SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT BABIES DELIVERED IN SELECTED HOSPITALS IN FREETOWN, SIERRA LEONE 2019-2020

BY

DAVID KABBA KARGBO

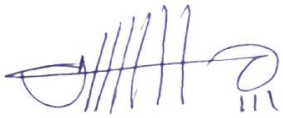
(ID #: 10701872)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE MASTER OF PHILOSOPHY (MPhil) DEGREE IN APPLIED EPIDERMIOLOGY AND DISEASE CONTROL

OCTOBER 2020

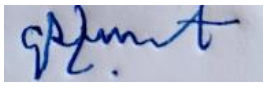
DECLARATION

I, David Kabba Kargbo hereby declare that this thesis is my original work under the guidance of my supervisors, except for the references of other people's work, which have been duly acknowledged. This thesis has not been submitted to the University or elsewhere for the award of a degree.



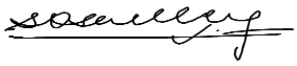
David Kabba Kargbo
(Student)

Date: 09/10/2020



Prof Francis Anto
(Supervisor)

Date: 14/10/2020



Dr. Samuel O. Sackey
(Co-Supervisor)

Date: 14/10/2020

DEDICATION

I dedicate this work to my late mother and father, Mrs Yealie Kargbo and Mr. Kabba Kargbo for their good upbringing and who wanted me to academically reach to this height and evening beyond. May their souls rest in perfect peace.

ACKNOWLEDGEMENT

My earnest thanks go to the Almighty God for empowering me to finish this interesting course. I am grateful to my supervisors Prof Francis Anto, Dr. Samuel O. Sackey and Dr. (Major) Philip Pelema Gevao for their uncountable support, ideas and guidance that helped me to become better person.

I recognize the roles played by the entire staff of the Department of Epidemiology and Disease Control, School of Public Health, University of Ghana-Legon. I would also like to thank the secretariat of the Ghana Field Epidemiology and Laboratory Training Programme (GFELTP) for the support in making me realize my goal.

Special appreciation goes to Prof Kofi Nyarko, staff, mentors and management of the Sierra Leone Field Epidemiology Training Programme (SLFETP) for their financial and technical support.

Special thanks go to the Ministry of Health and Sanitation, management of PCMH, King Harman Road Government Hospital, Lumley Government Hospital, 34 Military Hospital and Aberdeen Women's Centre, all from Sierra Leone for their diverse contributions and support they gave to the success of this work.

My thanks also go to the study participants and research assistants who gave their valuable time, commitment and information to make this study useful

Last, but not the least, I would like to appreciate my lovely wife, Mrs Deborah Kadiatu Kargbo, my beautiful daughters Davida Yealisatu Kargbo and Daverah Esther Kargbo for their prayers and patience when I was away from Sierra Leone.

ABSTRACT

Background: Each year, 15% to 20% of all deliveries are Low Birth Weight (LBW) representing about 20 million babies with 96.5% of these occurring in developing countries. About 60-80% of low birth deliveries contribute to neonatal deaths. For the past few years, the prevalence of LBW in Sierra Leone has not been stable with the Western Area Urban (WAU) district recording about 17.5% prevalence of LBW which is more than the national average of 7%.This study identified factors associated with low birth weight (LBW) babies delivered in five referral hospitals in the WAU district (Freetown), Sierra Leone.

Methods: A hospital-based an unmatched 1:2 case-control study was conducted among 438 mothers (146 cases and 292 controls) who delivered singleton live babies from November 2019 to February 2020 in five referral hospitals, WAU district. The hospitals were purposively selected and for each case, two subsequent controls were enrolled in the study. The independent variables where categorised as socio-demographic, obstetric, maternal health/life style factors and the outcome variable is LBW. Mothers' antenatal cards (ANC) were reviewed and a pre-tested semi-structured questionnaire was administered to the mothers by trained research assistants. Data were entered using SPSS version 22 and analyzed using Stata 15 (Stata Corp, College Station, TX, USA).The association between the independent variables and the outcome variable was estimated using simple and multiple logistic regression analyses at p-value <0.05 and 95% confidence interval.

