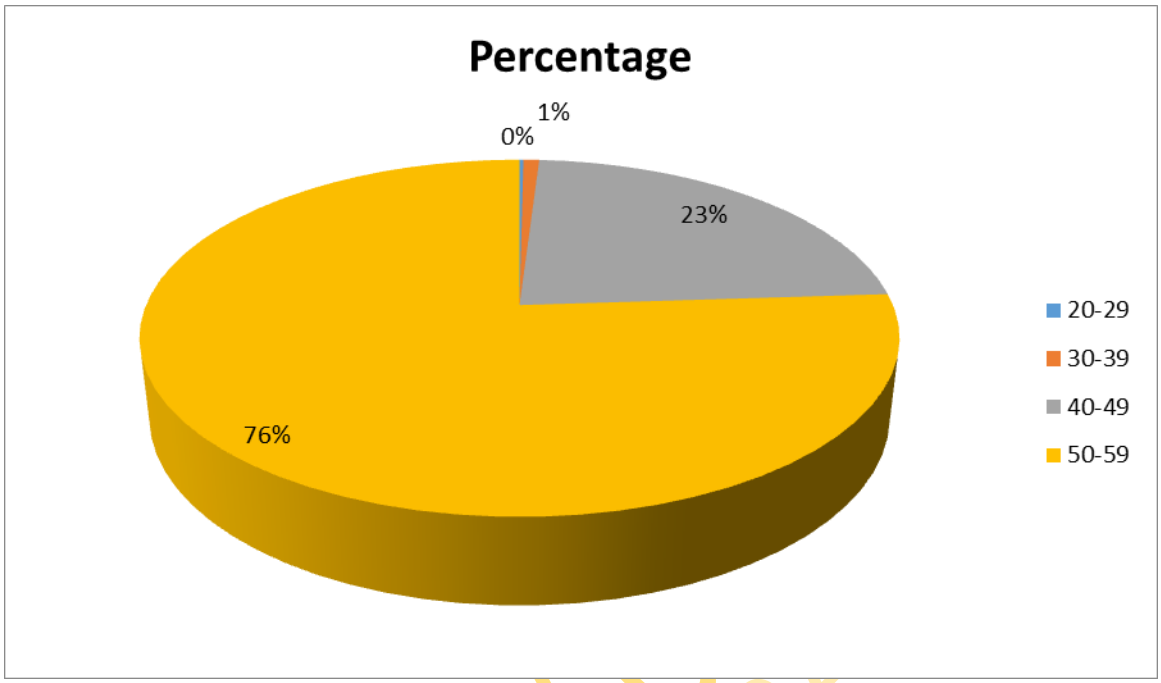


Fig 4.2: The Age (Years) Distribution of Adult Pregnant Women

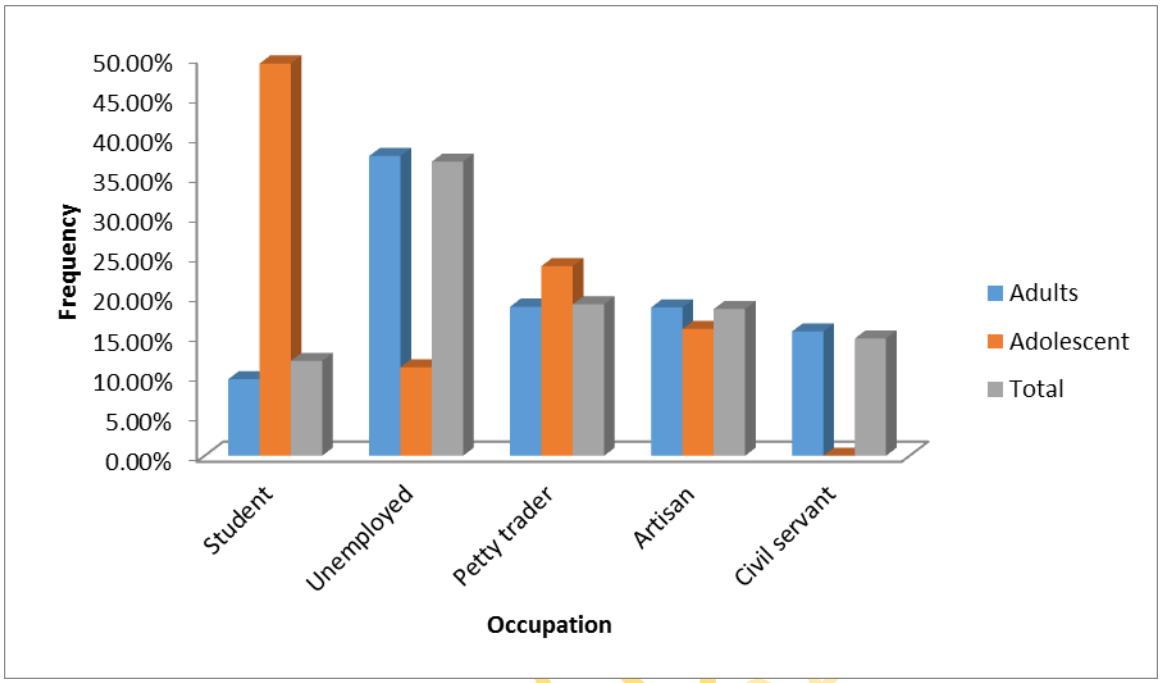


Fig 4.3 Occupation of the Pregnant Women

TABLE 4.1: Socio-Demographic Characteristics of the Pregnant Women

VARIABLE	ADULT (20-50yrs) n (%)	ADOLESCENT(15-19yrs) n (%)	GRAND TOTAL n(%)	p-value
Marital status				
Single	4(0.4)	0(0.0)	4(0.4)	
Married	970(99.6)	63(100)	1033(99.6)	0.610
Total	974(100)	63(100)	1037(100)	
Religion				
Christian	202(20.7)	4(6.3)	206(19.9)	
Islam	772(79.3)	59(93.7)	831(80.1)	0.006*
Total	974(100)	63(100)	1037(100)	
Ethnic Group				
Nupe	596(61.4)	39(61.9)	635(61.2)	
Gwari	6(0.6)	4(6.3)	10(0.96)	
Hausa	76(7.8)	9(14.3)	85(8.2)	0.185
Yoruba	140(14.4)	1(1.6)	141(13.6)	
Ibo	80(8.2)	10(15.9)	90(8.7)	
Others	74(7.6)	0(0.0)	74(7.1)	
Total	974(100)	63(100)	1037(100)	
Residence				
Urban	702(72.1)	45(71.4)	747(72.0)	0.912
Rural	272(27.9)	18(28.6)	290(28.0)	
Total	974(100)	63(100)	1037(100)	

***Indicates the socio-demographic characteristics that are significantly associated with maternal age*

4.2 Lifestyle of the Pregnant Women

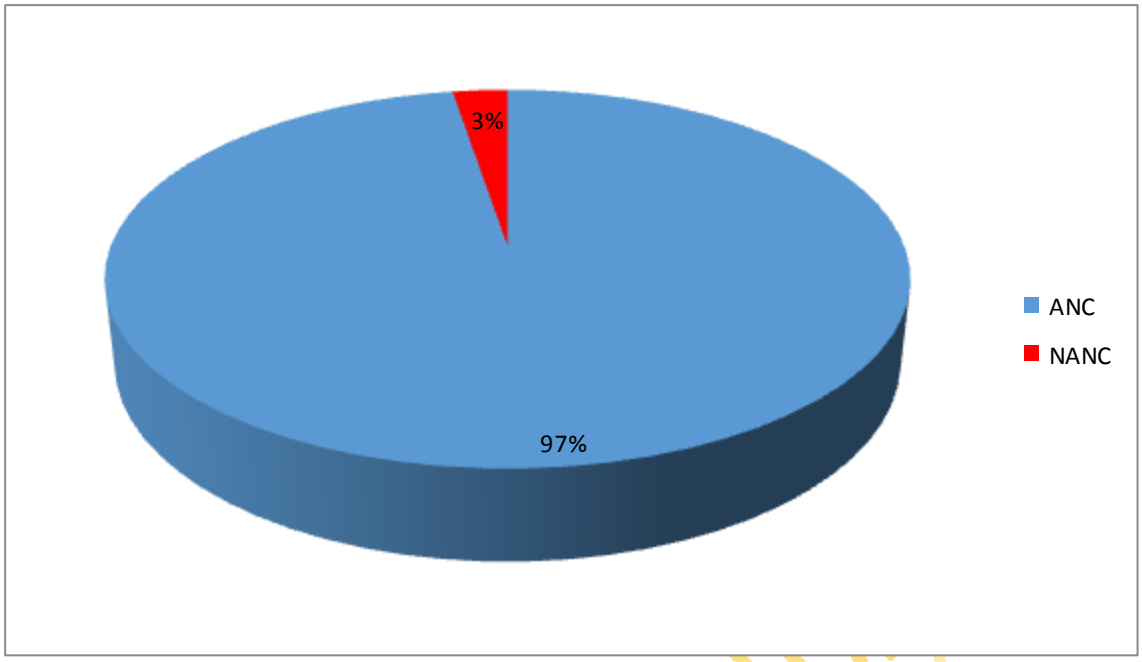
Majority (99.8%) of the pregnant women were non alcoholics while only 0.02% of the women were alcoholics. However, none of the pregnant women were smokers as shown in table4.2.

TABLE 4.2 Lifestyle of the pregnant women

Lifestyle	Adult n(%)	Adolescent n(%)	Total n(%)
Takes Alcohol			
Yes	2 (.02)	0	2(.02)
No	972(99.8)	63(100)	1035(99.8)
Total	974(100)	63(100)	1037(100)
Smoke cigarette			
Yes	0(0.0)	0(0.0)	0(0.0)
No	974(100)	63(100)	1037(100)
Total	974(100)	63(100)	1037(100)

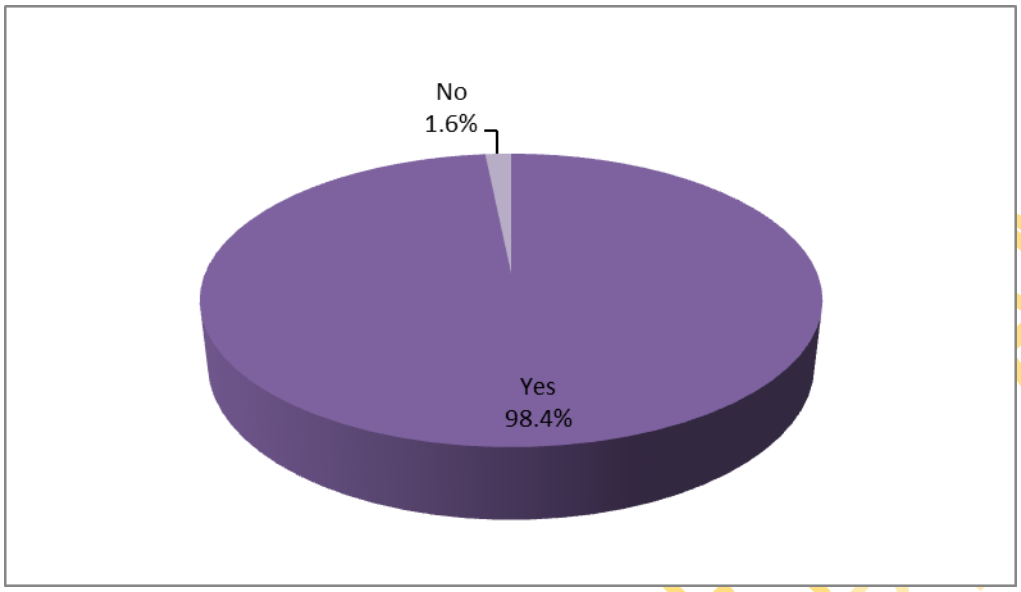
4.3 Proportion of Women who had access to regular Antenatal Care

Figures 4.4&4.5 show that a large proportion (97.5%) of the pregnant women had access to regular antenatal care while 2.5% did not. More of the adult pregnant women (2.6%) compared to a small proportion (1.6%) of the adolescent pregnant women did not have access to regular antenatal care ($p>0.05$).



Key: ANC: had regular antenatal care, NANC: no antenatal care.

Figure 4.4 Proportion of Adult Pregnant Women who had Access to Regular Antenatal Care



KEY: Yes: Had access to antenatal clinic, No: No access to antenatal clinic

Figure 4.5 Proportion of Adolescent Pregnant Women who had Access to Regular Antenatal Care

4.4 Obstetric (Clinical) information of the pregnant women

Table 4.3 shows the clinical information of the pregnant women. About (11.0%) of the pregnant women booked at 1st trimester, 46.0% and 43.5% of the pregnant women booked at second and third trimesters respectively while majority (44.4%) and 46.1% of the adolescent and adult pregnant women respectively booked at 2nd trimester. The mean gestational age at booking was 24.3±6.9 and 23.8±7.1weeks for the adolescent and adult women respectively. The majority (74.6%) of the adolescent as compared with (32.1%) of adult women had no previous delivery while 25.6% of adult as against 1.6% of adolescent mothers had ≥4 previous deliveries with a mean parity of 2.3±1.0 (adult) and 0.0±0.0 (adolescent). About (46.0%) of the pregnant women had inter-pregnancy spacing of >2 years. More of the adults (14.3%) compared to the adolescent mothers (10.4%) had inter-pregnancy spacing < 2years. Majority (91.6%) of the women had no infection in pregnancy, however, 5.2% had urinary tract infection (UTI) and others (3.1%) had wart, herpes, malaria, catarrh or cough. A high proportion (96.7%) of the women did not have nausea or vomiting in pregnancy.

Table 4.3: Obstetric (Clinical) information of the pregnant women

Variables	Adult n (%)	Adolescent n (%)	Grand Total n (%)	p-value
Trimester at booking (weeks)				
First trimester(0-12)	101(10.4)	8(10.4)	109(10.5)	
Second trimester(13-24)	449(46.1)	28(44.4)	477(46.0)	0.841
Third trimester(25-42)	424(43.5)	27(42.9)	451(43.5)	
Total	974(100.0)	63(100.0)	1037(100.0)	
Parity				
0	313(32.1)	47(74.6)	360(34.7)	
1	72(7.4)	4(6.3)	76(7.3)	
2	200(20.5)	8(12.7)	208(20.1)	
3	140(14.4)	3(4.8)	143(13.8)	0.000*
≥4	249(25.6)	1(1.6)	250(24.1)	
Total	974(100)	63(100.0)	1037(100)	
Interpregnancy spacing(years)				
<2yrs	101(10.4)	9(14.3)	110(10.6)	
>2yrs	449(46.1)	27(42.9)	476(45.9)	0.000*
None	424(43.5)	27(42.9)	451(43.5)	
Total	974(100)	63(100)	1037(100)	
Infection in pregnancy				
UTI	51(5.2)	3(4.8)	54(5.2)	
Herpes	2(0.2)	0(0.0)	2(0.2)	
Viral wart	1(0.1)	3(4.8)	3(0.3)	0.904
Others	27(2.8)	0(0.0)	27(2.6)	
None	893(91.7)	57(90.5)	950(91.6)	
Total	974(100.0)	63(100.0)	1037(100.0)	
Nausea and Vomiting				
Yes	34(3.5)	0(0.0)	34(3.3)	
No	940(96.5)	63(100)	1003(96.7)	0.289
Total	974(100.0)	63(100.0)	1037(100.0)	

*shows the socio-demographic variables that are significantly associated with age category

4.5 Mean Blood Pressure in Pregnancy

The mean systolic blood pressure of the pregnant women at first, second, and third trimesters were 120.4±14.5mm/Hg, 130.4±14.5mm/Hg, 138.7±12.5mm/Hg and 110.0±10.3mm/Hg, 115.0±12.5mm/Hg, 125.0±15.7mm/Hg for adolescent and adult pregnant women respectively. The women's mean diastolic pressure were 90.5±11.2mm/Hg, 94.8±11.2mm/Hg, 100.0±9.2mm/Hg and 80.0±12.4mm/Hg, 82.6±10.4, 85.6±12.4mm/Hg for adolescent and adult women respectively as shown in tables 4.4, 4.5, and 4.6.

