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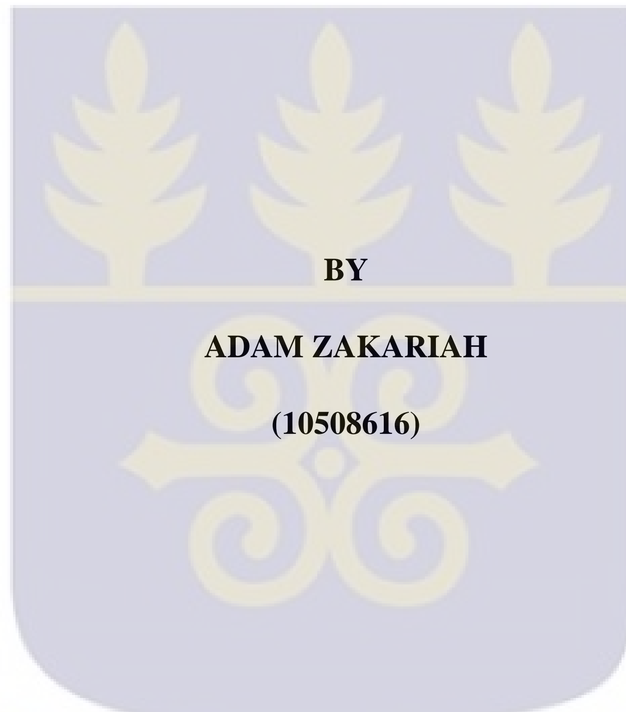
SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

DETERMINANTS OF LOW BIRTH WEIGHT IN NEONATES BORN IN THREE HOSPITALS IN BRONG AHAFO REGION



BY

ADAM ZAKARIAH

(10508616)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULLFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PHILOSOPHY DEGREE IN APPLIED EPIDERMIOLOGY AND DISEASE CONTROL

JULY 2016

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DECLARATION

I, Zakariah Adam declare that this thesis is my original work, except for duly referenced ones and that no form of this work has been presented elsewhere for another research.

……………………………………   ……………………………………

Adam Zakariah   Date

(Student)

……………………………………   ……………………………………

Dr Priscilia Awo Nortey   Date

(Supervisor)

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DEDICATION

I dedicate this work to my family who supported me throughout the course of my study.

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ACKNOWLEGEMENT

I am grateful to my supervisor, Dr Pricilia Nortey who contributed immensely to the successful completion of this work.

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LIST OF ABBREVIATIONS

ANC	-	Antenatal Care
BMI	-	Body Mass Index
DHIMS	-	District Health Information Management System
GDHS	-	Ghana Demographic and Health Survey
ICD	-	International Classification of Disease
IUGR	-	Intrauterine Growth Restriction
LBW	-	low birth weight
LMIC	-	Low and Middle Income Countries
MDG	-	Millennium Development Goals
PTB	-	Preterm birth
SGA	-	Small for Gestational Age
SVD	-	Spontaneous Vaginal Delivery
WHO	-	World Health Organization
CS	-	Caesarian section
ELBW	-	Extremely Low Birth Weight
VLBW	-	Very Low Birth Weight
GSS	-	Ghana Statistical Service

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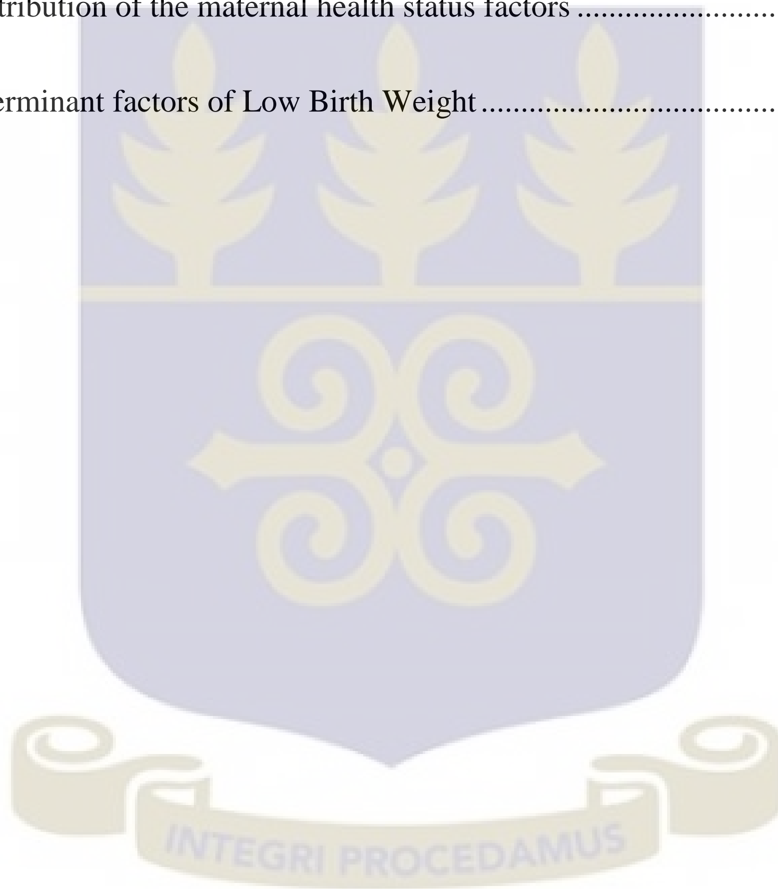

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DEFINITION OF TERMS

Low birth weight:

This is defined as the weight of a baby measured immediately after birth and is below 2500grams.

Extremely low birth weight

This is defined as the weight of a baby measured immediately after birth and is below 1000 grams,

Very low birth weight

This is defined as the weight of a baby measured immediately after birth and is 1500grams or less, but not lower than 1000grams.

Normal birth weight:

This is defined as the weight of a baby measured immediately after birth and its 2500grams or more but not exceeding 3400grams.

Chronic medical illness:

This is defined as the presence of a pre-existing medical illness of the mother that was documented in the medical record with an onset prior to the current pregnancy.

Parity:

It is defined as number of deliveries after at least 28 completed weeks of gestation. This is categorized into primiparous (mothers with one delivery) and multiparous (mothers with more than one delivery).

Body mass index (BMI) This is defined as the weight measured in kilograms per height in meters squared. Normal BMI is 18.5-24.9, underweight is <18.5 and overweight/obese >25)

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Gestation at booking:

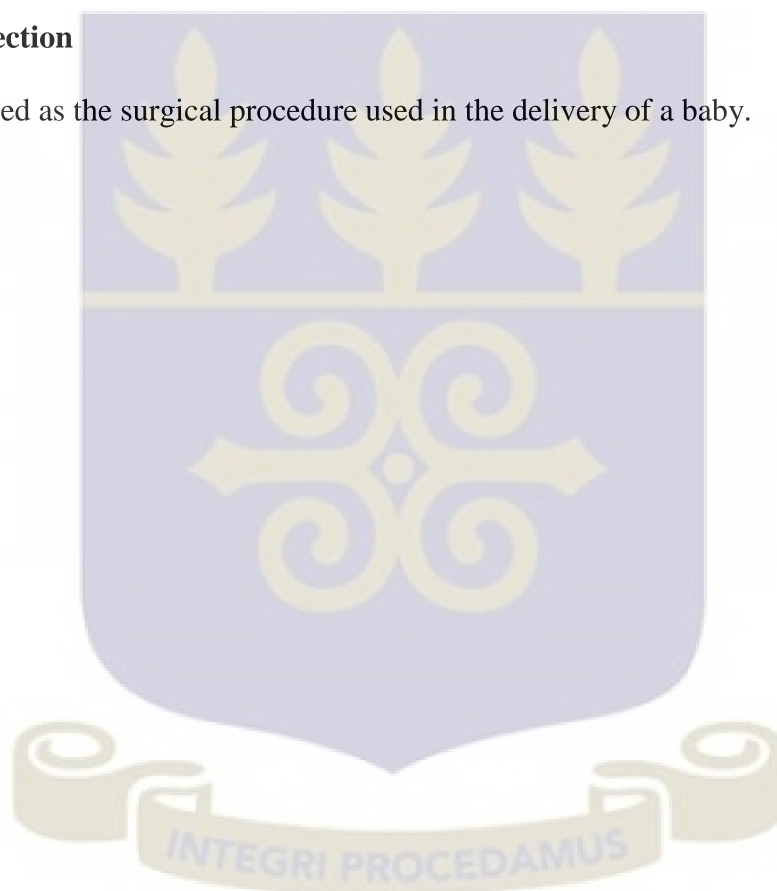
This is defined as the gestation at which the mother initiated/started ANC care. The gestation is calculated from either the mothers last menstrual period or from an early ultrasound scan done.

Gestation at delivery:

This is the gestation at which the mother delivered.it determines the duration of the pregnancy prior to delivery**.**

Caesarian section

This is defined as the surgical procedure used in the delivery of a baby.



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ABSTRACT

Introduction:

Low birth weight is the weight of the newborn measured immediately after birth and is less than 2500 grams. The global prevalence of LBW is 15.5 percent, which amounts to about 20 million LBW infants born each year. A high proportion (96.5%) of LBW babies are born in developing countries (Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. 2005). In Ghana, the recent incidence of LBW infants was estimated at 160 per 1000 births and has not witnessed any reduction in the last decade (Kayode et al., 2014). In the Brong Ahafo region the estimated prevalence of LBW is 91.9 per 1000 live births with a neonatal mortality rate at 6.6 per 1000 live births (DHIMS 2015).

The objective of the study is to determine the factors that influence low birth weight (LBW) delivery in three hospitals in the Brong Ahafo Region.

Method:

Unmatched Case-control study design was used;

A case was defined as a mother who delivers a baby with a birth weight below 2500grams in any of the study sites and a control defined as mothers with delivery of a baby with weight between 2500 grams and 3400 grams at the same site as a case within 24 hours of delivery of the case. A sample of 120 cases and 240 control mothers with singleton deliveries were recruited for the study. Case controls were collected in a ratio of 1:2 respectively. Three hospitals in Brong Ahafo Region, Ghana were used as the study sites.

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Results:

The factors with their adjusted odds which influenced the delivery of a low birth weight baby included; first trimester hemoglobin <11g/dl(aOR 3.14; 95%CI 1.50-6.58), delivery at 32-36weeks gestation (aOR 13.70; 95%CI 4.64-40.45), delivery below 32weeks gestation (aOR 58.50; 95%CI 6.66-513.87), Secondary Education of mothers (aOR 4.19; 95%CI 1.45-12.07), living with extended family (aOR 2.43; 95%CI 1.15-5.10, living alone during pregnancy (aOR 3.95; 95%CI 1.33-11.74), and not taking iron supplements during pregnancy (aOR 3.19; 95%CI 1.07-9.54) were found to be the determinant factors of LBW .

Conclusion:

The study in these three facilities showed that the determinant factors for the delivery of a LBW were; delivery at preterm, Educational level of mothers being secondary, living alone during pregnancy, not taking iron supplementation and mothers with first trimester hemoglobin below 11g/dl.

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CHAPTER 1

INTRODUCTION

1.1 Background

Low birth weight (LBW) is one of the major public health problems worldwide especially in low and middle income countries. It contributes hugely to the mortality, morbidity and disability in neonatal, infancy and childhood periods of life and has a long term effect on health outcomes in adult life. Low birth weight results in substantial costs to the health sector and imposes a significant burden on the society as a whole (WHO Cairo 2005).

Birth weight is the weight of the newborn measured immediately after birth. It is classified by the Centre for Disease and Control (CDC) as; extremely low birth weight (ELBW) is infants whose birth weight is below 1000 grams, very low birth weight (VLBW) is infants whose birth weight is below 1500 grams, low birth weight (LBW) is infants whose birth weight is below 2500 grams, normal birth weight (NBW) is infants whose birth weight is below 4000 grams, and high birth weight (HBW) is infants whose birth weight is more than 4000 grams. Birth weight of 2500grams to 3400grams is considered normal birth weight by the World Health Organization (WHO) and this is the classification used to determine a normal weight baby or otherwise.

LBW is an important predictor of infant death within the first month of delivery (Abel, 1980) (Abrams, Altman, & Pickett, 2000) and together with preterm births, they are indicators of potential lifelong consequences to individuals, families, and communities at large. The birth weight of a baby serves as a good indicator of the reproductive and general health status of a population. This indicator is not only about the baby's health and nutritional status but also the physical and psychosocial growth and development of babies

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and their chances of survival (Abel, 1980)(Abrams et al., 2000).(Ghana Statistical service cluster survey 2011).

A low birth weight infant can be born too small, too early (preterm) or both. This can happen for many different reasons which may or may not be related. These factors associated with birth weight are influenced through genetic, socio-demographic, maternal medical, fetal and environmental determinants. LBW in the developing world occurs primarily from the mother's poor health and nutrition, whiles cigarette smoking during pregnancy is the leading cause of LBW in the developed world.

Birth weight is influenced by two major processes, thus, duration of gestation and intrauterine growth rate. LBW is thus caused by either a short duration of pregnancy or retarded intrauterine growth or a combination of both. A pregnancy duration of less than 37 weeks is termed prematurity. Although Intrauterine Growth Retardation (IUGR), which is also referred to as "small-for-gestational-age" or "small-for-dates," has no generally accepted standard definition, the following are commonly used: birth weight less than 10th (or 5th) percentile for gestational age; birth weight less than 2500 grams and gestational age greater than or equal to 37 weeks; and birth weight less than 2 standard deviations below the mean value for gestational age.

Compared to infants of normal weight, low birth weight infants may be more at risk for many health problems. It predisposes the baby to short and long term morbidities. Some short term conditions include, respiratory distress syndrome, infections, entérocolitis, hydrocephalus and mental retardation(Lira, Ashworth, & Morris, 1996).The late onset morbid conditions may include coronary heart disease(Eriksson JG Tuomilehto J, Winter PD, Osmomnd C, Barker DJP, 1999) (Leon et al., 1998), non-insulin dependent diabetes(Leger et al., 1997), childhood hypertension(Forrester et al., 1996), behavioral

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disorders (Schothorst & van Engeland, 1996), impaired cognitive function(Wadsworth, Kuh, Richards, & Hardy, 2006) (Sorensen et al., 1997) and psychological disorders(Olsén et al., 1998).

Several risk factors increase a pregnant woman's chances of having a low birth weight baby in her lifetime, these may include: smoking, drinking alcohol, lack of weight gain, Younger than 15 years and older than 35 years. Also the social and economic factors, such as low income, low educational level, Stress, domestic violence or other abuse and woman been unmarried may increase the risk of a low birth weight delivery. Other risk factors are previous preterm birth, exposure to air pollution (both indoor and outdoor) and drinking water contaminated with lead, which are considered environmental risk factors.