Results: The mean birth weight was 1.9 kilograms ± SD 0.43 for cases and 3.2 kilograms ± SD 0.41 for controls while the pregnant mothers mean age was 24.2 years ± SD 5.80 for cases and 26.1 years ± SD 5.46 for controls. In the multiple logistic regression analysis, risk factors which influenced the delivery of LBW baby included: unemployment (aOR = 2.70, 95% CI 1.22 - 5.99, P = 0.014), being a student (aOR = 2.89, 95% CI 1.00 - 8.31, P = 0.048), anaemia (aOR = 3.54, 95% CI 1.70 - 7.38, P = 0.001), less than two years interpregnancy interval (aOR = 2.64, 95% CI 1.15 - 6.05, P = 0.021), cigarette smoking during pregnancy (aOR = 4.2, 95%

CI 1.84 - 9.59, P = 0.001) and taking herbal medicine during pregnancy (aOR = 2.11, 95% CI 1.06 - 4.18, P = 0.033).

Conclusion: This study revealed that the potential risk factors for LBW babies among mothers in Sierra Leone include unemployment, being a student, anaemia, less than two years interpregnancy interval, cigarette smoking during pregnancy and taking herbal medicine during pregnancy. Health facility specialists should screen and sensitize mothers on the risk factors of LBW during antenatal sessions.

Key words: Low birth weight, Risk factors, Case-control study, Freetown, Sierra Leone

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANC	Antenatal Care
ART	Antiretroviral Treatments
BMI	Body Mass Index
CDC	Centres for Disease Control and Prevention
ELBW	Extremely Low Birth Weight
HBW	High Birth Weight
HIV	Human Immunodeficiency Virus
IUGR	Intrauterine Growth Retardation
LBW	Low Birth Weight
MoHS	Ministry of Health and Sanitation
NBW	Normal Birth Weight
NGO	Non-Governmental Organization
PCMH	Princess Christian Maternity Hospital
PHU	Peripheral Health Units
PTB	Preterm Birth
SLDHS	Sierra Leone Demographic and Health Survey
SLESRC	Sierra Leone Ethics and Scientific Review Committee
STI	Sexually Transmitted Infection
TV	Trichomonas Vaginalis
VLBW	Very Low Birth Weight
WAU	Western Area Urban
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Birth weight is an important milestone of the child's susceptibility to the risk of childhood diseases and disability. It is a key indicator of the child's future development and the chances of survival (Hailu & Kebede, 2018). A child with low birth weight has increased risk of childhood diseases and death. Low birth weight is the weight of a newborn measuring 2500 grams, which is taken immediately after birth. Several factors are known to cause low birth weight, including early induction of labour or caesarean birth for medical or non-medical reasons, mother's lifestyle (i.e. smoking, drinking alcohol), multiple pregnancies, lack of weight gain, younger than 15 years and older than 35 years old, poverty, infections and chronic illnesses such as diabetes and high blood pressure (Asia, 2012). The Centres for Disease Control and Prevention (CDC) categorized birth weight as extremely low birth weight (ELBW): infants whose birth weight is below 1000 grams, very low birth weight (VLBW): infants whose birth weight is below 1500 grams, low birth weight (LBW): infants whose birth weight is below 2500 grams, normal birth weight (NBW): infants whose birth weight is between 2500 grams to 4000 grams, and high birth weight (HBW) in infants whose birth weight is more than 4000 grams.The World Health Organization (WHO) defined Low birth weight (LBW) as weight at birth less than 2,500 grams. Epidemiological studies showed that newborns weighing less than 2,500 grams are at greater risk of neonatal mortality compared to normal weight babies (Gebrehawerya et al, 2018). Asia (2012) also found that LBW increases the risk for non-communicable diseases including diabetes and cardiovascular disease in adulthood. LBW contributes significantly to the burden of diseases in a country and it is an important indicator of infant mortality, especially deaths in the first months of life (Hailu & Kebede, 2018). The increase in the survival rates of LBW deliveries increases health care costs due to extensive hospitalization. It is estimated that care for exceptionally LBW deliveries is about

six times more expensive compared to normal weight deliveries (Id, Dzikiti, Hajison, & Id, 2019). Low birth weight remains an important public health problem worldwide and is related to short and long-term consequences.