Table 4.4: Mean blood pressure of the pregnant women at first trimesters

Mean blood pressure(mm/Hg)	Adult	Adolescent	pvalue
Systolic BP at 1st trimester	110.0±10.3	120.4±14.5	p<0.05
Diastolic BP	80.0±12.4	90.5±11.2	

Table 4.5: Mean blood pressure of the pregnant women at second trimester

Mean blood pressure(mm/Hg)	Adult	Adolescent	p-value
Systolic BP at 2nd trimester	115.0±12.5	130.4±14.5	p<0.05
Diastolic BP at 2nd trimester	82.6±10.4	94.8±11.2	

Table 4.6: Mean Blood Pressure of the Pregnant Women at Third Trimester

Mean blood pressure(mm/Hg)	Adult	Adolescent	p-value
Systolic BP at 3rd trimester	125.0±15.7	138.7±12.5	p<0.05
Diastolic BP at 3rd trimester	85.6±12.4	100.0±9.2	

Table 4.7 Incidence of Anaemia at Delivery among the Pregnant Women

Maternal packed cell volume at delivery (%)	Adult n(%)	Adolescent n(%)	Total n(%)	p- value
<30%(anaemic)	301(30.9)	23(36.5)	324(31.2)	
≥30%(not anaemic)	673(69.1)	40(63.5)	713(68.8)	0.352
Total	974(100)	63(100)	1037(100)	

Table 4.8 Packed Cell Volume (PCV) of the Pregnant Women According to Trimester

Packed cell volume (%)	Adult	Adolescent	p- value
Mean PCV at first trimester	30.9±4.0	29.4±4.7	
Mean PCV at second Trimester	31.4±3.9	30.5±4.0	p>0.05
Mean PCV at third Trimester	32.9±4.0	28.4±4.1	

4.6 Packed Cell Volume (PCV) of the Pregnant Women according to Gestational Age at Delivery

About a third (30.9%) of the adult and 36.5 % of the adolescent pregnant women had PCV below 30% (anaemic) at delivery, which was not significantly different ($p>0.05$) as shown in fig4.7 Adolescent pregnant women had a mean PCV of 29.4±4.7%, 30.5±4.0 % and 28.4±4.1% at first, second and third trimesters respectively, as compared to adult women 30.9±4.0%, 31.4±3.9% and 32.9±4.0% respectively as shown in table 4.8. Figure 4.6, 4.7, and 4.8 showed the incidence of anaemia among the pregnant women. About 54.5% of adult pregnant women were anaemic at first trimester compared to 37.5% of adolescent pregnant women. However, a significantly ($p<0.05$) higher proportion (64.3%) of adolescent pregnant women compared to adult women (44.5%) were anaemic at second trimester (fig4.7). There was no significant difference ($p>0.05$) between the proportion of adult pregnant women (48.1%) and adolescent pregnant women (37.0%) who were anaemic at the end of the third trimester(fig.4.8).

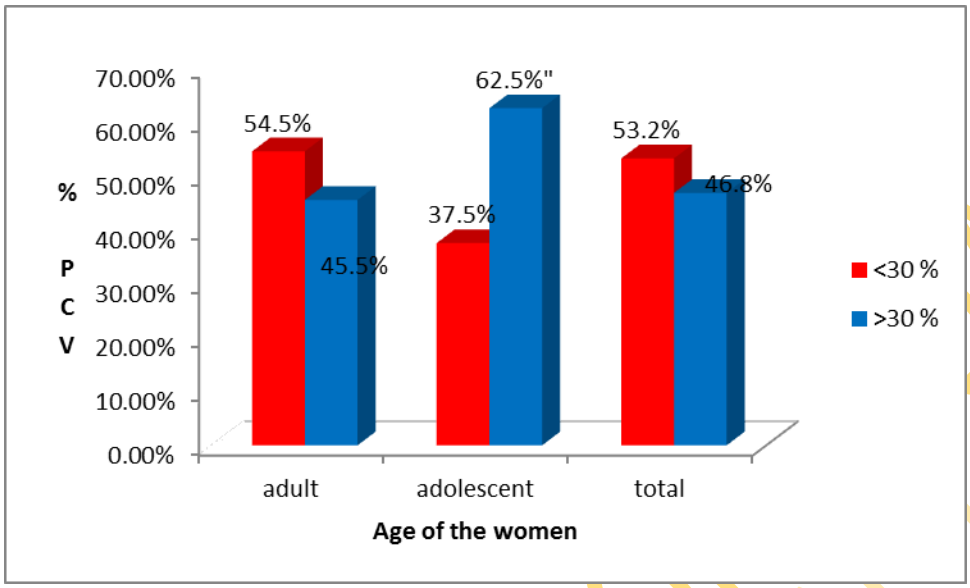


Fig 4.6 Incidence of anaemia among the pregnant women at beginning of first trimester

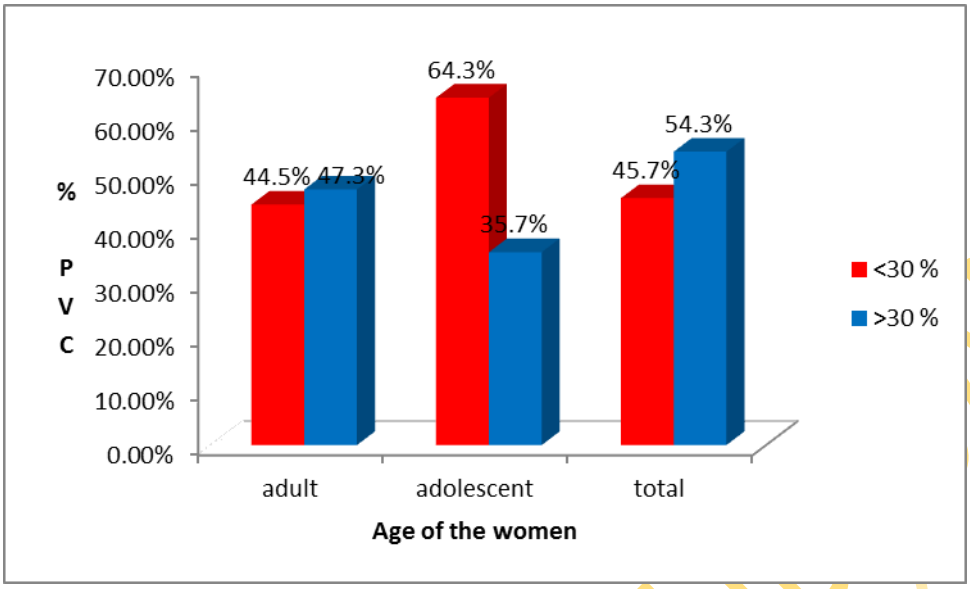


Fig 4.7 Incidence of Anaemia among the Pregnant Women at the Beginning of Second Trimester (of ANC)

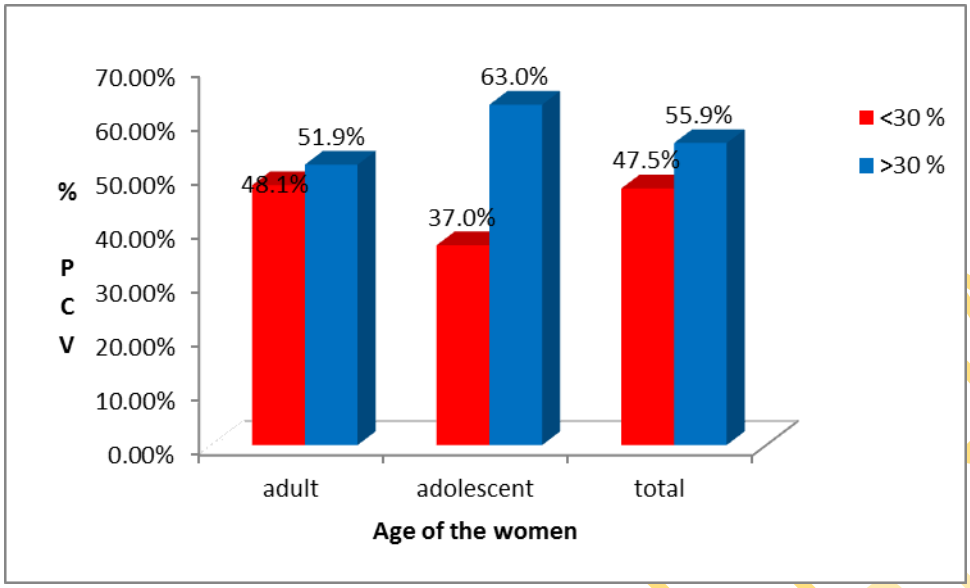


Fig 4.8 Incidence of Anaemia among the Pregnant Women at Beginning of Third Trimester (of ANC)

4.7 Anaemia and Parity

Figure 4.9 shows that the incidence of anaemia was significantly higher (55.8%),($p<0.05$)at delivery among grandmultiparous (≥4children) than multiparous (1-3children) (43.9%) and primiparous (no previous child) mothers (50.1%). There was no significant difference ($p>0.05$) in the proportion (36.5%) of adolescent women and 30.9% of adult women who were anaemic (<30%).

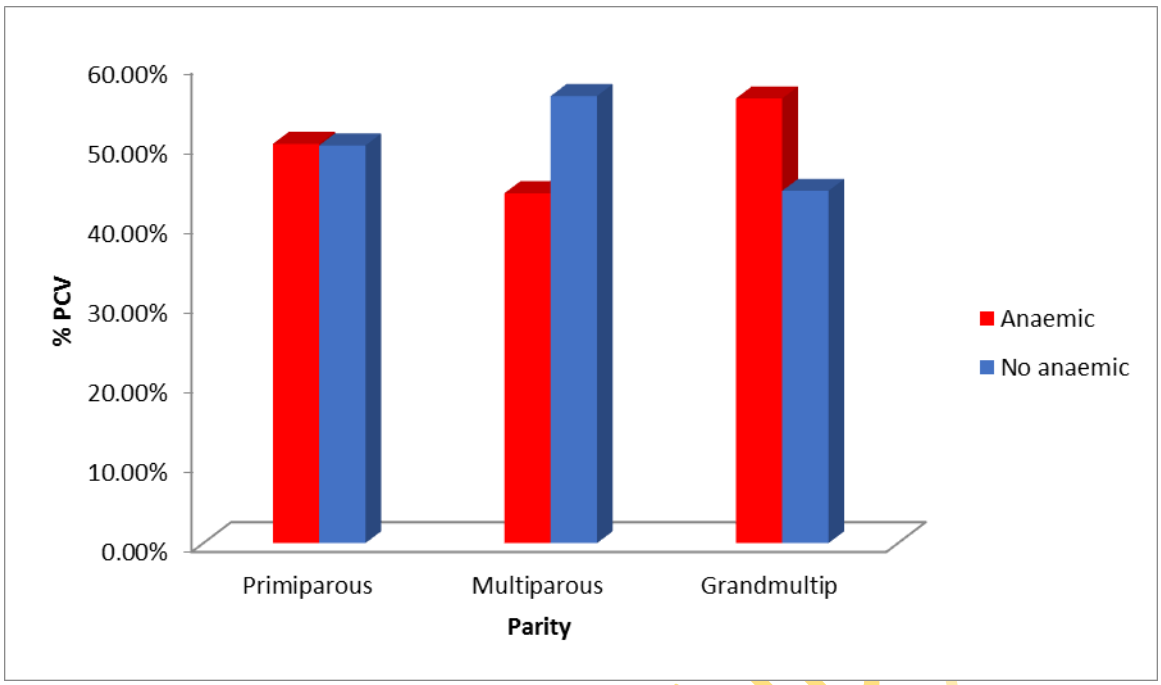


Figure4.9 Incidence Anaemia among Mothers Based on Parity

4.8 Pregnancy Complications

The following antenatal complications were more common among adolescent than adult pregnant women; gestational diabetes, gestational hypertension (preeclampsia) and obstructed labour while feotal distress, placenta previa and premature rupture of membrane (prom) were more common among the adult pregnant than the adolescent pregnant women. Tables 4.9 shows that majority (84.3% and 79.4%) of the adult and adolescent pregnant women had no pregnancy complications, However, antepartum complication in pregnancy was significantly higher among adolescent (20.6%) than adult pregnant women (15.7%), ($p<0.05$).

The proportion (14.3%) of gestational hypertension was significantly higher among the adolescent than 5.2% of adult women ($p<0.05$) while gestational diabetes was higher (6.1%) among adult women than the adolescent women (1.6%) as shown in table 4.10.

Table 4.9: The Incidence of Antepartum Complications among Pregnant Women

Complication in Pregnancy	Adult	Adolescent	Total	p-value
	n (%)	n(%)	n (%)	
Had complications	153(15.7)	13(20.6)	166(100)	p<0.05
Had no complications	821(84.3)	50(79.4)	871(100)	
Total	974(100)	63(100)	1037(100)	

Table 4.10: Types of Antepartum Complications experienced by the Pregnant Women

Complications in Pregnancy	Adult	Adolescent	Total	p-value
	n(%)	n (%)	n (%)	
Gestational diabetes				
Yes	6(0.6)	1(1.6)	7(0.7)	
No	968(99.4)	62(98.4)	1030(99.3)	0.352
Total	974(100.0)	63(100.0)	1037(100.0)	
Gestational hypertension	51(5.2)	9(14.3)	60(5.8)	
Yes	923(94.8)	54(85.7)	977(94.2)	0.003*
No	974(100.0)	63(100.0)	1037(100.0)	
Total				
Obstructed labour				
Yes	45(4.6)	4(6.3)	49(4.7)	
No	929(95.4)	59(93.7)	988(95.3)	0.012*
Total	974(100.0)	63(100.0)	1037(100.0)	
Foetal disress				
Yes	23(2.4)	0(0.0)	23(2.2)	
No	951(97.6)	63(100.0)	1014(97.8)	0.523
Total	974(100.0)	63(100.0)	1037(100.0)	
Placental previa				
Yes	3(0.3)	0(0.0)	3(0.3)	
No	971(99.7)	63(100.0)	1034(99.7)	0.760
Total	974(100.0)	63(100.0)	1037(100.0)	
Premature rupture of membrane				
Yes	7(0.7)	0(0.0)	7(0.7)	
No	967(99.3)	63(100.0)	1030(99.3)	0.576
Total	974(100.0)	63(100.0)	1037(100.0)	

**Indicate the antepartum complications that were significantly associated with maternal age*

4.9 Mode of delivery among the pregnant women

The mode of delivery among the pregnant women is presented in table 4.11. Majority (82.1%) of the pregnant mother had spontaneous vaginal delivery. However, the proportion (82.3%) of adult mothers who had spontaneous vaginal delivery was significantly higher compared to 79.4% of adolescent mothers ($p<0.05$). Few (16.8%) and (14.3%) of adult and adolescent mothers had their babies through caesarean section. Assisted vaginal delivery was significantly common among adolescent mothers than adult mothers ($p<0.05$).