Early and regular prenatal care helps identify conditions and behaviors that can result in low birth weight infants. To reduce the risk of having a low-birth weight infant, it is recommended that prospective pregnant women quit smoking and alcohol consumption, attend a health care provider for a medical checkup before pregnancy, work with a health care provider to control diseases such as high blood pressure or diabetes, and also the need to get preconception health care to identify risk factors. Also seeking care to address concerns during pregnancy and seeking medical attention for any warning signs or symptoms of preterm labor will all help reduce the risk of delivering a low birth weight baby.

In both developed and developing countries alike, LBW is most frequently associated with teenagers who give birth when their own bodies have not yet fully developed (Boerma, Weinstein, Rutstein, & Sommerfelt, 1996) . Studies show that in sub-Saharan Africa and other developing parts of the world, poverty, low education, late initiation of obstetric care, poor nutrition, and micronutrient supplementation during pregnancy are associated

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with LBW (Prentice, Watkinson, Whitehead, Lamb, & Cole, 1983) (Spangler & Bloom, 2010) (Fotso, Ezeh, & Essendi, 2009)(Magadi, Madise, & Diamond, 2001)(Onah, Ikeako, & Iloabachie, 2006). Parity and birth intervals are also risk factors (WilcoxAllen J, 2001) (Conde-Agudelo, Rosas-Bermúdez, & Kafury-Goeta, 2006) (Smith, Pell, & Dobbie, 2003) (Rawlings, Rawlings, & Read, 1995) (Zhu, Haines, Le, McGrath-Miller, & Boulton, 2001).

The prevalence of LBW is estimated to be 15 % worldwide with a range of 3.3–38 % and occurs mostly in low and middle income countries (WHO Cairo 2005). The prevalence is highest in South-Central Asia and sub-Saharan Africa, with an estimated 96.5 percent of LBW babies are born in developing countries (Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. 2005) but there are intra-country variations.

The World Health Assembly in 2012 set a goal to reduce the number of LBW by 30 % by the year 2025. This means a 3 % relative reduction per year between 2012 and 2025 and a reduction from approximately 20 million to 14 million infants with low weight at birth (WHO Geneva 2014).

Low birth weight still remains a global concern, as some developed countries such as Spain, Great Britain, Northern Ireland and the United States of America are also faced with high rates for their contexts (WHO, Geneva 2012).

The Ghana Multiple Indicator Cluster Survey (MICS) found a LBW prevalence of 9.1 % and 11 % in 2006 and 2011 respectively (Ghana Statistical service, cluster survey 2011) (Ghana Statistical service, cluster survey 2006)

In developing countries, facilities for intensive care for LBW babies are often minimal due to lack of qualified staff and equipment. Survival of low birth infants depends highly on the quality of facility care. In Ghana Vesel et al., in 2013, stated that there were major

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gaps in emergency and neonatal care equipment, drugs, staff, practices and skills. The same study said in order to save newborn lives these gaps must be addressed. Other studies have also reported inadequacies in the quality of facility care for maternal and child health in LMICs.(Nolan et al., 2001) (Fauveau & de Bernis, 2006) . The Brong Ahafo region which is the Second largest region in Ghana pose these challenges and factors that influence LBW as discussed. The region recorded 1622 LBW with 438 neonatal deaths in 2015(DHIMS2015). These factors informed the selection of the region for this study. The Regional Hospital, The Municipal Hospital and The Holy Family Hospitals all in the Brong Ahafo Region, which recorded a LBW prevalence of 125.7/1000 live births, 59.0/1000 live births and 124.4/1000 live births respectively(DHIMS 2015) were selected due to their high rates compared to all other health facilities in the Region.

The factors associated with low birth weight have been studied extensively but not much studies done in developing countries and Ghana in particular. Studying the socio-demographic, maternal health status and reproductive determinants of LBW is important for both public health and clinical perspectives since such information would help in understanding the effect of these variables and how modifying the factors would help in the reduction of the incidence of LBW infants .This study is carried out to identify these factors that influence the occurrence of low birth weight in the Brong Ahafo region, using three major health facilities as the study sites.

1.2 Problem statement

Low birth weight (LBW) is one of the major public health problems worldwide especially in low and middle income countries. It contributes hugely on the mortality, morbidity and

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disability in neonatal, infancy and childhood life and has a long term effect on health outcomes in adult life.

The weight of a newborn is an important predictor of an infant's growth and survival(Ashworth, 1998)(McIntire, Bloom, Casey, & Leveno, 1999). Infants born with low birth weights begin life immediately disadvantaged and face extremely poor survival rates. LBW babies have been known to have a higher risk of death compared to full term babies(Kinney, M. V., Kerber, K. J., Black, R. E., Cohen, B., Nkrumah, F., Coovadia, H., ... & Weissman, 2010).

Low birth weight (LBW) is a major contributor to neonatal morbidity and mortality and is a real issue of public health concern in developing countries (WilcoxAllen J, 2001)] . A Study carried out in Canada showed that there was a statistically significant association of LBW with neonatal death (odds ratio, 2.77 ;(Bernstein, I. M., Horbar, J. D., Badger, G. J., Ohlsson, A., & Golan, A. (2000).

The high prevalence of LBW constitutes a public health problem as LBW is usually an indicator of chronic maternal malnutrition, maternal illness and poor prenatal care, hence, a good indicator of the socioeconomic status of inhabitants (United Nations Children's Fund and World Health Organization, 2004). Nigeria ,which has similar socio economic, reproductive, demographic and general health characteristics like Ghana where a study of factors for low birth weight was done, showed that ; gestational age less than 37 weeks (76.5%), maternal age less than 20 years (58.5%), irregular antenatal checkup (70.5%), mother's height less than 150 cm (68.5%), mother's weight less than 50 kg (76.1%), hemoglobin less than 10 gm/dl (60.5%), and severe physical work (78%), are significant determinants of LBW (Agrawal, Agrawal, Chaudhary, Agarwal, & Agarwal, 2011). These

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modifiable factors pose similar challenges in Ghana and therefore identifying them in the effort to address low birth weight is critical.

Studies by Bhutta et al., 2010 have shown that there has been a slow progress towards reduction in neonatal deaths, and only 19 out of 68 countries were on track to meet MDG 4 (Bhutta et al., 2010). Low birth weight which contributes 60 to 80 percent of all neonatal deaths (Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. (2005) is therefore an issue of public health concern ,which needs to be addressed if the Millennium Development Goal 4 (MDG4) is to be achieved.

Tackling neonatal mortality which is significantly associated with LBW is therefore essential if the millennium development goal of reducing child mortality by two-thirds between 1990 and 2015 is to be achieved(Lawn, Cousens, & Zupan, 2005). Progress in reducing neonatal mortality has been slower in Sub-Saharan Africa than in any other region in the world (AbouZahr & Wardlaw, 2001).

In Ghana, the incidence of LBW infants estimate for 2014 was 160 per 1000 births and has not witnessed any reduction in the last decade (www.worldlifeexpectancy). The World Health Organization also estimated that in 2014 7,876 LBW deaths occurred in Ghana. (www.worldlifeexpectancy.com).

In one of the three major tertiary hospitals in Ghana,13.3% of the babies born were low birth weight (Klufio, Lassey, Annan, & Wilson, 2000).

To further highlight the problem in Ghana, Asare 2011, indicated that 30 neonatal deaths per 1000live births occurred with 15% of these deaths been LBW. Also 46% of all LBW in Ghana die in the first 28 days of life (Asare, 2011).

In the Brong Ahafo region the estimated prevalence of LBW is 91.9 per 1000 live births with a neonatal mortality rate of 6.6 per 1000 live births (DHIMS 2015). A total of 66616

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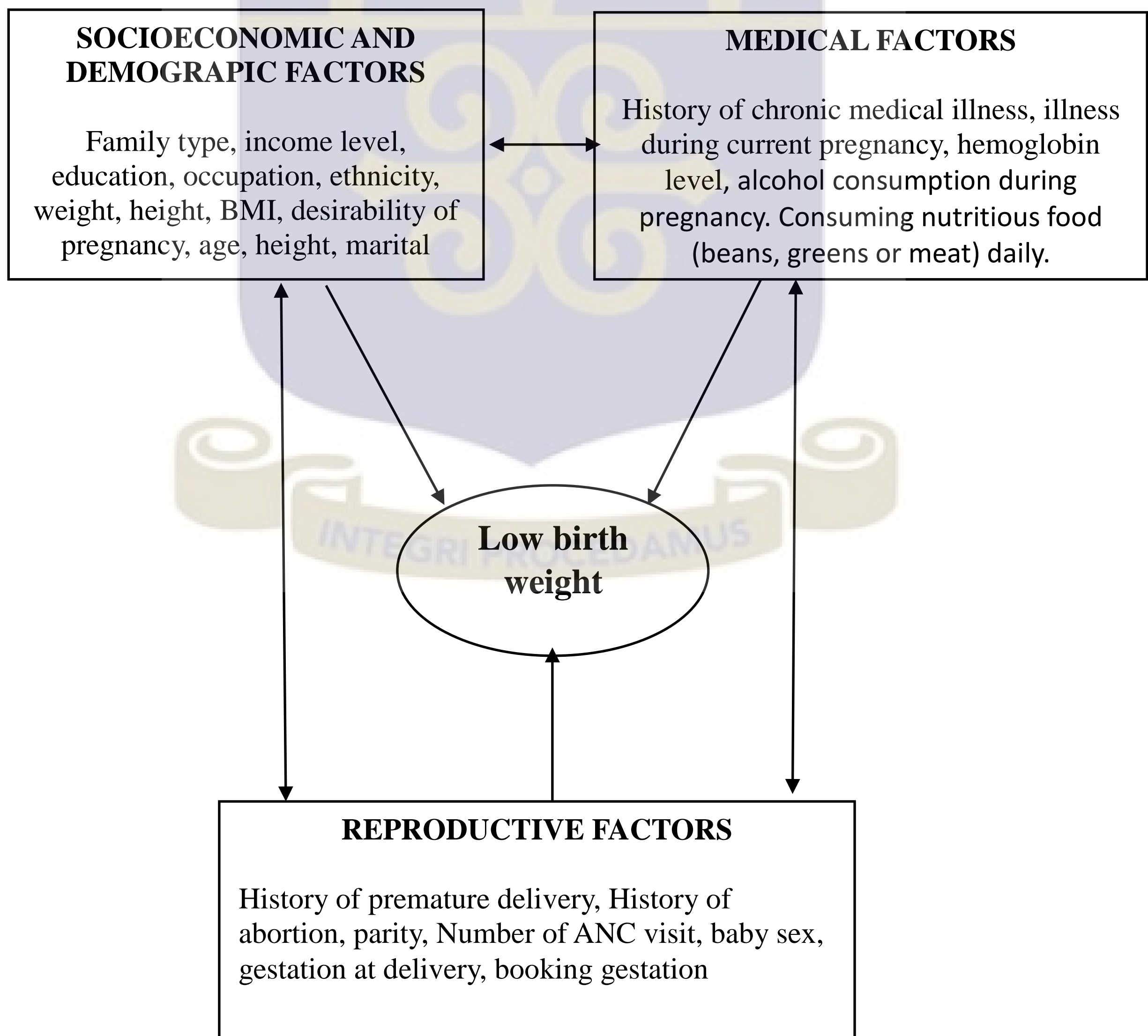
live births, 1149 low birth weight and 438 neonatal deaths (DHIMS 2015). The Regional hospital, The Municipal Hospital and the Holy Family Hospital in Techiman where the study will be done recorded a total of 410, 98 and 641 low birth weights respectively.

Also Low birth weight results in substantial cost to health services, substantial financial burden on special education services and on the families and cares of the infants. (Petrou, 2003).

1.3 Conceptual framework:

Factors that influence the delivery of a low birth weight baby

Figure 1: Conceptual framework



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1.4 Justification

The World Health Organization estimated that Ghana recorded 7,876 LBW deaths in 2014 (www.worldlifeexpectancy.com).Deaths due to LBW complications are decreasing more slowly, and these are now the second leading cause of child death. (Darmstadt, G. L., Munar, W., & Henry, S. K. 2014).

Care of the low birth weight baby possess substantial cost to the health system. There is therefore the need to focus on finding the preventable/modifiable factors to LBW in order to reduce this cost to the health service system and eventually reduce neonatal and child mortality. This analogy is supported by a study which said that innovation for preventive solutions is key to reducing LBW and neonatal mortality (Darmstadt, G. L., Munar, W., & Henry, S. K. (2014). This study aims to identify these modifiable factors

Also identifying the determinants of LBW in these facilities would add to the existing pool of knowledge, and therefore would help policy makers to develop strategies to tackle this public health concern.

1.5 Objectives

1.5.1 General objective

To determine the factors that influence the delivery of a low birth weight (LBW) baby in three health facilities in the Brong Ahafo Region.

1.5.2 Specific objectives

To determine the socio-demographic factors that influence LBW.

To determine anthropometric characteristics of the mother and baby that influence LBW.

To determine reproductive characteristics of the mother that influence LBW.

To determine the maternal health status factors that influence LBW.

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CHAPTER 2

LITERATURE REVIEW

Low birth weight (LBW) is defined as the delivery of an infant born preterm (at fewer than 37 weeks of gestation) with weight lower than 2500 grams, or born at term gestation but weight less than 2500 grams. LBW is thus caused by either a short gestation period or retarded intrauterine growth (or a combination of both).

The global prevalence of LBW is 15.5 percent, which amounts to about 20 million LBW infants born each year. An estimated 96.5 percent of LBW babies are born in developing countries (Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. 2005). In South-central Asia 27 percent of newborns are below 2500g at birth while LBW levels in sub-Saharan Africa are estimated at 15 percent (Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. 2005).

Low birth weight (LBW) is a major contributor to neonatal morbidity and mortality and is a real issue of public health concern in developing countries (WilcoxAllen J, 2001).

There are several factors that affect the delivery of a low birth infant. These factors include Social and demographic factors, medical factors and reproductive factors.

The etiology of LBW is yet to be completely understood even though several studies have attempted to unravel the underlying causes. Constitutional factors such as sex (Sebayang, Dibley, Kelly, Shankar, & Shankar, 2012), maternal height (Heaman et al., 2013) and weight (Chhabra, Sharma, Grover, & Aggarwal, 2004) have been identified as risk factors for LBW.