Globally, it is estimated that 15% to 20% of all births are LBW representing more than 20 million births a year (Asia, 2012 & WHO report). About 96.5% of this LBW occurred in developing countries and 60–80% of low birth deliveries contributes to neonatal deaths (Gebrehawerya et al., 2018). Studies also disclosed that LBW babies are more likely to develop disabilities including poor schooling, frequent hospitalization, poor language development and intellectual deficiencies (UNICEF & WHO, 2019).

The prevalence of LBW varies from regions and within countries. However, the greater percentage of LBW deliveries occur in low and middle-income countries estimating 28% in south Asia, 13% in sub-Saharan Africa and 9% in Latin America (Siyoum & Melese, 2019). The prevalence of LBW in Ghana was noted to be 21.1% which was similar to that of Ethiopia and Kenya (Fosu, Abdul-Rahaman, & Yekeen, 2013).

In Sierra Leone, the issue of LBW deliveries and its associated factors has not received much needed attention even with the initiation of the 'Free Health Care' scheme in 2010 for pregnant mothers and children less than five years old. Deliveries are still known to be conducted in communities that are hard-to-reach and the weights of these babies are not recorded. The reliability of the current data on LBW across the country remains limited. Therefore, assessing the real situation of LBW deliveries in Sierra Leone is difficult and extremely challenging compared to developed countries. Report of the Sierra Leone Demographic and Health Survey (2013) revealed seven percent of LBW deliveries for Sierra Leone and 17.5% for the Western Area Urban district (Freetown). However, the findings of this report did not focus on factors influencing LBW deliveries. Therefore, this study identified factors associated with low birth weight (LBW) babies delivered in five referral hospitals in Freetown, Sierra Leone.

1.2 Problem statement

Low birth weight (LBW) is a global public health problem, especially in low and middle-income countries. According to the Sierra Leone Demographic and Health Survey 2008 & 2013 (SLDHS) report, LBW deliveries in Sierra Leone decreased from 11.0% in 2008 to 7.1% in 2013 (3.9% decrease) and in the Western Area Urban district (Freetown) it increased by 8% from 9.5% in 2008 to 17.5% in 2013. More than one-third of newborn deaths in Sierra Leone is attributable to low birth weight (Sloan and Ahmed, 2011). In Ghana which shares similar geographical features with Sierra Leone identified socio-demographic factors for LBW and these, include mother's age less than 20 years old (13%), no formal education (88%) and unmarried (36%), obstetric factors: ANC visits less than three (94%), nulliparity (66%), preterm delivery (70%) and previous abortion (60%), maternal factors include haemoglobin less than 11.0g/dl(14%) and taking herbal medicine during pregnancy (20%) are significant factors for LBW(Adam, Ameme, Nortey, Afari, & Kenu, 2019). LBW contributes significantly to morbidity, disability and mortality among newborn babies (Gebrehawerya *et al.*2018). The babies who survive may have impaired immune function and this may increase the risk of diseases like diabetes and heart disease later in life. Besides, they may also suffer intellectual impairments, hence affecting their performance in school and their job opportunities later in life (UNICEF & WHO, 2019). Identifying the risk factors of LBW may help direct specific interventions to those at risk, and hence reducing the amount of LBW babies delivered in Sierra Leone. Besides, this would help stakeholders and policymakers develop strategies to tackle this public health concern in Sierra Leone.