Table 4.11: Mode of Delivery of the Pregnant Women

Mode of delivery	Adult n (%)	Adolescent n (%)	Total n (%)	p-value
Spontaneous vaginal delivery	802(82.3)	50(79.4)	852(82.1)	
Caesarean section	164(16.8)	9(14.1)	173(16.7)	0.000
Assisted vaginal delivery	8(0.8)	4(7.8)	13(1.3)	
Total	974(100)	63(100)	1037(100)	

4.10 Postpartum Complications experienced by the Pregnant Women

Postpartum heamorrhage was observed to be significantly higher among adolescent (4.8%) than in 1.3% of adult mothers ($p<0.05$) as shown in table 4.7c. On further analysis, the following variables; ethnicity, maternal height, weight at delivery, PCV, blood pressure, gestational age at delivery, mode of delivery, apgar score, infant sex, infant birth weight, foetal presentation and foetal outcome influenced pregnancy complications among the pregnant women as shown in tables 4.12.

Table 4.12: Postpartum complications experienced by the Pregnant Women

Post partum complication	Adult n(%)	Adolescent n(%)	p-value
Post partum heamorrhage	13(1.3)	3(4.8)	0.002
No postpartum heamorrhae	961(98.7)	60(96.2)	
Total	974(100)	63(100)	

4.11 Comparison between Pregnancy Complications among the Pregnant Mothers

Table4.13 showed the biviariate analysis of pregnancy complications between adolescents and adult mothers. A higher proportion of adolescents had gestational hypertension (14.1%) compared to adults (5.2%), (p=0.003). Also, a higher proportion (4.8%) of adolescent pregnant women had postpartum complications compared with 1.3% of adult pregnant women. This was also statistically significant (p=0.003) as shown in table4.14. The logistic regression analysis of pregnancy complications among adolescents and adults pregnant women showed that after adjusting for other variables, adolescent women were about three times more likely to have gestational hypertension compared to adult women (OR=2.712, 95%CI=1.169-6.295) also, adolescents were about three times more likely to have postpartum complications compared to adults (OR=2.874, 95%CI=0.751-10.990), this was however not significant.

Table 4.13: Biviariate Analysis of pregnancy complications among Adolescents and Adult Mothers

Variable	Adolescent's n (%)	Adult's n (%)	Total n (%)	Chi square	p-value
Gestational hypertension					
Yes	9 (14.3)	51 (5.2)	60 (5.8)	8.590	0.003*
No	54 (85.9)	923 (94.8)	977 (94.2)		
Anaemia					
Yes	23 (35.9)	301 (30.9)	324 (31.2)	0.709	0.400
No	40(64.1)	673 (69.1)	713 (68.8)		
Postpartum complications					
Yes	3 (4.8)	13 (1.3)	16 (1.6)	9.007	0.003*
No	60 (95.2)	961 (98.7)	1021(98.4)		

***Indicate the pregnancy complications that were significant*

Table 4.14: Logistic Regression of pregnancy complications among Adolescent and Adult Mothers

VARIABLE	ODDS RATIO	p-Value	95% CI
Gestational hypertension			
Yes	2.712	0.020*	1.169-6.295
No(ref)			
Post partum complications			
Yes	2.874	0.123	0.751-10.990
No (ref)			

***Indicate that gestational hypertension was significant*

4.12 Anthropometry Characteristics of the Pregnant Women

4.12.1 Maternal Height

The height distribution of the pregnant women is shown in figure 4.10. The adolescent women height ranged from 1.42 m-1.55 m with a mean value of 1.58±0.07 m while the height of adult pregnant women ranged between 1.22 m-1.89 m with a mean height of 1.59±0.07m. There was no significant difference in the mean height of the adolescent women and the adult women ($p>0.05$). A lower proportion (60.6%) of the adult pregnant women as compared with adolescent pregnant women (63.5%) had their height below 1.61m ($p<0.05$).

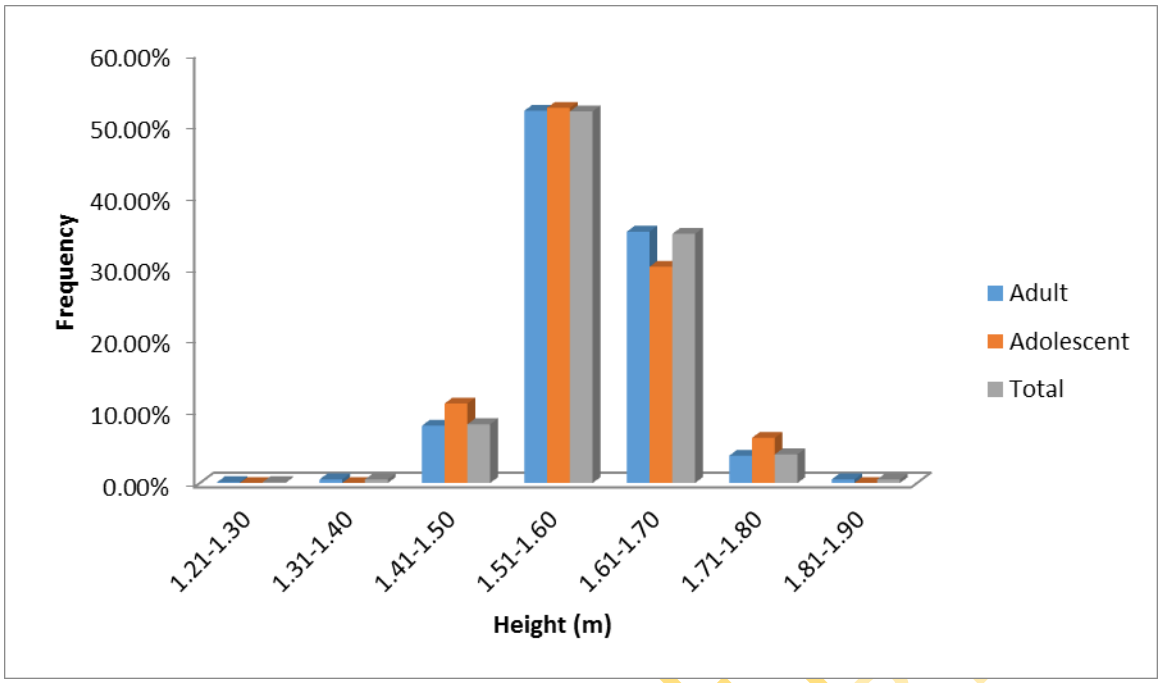


Figure4.10: Height distribution of the Pregnant Women (m)

4.12.2 Maternal Weight and Weight Gain

Table 4.15 shows the mean weight of the adolescent and adult pregnant women during the 1st, 2nd and 3rd trimesters. The mean weights (58.9±7.5kg, 60.4±8.0kg and 65.1±8.1kg) of the adolescent pregnant women at 1st, 2nd and 3rd trimesters were significantly lower as compared to (64.5±11.6kg, 68.0±13.7kg and 71.2±13.2kg) of the adult pregnant women ($p<0.05$).

Table 4.16 shows the mean weight gain of pregnant women that is the end of the second (24th week) and the end of the third trimester (≥37th week) in relation to their age groups. The adolescent (15-19 years) pregnant women had a mean weight gain of 4.7kg. The adult pregnant women in categories (20-29 years), (30-39 years), and (40-50 years) gained 7.5kg, 6.3kg, and 3.0kg respectively through their pregnancy period.

Table 4.15: The Mean Weight of Pregnant Women at the end of first, second and third Trimesters

Age category of women	Mean weight at the end of First Trimester(kg)	Mean weight at the end of second Trimester(kg)	Mean weight at end of third Trimester(kg)	Pvalue
Adolescent pregnant women	58.9±7.5 N=8(10.4%)	60.4±8.0 N=36(57.1%)	65.1±8.1 N=63(6.1%)	P<0.05
Adult pregnant women	64.5±11.6 N=101(10.4%)	68.0±13.7 N=550(56.5%)	71.2±13.2 N=974(93.9%)	

Table 4.16: The mean weight gain of the pregnant women from the end of second trimester to the end of third Trimester in relation to their ages (for 3rd trimester)

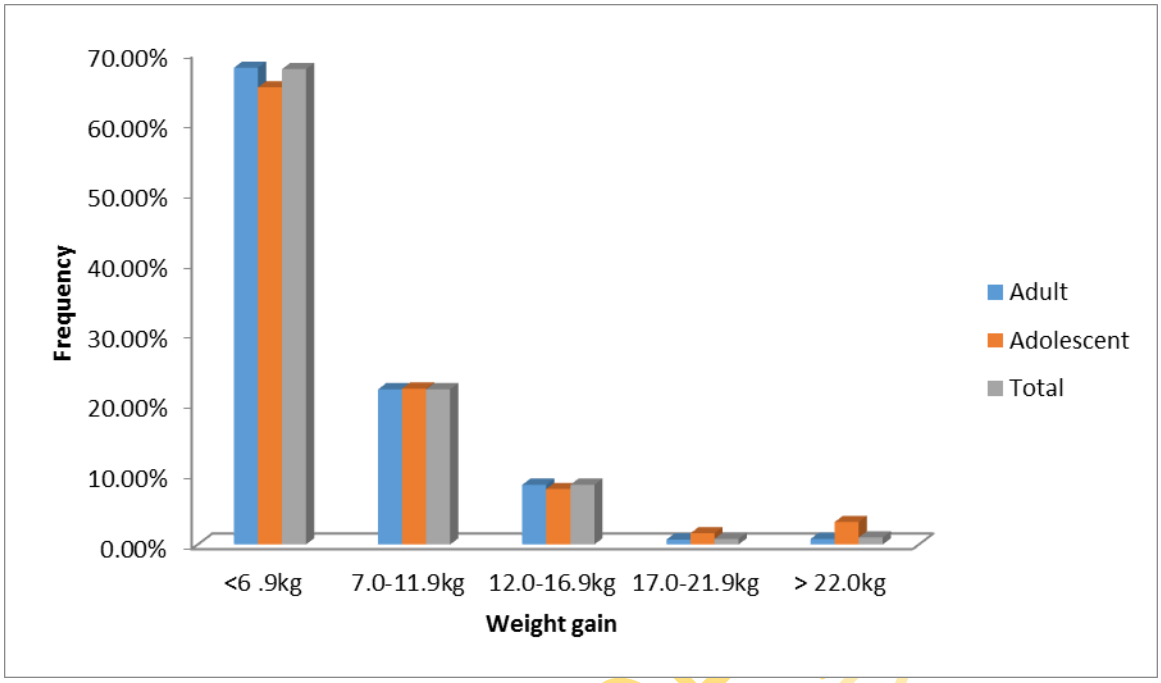
Age category (years)	Mean weight at end of second trimester(kg)	Mean weight at end of third trimester (kg)	weight gain (kg)	**p-value**
15-19	60.4±8.0	65.1±8.1	4.7±0.7	
20-29	69.9±12.0	76.6±11.4	6.7±1.6	p<0.05
30-39	75.1±15.3	84.0±16.0	6.3±1.3	
40-49	85.0±8.9	92.9±6.9	7.9±2.1	
50+	86.2±15.4	88.2±19.6	3.0±0.2	

4.12.3 The mean maternal weight gain at the end of 3rd trimester and Body Mass Index (BMI) of the pregnant women.

The distribution of the mean weight gain of the pregnant women from the beginning of second trimester to the end of third trimester is shown in table 4.17 and figure 4.11. Figure 4.11 shows that higher proportion (67.7%) of the pregnant women gained ≤ 6.9 kg at the end of the third trimester while only 1.0% gained ≥22kg at the end of third trimester as shown in figure4.11. A significant proportion (67.9%) of the adult pregnant women gained ≤ 6.0kg as compared to 65.1% of the adolescent pregnant women ($p<0.05$). The proportion (35.9%) of the adolescent that gained above 7.0kg at the end of the third trimester was higher compared to adult pregnant women (32.1%). The mean pregnancy weight gain (6.4±3.1kg) of the adolescent women was significantly lower when compared with (6.7±4.1kg) of the adult pregnant women at the end of third trimester as indicated in table 4.16 ($p<0.05$). However, the pregnant women had significantly higher mean weight gain in pregnancy as their age increases ($p<0.05$).

Tables 4.17 and 4.18 showed the proportion of the pregnant women in relation to their mean BMI at booking and delivery where more (6.3%) of adolescent women were underweight at booking compared with (2.8%) of adult women, however, more (20.2%) of the adults were obese as compared with 1.6% of adolescent women, meanwhile, at delivery 30.2% of the adolescent were underweight compared with 15.5% of adult women and 22.5% of adults were overweight compared with 4.8% of adolescents as shown in Fiure4.12. Table 4.19 presented the mean BMI of the pregnant women at1st, 2nd and 3rd trimester. The adult women had higher mean BMI (20.7±1.6 kg/m^2, 25.7±4.1kg/m^2 and 28.0±4.9kg/m^2) compared with (18.3±1.1 kg/m^2, 22.0±2.2 kg/m^2 and 25.3±3.6 kg/m^2) of the adolescent women, however, the mean BMI at delivery of the adolescent women was 25.3±3.6kg/m^2 while that of adult women was 28.0±4.9kg/m^2.

In summary, the following variables were found to be the predisposing factors of maternal body mass index; age, religion, ethnicity, occupation, height, weight and weight gain at delivery, ANC, parity, inter-pregnancy spacing, PCV, blood pressure, postpartum complication, gestational age at delivery, gestational age at birth, infant birth weight, and foetal outcome as shown in appendix XIII-XVI.