Similarly, maternal health, demographic and nutritional factors which include maternal age (Nobile, Raffaele, Altomare, & Pavia, 2007), ethnicity (Hillemeier, Weisman, Chase, & Dyer, 2007), parity,(Gao, Paterson, Carter, & Percival, 2006) birth interval (Sebayang et

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al., 2012), multiple gestation,(Nobile et al., 2007) maternal comorbidity(Gao et al., 2006), skilled antenatal care (Nobile et al., 2007)(Nguyen, Savitz, & Thorp, 2004), placenta causes(Abu-Heija, al-Chalabi, & el-Iloubani, 1998), nutritional deficiencies (Sebayang et al., 2012), and body mass index (Heaman et al., 2013) have been linked with LBW. In addition, maternal socioeconomic and psychological factors which comprise education (Sebayang et al., 2012), alcohol intake(Lazzaroni et al., 1993), smoking(Gao et al., 2006), use of hard drugs (Sprauve, Lindsay, Herbert, & Graves, 1997), occupation (O'Campo, Xue, Wang, & Caughy, 1997), wealth status (Sebayang et al., 2012), marital status (Hillemeier et al., 2007), and domestic violence (Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993) were also found to be associated with LBW.

2.1 Socioeconomic and demographic factors

2.1.1 Age

Women in the reproductive age who are 35years and above are known to deliver low birth weight infants (Tabcharoen, Pinjaroen, Suwanrath, & Krisanapan, 2009) (Chiavarini, Bartolucci, Gili, Pieroni, & Minelli, 2012). LBW disparities by maternal age are a complex related with socioeconomic disadvantage and current social and behavioral factors. It's been shown that LBW risk does not operate uniformly by maternal age. (Dennis & Mollborn, 2013).

The older group may also have more medical and obstetric complications (diabetes mellitus, chronic hypertension, malpresentation, pregnancy-induced hypertension, placenta praevia, multiple pregnancies, pre-term labor, fetal distress, retained placenta, postpartum hemorrhage and endometritis), and these may lead to adverse fetal outcomes such as low birth weight, low Apgar scores and congenital anomalies (Tabcharoen et al., 2009).

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Adolescents or teenage mothers (< 20 years of age) often have worse socioeconomic and reproductive conditions and perinatal outcomes when compared to other age groups such as those between 20-29 years. A study by Guimaraes et al showed that among mothers with no prenatal care and who were at risk of low birth weight, adolescence was a risk factor for LBW only for mothers who did not have a partner (Guimarães et al., 2013).

2.1.2 Educational level

The educational level of individuals in the family has a huge influence on the social welfare of members of the family. Therefore higher levels of education have relatively larger and increasing benefits (Rolleston, 2011). Less educated mothers, are known to have low birth weight infants (Chiavarini, Bartolucci, Gili, Pieroni, & Minelli, 2012). Infants of women with low/low intermediate education have significantly higher odds of a LBW than those of a higher education(Gisselmann, 2005). A study by Silvestrin et al., 2013 to prove the hypothesis of similarity between the extreme degrees of social distribution, which is translated by maternal education level in relation to the proportion of low birth weight could not be confirmed. This indicates that the extremes of educational level have a significant influence on LBW. Educational level is a key factor to improving birth outcomes(Sebayang et al., 2012).

INTEGRI PROCEDAMUS

2.1.3 Occupation

Some occupations have been known to have a negative effect on birth weights. Belonging to certain occupational groups during pregnancy could increase the risk of low birth weight and preterm birth. (Ronda, Hernández-Mora, García, & Regidor, 2009).

Studies by Ronda et al., 2009 showed that the highest prevalence of preterm infants was found in mothers working in agriculture (10.8%) and the lowest in professional women

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(6.6%). The highest prevalence of low birth weight was observed in women working in the services sector (3.5%) and manual workers in industry and construction (3.4%). But the lowest prevalence of low birth weight was found in professional women (2.5%). Women working in agriculture had a higher risk of preterm birth/LBW than professional women (Ronda et al., 2009).

2.1.4 Family income

Sub-Saharan countries are considered low income countries. In Ghana the minimum wage for 2015 stands at $2.2(GSS Report 2015). Majority of Ghanaians live below the minimum wage. Family poverty has been shown to be a strong predictor of a low birth weight birth. Depression has also been shown to partially mediate the effect of poverty on low birth weight (Lee & Lim, 2010).

2.1.5 Maternal anthropometry

LBW have been predicted in women with, critical limits of maternal weight, maternal height, mid upper arm circumference and maternal BMI of 45 kg, 152 cm, 22.5 cm, 20 Kg/m2 respectively (Mohanty et al., 2006). Most studies could not establish any association between anthropometric measurements and low birth weight.

A study in Nigeria with respect to height and weight found no significant association with LBW (Ezugwu, Onah, Odetunde, & Azubuike, 2010). Another study by Sr et al., 2015 did not find a significant association between height and LBW. In Nepal, Ojha & Malla, 2007 found an increased odds for height of below 146cm, though the findings were not significant. The same study by Ojha & Malla, 2007 also showed a low BMI(<18.5) to be associated with LBW. Overweight and obesity has been shown to increase the risk of preterm delivery (McDonald, Han, Mulla, & Beyene, 2010). A study by (Mohanty et al.,

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2006) also showed a significant positive correlation between maternal weight, height, BMI and maternal mid-arm circumference and weight of babies and also predicts the risk of LBW. A meta-analysis carried out has indicated that anthropometric measurements are not good predictors of LBW (Goto, 2015).

2.1.6 Marital status

Research work on health and mortality by marital status has consistently identified that unmarried individuals generally report poorer health and have a higher mortality risk than their married counterparts (Robards, Evandrou, Falkingham, & Vlachantoni, 2012). These can contribute to a mother giving birth to a LBW baby.

Unmarried women have higher rates of low birth weight than married women. However, assumptions that unmarried women are uniformly at a disadvantage may be unfounded. A woman's relationship characteristics may be more relevant for infant health than her formal marital status.(Bird, Chandra, Bennett, & Harvey, 2000).

2.1.7 Pregnancy desirability

The decision to have children significantly contributes to the birth outcomes.

The total fertility rate in Ghana is estimated to be 4.2 per 1000 women (GDHS 2014). The proportion of women in the reproductive age using a family planning method in Ghana is 27 %.(GDHS 2014). The unmet need for family planning among married women in Ghana is estimated to be 42% (Machiyama & Cleland, 2014). Also 23% have no access to family planning services (Machiyama & Cleland, 2014). This indicates that a lot of women in the reproductive age in Ghana may be having unintended, unwanted, and mistimed pregnancies due to the absence or use of these family planning services and methods. And having unintended, unwanted and mistimed pregnancies have been shown

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to be associated with an increased risk of LBW .(Shah et al., 2011). Some studies have also shown that women increased stress, psychosocial problems, economic disadvantages, and lack of prenatal care are proposed to explain the outcome of unintended pregnancies(Shah et al., 2011).

2.1.8 Residential status

In Ghana majority of inhabitants live in a rural residence. Residence determines the availability of social amenities like housing, health care, education ,and it is shown that rural urban difference pose these inequalities (Sahn & Stifel, 2003) . Living in rural areas in sub Saharan Africa means residing in a deprived community in terms of job opportunities, social amenities and infrastructures which carries an increased risk of LBW. It has also been shown in a study in Ghana that, being a rural dweller increased the likelihood of having a LBW infant (Kayode et al., 2014) . Another study in New York ,USA has also associated rural residence with the occurrence of LBW (Strutz, Dozier, van Wijngaarden, & Glantz, 2012).

2.1.9 Social support

Social support is a necessary factor for an uneventful pregnancy outcome. Lack of social support has been shown to increases the risk of LBW (Wado, Afework, & Hindin, 2014)

Measures of social support included support from family, support from the baby's father, and general functional support (Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000).

A study by Feldman et al., 2000 showed that prenatal social support is associated with infant birth weight through processes involving fetal growth rather than those involving

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timing of delivery. It could therefore be stated that, poor social support could affect fetal growth and result in a low birth weight.

2.2 Medical factors

2.2.1 Existing maternal medical condition

Several medical conditions have been established to be significantly associated with the delivery of a low birth weight baby. The commonest medical conditions that most pregnant women present are hypertension and diabetes. Maternal hypertension and diabetes are significantly associated with negative birth outcomes. Maternal cardiac diseases are also a medical condition which has been shown to be significantly associated with LBW among African Americans. (Graham, Zhang, & Schwalberg, 2007).

2.2.2 Illness during pregnancy

Maternal illnesses during pregnancy are known to influence the birth outcomes of a newborn. Malaria, anemia, pregnancy induced hypertension are some medical conditions that pregnant women develop during the course of their pregnancy. A study by Jammeh, 2011 have shown a strong association between antepartum hemorrhage, hypertensive pregnancy disorders and LBW. (Jammeh, 2011).

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2.2.3 Maternal Hemoglobin Level

Anemia in pregnancy, which is defined as a hemoglobin concentration (Hb) < 11.0 g/L (Goonewardene, Shehata, & Hamad, 2012) is one common cause of LBW and its prevention has a significant benefit in reducing the incidence of LBW (Imdad & Bhutta, 2012).Iron and folic acid supplementation during pregnancy which is routinely practiced in many sub-Saharan countries has been proven to be beneficial in reducing the incidence

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of LBW. (Imdad & Bhutta, 2012). Ghana is one of the sub Saharan countries that give iron and folic acid supplementation to pregnant women during antenatal clinic attendance throughout their pregnancy.

2.2.4 Maternal nutrition

Maternal micronutrient requirements during pregnancy increases to meet the physiologic changes in gestation and fetal demands for growth and development. Maternal micronutrient deficiencies are high and coexist in many settings. Deficiency of nutrients such as iron, folic acid, calcium and proteins critically influence birth and newborn outcomes. It is widely recommended for pregnant women to take iron and folic acid throughout pregnancy. Evidence is convincing that maternal iron supplementation improves birth weight and perhaps gestational length.

In one randomized trial, iron supplementation during pregnancy reduced child mortality in the offspring compared with the control group. Few other single micronutrients given antenatal, including vitamin A, zinc, and folic acid, have been systematically shown to confer such benefits (Christian, 2010).

A meta-analysis of 12 trials of multiple micronutrient supplementation with iron-folic acid reveals an overall 11% reduction in low birth weight but no effect on preterm birth and perinatal or neonatal survival (Christian, 2010).

Preventive iron supplementation during pregnancy has a significant benefit in reducing incidence of anaemia in mothers and low birth weight in neonates.(Imdad & Bhutta, 2012b).

An intervention trial which looked that Supplementation with Multiple Micronutrient concluded that , maternal nutrition is a key factor to improving birth

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outcomes(Sebayang, Dibley, Kelly, Shankar, & Shankar, 2012). A meta- analysis of nutritional intervention studies indicated that ,there was 32% reduction in the risk of LBW in the intervention group compared with the control group and therefore concluded that, balanced protein-energy supplementation is an effective intervention to reduce the prevalence of LBW (Imdad & Bhutta, 2012a).

2.3 Reproductive factors

2.3.1 History of premature/preterm delivery,

Premature delivery is defined as the delivery of a baby before 37 completed weeks from the last menstrual period. Premature delivery is strongly associated with LBW as indicated by studies carried out in Tanzania by Siza, 2008 and also in Nigeria by Ezugwu et al., 2010. It has been shown that women with a prior preterm delivery have an increased risk of recurrence preterm delivery. (McManemy, Cooke, Amon, & Leet, 2007) therefore increasing the risk of a LBW delivery. Also a prior history of a preterm delivery is shown to be significantly associated with low birth weight (Ip, Peyman, Lohsoonthorn, & Williams, 2010).

2.3.2 History of abortion

Abortion is the spontaneous or induced termination of a pregnancy before 28 weeks of gestation. A family history of recurrent miscarriage/abortion and early menarche (12-13years) as compared to 14years have been shown to have a significant risk of abortion (Parazzini et al., 1991). A Previous abortion is also known to be significantly associated LBW (Brown, Adera, & Masho, 2008). The risk of LBW also increases with an increasing number of previous abortions.(Brown et al., 2008).

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2.3.3 Parity

It is defined as the number of deliveries a woman has had after a pregnancy duration of at least 28 completed weeks. In Ghana the fertility rate is 4.2 (GDHS 2014). This is still high despite a 38% decline in the total fertility rate from 1988 to 2008. (Machiyama & Cleland, 2014). Studies have showed that Mothers who had given birth to one child were 80% more likely to have a child who is LBW compared to mothers who had given birth to 5 or more children (Muula, Siziya, & Rudatsikira, 2011). Also mothers who had 3-4 children were 24% less likely to bear children who are LBW compared to those who had given birth to 5 or more children. (Muula, Siziya, & Rudatsikira, 2011). In Another study an increase of low birth weight babies was noticed after 4th parity and the best outcome was also observed at the same parity (Mondal, 1998). A study by Mondal, 1998 has also showed that there was a higher incidence of low birth weight in mothers with a parity of 5+.

2.3.4 Sex of baby

Female babies are shown to have a significantly higher incidence of low birth weight than male babies (Mondal, 1998) .

2.3.5 Number of antenatal visits

This is the number of times a pregnant woman visits the clinic to receive antenatal care till delivery. The WHO recommends at least four visits till term delivery. Ghana has a high antenatal coverage, which is 97% for at least one ANC visit (GDHS 2014). Also 87% of pregnant women attend at least the recommended four ANC visits before delivery (GDHS 2014). Inadequate number of ANC visits, laboratory studies and exams, has shown to have an increased risk of LBW newborns (da Fonseca et al., 2014). A study by Pell et al.,2013 have showed that, ; checking the fetus' position or monitoring its progress and also

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mothers attending ANC to avoid reprimands from health workers are factors that motivate pregnant women to attend ANC. The same study by Pell et al., 2013 indicated that the timing of ANC initiation is influenced by concerns regarding pregnancy uncertainties, particularly during the first trimester. Low attendance could be attributed to ;how ANC services/workers responded to this uncertainty; age, parity and the associated implications for pregnancy disclosure; interactions with healthcare workers, particularly messages about timing of ANC; and the cost of ANC, including charges levied for ANC procedures - in spite of policies of free ANC (Pell et al., 2013).

Also the compulsory nature of follow-up appointments discourage attendance (Pell et al., 2013). A study in Nepal to find the factors of LBW noted that, mothers who do not attend antenatal care, have an increased odds of having a LBW infant by more than two times (OR 2.3) (Khanal, Zhao, & Sauer, 2014).

2.3.6 Mode of delivery

Spontaneous vaginal delivery is the commonest mode of delivery. A study in china has shown that the cesarean section rate of low birth weight infants increased with the increasing of gestational weeks (Chen et al., 2015). It indicated that the cesarean section rate of low birth weight infants was 61.14%, which was higher than that of normal birth weight infants (52.947%).