1.3 Justification

The weight of a child at birth is an important indicator of the child's susceptibility to childhood illness and the chance for survival. Newborns whose birth weight is less than 2500g are considered at risk of early childhood death and mental disability (Statistics Sierra Leone (SSL) and ICF Internationa, 2013).

In Western Area Urban district-Freetown, about 8.0% increase in LBW delivery was noted during the SLDHS (2008 & 2013). More than one-third of the newborn deaths in Sierra Leone are attributed to low birth weight. Timely prevention and control of these deaths may reduce half of the deaths in infants less than 2500g body weight.

The care for LBW babies demands an extensive cost to the health system. Therefore, it is critical to focus on finding the factors related to LBW deliveries to plan sustainable preventable measures. This will also reduce the cost to the health sector and eventually reduce newborns deaths in Sierra Leone.

Findings of the SLDHS 2008 and 2013 only indicated the proportion of babies delivered with LBW leaving out the predictors to LBW deliveries. In addition, whether these factors are associated with LBW in Sierra Leone is yet to be established. There is limited studies in Sierra Leone on LBW that is making it difficult to understand the main factors associated with LBW babies. This study identified factors associated with LBW babies in Western Area Urban district, Freetown Sierra Leone.

Operational terms/definitions

Low birth weight (LBW): a newborn measured immediately after birth with a birth weight less than 2500 grams

Normal birth weight (NBW): a birth weight measured immediately after birth and its measures between 2500 grams to 4000 grams

Preterm birth: newborn delivered before 37 completed weeks of gestation

Chronic medical illness: The mother with a pre-existing illness documented in her ANC card or medical record with an onset prior to the current pregnancy

Body mass index (BMI): The weight measured in kilograms per height in meters squared. It is categorized as underweight (<18.5 kg/m^2), normal BMI (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2) and obese (≥30 kg/m^2)

Anaemia: This is defined as a pregnant mother with haemoglobin concentration <11.0g/dl

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

Herbal use/traditional medication: any mother who took a unit of herbal or traditional medicine during the recent pregnancy.