Weight gain (kg) N(586 ie56.2% of total)

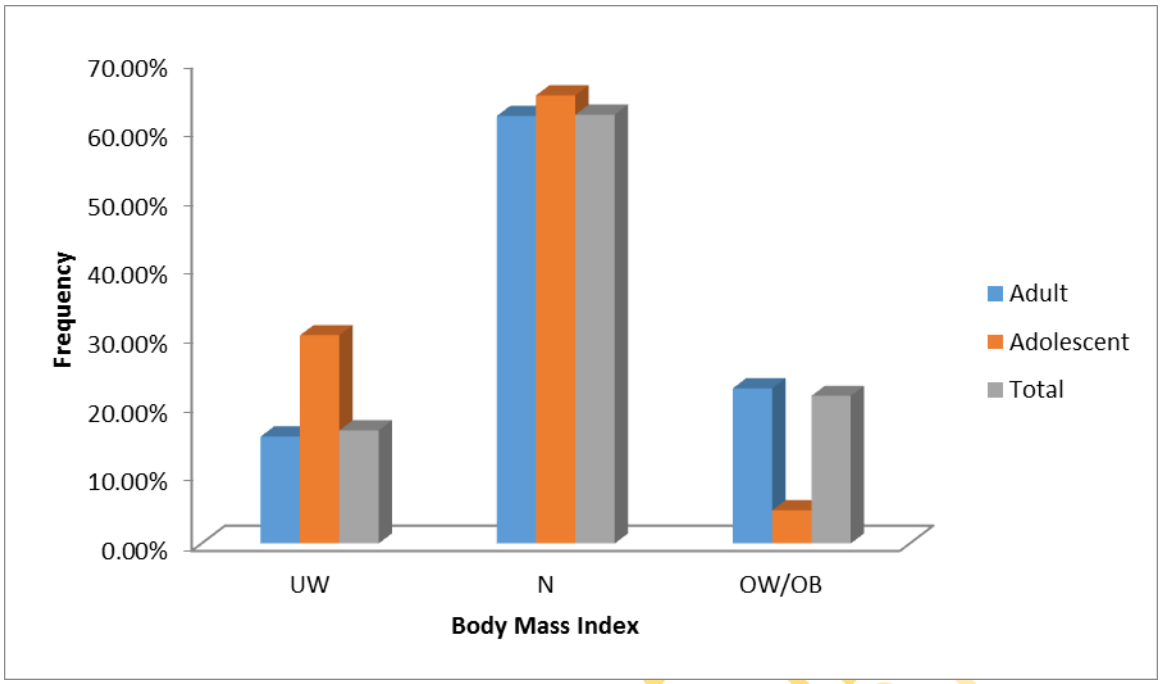
Figure.4.11 Proportion of Pregnant Women according to Their Weight Gain from the beginning of second trimester to the end of Third Trimester

Table 4.17: Mean Weight Gain of the Pregnant Women between the beginning of second trimester and the end of 3rd Trimester.

Age category	No of pregnant women N (%)	Mean weight gain(kg)	S.D	P value
Adolescent	63(6.08)	6.4	3.1	p<0.05
Adult	974(93.92)	6.7	4.1	
Total	1037(100)	6.6	3.6	

Table 4.18: Proportion of pregnant women in relation to their Maternal BMI at Booking.

Variable	Adult n (%)	Adolescent n (%)	Total n (%)
BMI at first ANC(kg/m^2)			
Underweight(<18.5kg/m^2)	26(2.8)	4(6.3)	30(2.9)
Normal(18.5-24.9kg/m^2)	451(48.2)	42(66.7)	493(47.5)
Overweight(25.0-30.0kg/m^2)	300(30.8)	16(25.4)	316(30.5)
Obese(>30.0kg/m^2)	197(20.2)	1(1.6)	198(19.1)
Total	974(100)	63(100)	1037(100)



Key: UW: Underweight (BMI < 18.5kg/m^2), N: Normal BMI (18.5-24.9kg/m^2), OW/OB: Overweight/Obese (≥ 25.0kg/m^2).

Fgure4.12 :Proportion the pregnant women in relation to their body mass index (BMI) at delivery

Table 4.19: Mean Body Mass Index of the pregnant women at first, second and third trimesters

Age category	Mean BMI at 1st trimester (kg/m^2)	Mean BMI at 2nd trimester(kg/m^2)	Mean BMI at 3rd trimester(kg/m^2)	p-value
Adolescent pregnant	18.3±1.6	22.0±2.2	25.3±3.6	P<0.05
Adult pregnant	20.7±1.1	25.7±4.1	28.0±4.9	

4.12.4 Comparison between Maternal Height and Mean Weight Gain

Adolescent pregnant women whose heights were within 1.41-1.50m and 1.51-1.60m gained 4.8kg and 6.6kg respectively as shown in Table 4.20 while adult pregnant women whose heights were within 1.51-1.60m and 1.61-1.70m had higher mean weight gains of 7.7kg and 7.1kg respectively as against those whose height was <1.40m as in table 4.21 Therefore, the highest weight gain was observed among pregnant women whose heights fell within 1.51-1.61m. However, occupation, maternal height, nausea/vomiting, PCV and blood pressure were positively associated with total weight gain in pregnancy among the pregnant women as shown in appendix V-VIII.

Table 4.20: The Weight Gain at the End of 3rd Trimester in Relation to Height for Adolescent Mothers

Height	Mean Weight at 2nd (kg)Trimester	Mean Weight at 3rd Trimester(kg)	Mean Weight gain(kg)
1.41-1.50m	55.8±3.4	60.6±6.2	4.8±1.0
1.51-1.60m	59.9±8.2.	66.5±9.3	6.6±2.2
1.61-1.70m	66.3±8.0	72±7.1	5.7±1.6.
1.71-1.90m	53.0±9.0	58.0±7.1	5.0±1.2

Table 4.21: Mean Weight at the end of 3rd Trimester in relation to Height for Adult Mothers

Height (m)	Mean Weight at 2nd (kg)Trimester	Mean Weight at 3rd Trimester(kg)	Weight gain(kg)
≤1.40	54.5±9.1	59±7.8	4.5±2.1
1.41-1.50	58.9±9.5	65.1±8.1	6.2±2.9
1.51-1.60	65.5±7.4	73.2±10.3	7.7±4.1
1.61-1.70	72.2±10.2	79.3±9.2	7.1±3.0
1.71-1.90	77.7±12.1	82.9±5.0	5.2±2.7

Table 4.22: Determinants of total weight gain in pregnancy

Variables	X^2	p-values
Nausea/vomiting	40.07	
Packed Cell Volume(PCV)	386.33	
Blood pressure	20.22	p<0.05
Occupation	38.16	
Maternal height	434.87	

4.13 Comparison between Mean weight and Weight Gain in Relation to Parity and gestational age

The distribution of mean maternal weight and weight gain in relation to parity at the end of third trimester is shown in tables 4.23, 4.24&4.25. The weight of the pregnant women increased in relation to parity and gestational age of the infant at each trimester as shown in tables4.23&4.24.

The primiparous and multiparous adolescent pregnant women gained lower weight (4.3kg and 5.4kg respectively) as compared to 6.7kg and 7.5kg gained by primiparous and multiparous adult pregnant women as their age and parity increases as shown in table 4.25 however, as parity increased for adolescent women their weight gain decreased, but for the adult pregnant women weight gain increased with increase in parity.

Table 4.23: Mean Weight of Adult Pregnant Women in Relation to Parity and Gestational Age

Parity	Mean weight at 1st trimester (kg)	Mean weight at 2nd trimester (kg)	Mean weight at 3rd trimester (kg)
0	62.1±12.4	63.7±11.0	67.0±10.4
1	60.5±4.0	65.1±13.8	68.2±13.7
2	63.7±12.1	67.7±13.9	70.8±14.1
3	64.4±9.3	71.65±13.9	71.8±13.9
≥4	66.7±11.9,	72.2±14.9	75.2±14.1

Table 4.25: Mean Weight of Adolescent Pregnant Women in Relation to Parity and Gestational Age

Parity	Mean weight at 1st trimester (kg)	Mean weight at 2nd trimester (kg)	Mean weight at 3rd trimester (kg)
0	59.6±9.2	61.4±8.2	63.9±8.6
1	61.0±7.2	63.0±3.6	66.5±2.4
2	54.0±3.6	55.5±4.3	57.4±3.8
3	-	56.0±5.2	59.2±9.0

Table 4.25: Mean weight gain of the pregnant women at the end of 3rd trimester in relation to parity.

Parity	Mean weight gain of adolescent (kg)	Mean weight gain of adult (kg)	p-value
0	4.3±0.2	5.1±2.9	
1	5.5±1.7	7.1±1.7	
2	3.4±1.5	7.4±1.4	P<0.05
3	3.2±1.8	7.7±2.0	
≥4	-	8.5±3.5	

4.14 Infant Characteristics

Table 4.26 showed the infants characteristics. Higher proportion (52.2%) of the infants were males as compared to 47.8% females. 89.5% of the mothers gave birth within 37-42 gestational

weeks while 10.5% delivered at >42gestational weeks. Majority (74.3%) of the infants had normal birth weight (2.5kg-3.5kg), 9.5% of the adolescent mothers as compared to 7.1% of the adult mothers had low birth weight babies (<2.5kg), the mean infant birth weight for adolescent mothers 3.0±0.4kg was significantly different from while the adult mothers 3.2± 0.5kg ($p<0.05$). Higher proportion (80.7%) of the infants had good apgar score while 19.2% had mild to moderate apgar score. 94.4% of the infant had cephalic presentation at birth as against 5.3% and 0.3% breech and transverse presentation respectively.

Table 4.26: Newborn/Infant Characteristics

Variables	Adult N (%)	Adolescent N (%)	Grand total N (%)	p-value
Infant sex				
Males	513(52.7)	28(44.4)	541(52.2)	
Female	461(47.3)	35(55.6)	496(47.8)	0.205
total	974(100)	63(100)	1037(100)	
Gestational age at birth(wks)				
37-42	867(89.7)	61(96.8)	928(89.5)	
>42	100(10.3)	2(3.2)	102(10.5)	0.065
Total	974(100)	63(100.0)	1037(100)	
Apgar score				
Good	787(80.8)	50(79.4)	837(80.8)	
Mild	104(10.7)	8(12.7)	112(10.8)	0.001*
Moderate	40(4.1)	4(6.3)	44(4.2)	
Severe	43(4.4)	1(1.6)	44(4.2)	
Total	974(100.0)	63(100.0)	1037(100.0)	
Infant birth weight(kg)				
< 2.5	69(7.1)	6(9.5)	75(7.2)	
2.5-3.5	720(73.9)	50(79.4)	770(74.3)	0.000*
>3.5	185(19.0)	7(11.1)	248(23.9)	
Total	974(100)	63(100)	1037(100)	
Fetal presentation				
Cephalic	921(94.6)	58(92.1)	979(94.4)	
Breech	50(5.1)	5(7.9)	55(5.3)	0.739
Transverse	3(0.3)	0	3(0.3)	
Total	974	63(100)	1037(100)	

4.15 Comparison between the Infant Characteristic of the Pregnant Mothers

Table 4.27 showed that all (100.0.%) of the adolescent pregnant women gave birth within 37-42 completed weeks of gestation which was significant at $p<0.05$, more (14.1%) of the adolescent women as compared with 9.8% of adult women gave birth to LBW babies, although, this was not significant, majority (72.9%) of the pregnant women gave birth to normal weight babies($p>0.05$). Majority (82.3%) of the adult pregnant women as compared with 78.1% of adolescent women gave birth to their children through spontaneous vaginal delivery, more (16.8%) adult women compared with (14.1%) of adolescent women had caesarean section as their mode of delivery while 7.8% of adolescent women as compared with 0.8% adult women had assisted vaginal delivery as their mode of delivery ($p<0.05$).

However, The following variables; religion, ethnicity, maternal height, weight at booking, weight at delivery, BMI at delivery, ANC, gestational age at booking, parity, inter-pregnancy, PCV, blood pressure, pregnancy complications, mode of delivery, behavioural lifestyle, apgar score, sex, foetal outcome and foetal presentation were observed to have influence on the birth weight of the infants of the pregnant women as shown in appendix XVII-XX.

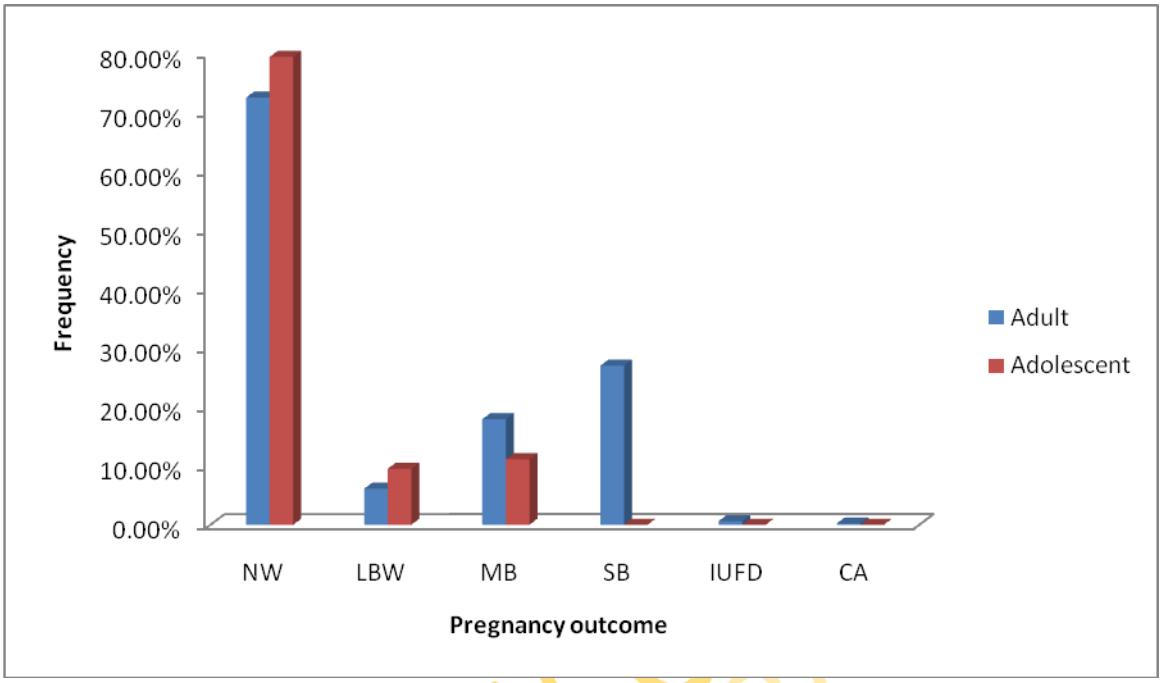
Table 4.27. Bivariate analysis of Obstetric information of the pregnant women and their infant characteristics

Variable	ADOLESCENT n(%)	ADULT n(%)	TOTAL n(%)	CHI square	p-value
Gestational age at birth (weeks)					
37-42	61(100.0)	867(89.7)	928(89.5)	15.317	<0.001*
>42	2(3.2)	100(10.3)	102 (10.5)		
Birth weight (kg)					
<2.5	6(9.5)	69 (7.1)	104(10.0)	3.338	0.188
2.5-3.5	50 (79.4)	720(73.9)	742 (71.5)		
>3.5	7 (11.1)	185(19.0)	192 (18.5)		
Foetal outcomes					
Normal	50 (79.4)	706 (72.5)	757 (72.9)	6.063	0.109
Low birth weight	6(9.5)	55 (5.6)	61 (5.9)		
Macrosomic	7 (11.1)	174 (17.9)	181 (17.4)		
Others	0 (0.0)	39 (4.0)	39 (3.8)		
Mode of delivery					
Vaginal	50 (78.1)	802 (82.3)	852 (82.1)	23.844	<0.001*
Caesarean section	9 (14.1)	164 (16.8)	173 (16.7)		
Assisted vaginal delivery	4 (7.8)	8 (0.8)	13 (1.3)		
Foetal presentation					
Cephalic	58 (92.2)	921 (94.6)	980(9.4)	1.192	0.755
Breech	5 (7.8)	49 (5.0)	54(5.2)		
Transverse	0 (0.0)	3 (0.1)	3(0.3)		

4.16 Selected Pregnancy outcomes of the Pregnant Women

The proportion (79.4%) of normal weight babies was higher among adolescent mothers than adult mothers (72.5%). Adolescent mothers had higher proportion (9.5%) of low birth weight than 6.1% of adult mothers while the proportion of macrosomic babies (17.9%) was more among adult mothers than adolescent mothers (11.1%), ($p<0.05$) while other outcomes like still birth, intrauterine foetal death (IUFD) and congenital malformation were observed only among adult mothers as shown in figure 4.13, there was no significance ($p>0.05$).