2.3.7 Gestation at delivery

The Birth weight of a baby is influenced by the gestation at which the baby is born. A duration of less than 37 completed weeks mostly lead to the delivery of a LBW baby, whiles if the pregnancy is 37 weeks and above mostly will result in the delivery of a

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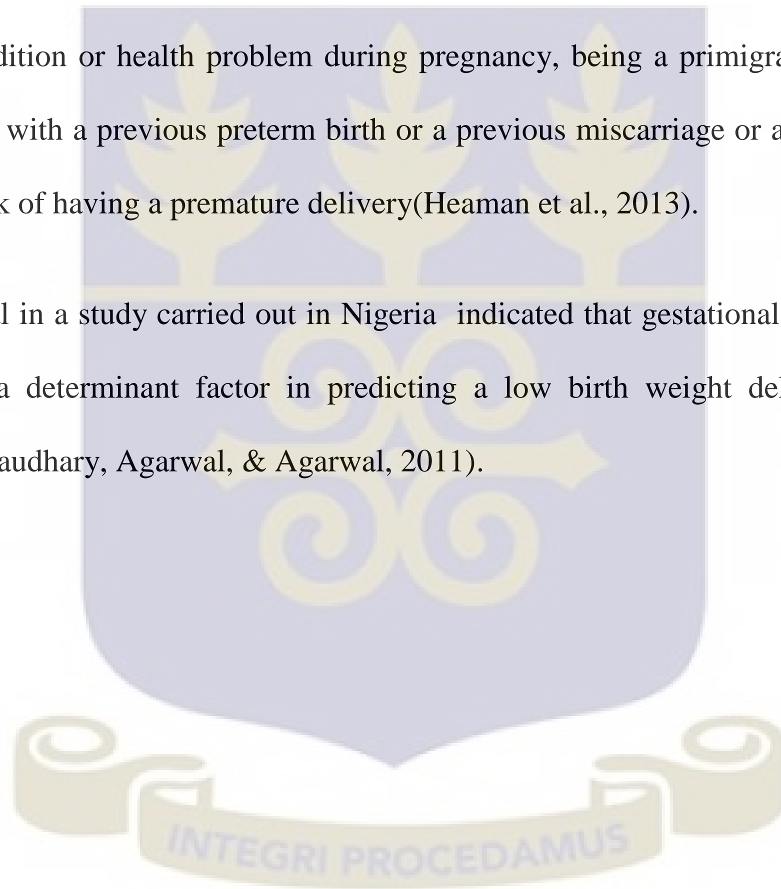
normal weight baby. A study done in The Gambia found 94% of LBW infants estimated to be preterm births(gestation below 37 weeks) (Jammeh, 2011). Another study indicated that there was (69.19%) of LBW been preterm deliveries, and concluded that gestational age at delivery significantly affects the incidence of low birth weight(Ezugwu, Onah, Odetunde, & Azubuike, 2010). Some factors have been associated with preterm delivery. A Canadian study which assessed the risk factors for LBW concluded that mothers with education less than high school, having a previous medical condition, developing a new medical condition or health problem during pregnancy, being a primigravida, or being a multigravida with a previous preterm birth or a previous miscarriage or abortion are at an increased risk of having a premature delivery(Heaman et al., 2013).

Agrawal et al in a study carried out in Nigeria indicated that gestational age less than 37 weeks was a determinant factor in predicting a low birth weight delivery (Agrawal, Agrawal, Chaudhary, Agarwal, & Agarwal, 2011).



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CHAPTER 3

METHOD

3.1 Study design

We carried out a case control study. This design enabled us analyze the determinant factors for low birth weight and also reduce biasness in the study.

3.2 Study area and population

The study was conducted in three hospitals in Brong Ahafo Region, Ghana. The Brong Ahafo Region is one of the ten regions of Ghana. It is the second largest Region and covers an area of 39,557 sq. km with 27 administrative districts. The Region has a 2014 projected population of 2,531,043 and an annual population growth rate of 2.3% (2010 Population and Housing Census). Agriculture and related work is the major occupation in the Region. It is the main occupation for about two-thirds of the economically active group in most districts in the Region.

The region has a total of 690 health facilities comprising 29 Hospitals, 82 Health Centres, 112 Clinics, 43 private Maternity Homes and 423 Functional Community Health Planning Services (CHPS). There are 1,393 outreach points in the Region and 3,292 communities. Seven districts out of the 27 districts do not have district hospitals. The Region has eight health training institutions.

Women in Fertile Age (WIFA) stand at 24.8% with an expected pregnancy of 4.0% (GDHS 2008). The Region recorded a total of 66,616 live births of which 1149 were low birth weight in 2015 with 438 neonatal deaths (DHIMS 2015)

The three hospitals where the study was carried out were the Regional Hospital, Sunyani, The Municipal Hospital, Sunyani and The Holy Family Hospital, Techiman.

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The regional hospital is the main referral centre for all medical cases including obstetric and gynecological cases of the Region. It is located in the capital of the Region. In 2015 the hospital recorded a total of 3,261 live births with 410 being low birth weight (DHIMS 2015). The hospital has one gynecological theatre, one labour ward and three post-delivery wards and one neonatal unit. These were the places where the data was gathered.

The Holy family hospital is also a referral centre for all medical conditions including obstetric and gynecological conditions. It is located in the town of Techiman, which is considered the busiest place for trading activities in the Region. In 2015 the hospital recorded a total of 5,152 live births with 641 low birth weight babies (DHIMS 2015). The hospital one labour ward, a post-delivery ward and one neonatal unit where the data was gathered.

The third hospital serves the municipality of Sunyani which is the regional capital. It recorded a total of 1,662 live births with 98 low birth weights for 2015 (DHIMS 2015). It has one theatre, one labour ward and one post-delivery ward where all data was gathered.

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The three hospitals where the study population was drawn from are located in Sunyani and Techiman. The distance between the two Districts is about 60 kilometers.

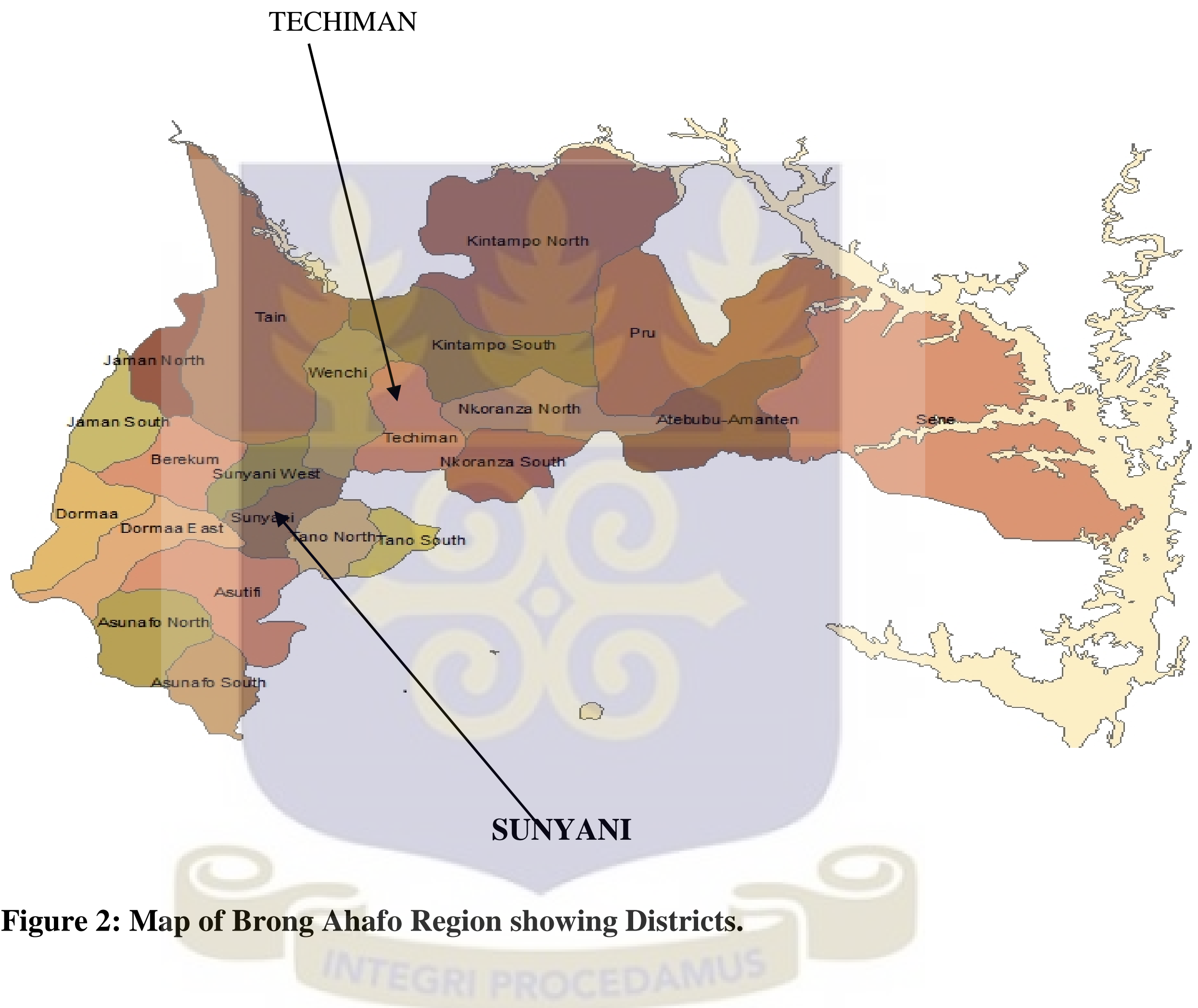

Figure 2: Map of Brong Ahafo Region showing Districts.

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3.3 Participants and Sampling method

3.3.1 Sample size estimation

Sample size was determined using the formula below:

Sample size in the case group

r=**ratio** of controls to cases

Represents the **desired power** (typically .84 for 80% power).

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

A measure of **variability** (similar to standard deviation)

Effect Size (the difference in proportions)

Represents the desired **level of statistical significance** (typically 1.96).

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

$$p_{case\exp} = \frac{ORp_{controls\exp}}{p_{controls\exp}(OR-1)+1}$$

Figure 3: Sample size calculation formula for unmatched case control study

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For 80% power, Z_{β}=.84 for 0.05 significance level, Z_{α}=1.96

r=2 (1:2 ratio of cases and controls)

The proportion exposed in the control group used was 33% using the exposure nulliparity in a study carried out in The Gambia (Jammeh et al, 2011)

OR=Minimal detectable odds ratio is 2

P_1 = proportion of exposure among the cases

P_2= the proportion exposed in the population

A total of 315 case control respondent pairs was arrived at. An additional 15% was added to control for non-response and missing data. A total of 360 case controls respondents' data was collected.

3.3.2 Sampling method

Case definition

The cases were identified as newborns who were delivered in any of the three selected health facilities between November, 2015 and March, 2016 and whose birth weight checked immediately after birth was below 2500grams.

Control definition

The controls were identified as newborns who were delivered in the same health facility as the case, within 24 hours of delivery of a case and whose birth weight checked immediately after birth was 2500grams or above, but not more than 3400grams.

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3.3.3 Criteria for selecting cases and controls

Inclusion criteria

Mothers with singleton deliveries of .babies whose weight is 3400grams or below.

Mothers who consent to participate in the study.

Exclusion criteria

Babies with congenital abnormalities or Babies who are still births.

Mothers who are critically ill.

3.4 Data collection tools

A data collection questionnaire was designed to collect data from mothers who delivered and met the criteria to be included in the study. The questionnaire was designed based on the objectives of the study. It was also designed with reference to questionnaires for studies with similar objectives. The questionnaire obtained both primary and secondary data. The secondary data involved reviewing and recording information from the maternal antenatal health record and also from the maternity ward records of the mother. The questionnaire was pretested in one of the study facilities, and after which necessary adjustments made before the final data collection took place.

3.5 Data collection technique

The required data from mothers with low birth babies was collected within 24 hours upon delivery of a baby. The data was collected each time a low birth weight baby was delivered until the required sample size was attained. The data collection officer visits the post-delivery, labour neonatal wards three times each day (morning, afternoon and evening) to identify study participants. Also the staffs on duty at the post delivery, labour

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and neonatal units alerts the data collection officer each time a delivery was made and falls within the case definition and inclusion criteria. Data was collected by administering the structured questionnaire to the mother and also recording information from the mothers' antenatal records book and the maternity ward records. This method was repeated simultaneously in all the selected facilities until the total required sample size was obtained.

Two controls were selected on the same day of delivery of a case by a simple random method if the number of controls delivered were more than two within 24 hours after delivery of the case. This was repeated simultaneously in all the study sites until the require sample size was reached.

Mothers selected were taken to a secured office within the ward for the questionnaire to be administered to ensure confidentiality.

The data collected included;

Socio demographic information: Age, maternal occupation, educational status, income status, baby's sex, marital status, social support status, maternal height and weight, maternal residence and planning of pregnancy.

Reproductive information included; gestation at booking, gestation at delivery, mode of delivery, family planning methods used, previous abortions, previous delivery of a LBW baby, parity, number of Antenatal Care(ANC) visits.

Medical status information;: any chronic medical condition, illness during pregnancy, Hospital admissions during pregnancy, intake of iron supplementation, appetite during pregnancy, use of herbal medications during pregnancy and alcohol intake during pregnancy.

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3.9 Study Variables

The dependent variable was the outcome variable of interest, which is a low birth weight (< 2500grams).

The independent variables were divided into medical factors, reproductive factors, and socio- demographic factors. The factors included history of chronic medical illness, history of abortion, history of premature delivery, illness during current pregnancy, parity, Number of ANC visits and gestation at initiation, gestation at delivery, hemoglobin level, the practices of taking iron tablets, problems with appetite, drinking alcohol during pregnancy mode of delivery, and use of herbal preparations.

Socioeconomic and demographic factors includes age of mother, height and weight of mother, Body Mass Index (BMI), education and occupation status of the parents, ethnicity, and place of residence, type of housing, and income of the family.

3.10 Defining variables

Chronic medical illness:

This is defined as the presence of a pre-existing medical illness of the mother that was documented in the medical record with an onset prior to the current pregnancy.

Illness during current pregnancy:

This is defined as a medical condition that developed during current pregnancy for which medical attention or treatment was sought. This includes pregnancy related medical illnesses and complications based on the International Classification of Diseases (ICD), 10th revision.

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Maternal age:

This is defined as the current completed age in years.

Parity:

It is defined as number of deliveries after at least 28 completed weeks of gestation. This was categorized into primiparous (mothers with one delivery) and multiparous (mothers with more than one delivery).

Height and weight

This is defined as the anthropometric measurement at initiation of ANC. They were placed into two groups on the basis of their height; less than146 cm and 146 cm or more, weight of below 45kg or 45kg and above,

Body Mass Index (BMI)

This is defined as the weight in kilograms per height in meters squared. This was grouped into normal (18.5-24.9), underweight (<18.5) and overweight/obese (>25).