1.4 Conceptual frame work

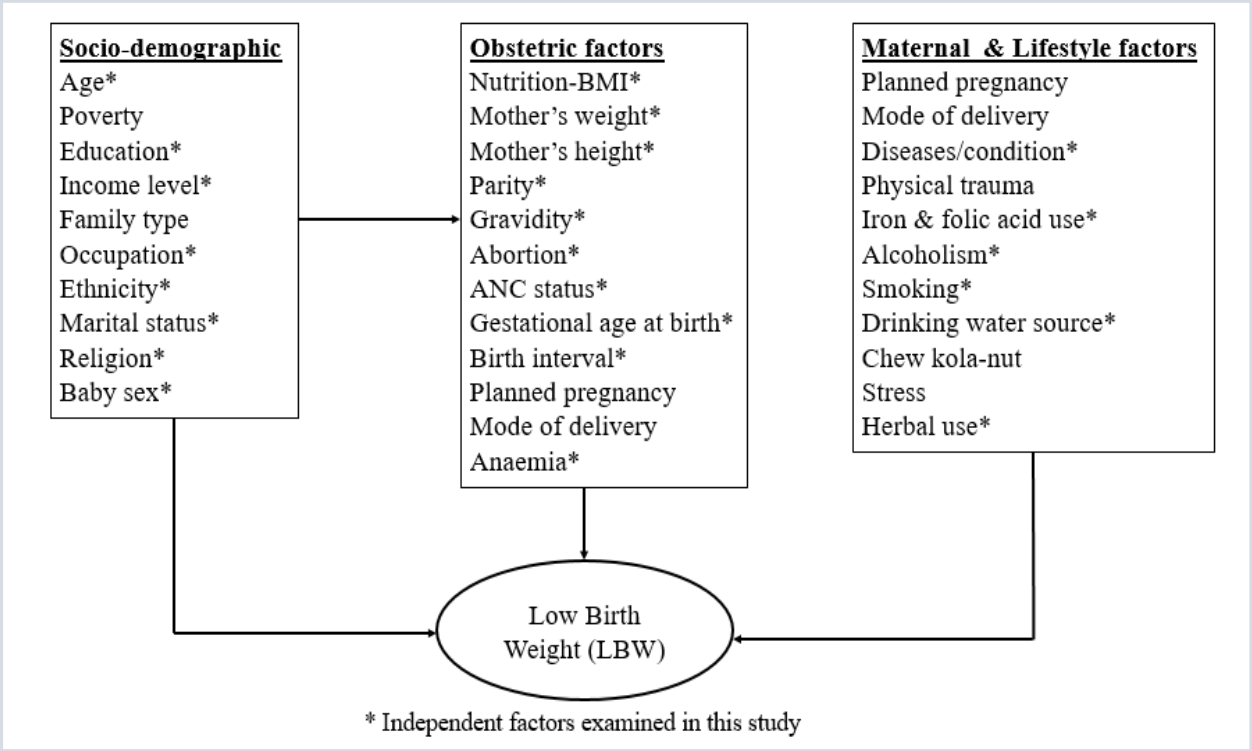


Figure 1: Conceptual Framework: potential factors of LBW, Western Area Urban-Freetown

Socio-demographic factors such as mother age, education, poverty, income level, family type, occupation, ethnicity, marital status, religion and sex of the baby can contribute to the delivery of LBW babies. The socio-demographic factors themselves can influence LBW deliveries either independently or with other factors (Fig. 1).

Obstetric factors such as maternal nutrition (before and during pregnancy), antenatal care, mother's weight and height, history of abortion, number of ANC visit, number of deliveries (parity), number of pregnancies (gravidity), birth interval and anaemia may directly contribute to LBW. On the other hand, this may indirectly be predisposed by the socio-demographic factors, thereby influencing the occurrence of LBW deliveries.

Maternal health-related factors of the mother during pregnancy are other known determinants that pose a negative effect on the weight of a newborn. These include diabetes, hypertension, HIV infection, physical trauma and malabsorption of iron and folic acid.

Lifestyle or environmental factors including mother taking alcohol, smoking cigarette or cannabis, water sources, amount of water drank by mother during pregnancy, chewing kola-nut, use of herbal medicine and stress can directly impact on the growth of the foetus in utero, hence LBW delivery.

1.5 Research questions

The study try to answer the following research questions

1. Is there an association between socio-demographic factors of the mother and LBW?
2. Is there association between obstetric factors of the mother and LBW?
3. Is there an association between maternal health status factors and LBW?

1.6 General objective

To identify factors associated with low birth weight (LBW) babies delivered in five referral hospitals in Western Area Urban (Freetown), Sierra Leone

1.7 Specific objectives

1. To determine the socio-demographic factors of the mother associated with LBW
2. To determine the obstetric factors of the mother associated with LBW
3. To determine maternal health status factors associated with LBW

CHAPTER 2

LITERATURE REVIEW

The World Health Organization (WHO) defined LBW as the delivery of a preterm baby (less than 37 weeks gestation) with weight lower than 2500 grams or born at term pregnancy with weight less than 2500 grams. LBW is therefore, caused by either a short gestational period or retarded intrauterine growth or both.

The prevalence of LBW deliveries Worldwide ranges from 15% to 20%, amounting to about 20 million LBW babies each year. An estimated 96.5% of LBW babies are delivered in developing countries and 60% to 80% of these LBW contributes to neonatal deaths (Gebrehawerya et al., 2018).

Several factors contribute to the delivery of LBW babies. These factors were categorized into socio-demographic, obstetric, maternal health status, or lifestyle/environmental factors.