Religion, ethnicity, residence, maternal height, weight at delivery, ANC, gestational age at booking, parity, inter-pregnancy spacing, PCV, blood pressure, pregnancy complications, gestational age at delivery, mode of delivery, behavioural lifestyle, apgar scores, sex, infant birth weight and foetal presentation influenced the outcomes of pregnancy among the pregnant women as shown in appendix XIII-XVI .



Key: *NW: normal weight babies, LBW: low birth weight babies, MB: Macrosomic baby, SB: still birth, IUFD: intrauterine feotal death, CA: congenital anomaly*

Fig 4.13: Selected Pregnancy Outcomes of the Women

4.17 Association between Selected Maternal Variables and Body Mass Index of the Pregnant Women.

The association between socio-demographic characteristics, anthropometric indices, obstetric information, infant characteristics and body mass index are shown in appendix I, II, III and IV. Appendix I showed that age, religion, ethnicity, and occupation of the pregnant women were significantly associated with their body mass index ($p<0.05$). Appendix II showed that maternal height and weight at delivery were significantly associated with body mass index of the women ($p<0.05$). Also, antenatal care, parity, inter-pregnancy spacing, packed cell volume, blood pressure, postpartum complication, gestational age at delivery, gestational age at delivery were significantly associated with body mass index of the pregnant women ($p<0.05$) as shown in appendix III, while gestational age of the infant at birth, infant birth weight, and foetal outcome were also significantly associated with body mass index of their mothers as shown in appendix IV.

4.18 Comparison Between Maternal Mean BMI And Socio-demographic Characteristics

Table 4.28 showed the comparison between socio-demographic characteristics of the mothers and their mean BMI. Adults had higher mean BMI (28.0±4.9kg/m^2) compared to adolescents (25.3±3.6kg/m^2). This was significant at p<0.001. Also, women who were from the urban areas had slightly higher mean BMI (28.1 kg/m^2) compared to those from the rural areas (27.6 kg/m^2). This was also significant at p=0.014. The mean BMI of Christians (29.1 kg/m^2) was slightly higher than that of the Muslims (27.6 kg/m^2), (p=<0.001). Women who were civil servants also had slightly higher BMI (28.5 kg/m^2) compared to the self-employed (27.7 kg/m^2) and unemployed (27.5 kg/m^2). This was also statistically significant (p=0.05).

Table 4.29 shows the bivariate analysis of socio-demographic characteristics of respondents and their Body Mass Index. A higher proportion of adults were overweight/obese (70.9%) compared to adolescents (50.0%) and this was significant at p=0.001. Also, a higher proportion of Christians were overweight/obese (79.4%) compared to Muslims (67.2%), (p=0.001). A higher proportion of those from the Igbo ethnic group were overweight/obese (82.7%) compared to those from other ethnic groups (76.3%), the Yoruba's (63.9%) and the Hausas (63.5%), (p=0.017).

Table4.28: Comparison of Mean BMI between Socio-demographic Characteristics of the pregnant women

VARIABLE	MEAN BMI	SD	T/F TEST	p-value
Adolescents	25.3	3.6	-5.7	<0.001*
Adults	28.0	4.9		
Marital status				
Single	26.6	1.6	-1.562	0.210
Married	27.9	4.9		
Place of residence				
Urban	28.1	4.9	2.474	0.014*
Rural	27.3	4.8		
Religion				
Christian	29.1	5.4	3.663	<0.001*
Islam	27.6	4.7		
Ethnic group				
Nupe	27.8	4.7	1.811	0.124
Hausa	27.2	5.3		
Igbo	29.0	4.8		
Yoruba	27.6	5.6		
Others	28.2	4.3		
Total	27.6	4.9		
Mothers occupation				
Civil servant	28.5	5.0	2.997	0.050
Self employed	27.7	4.9		
Unemployed	27.5	4.8		
Total	27.9	4.9		

Table4.29: Bivariate Analysis of Sociodemographic Characteristics of the pregnant Women and their Body Mass Index at Delivery

Variable	BMI overweight /obese (%)	BMI underweight /normal (%)	Total	Chi square	p-value
Age category					
Adolescents	30 (50.0)	30 (50)	60 (100)	11.684	0.001*
Adults	680 (70.9)	279 (29.1)	959 (100)		
Marital status					
Single	3 (75.0)	1 (25.0)	4 (100)	0.054	0.816
Married	707 (69.7)	308 (30.3)	1015 (100)		
Place of residence					
Urban	519 (70.9)	213 (29.1)	732 (100)	1.847	0.174
Rural	191 (66.6)	96 (33.4)	287 (100)		
Religion					
Christian	162 (79.4)	42 (20.6)	204 (100)	11.442	0.001*
Islam	548 (67.2)	267 (32.8)	815 (100)		
Ethnic group					
Nupe	434 (69.3)	192 (30.7)	626 (100)	11.996	0.017*
Hausa	54 (63.5)	31 (36.5)	85 (100)		
Igbo	67 (82.7)	14 (17.3)	84 (100)		
Yoruba	94 (63.9)	53 (36.1)	147 (100)		
Others	61 (76.3)	19 (23.8)	80 (100)		
Mothers' occupation					
Civil servant	186 (75.3)	61 (24.7)	247 (100)	5.449	0.066
Self employed	260 (69.1)	116 (30.9)	376 (100)		
Unemployed	264 (66.7)	132 (33.3)	396 (100)		

4.19 Comparison of Maternal Body Mass Index (BMI) across group

Table 4.30 shows the logistic regression of nutritional status on variables. After adjusting for other variables, adolescents were about two times less likely to be overweight or obese compare to adults (OR=0.583, 95%CI=0.333-1.019). Christians were about two times more likely to be overweight or obese compared to Muslims (OR=1.676, 95% CI=1.035-2.714). Also, primiparous and multiparous women were about twice less likely to be overweight or obese compared to grand multiparous women (OR=0.561, 95%CI=0.319-0.986; OR=0.685, 95% CI=0.397-1.182) respectively. Also, women who gave birth to full term babies were twice less likely to be overweight or obese compared to those that gave birth to post-term babies (OR=0.698, 95%CI=0.521-0.935). Adolescents were about eight times less likely to have vaginal deliveries compared to assisted vaginal deliveries (OR=0.115, 95%CI=0.034-0.394) and were about twelve times less likely to have had a caesarean section compared to assisted vaginal deliveries. Women who gave birth to underweight and normal weight babies were three times less likely to be overweight or obese compared to those who gave birth to macrocosmic babies (OR= 0.365, 95% CI=0.198-0.671; OR=0.384,95% CI=0.243-0.607) respectively.

Table 4.31 shows the comparison between levels of obstetric characteristics of the pregnant women and their mean BMI. Women who had five previous deliveries had higher BMI (29.6) compared to those who had none (26.8), between 1-2 deliveries (27.7) and between 3-4 deliveries (28.6), this was significant (p=<0.001). Women with gestational weeks greater than 42 weeks had a higher mean BMI (32.0) compared to those who gave birth between 37-42 weeks (28.8). This was also significant (p<0.001). The mean BMI of women with macrocosmic babies (30.3) was higher than those with underweight babies (26.4) and those with babies between 2.5-3.5kg (27.4), (p<0.001) as shown in table 4.31.

Table4.30: Logistic Regression of Nutritional Status (BMI) on Variables

VARIABLE	ODDS RATIO	p-value	95% CI
Adolescents	0.583	0.058	0.333-1.019
Adults (ref)			
Religion			
Christian	1.676	0.036	1.035-2.714
Islam (ref)			
Parity			
Primiparous	0.561	0.045	0.319-0.986
Multiparous	0.685	0.175	0.397-1.182
Grand multiparous (ref)			
Gestational age (weeks)			
37-42 (Term)	0.698	0.016*	0.521-0.935
≥ 42 (Post-term) (ref)			
Mode of delivery			
Spontaneous Vaginal	0.115	0.001*	0.034-0.394
Caesarean section	0.086	<0.001*	0.022-0.342
Assisted vaginal delivery(ref)			
Gestational age at birth (weeks)			
37- 42	1.563	0.108	0.906-2.695
≥ 42 and above (ref)			
Birth weight (kg)			
<2.5(low birth weight)	0.365	0.001*	0.198-0.671
2.5-3.5 (Normal weight)	0.384	<0.001*	0.243-0.607
>3.5(macrosomic) (ref)			

Table4.31: Comparison of Mean BMI at Delivery between Obstetric Characteristics of Pregnant Women

VARIABLE	MEAN BMI	SD	T/F TEST	p-value
Parity				
0	26.7	4.1		
1-3	28.3	5.1	21.907	<0.001*
≥4	29.8	5.3		
Total	27.9	4.9		
Antenatal care				
None	27.0	4.8		
1	28.0	5.2		
2	27.3	5.0	2.457	0.044*
3	28.2	4.8		
>3	27.1	3.0		
Total	27.9	4.9		
Gestational age(weeks)				
37-42	55.9	9.7	16.619	<0.001*
>42	32.0	3.0		
Birth weight (kg)				
<2.5	26.4	4.4		
2.5-3.5	27.4	4.6	32.993	<0.001*
>3.5	30.3	5.3		
Total	27.9	4.9		

4.20 Association between Socio-demographic Characteristics and Total Weight Gain of the Pregnant Women at Delivery

The associations between socio-demographic, anthropometric indices, obstetric and infant characteristics with total weight gain at delivery of the pregnant women are shown in the appendix v, vi, vii, and viii. It is shown in appendix v only mother's occupation was significantly associated with total weight gain ($p<0.05$), only maternal height was significantly associated with total weight gain of the women at delivery as shown in appendix vi. Likewise, appendix vii showed that nausea/vomiting, packed cell volume and blood pressure were positively associated with total weight gain of the pregnant women ($p<0.05$),while none of the infant characteristics assessed was significantly associated with the total weight gain of the pregnant women at delivery as indicated in appendix viii.

Table 4.32shows the comparison of mean weight gain between adolescents and adult mothers from the first trimester to delivery. Generally, the weight gain in pregnancy increased as the gestational age of the foetus increased however, in the first trimester, adults had a significantly higher mean weight gain of 3.5±2.3kg compared to adolescents (1.5±1.0kg). This was significant at $p=0.028$. However, in the second trimester, adolescents had a higher mean weight gain (4.9±2.2kg) compared to adults (4.7±1.3kg). This was however not significant ($p=0.077$). Although, in the third trimester and at delivery adults had higher mean weight of 6.7±4.1kg compared to adolescents who had mean weight gain of 6.4±3.1kg. This was significant at ($p<0.05$).

Table 4.32: Comparison of Mean Weight Gain of the Pregnant Women in Relation to Gestational Age (Trimesters).

Variable	Mean weight gain (kg)	SD	T test	p-value
First trimester				
Adolescent	1.5	1.0	2.7	0.028*
Adults	3.5	2.3		
Second trimester				
Adolescent	4.9	2.2	2.1	0.077
Adults	4.7	1.3		
Third trimester				
Adolescent	6.4	3.1	1.7	0.042*
Adults	6.7	4.1		

4.21 Association of Socio-Demographic, Anthropometry, Obstetric and Infant Characteristics Data with Pregnancy Complications of the Pregnant Women

Appendix IX, X, XI, and XII indicate the associations between socio-demographic, anthropometric, obstetric characteristics, infant characteristics and pregnancy complications. Appendix IX showed that none of the socio-demographic data assessed except ethnicity was significantly associated with maternal complications in pregnancy ($p<0.05$). Also, it is shown in appendix X that only maternal height and maternal weight at delivery were significantly associated with complications in pregnancy among the pregnant women ($p<0.05$). Also, PCV at third trimester, blood pressure at third trimester, gestational age at delivery and mode of delivery were significantly associated with complications in pregnancy among mothers as indicated in appendix X ($p<0.05$). Appendix XI showed that all the infant characteristics assessed were significantly associated with pregnancy complications in mothers as shown in appendix XII ($p<0.05$).

4.22 Association between Socio-Demographic Data and Foetal Outcomes of the Pregnant Women.

The association between socio-demographic factors, anthropometric indices, obstetric/ lifestyle, infant characteristics and foetal outcomes are presented in appendix xiii, xiv, xv, and xvi. Appendix xiii showed that religion, ethnicity and place of residence of the mothers were directly associated with their foetal outcomes ($p<0.05$). Likewise, maternal height, weight at delivery and maternal BMI at delivery were significantly associated with foetal outcomes as shown in appendix xiv ($p<0.05$). Appendix xv showed that all the obstetric and lifestyle characteristics assessed except nausea/vomiting and infection in pregnancy were significantly associated with pregnancy(foetal) outcomes among the pregnant women ($p<0.05$). However, all the infant characteristics assessed were significantly associated with outcome of pregnancy among the women as indicated in appendix xvi.

Table 4.33 shows the logistic regression output of the maternal determinant of foetal outcome. After adjusting for other variables, the following maternal obstetric variables; parity, BMI, pregnancy complication, and number of ANC visits were positively associated with foetal outcome (normal weight=2.5kg-3.5kg, low birth weight=<2.5kg, macrosomia=>3.5kg, still birth, IUFD and congenital abnormality). The result is shown as follows; primiparous mothers were 2times less likely to have macrosomic babies than multiparous mothers (OR= 0.535, p=0.002, CI=0.363-0.787). Also, underweight mothers (BMI<18.5kg/m^2) were 27 times more likely to have LBW babies than obese/overweight mothers (OR=27.090, p=0.002, 95%CI=3.522-208.361) while normal weight mothers were 12 times more likely to have LBW babies than obese/overweight mothers (OR=12.186, p=0.015, 95%CI= 1.638-90.636). Women who had pregnancy complications were 5 times more likely to have macrosomic babies than those with no pregnancy complications (OR= 4.792, p=0.000, 95%CI=2.858-8.033).Women who had ANC 1-3times were 4 times more likely to have LBW than those who had≥3 times ANC visits (OR= 3.733, p=0.000, 95%CI=2.027-6.874).