First trimester Hemoglobin level

This was recorded as the first hemoglobin test at initiation of antenatal care.

Participants were categorized into two groups based on hemoglobin level; one with hemoglobin level less than 11gm/dL and hemoglobin level 11gm/dL or more.

Number of Antenatal visits

This is defined as the number of times the pregnant woman visits the hospital to receive care for herself and her unborn child.

Number of ANC visit is classified on the basis of the minimum recommended visits i.e. having four or more visits and less than four visits.

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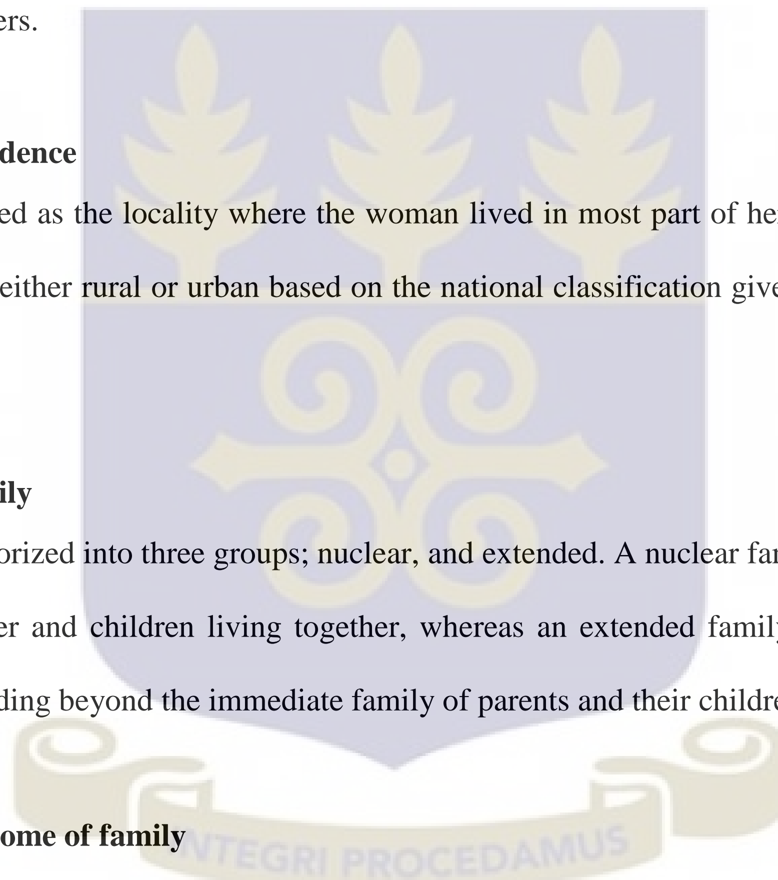
Maternal educational status:

This was grouped as illiterate, primary/junior high, secondary, college, bachelors and above. Further categorization into primary level or less and secondary or above.

Maternal Occupation

This is defined as the type of work the woman does. It is categorized into five groups; farming, trader/business woman, seamstress, artisan, Gov. Work/paid formal job, house wife and others.



Place of residence

This is defined as the locality where the woman lived in most part of her pregnancy. It is classified as either rural or urban based on the national classification given to that locality in Ghana.

Type of family

This is categorized into three groups; nuclear, and extended. A nuclear family is defined as mother, father and children living together, whereas an extended family is defined as a family extending beyond the immediate family of parents and their children.

Monthly income of family

The maternal income was used to assess the family income levels.

The monthly income of the family is hypothetically divided into three levels as below GH¢500, GH¢ 500-900, and GH¢1000 or more.

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Gestation at booking:

This is defined as the gestation at which the mother initiated/started ANC care. The gestation is calculated from either the mothers last menstrual period or from an early ultrasound scan done.

Gestation at delivery:

This is the gestation at which the mother delivered. It determines the duration of the pregnancy prior to delivery.

Who mother lived with during the pregnancy

This is defined as who the pregnant woman lived with in most of the time, in the duration of the pregnancy.

Desirability of pregnancy

This is assessed as whether the mother planned to have a baby before getting pregnant or whether she desires the pregnancy even though it was not planned for.

Hospital admissions during pregnancy

This is defined as whether the pregnant woman had any hospital detention or admissions for any medical condition during the course of the pregnancy.

Intake of iron supplementation

This is defined as the mother taking routine iron supplementation from initiation of antenatal care till delivery. It is categorized into regular intake or no intake.

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Alcohol intake

This is assessed as whether mother took any alcoholic beverage in the course of her pregnancy.

Poor appetite

This is defined as the mother having any problems with eating in most of the duration of the pregnancy. This is assessed as whether she had problems like vomiting, nausea, loss of appetite.

Mode of delivery

This is defined as the type of delivery the pregnant woman had. It was categorized into spontaneous vaginal delivery or caesarian section.

Use of family planning method

This is defined as whether the pregnant woman has ever used a hormonal contraceptive family method.

Previous spontaneous abortions

This is defined as whether the woman has ever lost a pregnancy before 28 weeks of gestation without it been terminated.

Use of herbal medications

This is defined as whether the pregnant woman took any form of unorthodox drug preparations or local herbal preparations during the course of the pregnancy.

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3.6 Training of data collection officers

Two data collection officers were recruited in addition to the principal investigator to carry out the data collection process. The officers were health professionals trained in the area of maternal and child health. They were selected from the facilities used for the study. They were trained a week prior to commencement of the data collection. The training involved an introduction to the study, the purpose and objectives of the study. The training also involved discussions to ensure they understood the aims and objectives of the study. There was also training on the use of the data collection tools. Trainees also received training on data collection techniques employed, data storage and the confidentiality of the information they received from the respondents.

We undertook simulated practices repeatedly to ensure consistency in the information gathering and use of the data collection tools. The data collection officers were finally introduced to the various unit heads where the respondents were identified.

3.7 Data management and statistical analysis

Data were cross-checked for errors before entry using epi-info and excel software into a password-protected personal computer. The data were stored securely in a private location and kept confidential after cleaning of the data was done. Participants were referred to only by identification numbers. Identifiable information (consent forms) was kept separate from the data collection forms and it was only possible to link both through a coding sheet which was available solely to the principal investigator.

Data were analyzed using STATA 13 software. Continuous variables were summarized into means and proportions, whiles categorical variables were summarized into frequencies.

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Bivariate analysis was done between the outcome variable/dependent variable and each of the independent variables to determine the associations using the chi-square test. The odds ratios and confidence intervals were reported using 95% level of significance. All variables in the bivariate analysis with a p-value of less than 0.05 (95% level of significance) was considered for multiple logistic regression analysis. The backward stepwise logistic regression model was used to test for the determinant predictors for LBW. The level of significance for regression analysis was set at 95%.

3.8 Ethical considerations.

The study proposal had ethical approval from the Ethical Review Board of the Ghana Health Service. Permission was also obtained from the Brong Ahafo Regional Health Directorate to access the selected facilities. Permission was also obtained from the Heads of the selected institutions. The study participants were explained to about the objectives and aims of the study. It was explained that participating in the study was entirely voluntary. Participants were made aware that they had the right to refuse to participate and that will not affect their rights in anyway, especially to their healthcare. It was also made clear that they were at liberty to withdraw from the study at any stage of participation. It was made known to them that there were no direct benefits or risks in participating. Participants were made aware of no compensation for participating. However, it was made clear that the information that the study will come out with, will help us to understand the factors and circumstances associated with low birth weight. The participants were made aware of the sensitive nature of some of the questions, and therefore they may choose not to answer. Assurance of confidentiality of the information was given and explained that the information is to be used for the intended purpose only. Again participants were made aware that they will not be identified by name in any dissemination reports or publications

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resulting from this study, and that the information will be stored on computers and secured with codes to prevent unauthorized persons from assessing the information. Finally it was made clear that this research work is entirely for academic purposes and therefore declare that there is no conflict of interest in any aspect of the work.

6.11 Limitations

The sampling method used was purposive sampling, and therefore this could introduce biasness in the sampling for cases. The hemoglobin level used to assess anemia as a risk factor in this study was what was available in record. Owing to the fact that mothers attend ANC clinic at different gestation in their pregnancy, it would have been more scientifically logical to follow the pattern of hemoglobin level from antenatal period to delivery in estimating the association of anemia and low birth weight. The Last Normal Menstrual Period (LNMP) was obtained from the mother booklet, the delivery register or asking the mother. The LNMP was then used to calculate gestational age. For those mothers whose LNMP was recorded unknown or could not recall and no ultrasound record was available, gestation age at delivery could not be determined and was therefore regarded as nonresponse.

The study is hospital based, and therefore it may not be possible to generalize the results to a particular population as compared to population based studies, even though the hospitals serves as the major health facility in the population and records the most number of clients from the population.

Another limitation was that we relied on mothers booklet to record anthropometric measurements therefore mothers whose measurements were not recorded was recorded as missing data.

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Despite the limitations, this study has made an important contribution on the socio-demographic, medical and the reproductive characteristics of women delivering in the three hospitals. The study has identified the important risk factors (determinants) that may contribute to the occurrence of low birth weight in the Brong Ahafo Region.

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CHAPTER 4

RESULTS

4.1 Socio demographic characteristics of study population

A total of 120 cases and 240 controls were studied in the three health facilities.

Majority of mothers belonged to age group 30yrs and above (49.2% among cases and 49.6% among controls), a fairly low proportion of the mothers had no formal education (10.1% among cases and 11.8% among controls), and majority of the mothers lived in an urban residence(61.1% and 73.5% for cases and controls respectively).majority of the mothers were traders/artisans(52.9% and 57.1% for cases and controls respectively) with most of them having a monthly income below 500ghana cedis (67.5% among cases and 61.9% among controls).

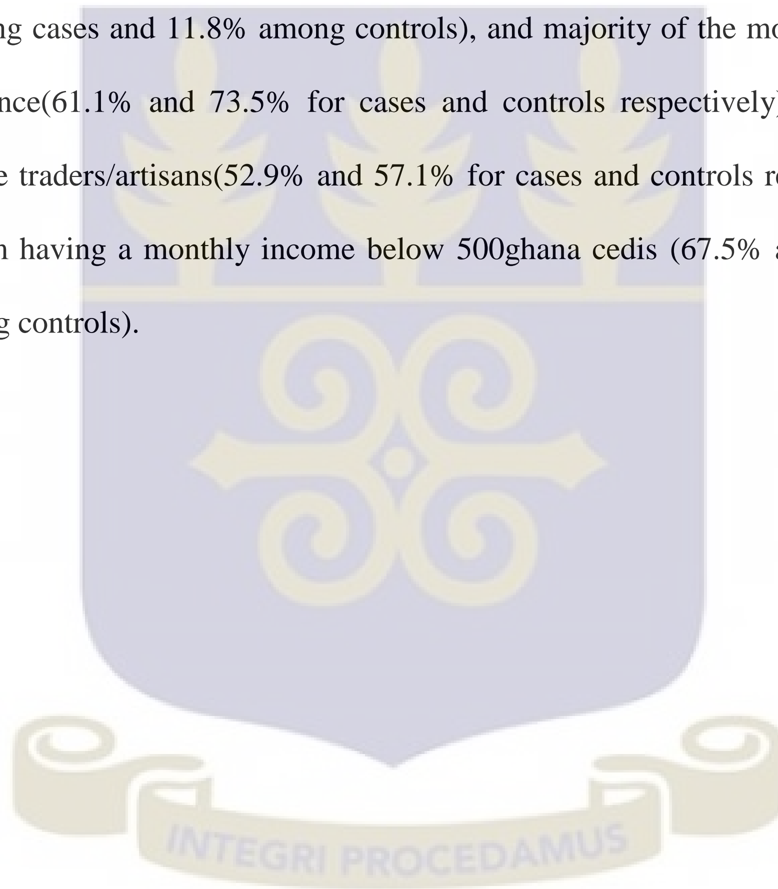

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Table 1: The frequency distribution of socio-demographic factors

variable	No.(%) of Cases(n=120)	No.(%) of Control(n=240)
Age group of mother(years)		
19 and below	10(8.3)	18(7.5)
20-29	51(42.5)	103(42.9)
30+	59(49.2)	119(49.6)
Marital status of mother		
Married	83(69.2)	186(78.5)
Not married	37(30.8)	51(21.5)
Education level of mother		
No formal education	12(10.1)	28(11.8)
Primary/,JHS	35(29.4)	100(42.0)
Secondary	56(47.1)	67(28.2)
Post-secondary/tertiary	16(13.4)	43(18.1)
Mothers occupation		
Farming	17(14.3)	28(11.8)
Trader/artisan	63(52.9)	136(57.1)
Gov./formal job	16(13.4)	33(13.9)
Unemployed	23(19.3)	41(17.2)
Residence of mother		
Urban	69(61.1)	172(73.5)
Rural	44(38.9)	62(26.5)

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Table 2: The distribution of socio-demographic factors

variable	No.(%) of Cases(n=120)	No.(%) of Control(n=240)	OR	95% CI	p-value
Age group of mother(years)					
19 and below	10(8.3)	18(7.5)	1.13	0.49-2.64	0.77
20-29	51(42.5)	103(42.9)	1		Ref
30+	59(49.2)	119(49.6)	1.01	0.64-1.60	0.96
Marital status of mother					
Married	83(69.2)	186(78.5)	1		ref
Not married	37(30.8)	51(21.5)	1.36	0.84-2.21	0.21
Education level of mother					
No formal education	12(10.1)	28(11.8)	1.16	0.47-2.81	0.76
Primary/,JHS	35(29.4)	100(42.0)	0.94	0.47-1.88	0.86
Secondary	56(47.1)	67(28.2)	2.25	1.13-4.47	0.02
Post-secondary/tertiary	16(13.4)	43(18.1)	1		Ref
Mothers occupation					
Farming	17(14.3)	28(11.8)	1.25	0.53-2.94	0.61
Trader/artisan	63(52.9)	136(57.1)	0.96	0.49-1.87	0.89
Gov./formal job	16(13.4)	33(13.9)	1		Ref
Unemployed	23(19.3)	41(17.2)	1.16	0.53-2.55	0.72
Residence of mother					
Urban	69(61.1)	172(73.5)	1		ref
Rural	44(38.9)	62(26.5)	1.77	1.07-2.93	0.018

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4.2 Anthropometric characteristics

Majority of the mothers had a height of 146cm or more (97.2% among cases and97.8% among controls), most of the respondents had a normal BMI (56.9% among cases and 63.3% among controls). Majority also had a weight of 45kg or above. The bivariate analysis showed p-values which indicated no significant association between the anthropometric measurements and low birth weight (LBW).