Table4.33: Logistic Regression Output of Maternal Determinant of Foetal Outcomes

VARIABLE	ODD RATIO	p-value	95% CI
Parity			
Primiparous	0.535	0.002*	0.363-0.787
multiparous(ref)			
BMI			
Underweight(<18.5kg/m^2)	27.090	0.002*	3.522-208.361
Normal weight(18.5-24.9kg/m^2)	12.186	0.015*	1.638-90.636
Obese/overweight(>25kg/m^2)(ref)			
Pregnancy complication			
Yes	4.792	0.000*	2.858-8.033
No(ref)			
No of Antenatal Care visits			
1-3times	3.733	0.000*	2.027-6.874
≥3times (ref)			

4.23 Association between Socio-Demographic Data, Anthropometric Indices, Obstetric/Lifestyle, Infant Characteristics and Infant Birth Weight

The association between socio-demographic data, anthropometric indices, obstetric/lifestyle, infant characteristics and infant birth weight are indicated in appendix XVII, XVIII, XIX, and XX below. It is shown in appendix XVII that religion and ethnicity were significantly associated with infant birth weight ($p<0.05$). Appendix XVIII also showed that all the maternal anthropometric indices assessed except maternal weight gain at delivery were significantly associated with the infants birth weights ($p<0.05$). However, all the obstetric and lifestyle information were significantly associated with the birth weight of the infants except infection such as herpes, wart, UTI, cough and nausea/vomiting as indicated in appendix XIX($p<0.05$). Likewise, all the selected infant characteristics assessed were significantly associated with the birth weights of the infants except feotal outcome as shown in appendix XX ($p<0.05$).

4.24 Association between Infant Birth Weights in Relation to Pregnant Mothers' Height

The comparison between infant birth weight and maternal height shows that the proportion (14.3%) of low birth weight was generally high among mothers whose height is <1.50m,while the proportion of normal weight babies (74.6% and 74.8%) was higher among mothers whose height were within 1.51-1.60m and 1.61-1.70m respectively. However, incidence of LBW among the women decreased with increase in maternal height, while incidence of macrosomic babies was directly proportional to increase in maternal height which was significant ($p<0.05$, $X^2 = 25.12$) as shown in Table 4.34 below.

Table 4.34: **Association between Percentage Infant Birth Weights in Relation to Pregnant Mothers' Height**

Mothers height(m)	**Low Birth Weight n (%)**	**Normal birth weight n (%)**	**Macrosomic weight n (%)**	**Total n (%)**	**p-value**
<1.50	13(14.3))	65(71.4)	13(14.3)	91(100)	
1.51-1.60	48(8.9)	402(74.6)	89(16.5)	539(100)	0.000
1.61-1.70	10(2.8)	270(74.8)	81(22.4)	361(100)	X^2=25.12
>1.70	4(8.7)	33(71.7)	9(19.6)	46(100)	
Total	75(13.3)	707(68.2)	192(18.5)	1037(100)	

4.25 Comparison between Parity and Low Birth Weight

The association between infants birth weight and parity indicated that most of (32.8%) the primiparous mothers had significantly higher incidence of low birth weight compared to grand multiparous (5+previous deliveries) mothers (6.6%), this shows that the higher the numbers of previous deliveries, the lower the incidence of low birth weight. Unlike multiparous mothers who had 60.7% low birth weight as shown in table4.35 which could be as a result of short or too close inter-pregnancy spacing. Incidence of macrosomic babies increased with increase in parity but decreases as parity ≥5 ($p<0.05$), ($X^2=25.02$) as shown in Table 4.35.

As it is presented in table 4.36 the mean birth weight of the infants was directly proportional to their mothers' age and mean weight gain, although there was a sharp drop at ages above 50 years old. Generally, the mean weight gain in pregnancy was suboptimal, although the adult mothers had higher mean weight gain than adolescent mothers.

It is shown in appendix XXII that occupation, height, weight at booking and delivery, total weight gain in pregnancy, parity, pregnancy complications such as gestational hypertension and diabetes, infant sex and mode of delivery were significantly associated with Low birth weight in infants.

Table 4.37 indicated that after adjusting for confounding variables using logistic regression; parity, BMI, number of antenatal care visit and pregnancy complications were directly associated with Low birth weight (LBW).

Table 4.35: Association between Parity of the Pregnant Women and Infant Birth Weight

Parity	Normal birth weight (%)	Low birth weight (%)	Macrosomic (%)	Others (%)	Total (%)	p-value
0	39.9	32.8	26.0	15.4	36.2	.000
1-4	51.3	60.7	64.6	64.1	54.7	X^2=25.02
≥5	8.7	6.6	9.4	20.5	9.2	

Table 4.36: **Distribution of Mean Infant Birth Weight in Relation to Pregnant Mothers' Age**

Mothers age(years)	Mean weight gain(kg)	Mean infant birth weight(kg)	p-value
≤19	6.4±4.37	3.01±0.4	
20-29	7.5±5.85	3.13±0.5	p<0.05
30-39	7.7±4.79	3.26±0.6	
40-49	8.90±4.02	3.61±0.5	
≥50	4.0±1.00	2.8±0.0	

Table 4.37: Logistic Regression Output of Maternal Determinant of Low Birth Weight (LBW).

VARIABLE	ODD RATIO	p-value	95% CI
Parity			
0	0.535	0.002	0.363-0.787
≥1(ref)			
BMI			
Underweight(<18.5kg/m^2)	27.090	0.002	3.522-208.361
Normal weight(18.5-24.9kg/m^2)	12.186	0.015	1.638-90.636
Obese/overweight(>25kg/m^2)(ref)			
Pregnancy complication			
Yes	4.792	0.000	2.858-8.033
No(ref)			
Number of Antenatal Care visits			
1-3times	3.733	0.000	2.027-6.874
≥4times (ref)			

CHAPTER FIVE

Discussion, Conclusion and Recommendations

5.1: Socio-demographic characteristics of the pregnant Women

Malnutrition in pregnant women is of public health concern because of its associated risk both to the mothers and their infants. Inadequate weight gain in pregnancy is a known risk factor for poor pregnancy outcome (McGuire and Popkin, 1990). Likewise, the amount and pattern of weight gain during pregnancy whether over a limited number of weeks or total gain during pregnancy are indicators of maternal nutritional status and thus correlates in all studies with feotal growth which may be a critical indicator of pregnancy outcome (McGuire and Popkin, 1990). In this study, maternal weight gain and pregnancy outcome among women of childbearing age who attended antenatal clinic of Federal Medical Centre, Bida, Niger state was assessed.

Maternal socioeconomic status and non-modifiable, non-biological factors that affect mental and physical well-being have been associated with maternal nutrition and pregnancy outcomes although, it is increasingly acknowledged that societal factors play a significant role in micronutrient status and pregnancy outcomes(Ugwuja *et. al.*, 2011).

In Bida (north-central part) of Nigeria, it was observed that almost all the pregnant women were married and single motherhood was only observed in a very few number among the adult mothers this observation confirms the report of the Nigeria Demographic and Health Survey (NDHS, 2003) that early marriage and childbirth are common practices in Nigeria especially in the northern part. The report further indicates that in the north central part of Nigeria, women continues to follow the traditional pattern of early marriage at median age of 15years however in this study, the mean ages of the adult and adolescent pregnant women involved in this study were 26.24±4.76years and 17.57±1.32years respectively. This observation is in accordance with a similar study conducted in South Africa by Hoque *et.al.*,(2010) where the mean ages of the pregnant women were 25.50±5.0 years for the adult women and 17.08±3.2years for the adolescent women. This finding implies that since the pregnant women especially the adolescent mothers involved were married thus their pregnancies were wanted and planned for within the family setting unlike what was reported

in a similar study carried out in South-Africa where most of the adolescent mothers were within the context of unstable relationship with the fathers of their babies and their pregnancies were unplanned for and unwanted (Hoque *et.al.*,2010). More so, according to Ihejia et. al.,(1998),age at which pregnancy occurs is an important predictor of pregnancy outcome for the mother and her unborn baby, as pregnancy in very young women is generally a high risk event which is becoming a serious and social problem all over the world, especially in developing countries. It was observed in this study that maternal age was significantly($p<0.05$) associated with maternal weight in pregnancy at each trimester, maternal BMI at delivery, parity, pregnancy complications, and foetal outcomes.

Majority of the respondent were Muslims and were from Nupe ethnic group which confirmed the demographic data of National Population Commission (2006) which established that Nupe is the predominant tribe in Bida and their main religion was Islam. It was revealed in this study that the religion was significantly associated with maternal BMI, pregnancy complications, feotal outcome and infant birth weight.

Most of the pregnant women in this study were full house wives (unemployed), while others were petty traders, artisans or students. A higher percentage of the adolescent women compared with the adult women were either students or not employed ($p<0.05$) this explains the low economic status of the women more so of the teenage women because teenage pregnancy have been reported to have a profound impact on mothers and their children by placing limits on their educational achievement and economic stability and their clinical care as well as the outcomes of their pregnancies (Fadupin and Pikuda,2011). Mother's education provides direct measure of the woman's relative socio-economic status especially in developing countries and the consequences are reinforced by the fact that children of young and illiterate mothers tend to face the same cycle of economic deprivation and under nutrition experienced by their mothers (Morrison *et. al*., 1989). Low levels of education, discriminatory cultural attitudes and religious practices were likely contributory factors to the low socioeconomic status of the women and these have been reported to contribute to high maternal mortality rate among women of childbearing age in the northern part of Nigeria. The poor socio-economics condition and educational status of the adolescent women is likely to affect their self-care and clinical care received during pregnancy compared with the adult women who had access to regular antenatal care ($p<0.05$), for instance, a study at the Jos

University Teaching Hospital showed that nearly three-quarter of maternal deaths in 2005 occurred among illiterate women (Aisien *et.al.*, 2003).

5.2: Lifestyle of the pregnant women

In this study almost all (99.8%) of the pregnant women were non alcoholics while only 0.02% of the adult women were alcoholics, more so, none of the pregnant women were smokers this could be due to the fact that in Nigeria, alcohol and cigarette use is discouraged and thus this practice in not culturally acceptable among Nigerian women especially muslim women. Majority of the pregnant women being Muslims could have contributed to the low incidence of alcohol consumption and cigarette smoking. Maternal behavioural lifestyle was one of the determinants of pregnancy (foetal) outcome and infant birth weight in this study this is in line with the report of Sanusi *et. al.*, 2002 which states that LBW can be due to a number of factors, such as a woman's small size and stature, uterine infections, smoking and malaria infection, although the most significant cause is poor maternal weight gain due to inadequate dietary intake, low maternal nutritional status at conception and poor lifestyle.

5.3. Obstetric Information of the Pregnant Women

Late or lack of antenatal care, lack of information and experience, poor socio-economic conditions are known to affect the outcome of pregnancy (Chanhande et. al., 2002). In this study, a lower proportion of adolescent pregnant women compared with the adult women had access to regular antenatal care ($p<0.05$).Majority of the pregnant women booked at second and third trimester while just few booked at first trimester and the mean gestational age at booking was 24.3±6.9weeks for adolescent and 23.8±7.1weeks for adult women which is similar to the report of Fadupin and Pikuda (2011) where most pregnant women in the southern part of Nigeria did not book for antenatal care in the first trimester but booked at the second or third trimesters. Majority of the pregnant women received antenatal care during pregnancy and, on the average, made more than three antenatal care visits before delivery, higher proportion of the adolescent pregnant women had ANC compared to adult pregnant women this is in contrast to a population-based study in Nigeria reported by Igwegbe *et. al.*, (2001) and Fadupin et. al., (2011) that young pregnant girls often did not receive antenatal care like the adult pregnant women, especially if they were unmarried because of high cost of

medical care and the fact that some did not want to be seen in public whilst pregnant. Also, mortality rate among women who did not receive antenatal care at all was about 20 times higher than for those who did (Aisien *et. al.*, 2003;Veneman, 2009). The fact that adolescent marriage is culturally accepted in the northern part of Nigeria and almost all the adolescent pregnant women were married and are fully supported by their spouses could have contributed to the better rate of antenatal attendance by the adolescent pregnant women which could have been the reason for the low incidence of pregnancy complication such as gestational diabetes, pre-eclampsia and infections this is in line with previous studies that stressed that around 80% of maternal deaths, ill-health among pregnant women are preventable, detectable or treatable during ANC visit (Aisien *et. al.*, 2003; Veneman, 2009). Likewise, reduction in child mortality and morbidity can be obtained through adequate essential maternity and basic health-care services (Veneman, 2009). Although, majority of the women booked at second trimester (13^{th} -24^{th} week) this is not strange considering the fact that in developing countries women's attitude towards antenatal care has not been encouraging, which could be as a result of ignorance of the associated risk that accompany pregnancy, more so, poor socio-economic status and empowerment and poor educational status to make an informed choice on reproductive health issue could be a contributory factor. All women at childbearing age need to be advised on the importance of early antenatal care as such practice have positive consequences on both mother and child.

More so, majority (74.6%) of adolescent compared with 32.1% of adult had no previous delivery (primigravidae). However, more of the adolescent women who were multigravida had <2years inter-pregnancy interval compared to adult women this could have contributed to the higher incidence of LBW among the adolescent pregnant women than adult pregnant women. Very few of these pregnant women had infections, nausea and vomiting in pregnancy which was not significantly associated with their parity. This could be the reason for the low incidence of poor pregnancy outcome and complications in pregnancy among the women ($p<0.05$).

It was also observed that the weight gain in pregnancy was directly influenced by parity and gestational age at booking of the women. Although parity was found to significantly influence infant birth weight ($p<0.05$). Primiparous and multiparous adolescent pregnant

women gained lower weight as compared with primiparous and multiparous adult women which also confirms that adolescence pregnancy influence weight gain and LBW. This observation is in accordance with a similar study which reported that competition for nutrients by the foetus in the adolescent pregnant women undergoing normal growth spurts resulted into suboptimal growth (Quinlivan, 2006). Majority of the adolescent were primiparous and their weight gain was significantly lower compared to multiparous mothers, thus, weight gain in pregnancy increases with increase in parity, this is consistent with earlier research work which found out that mothers with low weight or height or who were primigravid had lower mean weight gain in pregnancy and are at risk of preterm or LBW deliveries (Kalanda, 2007) Likewise, Yekta *et. al.*, (2006) also confirmed a strong association between weight gain during pregnancy and infant's size, while Onah *et. al.*, (2002) stated that primigravity is a high-risk pregnancy and it increases in teenager and elderly primigrvidae. However, this is in contrast with Asbee et. al.,2009, who reported that primiparous women gained significant weight than multiparous women.

Also in this study, grandmultiparous (Women who had five previous deliveries) had significantly higher BMI compared to multiparous and primiparous women because the higher the gestational age at delivery, the higher the mean BMI ($p<0.05$).

5.4 Anthropometric characteristics of the pregnant women

Anthropometric indices provide an approximate reflection of nutritional status of individual in relation to their health status. For pregnant women, nutritional status is an important prognostic indicator of pregnancy outcome. Good nutritional status is known to be an important factor for intrauterine development of foetus and reduction in the prevalence of maternal and newborn mortality and morbidity (Institute of Medicine, Food and Nutrition Board, Committtee on Nutritional Status, 1999). A woman's nutritional status in pregnancy measured by anthropometric indices is an indicator of her overall wellbeing and pregnancy outcome (Mehta, 1998).

In this study, the record of the prenatal weight and weight during the first trimester of the pregnant women were not available because majority of the pregnant women did not know or had their weight in the hospital record, thus calculation of the women's total pregnancy weight gain could not be done. Weight gain in this report was based on the weight gained

between the beginnings of the second trimester to the weight at delivery≥37weeks. Based on the IOM recommendation, the total weight gain from the beginning of the second trimester to the end of the third trimester is generally the highest and should range between 10.8kg-17.3kg (IOM, 1990) thus the anthropometric indices assessed were weights at second trimester and delivery.