Table 3: Distribution of anthropometric factors

Variables	Cases(N=120) N (%)	controls (N=240) N (%)	OR	95% CI	p-value
Mothers height					
146cm or above(normal)	103(97.2)	221(97.8)	1		ref
Below 146cm(short)	3(2.8)	5(2.2)	1.29	0.20-6.75	0.73
Mothers weight					
45kg and above	107(97.3)	219(96.5)	1		ref
Below 45kg	3(2.7)	8(3.5)	0.77	0.13-3.27	0.70
BMI of mother					
18.5-24.9(normal)	58(56.9)	138(63.3)	1		ref
Below 18.5(underweight)	3(2.9)	13(6.0)	0.55	0.15-2.01	0.36
Above 24.9(obese)	41(40.2)	67(30.7)	1.46	0.89-2.40	0.14

4.3 Reproductive characteristics

Majority of the mothers had a first trimester ANC attendance(64.8% among cases and 69.1% among controls, had attended ANC at least four times during the pregnancy period(82.2% and 95.8% among cases and controls respectively).most of the mothers delivered at term and the majority delivered by spontaneous vaginal delivery.53.8% and 65.1% of the cases and controls had planned their pregnancies.in the bivariate analysis

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gestation at booking, ANC visits, gestation at delivery, planned pregnancy, mode of delivery, parity of mother and previous delivery of a LBW/premature baby were significantly associated with delivery of a LBW baby

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Table 4: Distribution of reproductive factors

Variables	Cases (N=120) N (%)	Controls (N=240) N (%)	OR	95% CI	P-value
Gestation at booking					
1st trimester	68(64.8)	161(69.1)	1		ref
2nd trimester	26(24.8)	67(28.8)	0.92	0.54- 1.57	0.76
3rd trimester	11(10.5)	5(2.1)	5.21	1.70- 15.98	<0.001
ANC visits					
4 and above	97(82.2)	228(95.8)	1		Ref
0-3	21(17.8)	10(4.2)	4.94	2.12- 11.12	<0.001
Gestation at delivery					
Term	70(63.6)	228(95.8)	1		ref
32-36weeks	29(26.4)	9(3.8)	10.5	4.46- 24.68	<0.001
Below 32weeks	11(10.0)	1(0.4)	61.89	6.84- 560.33	<0.001
Planned pregnancy					
Yes	64(53.8)	155(65.1)	1		ref
No	55(46.2)	83(34.9)	1.6	1.00-2.53	0.038
Mode of delivery					
Spontaneous	73(61.3)	172(72.3)	1		Ref
Caesarian section	46(38.7)	66(27.7)	1.64	1.00-2.68	0.036
Parity					
Nulliparity	44(37.3)	62(26.1)	2.66	1.09-6.48	0.024
Primiparity	21(17.80	55(23.1)	1.43	0.56-3.65	0.45
Multiparty(2-3)	45(38.1)	91(38.2)	1.85	0.78-4.41	0.16
Grand multiparity(4+)	8(6.8)	30(12.6)	1		ref
Family planning method					
No	84(70.0)	185(77.1)	1		Ref
Yes	36(30.0)	55(22.9)	1.45	0.86-2.44	0.14
Previous abortion					
No	96(80.0)	192(80.0)	1		ref
Yes	24(20.0)	48(20.0)	1.01	0.55-1.79	0.99
Previous LBW/premature Delivery					
No	109(90.8)	232(96.3)	1		ref
Yes	11(9.2)	9(3.7)	2.6	0.95-7.31	0.034

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4.4 Maternal health status characteristics

The hemoglobin level of 66.6% of the mothers with low birth weight babies was below 11g/dl, whiles 47.9% of the mothers of normal weight babies had theirs below 11g/dl. Majority of the mothers in the control group (73.2%) regularly took iron supplementation throughout the period of their pregnancy, whiles only 57.5% of mothers in the case group did. First trimester hemoglobin, hospital admissions during pregnancy, iron supplementation intake and intake of herbal preparations were significantly associated with delivery of a LBW in the bivariate analysis as shown in the table below.

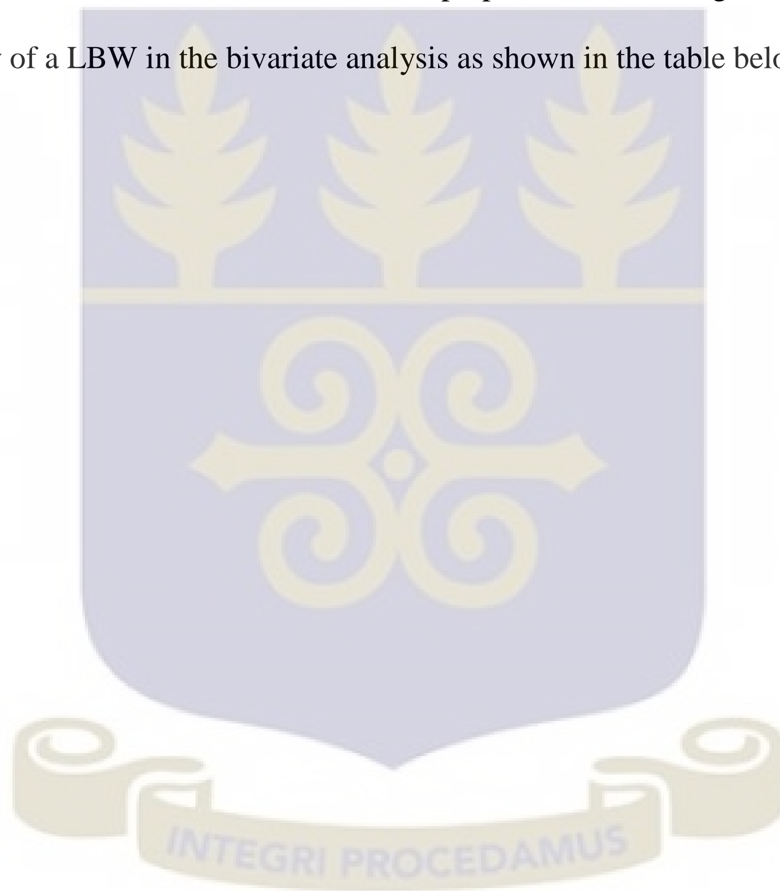

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Table 5: Distribution of the maternal health status factors

Variables	Cases(N=120) N (%)	Controls(N=240) N (%)	0R	95% CI	p-value
First trimester hemoglobin					
11g/dl and above	39(33.3)	124(52.1)	1		ref
Below 11g/dl	78(66.6)	114(47.9)	2.18	1.34-3.55	<0.001
Hospital admissions in pregnancy					
No	72(60.0)	191(79.9)	1		ref
Yes	48(40)	48(20.1)	2.65	1.59-4.42	<0.001
iron supplementation intake					
Always	69(57.5)	175(73.2)	1		ref
Not regularly	32(26.7)	47(19.7)	1.73	1.01-2.94	0.042
Never	19(15.8)	17(7.1)	2.83	1.37-5.85	<0.001
Poor appetite					
No	49(41.2)	122(52.6)	1		ref
Yes	70(58.8)	110(47.4)	1.58	0.99-2.54	0.043
Intake of Herbal medications					
No	92(76.7)	218(90.8)	1		ref
Yes	28(23.3)	22(9.2)	3.02	1.57-5.84	<0.001

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4.5 Determinant factors of LBW

Results of the multivariate analysis/ to study the association between the significant factors in the bivariate analysis (independent variables) and the occurrence of LBW (outcome variable) have been summarized on Table below. These variables were then subjected to a regression analysis using backward stepwise logistic regression method .,1st trimester hemoglobin <11g/dl(aOR 3.14; 95%CI 1.50-6.58),delivery at 32-36weeks gestation(aOR 13.70; 95%CI 4.64-40.45),delivery below 32weeks gestation(OR 58.50; 95%CI 6.66-513.87),secondary education of mother(aOR 4.19; 95%CI 1.45-12.07),living with extended family(aOR 2.43; 95%CI 1.15-5.10,living alone during pregnancy(aOR 3.95; 95%CI 1.33-11.74), and not taking iron supplements during pregnancy(aOR 3.19; 95%CI 1.07-9.54) were , found to be significantly associated in multivariate analysis.

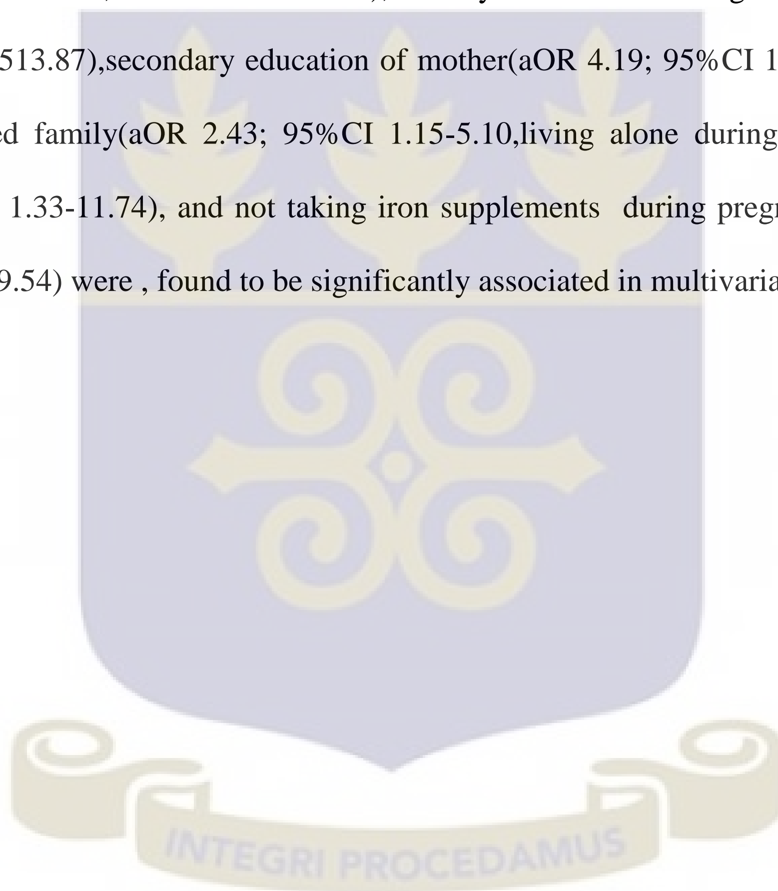

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Table 6: Determinant factors of Low Birth Weight

Independent variables	Adjusted Odds Ratio(aOR)	*P*- value	95% confidence interval
Gestation at delivery			
Term delivery(37-40 weeks)	1	Ref	
Preterm delivery(32-36weeks)	13.70	<0.001	4.64-40.45
Severe preterm delivery(<32weeks)	58.50	<0.001	6.66-513.87
Educational level of mother			
Post-secondary/tertiary	1	Ref	
Primary/JHS	1.15	0.79	0.39-3.40
Secondary	4.19	<0.001	1.45-12.07
No formal education	1.88	0.38	0.46-7.63
Supplementary iron intake			
Regular intake	1	Ref	
Irregular intake	2.19	0.05	0.99-4.84
No intake	3.19	0.04	1.07-9.54
Who mother lived with during pregnancy			
Partner	1	ref	
extended family	2.43	0.02	1.15-5.10
Lived alone	3.95	0.01	1.33-11.74
1st trimester hemoglobin			
11g/dl and above	1	Ref	
Below 11g/dl	3.14	<0.001	1.50-6.58
Any hospital admissions during pregnancy			
No	1	Ref	
Yes	2.08	0.05	1.00-4.30

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CHAPTER 5

DISCUSSIONS

5.1 Socio-demographic factors and LBW

Half of the respondents were aged 30years and above. Women of the younger age (<19years) had an increased odds of delivering a low birth weight baby, but this finding was not significant and it agrees with a study by Mondal, 1998 which also found a similar result, though both findings were not significant. Another study found a contrary result, it indicated that mothers of an older age had a higher risk of delivering a low birth weight baby compared to the younger age group , (Chiavarini et al., 2012).

A study by Guimarães et al., 2013 has showed that Adolescent (< 20 years of age) mothers have poorer socioeconomic and reproductive conditions as compared with other older age groups and this pose a higher risk of having a LBW baby. They also stand a higher risk of having a LBW baby if they don't have a partner (Guimarães et al., 2013). Even though in our study there was an increased odds, this was not significant, but the above reason could explain the outcome in our study. Advocacy is therefore important to prevent teenage and adolescent pregnancy in order to help reduce the incidence of low birth weight babies.

With respect to the educational level, mothers with secondary education had a fourfold increased odds of delivering a low birth weight baby compared with mothers with tertiary education. A meta-analysis by Silvestrin et al., 2013 showed that having a higher education had a 33% protective effect, whereas having a medium education or low education had no protective effects . This was similarly shown in our study.

Farming was a major occupation of the respondents in the study. Studies carried out in Nepal by. Ronda et al., 2009 and Spain by Sr et al., 2015 indicated that farming is

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considered as a physically demanding job and has a significant association with LBW. This was contrary to our study which did not find a significant association between farming as an occupation and LBW. A study in north Carolina, USA also concluded that physically demanding work does not seem to be associated with adverse pregnancy outcomes(Pompeii, Savitz, Evenson, Rogers, & McMahon, 2005).

Our study revealed that majority of the mothers were in urban residence. Residence determines the availability of social amenities like housing, health care, education and it is shown that rural urban difference pose these inequalities (Sahn & Stifel, 2003). These inequalities have a negative bearing on the health of persons living in a rural residence. Rural residence was shown to be associated with LBW even though it didn't show significance in the logistic regression analysis. This indicates that maternal residence has an effect on pregnancy outcomes. A study conducted in Ghana by Kayode et al., 2014 also had similar findings. Even though majority of the respondents live in an urban residence there is still the need for implementation of community based interventions that will bridge the gap between the rural and urban settlements in terms of health infrastructure, education and social amenities; this will help reduce the incidence of LBW.

Social support which is a measures of support from family, support from the baby's father, and general functional support (Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000) is a necessary factor for an uneventful pregnancy outcome. Lack of social support has been shown to increases the risk of LBW (Wado, Afework, & Hindin, 2014). In our study the social support system analyzed was finding out who the mother lived with during the pregnancy .Our study showed an over 200% increase in odds for a mother who lived alone as compared with those who lived with a partner or the unborn baby's father during the pregnancy. A study by(Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000) showed that social support is associated with infant birth weight through processes involving fetal

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growth. It could therefore be stated that, poor social support could affect fetal growth and result in a low birth weight. Our study also revealed that who the pregnant woman lives with was a determinant factor in predicting the delivery of a LBW baby. It is therefore recommended that, there should be strong advocacy for expectant mothers to live with their partners throughout their pregnancy.

Alcohol consumption has been well documented to be associated with LBW. A small proportion of the study population took alcohol, and also our study did not asses the amounts taken and also over what period, which is critical in determining the effect of alcohol in pregnancy. A study conducted by Jaddoe et al., 2007 has shown an increased risk of association between alcohol use and LBW (OR 4.81).This was similarly found in our study (OR 2.02), but our findings were not statistically significant. The insignificant nature of the findings could be as a result of the small number of respondents who took alcohol.

5.2 Maternal anthropometric factors and LBW

Majority of the participants had their anthropometric measurements within the normal ranges. Women with short stature and those who were overweight or obese had an increased odds of having a LBW baby. A study in Nepal by Ojha & Malla, 2007 also had the same conclusion for mothers with short stature. They however had a contrary outcome with respect to the BMI. They concluded that underweight mothers rather had an inreased odds of giving birth to a LBW baby. Other studies by Ezugwu et al., 2010 and Sr et al., 2015 also found associations between anthropometric measurements and LBW, but all these findings were not statistically significant. A study by Mohanty et al., 2006 has showed a significant positive correlation between maternal weight, height, BMI and maternal mid-arm circumference and weight of babies and also predicts the risk of LBW.

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The increased odds in the overweight/obese mothers could probably be explained that, these mothers might have had a preterm delivery which resulted in a LBW. This explanation is supported by a study conducted by McDonald et al., 2010 who indicated that overweight and obese mothers have an increased risk of preterm delivery. A meta-analysis has concluded that anthropometric measurements are not good predictors of LBW (Goto, 2015). Further studies will need to be conducted with large numbers, since this study was limited by the very small numbers of the study population who had either low weight (<45kg) or height below 146cm.

5.3 Reproductive factors and LBW

In Ghana only 27% of women in the fertile age use a modern contraceptive method (GDHS2014). The unmet need for family p0lanning services for married women is 30% and the unmet need for those not married but are sexually active is 42% (GDHS 2014). These proportions indicate that a lot of women run the risk of having unplanned or undesirable pregnancies.

Our study has showed a 60% increased odds for mothers with an unplanned or undesirable pregnancy. A UK cohort study also showed a 34% increase in LBW (Flower, Shawe, Stephenson, & Doyle, 2013). Another prospective cohort study, looking at the effect of unwanted pregnancy conducted in Ethiopia also found an increased incidence of LBW in unwanted pregnancies.(Wado et al., 2014). Planning of pregnancy or desirability of a pregnancy has been known to predict early antenatal attendance and also the attainment of at least 4 ANC visits before birth (Ochako & Gichuhi, 2016). Early ANC would help identify and manage conditions that could lead to a negative pregnancy outcome. Our study could not establish in the regression analysis that planning or desirability of a pregnancy was a determinant factor in predicting LBW. It's been shown that planning or

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desirability of a pregnancy is an important contributor in predicting the risk of a LBW delivery. We recommend that the Ministry of Health must intensify the advocacy for the use of a modern contraceptive/family planning method, and also the expansion of family planning services to serve the unmet population.

Early initiation of ANC enables access to early diagnosis, monitoring and therapeutic measures for several pathologies that are known to have serious repercussions on newborn and maternal health. Most of the mothers in our study initiated ANC in the first trimester. This finding was similar to a study by Pell et al 2013 in Ghana. Mothers who had late (third trimester) initiation of ANC had significantly increased odds of delivering a LBW baby. A study in Nepal has also found a two fold increase in the odds for LBW in women who initiated ANC late or did not attend ANC during their pregnancy (Khanal et al., 2014). In Kenya and Malawi initiation of ANC was noticed in the sixth and seventh months respectively (Pell et al., 2013). .Pell et al 2013 found that primigravidae women, particularly adolescents initiated ANC late in their pregnancy. This delay has been attributed to repercussions the adolescents receive from health personnel when they seek care. It has also been shown that, for multiparous women who delay initiation of ANC, has ascribed to them been accustomed to pregnancy experience and therefore are less concerned to receiving assistance in monitoring their pregnancy (Pell et al., 2013).

The 2014 Ghana demographic and health survey report indicated that 87% of pregnant women had an adequate number of ANC visits. Our study indicated a 91% of mothers with adequate ANC visits. Mothers with an inadequate number of ANC attendance showed an increased odds (OR 4.94 CI 2.19-11.12) of delivering LBW and similar results were found in a study by da Fonseca et al., 2014. It has also been shown that reduction in the incidence of LBW could be expected if women attended an adequate number of antenatal visits. (Coria-soto, Bobadilla, & Notzon, 1996).

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The gestation at which a baby is delivered has been known to have an effect on the birth weight of the baby and our study showed that 14% of the mothers had a premature delivery. It showed a significant increase in the odds as compared with the term deliveries Studies in Tanzania (Siza,2008) and Nigeria (Ezugwu et al., 2010) found similar results ,but comparatively our odds were very high(OR 13.7; 95%CI 4.64-513.87) A study carried out in Vietnam associated farming /agriculture work which is considered a physically demanding work with an increased risk of premature delivery and subsequently LBW (Nguyen et al., 2004),but in our study maternal occupation which was also predominantly farming/agriculture didn't show a significant association with premature delivery/LBW. We therefore can't ascribe physical demanding work as the reason for the study population having premature delivery and therefore LBW babies. Also a caesarian section which could result from a maternal or fetal indication could lead to the delivery of a premature baby/LBW. A study in china, indicated that cesarean section had a 61.14% increased odd of LBW(Chen et al., 2015). This Chinese finding is similar to our finding of a 64% increased odds. Our study however did not asses the association between caesarian section and premature delivery premature delivery. Therefore maternal occupation and caesarian section could not be used to predict the occurrence of prematurity in this study, though it could have an effect on the occurrence of prematurity. Our study concluded that premature delivery was a determinant factor in predicting LBW in the study area. Similarly a case control study in Nepal also found premature delivery as a determinant factor of LBW (OR 5.24) (Sr et al., 2015). Further studies is therefore recommended to identify the factors that influence premature delivery.

Mothers with a previous LBW or premature delivery had an increased odds (OR 2.60 p-value 0.034, CI 0.94-7.31) of another LBW.A Study conducted in Kenya by the field epidemiology and laboratory Training programme also reported an increased odds (OR

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4.7) of LBW (Region, 2015). In Ghana a study by (Klufio et al., 2000) also found a significant association between having previous LBW and a current LBW. The finding in our study implies that mothers with previous premature or LBW delivery will need special attention during their ANC visits to identify and manage the factors that may lead to the delivery of a LBW.

Most of the participants in this study were multiparous women. The results showed that nulliparous women had an increased odds (OR 2.66 CI 1.09-6.48, p-value 0.024) of having a LBW , this findings were similar with to cluster study in Malawi which assessed factors associated with LBW and showed an increased odds of 1.8 (Muula et al., 2011). A meta-analysis also showed that nulliparity was associated with a significantly increased risk of LBW birth, whereas grand multiparity and great grand multiparity were not associated with increased risk of pregnancy outcomes.(Shah, 2010).The possible reasoning to this could be that multiparous women have more experiences to rely on to improve their pregnancy outcomes.

5.4 Maternal health status and LBW

The Health of a pregnant woman has an effect on the unborn baby. Maternal conditions such as hypertension, diabetes, asthma, sickle cell disease, and retroviral infection have detrimental effects on the unborn baby and could influence the weight of the baby. Also illness during pregnancy and hospital admissions may influence the outcome of a pregnancy. Our study showed that mothers who had a hospital admission during the course of their pregnancy had an increased odds of LBW. Iron deficiency has been known to be the commonest form of anemia in pregnancy (Goonewardene et al., 2012) Maternal anaemia have been shown to increase the odds of a LBW delivery (Sr et al., 2015). A similar finding was arrived at in our study where the odds were significantly increase by a

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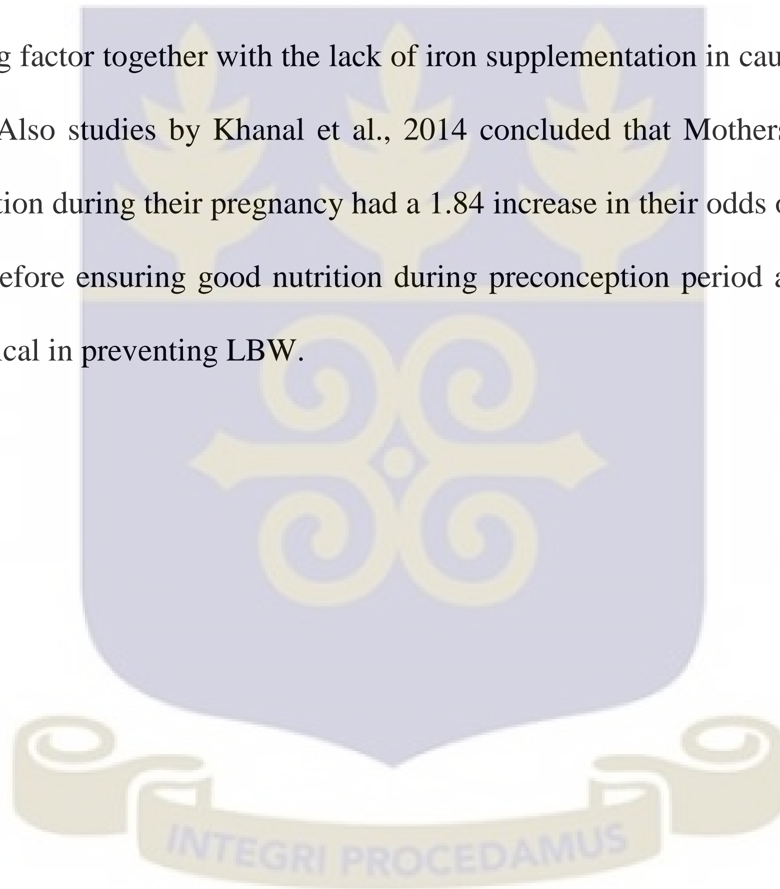
threefold (OR 3.14 CI 1.50-6.58). Poor nutrition and lack of iron supplementation during pregnancy may account for the occurrence of anemia in pregnancy. A meta-analysis conducted by Imdad & Bhutta, 2012 has shown that Iron supplementation significantly reduces the incidence of anemia in pregnancy by up to 20%. Our study also revealed that mothers who never took iron supplementation during pregnancy had a threefold increase in their odds (OR 3.19 CI 1.07-9.54) of delivering a LBW. Mothers with poor appetite during pregnancy in our study had a 58% increased odds of LBW, this could be said to be a contributing factor together with the lack of iron supplementation in causing LBW in the study area. .Also studies by Khanal et al., 2014 concluded that Mothers not taking iron supplementation during their pregnancy had a 1.84 increase in their odds of having a LBW infants. Therefore ensuring good nutrition during preconception period and the antenatal period is critical in preventing LBW.



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CHAPTER 6

CONCLUSIONS AND RECOMMENDATION

6.1 Conclusions

The three major facilities used for the study in the Brong Ahafo region accounted for 19% of the low birth weights babies delivered in the region for 2015(DHIMS).

Delivery of a low birth weight baby in the three hospitals in the Brong Ahafo Region was influenced by sociodemographic factors such as rural maternal residence, unplanned pregnancy, but educational level of mother being secondary and living alone during pregnancy were the socio demographic determinants factors for LBW.The maternal reproductive factors influencing LBW were; caesarian section as the mode of delivery, been a nulliparous woman and previous delivery of a LBW baby. However the reproductive determinant factors for LBW was previous delivery of a LBW baby and delivery at preterm. Maternal hospital admissions during the pregnancy, problems with appetite, and the use of herbal medications during pregnancy were the maternal health status factors that influenced delivery of a LBW baby. But the determinant factors were, mothers not taking iron supplementation during their pregnancy and mothers whose first trimester hemoglobin was below 11g/dl.

Maternal anthropometric measurements did not influence or determine the delivery of a LBW baby among the study participants.

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6.2 Recommendations

6.2.1 Research community

We make recommendations to the public health and health research community to carrying out further studies to identify factors that determine prematurity in the study area as it had the highest odds in predicting LBW. Also prematurity constituted about 36% of all the LBW babies delivered. We also recommend further studies on the anthropometric factors for determining LBW with larger samples.

6.2.2 Ghana Health Service and Brong Ahafo Regional Health Directorate.

We make recommendations to the regional health directorate and the municipal health directorates in the Brong Ahafo regions to advocate and educate all pregnant women on the need to take iron supplementation during pregnancy to prevent anemia which is a contributory factor to the occurrence of LBW.

Establishment of preconception clinics by the ministry of health to identify high risk pregnancies in all health facilities will add to the efforts at preventing negative birth outcomes.

We also recommend to the hospitals to give special attention to pregnant women with previous history of LBW/premature delivery and all other factors in this study that influences or predicts the delivery of a LBW baby. Ministry of Health must intensify the advocacy for the use of a modern contraceptive/family planning method which is key to preventing unwanted pregnancies, and the expansion of family planning services to serve the unmet population.

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APPENDICES

Appendix A

Consent Form – Participants

Study Title: Determinants of low birth weight in neonates born in Brong Ahafo Regional hospital.

Address: School of Public Heath, University of Ghana, Legon

Greetings, my name is ……………………………………………..and I am conducting this interview on behalf of Zakariah Adam, a Master of Philosophy Applied Epidemiology. The study is interested in finding the factors that determine low birth weights. low birth is delivering a neonate with a birth weight below 2.4kg.the aim of the study is to find these factors to inform policy as to interventions to prevent low birth weight ,as this leads to high neonatal and infant mortality

Participating in this study is entirely voluntary. You have the right to refuse to participate and this will not affect your rights in anyway, especially to your healthcare. You are also at liberty to withdraw from this study at any stage of your participation. There are no direct benefits or risks in participating. You will not be paid or compensated for your participation. However, the information that the study will come out with, will help us to understand the factors and circumstances association with low birth weight. You may feel uncomfortable answering some of the questions and therefore you can choose not to answer them. All the information collected from you will be treated strictly confidential and will be used for the intended purpose only. You will not be identified by name in any dissemination reports or publications resulting from this study. The Ghana Health Service Ethics Review Committee has reviewed and given approval for this study to be conducted

Do you have any questions for clarifications?

However, if you have any further questions regarding this study, you may contact:

Principal Investigator, Zakariah Adam 0267145415

Supervisor, Dr. Priscillia Awo Nortey 0243303362

Hannah Frimpong on Tel 0507041223

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Appendix B

Questionnaire

Study Title: Determinants of low birth weight in neonates born in the Brong Ahafo Regional hospital.

Record ID ………………… Interviewer ID ………………

Date of administration of form ……/…../……..