5.4.1 Maternal Weight and Weight Gain in pregnancy

Weight during pregnancy for this study was majorly from available data from second and third trimesters (13^{th} week – 37th weeks of gestation) and few from first trimester (1^{st}-13^{th} week). The mean weight gain of the pregnant women in this study between the second and third trimester was significantly lower when compared with the IOM recommendation at the end of third trimester. Despite the general knowledge that pregnancy weight and weight gain associated with an optimal or average newborn weight is greater for young teenagers than for older women and that rapidly growing teenager's nutritional requirements in pregnancy may be greater than those of older women, this study revealed that the adolescent women had lower weight gain compared with adult women. This could be as a result of the fact that increased maternal nutrient requirement competes with the growth needs of the foetus thereby affecting the overall weight of the adolescent mother (Frisancho *et. al.*, 1983). Adolescence is known to be a time of intense growth second to infancy because growth is not yet completed at this period, pregnancy causes competition for nutrient between mother and foetus in adolescent pregnant mothers which often have adverse consequences on both mother and foetus (Fadupin and Pikuda, 2011).

Thus, teenage pregnancy should be discouraged because of the competition in the nutritional requirement for growth between the mother and the growing foetus. However, the nutritional requirement of the adolescent pregnant mothers would need to be increased greatly than the adult mothers to overcome the adverse effect of poor weight gain, pregnancy complication and low birth weight. Due to suboptimal growth in poorly nourished adolescent women, as a result of competition for nutrients with the foetus, failure of secondary growth spurt and delay in the full attainment of their bone density can occur as compared to mothers in their twenties (Quinlivan, 2006).

Increased weight gain or lower weight gain outside IOM recommendation was reported to be associated with adverse pregnancy outcome (Abram et. al., 1995). In this study, the total

weight gain of the adolescent mothers at delivery was significantly lower than the adult mothers which were in contrast with what was obtained by Phaneendra et. al., (2001). Likewise, weight gain in pregnancy in this study was observed to increase with increase in age of the pregnant women which support a similar study by Dawes *et.al.*, (1991) which reported that the mean maternal weight gain in younger women (<20years of age) was lower compared to older women (>25years of age). However, this observation is in contrast to Akinyele and Oguntona (2004) which indicated that weight gain in pregnancy among adolescent pregnant women was higher than that of adult pregnant women. Although, Mcguire and Popkin, (1990) reported that the weight gain during pregnancy strongly correlate with foetal growth, a study reported by Nielsen *et. al.*, (2006) however indicated that higher maternal weight gain did not result in larger infants for black adolescents and it's also least beneficial in overweight adolescents whose infants were within normal (healthy) birth weight range.

The total weight gain of the women from the beginning of the first trimester for the women could not be estimated because the record of prenatal weights and weight at first trimester of the women in this study were not available since majority of them did not attend antenatal clinic during first trimester, therefore, their total weight gain in pregnancy could not be compared with the IOM recommended standard for total weight gain in pregnancy. However, is has been reported that women whose weight gain during pregnancy is outside the recommended range may experience adverse maternal outcomes which may include risk for pregnancy induced hypertension(PIH), gestational diabetes, complications during labour and delivery and post-partum weight retention which could subsequently lead to maternal obesity among others (IOM,2009).

All mothers most especially teenagers need to be advised on the importance of early antenatal care as late utilization of quality reproductive health services are known to contribute significantly to high maternal mortality (Lawoyin and Oyediran,1992).Majority of the pregnant women had ≤6.0kg as their mean weight gain from the beginning of the second trimester to the end of third trimester which was significantly lower than 10.8-17.3kg IOM recommendation. Generally, the pregnant women had significantly high mean weight gain in pregnancy as their ages increases ($p<0.05$), however, the mean weight gain of the adolescent women from the beginning of the second to the end of the third trimester was significantly

lower than adult women ($p<0.05$). Occupation, maternal height, nausea/vomiting, PCV and blood pressure were positive associated with total weight gain in pregnancy of the pregnant women.

5.4.2 Maternal Body Mass Index (BMI) at Delivery

Obesity(BMI>30kg/m^2) in pregnancy has been reported to be more common among older and multiparous women than adolescent women and is linked to maternal complications ranging from effects on fertility to effects on delivery and in the postpartum period, as well as many complications affecting the foetus and newborn (Arendas *et al.* 2008). In this study, it was observed that adult pregnant women had higher mean BMI than adolescent pregnant women, also the maternal BMI increased with increase in parity of the women and also with their weight gains in pregnancy. The adult pregnant women had higher mean BMI as gestational age increased compared with the adolescents women, thus, the mean BMI at delivery of the adolescent women was lower compared with that of adult women. Many adolescent women were underweight (BMI<18.5 kg/m^2) at first ANC visit compared with adult women, while more of the adults were obese (BMI>30 kg/m^2)as compared with adolescent women at first ANC visit. At delivery, more of the adolescents were underweight(<18.5kg/m^2) compared with adult women while more of adults were overweight(25.0-29.9 kg/m^2) compared with adolescents, this could be due to the higher weight gained with increase in maternal age and parity among the older and multiparous women than adolescent women which could be as a result of poor socio-economic situation, poor antenatal attendance and the higher demand for nutrients especially among adolescents to satisfy the growth spurt and the competition for nutrients with the growing foetus, likewise, failure of secondary growth spurt and delay in the full attainment of their bone density occurs more among adolescent mothers as compared with older mothers (Quinlivan, 2006).

Enhrenberg *et. al.*, (2003) emphasized that women with lower weight gain than normal maternal weight have increased risk for adverse pregnancy outcomes such as low birth weight and intrauterine growth retardation (IUGR). This information indicates that the risk 0f pregnancy complications and delivering babies with LBW is much greater among adolescents than the adult pregnant women as shown in this study. O'Brien *et. al.*, 2003 and

Frederick *et. al.*, 2006, reported that the incidences of pre-eclampsia and Caesarean section increase with maternal overweight and obesity during pregnancy this might have contributed to the higher incidence of caesarean section among the adult pregnant women compared with adolescent women in this study..

It is paramount to note that the following variables were found to be the predisposing factors (determinant) which were significantly associated with maternal body mass index among the pregnant women; age, religion, ethnicity, occupation, height, weight and weight gain at delivery, regular attendance of ANC, parity, inter-pregnancy spacing, PCV, blood pressure, postpartum complication, gestational age at delivery, gestational age at birth, infant birth weight, and feotal outcome.

5.4.3 Maternal Weight Gain and BMI in Pregnancy in relation to infant birth weight

Weight gain in pregnancy was found to increase with maternal age, height, and parity. However, among adolescent women the rate of weight gain in pregnancy declined in relation to increase parity which may be as a result of short inter-pregnancy spacing and the influence of age due to nutrient partitioning which is altered to promote growth of the maternal body at the expense of the gradually evolving nutrient requirements of the gravid uterus and mammary gland (Janet, 2003). Likewise, among the adult pregnant women maternal weight gain increased with parity although, there was a sharp drop as parity exceeded four (>4) this could be as a result of maternal nutrient store depletion due to closely spaced or short inter-pregnancy spacing and physiological ageing of the body system.

About 9.5% of the adolescent mothers as compared to 7.1% of the adult mothers had low birth weight babies (<2.5kg). The mean infant birth weight for adolescent mothers 3.0±4.0kg was significantly lower than infant born to the adult mothers 3.2±5.0kg ($p<0.05$). Higher proportion adolescent women as compared with adult women gave birth to LBW babies, although, this was not significant ($p>0.05$).

According to Scholl and Hediger (1994), macrosomia increases with increasing gestational weight gain and BMI especially if the weight gain is large. Also feotal macrosomia was observed among the overweight and obese adult women in this study which is in agreement with reports of Abrams et al. 2000, Stotland et. al., 2004, Helms et. al., 2006 which stated that complications due to excessive gestational weight gain and BMI also include caesarean

deliveries and feotal macrosomia thus resulting in the delivery of large-for-gestational-age infants.

The mean BMI of women with macrosomic babies was higher than those with underweight babies and normal weight babies (weight between 2.5-3.5kg) in this study. This observation is in agreement with the report of Ezenwa *et. al.*, (1998) that pregnancy body weight and BMI were important factors associated with the birth weight of babies born in Nigeria, the report indicate that obesity in pregnancy was more common among older and multiparous women than adolescent women and both obesity and overweight were linked to maternal complications at delivery and postpartum periods which also affects feotus and newborn (Arendas *et. al.*, 2008).

The following variables were positively associated with infant birth weight; religion, ethnicity, maternal height, maternal weight at booking and delivery, maternal BMI at delivery, number of antenatal visits, gestational age of the infant at delivery, number of previous deliveries(parity), intervals between previous and present delivery, PCV, gestational hypertension, pregnancy complications, mode of delivery, behavioural lifestyle, infant sex, apgar score, foetal outcome such as LBW, macrosomic, IUFD, stillbirth to mention a few and presentation at birth.

5.5 Pattern of Selected Pregnancy Outcome among the Women

Birth weight is generally a reflection of intrauterine experience and a good indicator of not only the mother's health and nutritional status and also the infant's chances of survival, growth, long-term health and psychosocial development (Annan, 2001). However, maternal weight gain has been recognized as one of the major predictor of infant birth weight as well as pregnancy outcome thus, women have been encouraged to gain between 12.5-18kg depending on their pre-pregnancy BMI (IOM, 1990).

From this study, higher proportion of normal weight babies was observed among the pregnant mothers although, adolescent mothers had higher proportion of low birth weight than adult mothers while the proportion of macrosomic babies was more among adult mothers than adolescent mothers, ($p<0.05$) this was similar to a study reported by Groth (2006) and Acharya *et. al.*, (2010) that the incidence of low birth weight was statistically significant among teenage mothers than adult mothers, more so, reduction in birth weight

among young teenagers can be explained in part by a decreased net availability of nutrients resulting from the competition for nutrients between the mother's growth needs and the growth needs of her fetus, likewise micronutrient poor diets, short stature, anaemia and low body weights(<45.5kg) among the adolescent mothers were likely to be some of the contributing risk factors (IOM, 1990; Baker *et. al.*, 2009). There is therefore a complex relationship between nutritional status and pregnancy outcome because of environmental exposure, educational status and antenatal care attendance. Other outcomes like still birth, intrauterine Foetal death (IUFD) and congenital malformation were observed only among adult mothers, ($p>0.05$). This is in agreement with previous studies which reported that maternal and child mortality rate is generally high for teenagers than adult pregnant mothers due to possible combination of the following factors: poor nutrition, early marriage and child birth (Mehta, 1998). Religion, ethnicity, residence, maternal height, weight at delivery, maternal BMI at delivery, ANC, gestational age at booking, parity, inter-pregnancy spacing, PCV, blood pressure, pregnancy complications, gestational age at delivery, mode of delivery, behavioural lifestyle, apgar scores, sex, and foetal presentation were found to significantly influence the outcomes of pregnancy among the pregnant women. However, occupation, height, weight at booking and delivery, total weight gain in pregnancy, parity, pregnancy complications such as gestational hypertension and diabetes, infant sex and mode of delivery were found to be significantly associated delivery of Low birth weight (LBW)infants. Although, after adjusting for confounding variables, parity, maternal BMI, number of antenatal care visit and pregnancy complications (eclampsia, anaemia) were found to be significantly associated with delivery of Low birth weight (LBW) infants ($p<0.05$). This is in line with a similar study carried out in South-Africa by Hoque *et. al.*, 2010, who reported that eclampsia and pregnancy induced hypertension were risk factors associated with preterm deliveries and delivery of low birth weight infants. According to the report of FAO (2007), young girls who grow poorly due to malnutrition becomes stunted women and are more likely to give birth to LBW infants and if these infants are girls, they are likely to continue the cycle by being stunted in adulthood, if nothing is not done to break the cycle thus, adolescent pregnancy heightens the risk of LBW and the difficulty of breaking the cycle.

Baker *et. al.*, (2009) have reported that mothers less than 20 years old are at a greater risk of having preterm deliveries, low birth weight infants, stillbirths, anemia and neonatal deaths

than adult mothers. Summarily, lack of proper nutrition can lead to other pregnancy outcomes like macrosomia, IUGR/SGA, anaemia, LBW, and congenital abnormality (Robin, 2009). More so, domestic responsibilities, working for livelihood, inadequate rest, under-nutrition have been reported to contribute to women delivering low birth weight (Mehra and Agrawal, 2004).

5.6 Pregnancy Complications among The Pregnant Women

Although a higher proportion of the adolescent pregnant women had their PCV <30% compared with the adult women though this was not statistically significant ($p>0.05$). The mean systolic and diastolic blood pressure for adolescent women was significantly higher in comparison to that of adult women ($p<0.05$). Thus, higher incidence of gestational hypertension and gestational anaemia was observed among the adolescent than the adult mothers.

CONCLUSIONS

This study has shown the following;

- That weight gain in pregnancy is an important determinant of nutritional status of pregnant women and their infants and this was observed to increase with increase in the gestational age (trimester) of the pregnancy, maternal age, parity and height. Although, it was quite lower than the IOM recommendation for pregnant women.
- The birth weight of the infants increased with increase in total maternal weight gain in pregnancy especially at the end of third trimester, maternal age, height and parity among the pregnant women.
- Maternal weight gain and BMI was found to be higher among the Christians than the Muslims also, higher proportion of the pregnant women who were overweight and obesity was among the Ibo tribes than the Nupes.
- More of the adult mothers had macrosomic (>3.5kg) babies when compared with adolescent mothers while the incidence of LBW (<2.5kg) was higher among adolescent and primigravidae mothers than adult and multiparous mothers.
- More so this study showed that maternal age at conception, religion, ethnicity, parity, weight gain in pregnancy, BMI to mention few had significant influence on the infant's birth weight while the following ; Occupation, maternal height,

nausea/vomiting, PCV and blood pressure had significant influence on the maternal total weight gain from the beginning of second trimester to the end of third trimester..

- ❖ Generally, most of the women presented late for antenatal care, and the incidence of LBW was higher among women who presented late for ANC.

RECOMMENDATIONS

The following recommendations are made based on the findings of this study.

- Women should be encouraged to book early for antenatal care at and attend regularly any available good health services once they notice they are pregnant to prevent the incidence of adverse pregnancy complications and poor outcome.
- Women in this study area should be enlightened and empowered to make inform choices on adequate food intake before, during and after pregnancy as it affect pregnancy outcome in relation to both mother and child (safe motherhood).
- Adolescent pregnancy should be discouraged in every society to prevent severe inter-linked factors, such as their pelvic, muscles and bones not yet reaching maturity, poor education and other socio-economics status, inadequate nutrition and poor pregnancy outcomes because it is still an obstetric risk factor of maternal and child mortality, and LBW .
- Proper documentation of client information during antenatal visits by healthcare providers into their hospital folders should be accurately done and back up copy should be kept in electronic media, as inadequate record keeping was a major challenge to this study.
- Strategies to empower women especially the girl-child through formal education to enable them make informed decision on sexual and reproductive health issues prior to conception, and access to contraception should be given utmost priority especially in the north central zone of the country where this study was carried out.
- More intensified aggressive awareness and advocacy programmes on the importance of adequate dietary intake before, during and after pregnancy for mother and child, early booking and regular ANC visits, possible complications in pregnancy, high parity and teenage pregnancy should be channeled through religious, and community

leaders, clan heads, husbands of this women, policy makers, basic education school curriculums to women and girl child especially at grassroots' level in northern part of the country using local dialects, mass media, jingles and visual aids just like voluntary counseling and testing(VCT) for HIV/AIDS was done.