Socioeconomic and demographic data

1. Maternal Age (years)……….. 2. Maternal Height (cm)………
3. Maternal weight at booking………….. 4. Baby's weight………..
5. Baby's sex……... 6. Gestation at booking…………
7. How many ANC visits before this birth (Check ANC card)………………
8. Mothers Hemoglobin level (check ANC card if available) during
   a. booking or 1st trimester. ………….. b. 3rd trimester or 36weeks……………
9. How many doses of SP has she had till delivery? (Check ANC card) …………………
10. How many doses of tetanus has she had till delivery (check ANC card)………………………
11. What was her Gestation at delivery………………………………
12. Laboratory results at antenatal booking (Check ANC Card)

a .Hepatitis B status i. Negative [ ] ii. Positive [ ] c. Not done [ ]

b. stool RE/flagellates. I .YES [ ] ii.NO [ ] c .Not done [ ]

c. blood pressure i. Normal [ ] ii. High [ ] iii. Low [ ]

d .HIV status i. Negative [ ] ii Positive [ ] c. Not done [ ]

e. VDRL status i. Non Reactive [ ] ii. Reactive [ ] c .Not done [ ]

13. Marital status of mother.

a .Married [ ] b. single [ ] other specify………………………………………

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14. What is your level of education?

a. primary/JHS [ ] b. secondary [ ] c .post-secondary/tertiary [ ]

d. illiterate [ ]

15. What work do you do?

a. farming [ ], b. trader/business woman [ ], c. hairdresser/seamstress [ ],

d .artisan [ ]

e..Gov. Work/paid formal job [ ], f, .house wife [ ] g, unemployed [ ]

16. What work does your husband do if married?

a. farming [ ], b. trader/business man [ ], c. artisan [ ] e.Gov. Work/paid formal job [ ] f.not married [ ]

17. What locality do you stay a. Within Techiman [ ] b. outside techiman [ ]

18. What tribe are you? a. Ashanti [ ] b. Bono [ ] d. northern [ ]

e. Others [ ]

19. Who did you live with for the most period of the pregnancy (family type?)

a. husband and children only [ ] b. extended family [ ] c. alone [ ]

20. Did you plan for this pregnancy or desired it a. YES [ ] b.NO [ ]

21. Gross monthly Income of family

a.GH¢1500 or more [ ] b. 1400-1000, [ ] c.900-500 [ ] d. below 500 [ ]

22. What type of house do you live in? a. rented [ ] b. owned [ ]

c. family house [ ]

23 What type of building do you live in?

a. Separate house/bungalow [ ] b. Semi-detached house [ ] c. Flat/Apartment [ ] d. Compound house (rooms [ ] e. other [ ]

Medical factors

24. Did you have any medical illness before you got pregnant (hypertension, diabetes, sickle cell disease, a .yes [ ] b .No [ ].

If yes what condition was it?

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a. hypertension [ ] b. diabetes [ ] c .sickle cell disease [ ] c asthma [ ]

d. HIV [ ] d. other, specify…………………..

25. Did you ever get sick during this pregnancy? a. YES [ ] b.NO. [ ]

If yes what condition was it?

a. .Malaria [ ] b. UTI/dysuria [ ] c. LAP [ ] d. RTI e. Anemia [ ]

f. Other [ ] specify…………………………

26. Have you been admitted with any illness during this pregnancy a.YES [ ] b.NO? [ ]

If yes, what condition was it?

a. .high blood pressure [ ] b. bleeding [ ] c. low blood level [ ] d. high sugar [ ]

e. loosing liquor [ ] f .malaria [ ] g. Other [ ] specify…………………………

27. Did you always take your ANC folic acid and iron tablets

.a. YES [ ] b .not regularly [ ] c .NO [ ]

28. Have you been taking alcohol during the pregnancy a. YES [ ] b. NO? [ ]

29. Did you have any of the following problems with eating and nutrition?

a .nausea/vomiting [ ] b. heartburns [ ] c. poor appetite [ ] d. constipation [ ]

e. pica [ ] f. none [ ]

Reproductive factors

30. What was the mode of delivery of your baby?

a. spontaneous vaginal delivery [ ] b. Operation(C/S) [ ] c.induced spontaneous delivery [ ]

If delivery was operation(C/S), was it an emergency a. YES b. NO

What was the reason for the operation(C/S)

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A. pre-eclapsia/ecalpsia [ ] b. antepartum hemorrhage [ ] c. Medical [ ]

d .oligohydramnous/loosing liquour [ ] e .other obstetric complication [ ]

31. How many deliveries have you had, excluding this delivery (parity)……………………

32. How many children do you have alive…………………

33. How old is your last child………………….

34. Have you used any family planning method before (hormonal) a. YES [ ] b. NO? [ ]

35. Have you had any spontaneous abortions in any previous pregnancy before 28weeks?

a. YES [ ] b. NO [ ]

36. If yes how many abortions………..

at what gestation was the last abortion (months/weeks)………………..

37. Have you had any previous premature delivery or low birth baby, a. YES [ ] b. NO? [ ]

38. Have you had a delivery and the baby died within the first month a .YES [ ] b. NO [ ]

39. Have you had any previous surgery on uterus and cervix a. YES [ ] b. NO [ ]

40. Where you on any medicines apart from routine ANC drugs during pregnancy

a. YES [ ] b.NO [ ]

If yes what medicines where you on

a. Blood pressure drugs [ ] b. Antibiotics [ ] c. Haematinics [ ]

d. other [ ]

41. Did you take any herbal medications during the pregnancy? a. YES [ ] b.NO [ ]

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Appendix C

Results of bivariate analysis(chi-square) showing p-values of the association between independent variables and outcome variable

variable	No.(%) of Cases(n=120)	No.(%) of Control(n=240)	p-value
Age group of mother			
19 and below	10(8.3)	18(7.5)	0.77
20-29	51(42.5)	103(42.9)	Ref
30+	59(49.2)	119(49.6)	0.96
Mothers height			
146cm or above(normal)	103(97.2)	221(97.8)	ref
Below 146cm(short)	3(2.8)	5(2.2)	0.73
Mothers weight			
45kg and above	107(97.3)	219(96.5)	ref
Below 45kg	3(2.7)	8(3.5)	0.70
BMI of mother			
18.5-24.9(normal)	58(56.9)	138(63.3)	ref
Below 18.5(underweight)	3(2.9)	13(6.0)	0.36
Above 24.9(obese)	41(40.2)	67(30.7)	0.14
Gestation at booking			
1st trimester	68(64.8)	161(69.1)	ref
2nd trimester	26(24.8)	67(28.8)	0.76
3rd trimester	11(10.5)	5(2.1)	<0.001
ANC visits			
4 and above	97(82.2)	228(95.8)	Ref
0-3	21(17.8)	10(4.2)	<0.001
1st trim hemoglobin			
11g/dl and above	39(33.3)	124(52.1)	ref
Below 11g/dl	78(66.6)	114(47.9)	<0.001
Gestation at delivery			
Term	70(63.6)	228(95.8)	ref
32-36weeks	29(26.4)	9(3.8)	< 0.001
Below 32weeks	11(10.0)	1(0.4)	< 0.001
Education level of mother			
No formal education	12(10.1)	28(11.8)	0.76
Primary/,JHS	35(29.4)	100(42.0)	0.86
secondary	56(47.1)	67(28.2)	0.02
Post-secondary/tertiary	16(13.4)	43(18.1)	Ref
Mothers occupation			
farming	17(14.3)	28(11.8)	0.61
Trader/artisan	63(52.9)	136(57.1)	0.89
Gov./formal job	16(13.4)	33(13.9)	Ref
unemployed	23(19.3)	41(17.2)	0.72
Residence of mother			
Urban	69(61.1)	172(73.5)	ref

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rural	44(38.9)	62(26.5)	0.018
Who mother lived with during pregnancy			
Partner	55(46.20	155(65.4)	ref
Extended family	41(41.2)	62(26.2)	0.014
Alone	23(19.3)	20(8.4)	<0.001
Planned pregnancy			
Yes	64(53.8)	155(65.1)	ref
No	55(46.2)	83(34.9)	0.038
Chronic medical condition			
No	112(93.3)	222(92.5)	ref
Yes	8(6.7)	18(7.5)	0.781
Ill during pregnancy			
No	66(55.0)	148(61.90)	ref
Yes	54(45.0)	91(38.1)	0.207
Any hospital admissions in pregnancy			
No	72(60.0)	191(79.9)	ref
Yes	48(40)	48(20.1)	<0.001
iron supplementation intake			
Always	69(57.5)	175(73.2)	ref
Not regularly	32(26.7)	47(19.7)	0.042
never	19(15.8)	17(7.1)	<0.001
Alcohol intake			
No	114(95.0)	230(97.5)	ref
yes	6(5.0)	6(2.5)	0.225
Issues with eating(poorappetite,nausea vomiting etc.			
yes	70(58.8)	110(47.4)	0.043
no	49(41.2)	122(52.6)	Ref
Mode of delivery			
svd	73(61.3)	172(72.3)	Ref
Caesarian section	46(38.7)	66(27.7)	0.036
Parity			
nulliparity	44(37.3)	62(26.1)	0.024
primiparity	21(17.80	55(23.1)	0.45
Multiparty(2-3)	45(38.1)	91(38.2)	0.16
Grand multiparity(4+)	8(6.8)	30(12.6)	ref
Ever used hormonal Family planning method			
No	84(70.0)	185(77.1)	Ref
yes	36(30.0)	55(22.9)	0.14
Previous spontaneous abortion			
No	96(80.0)	192(80.0)	ref

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yes	24(20.0)	48(20.0)	0.99
Previous delivery of a low birth/premature baby			
No	109(90.8)	232(96.3)	Ref
yes	11(9.2)	9(3.7)	0.034
Intake of Herbal medications			
No	92(76.7)	218(90.8)	ref
yes	28(23.3)	22(9.2)	0.0002

Bivariate results with p-values and Odds ratios between outcome variable and independent variables

variable	No. of Cases(n=120)	No.of Control(n=240)	p-value	OR
Age group of mother				
19 and below	10	18	0.77	1.13
20-29	51	103	Ref	
30+	59	119	0.96	1.01
Mothers height				
146cm or above(normal)	103	221	ref	
Below 146cm(short)	3	5	0.73	1.29
Mothers weight				
45kg and above	107	219	ref	
Below 45kg	3	8	0.70	0.77
BMI of mother				
18.5-24.9(normal)	58	138	ref	
Below 18.5(underweight)	3	13	0.36	0.55
Above 24.9(obese)	41	67	0.14	1.46
Baby's sex				
Male	58	117	Ref	
female	58	122	0.85	0.96
Gestation at booking				
1st trimester	68	161	ref	
2nd trimester	26	67	0.76	0.92
3rd trimester	11	5	0.001	5.21
ANC visits				
4 and above	97	228	Ref	
0-3	21	10	<0.01	4.94
1st trim hemoglobin				
11g/dl and above	39	124	ref	
Below 11g/dl	78	114	<0.01	2.18
Gestation at delivery				
Term	70	228	ref	
32-36weeks	29	9	<0.001	10.5
Below 32weeks	11	1	<0.001	61.89
Malaria prophylaxis doses				

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3 or above	47	95	ref	
Below 3	71	141	0.94	1.02
Marital status of mother				
married	38	82	ref	
Not married	61	179	0.2106	
Education level of mother				
No formal education	12	28	0.76	1.16
Primary/,JHS	35	100	0.86	0.94
secondary	56	67	0.02	2.25
Post-secondary/tertiary	16	43	Ref	
Mothers occupation				
farming	17	28	0.61	1.25
Trader/artisan	63	136	0.89	0.96
Gov./formal job	16	33	Ref	
unemployed	23	41	0.72	1.16
partners occupation				
Farming	24	44	0.63	1.19
Trader/artisan/business	36	92	0.61	0.85
Gov./formal job	23	50	ref	
Not married	37	51	0.17	1.58
Residence of mother				
Urban	69	172	ref	
rural	44	62	0.0184	1.77
Tribe of mother				
Ashanti	23	40	0.45	1.26
Bono	63	138	Ref	
Northern	22	42	0.65	1.15
other	9	17	0.74	1.16
Who mother lived with during pregnancy				
Partner	55	155	ref	
Extended family	41	62	0.014	1.86
Alone	23	20	0.0004	3.24
Planned pregnancy				
Yes	64	155	ref	
No	55	83	0.038	1.60
Monthly Income				
1000 or more	14	35	ref	
900-500	25	55	0.75	1.13
Below 500	81	146	0.34	1.39
Type of house mother lives in				
Rented	52	118	0.42	0.80
Owned	33	60	ref	
Family house	35	58	0.76	1.09
Type of building mother lives in				

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Self-contained/bungalow	77	130		
Compound house	41	97	0.15	2.06
Others(eg mud house,)	2	9	0.2	1.63
Chronic medical condition				
No	112	222	ref	
Yes	8	18	0.781	0.89
Ill during pregnancy				
No	66	148	ref	
Yes	54	91	0.207	1.33
Any hospital admissions in pregnancy				
No	72	191	ref	
Yes	48	48	0.0001	2.65
iron supplementation intake				
Always	69	175	ref	
Not regularly	32	47	0.042	1.73
never	19	17	<0.01	2.83
Alcohol intake				
No	114	230	ref	
Yes	6	6	0.225	2.02
Issues with eating(poorappetite,nausea vomiting etc.				
Yes	70	110	0.043	1.58
No	49	122	Ref	
Mode of delivery				
Svd	73	172	Ref	
Caesarian section	46	66	0.036	1.64
Emergency cs				
No	11	17	Ref	
Yes	35	49	0.82	1.10
Parity				
nulliparity	44	62	0.024	2.66
primiparity	21	55	0.45	1.43
Multiparty(2-3)	45	91	0.16	1.85
Grand multiparity(4+)	8	30	ref	
Number of Children alive				
No child	46	66	0.09	2.19
1	24	59	0.62	1.28
2-3	41	91	0.46	1.42
4+	7	22		
Age of last child				
No child	46	66	0.45	2.78
1-2yrs	23	59	0.52	1.56
3-6yrs	44	92	0.22	1.91
7+yrs	5	20	ref	

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Ever used hormonal Family planning method				
No	84	186	Ref	
Yes	36	55	0.14	1.45
Previous spontaneous abortion				
No	96	192	ref	
Yes	24	48	0.99	1.01
Previous delivery of a low birth/premature baby				
No	109	232	Ref	
Yes	11	9	0.034	2.60
Previous death of child				
No	114	229	ref	
Yes	6	12	0.99	1.00
Previous obstetric/gynaec surgery				
No	114	212	ref	
Yes	6	27	0.051	0.41
Intake of Herbal medications				
No	92	218	ref	
yes	28	22	<0.001	3.02