5.12 Contribution to knowledge

1. This study has further emphasized the implications of maternal nutritional status, weight gain and early marriage on pregnancy outcomes.
2. Also identified factors that may contribute to adverse pregnancy complications and outcomes among women of childbearing age such as early age at conception, low PCV, late and inconsistent ANC visit, Parity among others.
3. Early marriage and childbirth has remained a predisposing factor for adverse pregnancy outcome and complication among women of childbearing age.
4. Short or close inter-pregnancy interval has remained a challenge among the women which could be due to religious and cultural belief.
5. Despite the advancement in technology and education, awareness on importance of pre-pregnancy weight, advantage of early and regular antenatal visits, implications of early marriage and high parity on health status of women of childbearing age in this populace is still poor.
6. Gestational anaemia and hypertension still remain a challenge among pregnant women across all culture in Nigeria thus we are still far from reaching the MDGs of reducing maternal and child morbidity and mortality by 2015.

5.13 Suggestions for further studies

1. Findings from this research can proffer guidelines for further studies on how to reduce malnutrition and achieve adequate maternal weight gain before, during and after pregnancy among women of childbearing age through interventions and awareness programs.
2. Comparative study on pattern of weight gain and pregnancy outcome with possible complications among women of childbearing age from other minority group across

the nation can be explored using a cross sectional or longitudinal study approach so as to provide an insight to the dietary pattern, food choices of women and pattern of weight gain and pregnancy outcome among women of childbearing age.

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APPENDIX I

Association between socio-demographic characteristics and Body Mass Index of the pregnant women at delivery.

Variables	X^2	p-value
Age group	16.52	0.000
Marital status	2.44	0.295
Religion	18.29	0.000
Ethnicity	25.66	0.004
Occupation	54.32	0.000
Residence	3.83	0.148

APPENDIX II

Association between Maternal Anthropometric Indices and Body Mass Index of the Mothers at Delivery.

Variables	X^2	p-value
Maternal height	163.11	0.000
Maternal weight at delivery	1638.62	0.000
Maternal weight gain at delivery	9.09	0.059

APPENDIX III

Association between Obstetric Information, Lifestyle and Body Mass Index and of pregnant women

Variables	X^2	p-value
Antenatal care	9.05	0.016
Gestational age at booking	7.65	0.105
Parity	38.39	0.000
Inter-pregnancy spacing	24.36	0.000
Infection in pregnancy	11.42	0.179
Nausea/vomiting	2.14	0.710
Packed cell volume	119.41	0.000
Blood pressure	35.78	0.003
Gestational diabetes	5.50	0.064
Postpartum complications	7.61	0.020
Gestational age at delivery	13.21	0.001
Mode of delivery	12.08	0.017
behavioural lifestyle	1.23	0.544

APPENDIX IV

Association between Infant Characteristics and Body Mass Index of the pregnant women.

Variables	X^2	p-value
Apgar score	3.97	0.694
Sex	3.73	0.155
Gestational age at birth	1302.05	0.001
Infant birth weight	56.21	0.000
Feotal outcome	52.36	0.000
Feotal presentation	2.14	0.711

APPENDIX V

Association between Socio-demographic characteristics and Total Weight Gain of the pregnant women at delivery

Variables	X^2	p-value
Age group	0.33	0.848
Marital status	0.02	0.990
Religion	1.24	0.538
Ethnicity	3.09	0.979
Occupation	38.16	0.000
Residence	1.92	0.059

APPENDIX VI

Association between Anthropometric Indices and Total Weight Gain of the Pregnant Women at Delivery.

Variables	X^2	p-value
Maternal height	434.87	0.000*
Maternal weight at booking	223.33	0.847
Maternal weight at delivery	177.35	0.996
BMI at delivery	9.09	0.059

APPENDIX VII

Association between and obstetric and lifestyle with Total Weight Gain of the pregnant women

Variables	X^2	p-value
Antenatal care	12.58	0.127
Gestational age at booking	35.99	0.994
Parity	4.75	0.314
Inter-pregnancy spacing	6.79	0.341
Infection in pregnancy	0.47	1.000
Nausea/vomiting	40.07	0.000*
Packed cell volume	386.33	0.000*
Blood pressure	20.22	0.000*
Pregnancy complications	0.546	0.761
Mode of delivery	1.09	0.896
behavioural lifestyle	0.01	0.995

APPENDIX VIII

Association between Infant characteristics and Total Weight Gain of the pregnant women

Variables	X^2	p-value
Apgar score	1.19	0.977
Sex	2.27	0.322
Gestational age at birth	2.15	1.000
Infant birth weight	2.01	0.733
Foetal presentation	0.29	0.990
Foetal outcome	1.85	0.933

APPENDIX IX

Association of Socio-Demographic Data with Pregnancy Complications of the Pregnant Women

Variables	X^2	p-value
Age group	4.17	0.525
Marital status	0.46	0.994
Religion	7.28	0.201
Ethnicity	39.61	0.032*
Occupation	29.33	0.500
Residence	5.63	0.344

APPPENDIX X

Association of Maternal Anthropometric indices with Pregnancy Complications among the Pregnant Women.

Variables	X^2	p-value
Maternal height	65.35	0.012*
Maternal weight at delivery	226.66	0.000*
Maternal weight gain at delivery	0.54	0.761
BMI at delivery	0.46	0.292

APPENDIX XI

Association between Obstetric, Lifestyle Characteristics and Pregnancy Complications among the Pregnant Women.

Variables	X^2	p-value
Antenatal care	5.39	0.244
Gestational age at booking	2.18	0.336
Parity	5.84	0.054
Inter-pregnancy spacing	1.17	0.760
Infection in pregnancy	9.39	0.052
Nausea/vomiting	0.42	0.810
Packed cell volume	38.77	0.000*
Blood pressure	22.76	0.000*
Gestational age at delivery	31.38	0.001*
Mode of delivery	313.07	0.000*
behavioural lifestyle	0.23	0.630

APPENDIX XII

Association between Infant Characteristics and Pregnancy Complications of the Mothers

Variables	X^2	p-value
Apgar score	82.33	0.000
Sex	11.75	0.001
Gestational age at birth	31.38	0.001
Infant birth weight	33.72	0.000
Foetal presentation	55.10	0.000
Foetal outcome	58.05	0.000

APPENDIX XIII

Association between Socio-demographic Data and Foetal outcomes of the Pregnant Women.

Variables	X^2	p-value
Age group	5.97	0.113
Marital status	1.49	0.684
Religion	20.73	0.000*
Ethnicity	42.98	0.000*
Occupation	26.56	0.880
Residence	12.59	0.006*

APPENDIX XIV

Association of Anthropometric indices with Foetal Outcomes of the Pregnant Women.

Variables	X^2	p-value
Maternal height	204.88	0.000*
Maternal weight at delivery	669.97	0.000*
Maternal weight gain at delivery	1.60	0.808
Maternal Body Mass Index at delivery	234.58	0.002*

APPENDIX XV

Association between Obstetric/ Lifestyle characteristics and Foetal Outcomes of the Pregnant Women

Variables	X^2	p-value
Antenatal care	33.021	0.000*
Gestational age at booking	111.07	0.000*
Parity	25.02	0.000*
Inter-pregnancy spacing	20.14	0.003*
Infection in pregnancy	3.52	0.742
Nausea/vomiting	4.19	0.380
Packed cell volume	42.19	0.000*
Blood pressure	17.19	0.001*
Pregnancy complications	37.42	0.000*
Gestational age at delivery	19.33	0.000*
Mode of delivery	35.56	0.000*
behavioural lifestyle	9.05	0.011*

APPENDIX XVI

Association between Infant Characteristics and Foetal Outcomes among Pregnant Women

Variables	X^2	p-value
Apgar score	246.62	0.000
Sex	39.95	0.000
Gestational age at birth	17.99	0.000
Infant birth weight	1563.68	0.000
Feotal presentation	12.87	0.045

APPENDIX XVII

Association between Socio-demographic Data of the Mothers and Infant Birth Weight

Variables	X^2	p-value
Age group	3.29	0.193
Marital status	1.60	0.448
Religion	15.78	0.000*
Ethnicity	28.47	0.002*
Occupation	15.90	0.196
Residence	4.67	0.097

APPENDIX XVIII

Association between Anthropometric Indices of the Mothers and Birth Weight of their Infants

Variables	X^2	p-value
Maternal height	157.12	0.000*
Maternal weight at booking	460.14	0.000*
Maternal weight at delivery	465.52	0.000*
Weight gain at delivery	2.01	0.733
BMI at delivery	56.21	0.000*

APPENDIX XIX

Association between Obstetric/ Lifestyle Characteristics and Birth Weight of the Infants

Variables	X^2	p-value
Antenatal care	45.42	0.000*
Gestational age at booking	460.14	0.000*
Parity	15.24	0.004*
Inter-pregnancy spacing	21.15	0.002*
Infection in pregnancy	9.54	0.299
Nausea/vomiting	2.45	0.653
Packed cell volume	146.34	0.000*
Blood pressure	19.99	0.000*
Pregnancy complications	33.73	0.000*
Mode of delivery	37.56	0.000*
behavioural lifestyle	8.82	0.012*

APPENDIX XX

Association between Infant Characteritics Data and Infant Birth Weight.

Variables	X^2	p-value
Apgar score	48.82	0.000*
Sex	40.76	0.000*
Gestational age at birth	78.53	0.000*
Foetal outcome	1577.39	0.000*
Foetal presentation	18.56	0.001*
Foetal outcome	1.85	0.933

APPENDIX XXII

The Relationship between Low Birth Weight and Maternal Variables.

Variable	X^2	p-value
Age of mothers	24.6	.003
Mothers occupation	23.4	.025
Height of mother <1.50m	26.6	.002
Weight at booking	61.9	.000
Weight at delivery	57.3	.000
Total weight gain in pregnancy	25.1	.003
Parity	25.0	.002
Gestational hypertension	17.1	.001
Gestational diabetes	13.3	.004
Post partum complications	19.4	.000
Pregnancy complication	199.9	.000
Infant sex	39.9	.000
Mode of delivery	42.2	.000

APPENDIX XXIII

INFORMED CONSENT

ADULOJU, BOSEDE ALICE a postgraduate student of the Department of Human Nutrition Faculty of Public Health College of Medicine, University of Ibadan, Ibadan is presently carrying out a study on the topic "PATTERN OF MATERNAL WEIGHT GAIN AND PREGNANCY OUTCOME AMONG WOMEN OF CHILDBEARING AGE ATTENDING ANTENATAL CLINIC AT FEDERAL MEDICAL CENTER BIDA, NIGER STATE". I have sought and obtained the approval of the Federal Medical Center Bida Ethical committee to carry out the research.

I intend to obtain data for the study from the case notes of pregnant women who have attended Antenantal clinic in Federal Medical Center from 2005 to 2009 period. Necessary information obtained shall be filled into approved Record review guides for each case file.

I shall appreciate your consent to use the records as desired

Thank you for your co-operation,

Aduloju, B.A

For the consenting officer

NAME_____

SIGNATURE_____

DATE_____

APPENDIX XXIV

SAMPLE OF RECORD REVIEW GUIDE

TITLE OF SURVEY : PATTERN OF MATERNAL WEIGHT GAIN AND PREGNANCY OUTCOME AMONG WOMEN OF CHILDBEARING AGE ATTENDING ANTENATAL CLINIC AT FEDERAL MEDICAL CENTER BIDA, NIGER STATE.

RECORD REVIEW GUIDE IDENTIFICATION NUMBER ----------

Year Conducted 2011

SECTION A: Socio-Demographic Data

1. Sex; Male □ Female □

2. Age at conception ……

3. Marital status; 1.Single □ 2.Married □ 3. Divorced □ 4.Widowed □

4. Religion Affinity; 1.Christianity □ 2.Islam □ 3.Traditional □ 4. No Religion □ 5. others (please state) ……

5. Ethnic group 1. Nupe □ 2. Gwari □ 3. Hausa □ 4. Igbo □ 5. Yoruba □ 6.Others (specify) ……

6. Occupation 1.House wife 2.Farmer □ 3.Trader □ 4. Artisan □ 5. Public servant □ 6. Student □ 7. Others specify

7. Place of residence 1. Urban dweller □ 2. Rural dweller □

8. How many antenatal visits before delivery did you have? 1. None □ 2. Once □ Twice □ Thrice □ 5. > thrice □.

SECTION B: Maternal Anthropometry

9. Maternal height (m) as at booking ----------

10. Maternal weight (kg) as at booking ----------

b. Maternal BMI at booking (kg/m^2) ----------

11. Maximum Weight during 2^{nd} trimester (kg) ----------

b. Maternal BMI at 2^{nd} Trimester (kg/m^2) ----------

12. Maximum Weight during 3^{rd} trimester (kg) ----------

13. Maternal BMI at 3rd Trimester (kg/m^2) ---------- (to be calculated using the mother's weight before delivery)

14. Behavioural lifestyle 1. Cigarette smoking □ 2. Alcohol consumption□

3. Coffee consumption □ 4. Cigarette snuffing□

SECTION C: Obstetric Information and History.

15. Gestational age as at first booking (months) ----------

16. Date of last menstrual period----------

17. Parity……..

a. Inter-pregnancy spacing; YES □ NO □

b. 1. ≤ 2 years □ 2. ≥ 2 years□

18. Infection during pregnancy? I. UTI (Urinary Tracts Infection)

II. Herpes

III. Viral

IV. Specify any other (s)

19. Malaria in pregnancy? YES □ NO □

20. Nausea and/or vomiting in pregnancy? YES □ NO □ if yes,

b. which of the Trimester? 1ST □ 2nd □ 3rd□

21. Blood pressure at 1st, 2nd, 3rd trimesters ……

22. Pack cell volume at 1st, 2nd, 3rd trimesters ……

23. Pack cell volume at Delivery …….

24. Gestational diabetes? YES □ NO □

25. Chronic and gestational hypertension? YES □ NO □

26. Postpartum complication YES □ NO□

If yes, specify ----------

27. Mode of delivery vaginal□, CS□, assisted vaginal delivery/instrumentation□

SECTION C: Newborns' information

28. Gestational age of new born at birth ----------

29. Apgar score …….

30. Sex Male □ Female □

31. Birth weight of infant (kg) ----------

32. Position of child in the family (specify) ----------

33. Foetal presentation; cephalic □ breech □ shoulder □ transverse □ cord □ others

34. Feotal (pregnancy) outcomes; Normal weight baby □ LBW □ macrosomia □ SGA□; stillbirth/intrauterine foetal death □ congenital abnormality□ Others (specify)-------