2.1 Socio-demographic factors

2.1.1 Mother's age

The mother's age during pregnancy, determine the survival rate of the baby at birth and has a significant association with low birth weight deliveries. Sutan et al., (2014) found that younger age mothers are at greater possibility of having LBW babies compared to older age mothers. However, the same studies reported that older mothers are at higher risk having LBW babies. The study concluded that this could be related to the reduction of the nutritional nutrients presence in teenage pregnancy and older age due to poor eating habits. Similar studies explained that younger pregnant mothers are mostly faced with lesser socioeconomic condition. Besides, their reproductive system may not have fully developed compared to older mothers and these increases the risk of LBW deliveries (Adam et al., 2019).

2.1.2 Mother's educational level

The mother educational level has significant effect on the well-being of the family. Thus, a higher level of education has comparative benefits to the mother and the unborn child. Mothers who are less educated are known to have LBW babies (Wachamo, Bililign, Id, & Bizuneh, 2019). This may be attributed to the inadequate social amenities and nutritional diet of the mother before and during pregnancy.

2.1.3 Occupation

Some occupations have been identified to harm birth weights. Pregnant women frequently engage in hard physical work during pregnancy are known to have a higher prevalence of LBW deliveries compared to pregnant women with no hard physical work. Vigorous jobs predispose a woman to preterm labour which in-turn may lead to LBW. Other studies also showed that jobs involving night duties during pregnancy may delay pregnancy and reduce the growth of the foetus(Hailu & Kebede, 2018).

2.1.4 Ethnicity

This involves the cultural background of people in a community or country. The link between LBW deliveries is not entirely understood as recent studies emphasized the need for more detail understanding of the effects of ethnicity on LBW babies (Fulda, Kurian, Balyakina, & Moerbe, 2014).

2.1.5 Mother's or household income

Mother's or household income is a key indicator in determining the risk of delivering a LBW baby. A mother with low monthly income is known to be 13.9 times at higher risk of delivering LBW babies(Viengsakhone et al., 2010). It is also known that low birth weight decreased with an increasing total monthly income of a family. This may be attributed to the availability of money to buy nutritious foods and other food items.

2.1.6 Marital status

Babies delivered by unmarried mothers are now becoming a public health concerns, particularly in low-income nations. Unmarried women are especially known to carry an

unintended pregnancy and this may have adverse effects on the mother and the baby. Studies showed that mothers who carry unplanned pregnancies are more likely to experience LBW deliveries and other adverse pregnancy outcomes(Othman, 2015).The same study compared babies born to married mothers and unmarried mothers and found a higher possibility of LBW babies among unmarried mothers. The low birth delivery may be due to the inadequate and delayed prenatal care among unmarried mothers compared to married mothers.Unmarried pregnant mothers were also found to have 1-3 fold increased risk of LBW deliveries compared to deliveries of married mothers. Lack of socio-economic support was notably observed to be responsible(Oladeinde, Oladeinde, Omoregie, & Onifade, 2015).

2.1.7 Religious affiliation

Higher involvement in religious activities was noted to be protective against LBW deliveries. A religious mother mainly involved in activities that may discourage drinking alcohol, cigarette or cannabis smoking reduces the risk of LBW deliveries (Burdette, Weeks, Hill, & Eberstein, 2012).

2.1.8 Baby sex

Female babies are found to have a significant risk of LBW than male babies (Taywade & Pisudde, 2016).

2.2 Obstetric factors

2.2.1 Body Mass Index (BMI)

Body Mass Index (BMI) is a measure of the individual weight and height to determine if the person's weight is in good physical shape. The BMI is calculated by dividing the weight in kilograms by the height in metres squared. Normally, the higher the BMI the heavier the individual. It is a screening tool used to categorize weights groups' of an individual. The Centers for Disease Control and Prevention (CDC) defines "underweight as BMI less than 18.5 kg/m^2, normal weight as BMI between 18.5 - 24.9 Kg/m^2, overweight as BMI between 25 - 29.9 kg/m^2, while obese as BMI 30 kg/m^2 and more. Younger mothers, low maternal BMI, and

poor weight gain during pregnancy are related to high risk of LBW deliveries(Singh, Shehu, & Nnadi, 2016).A study explained that pregnant mothers with BMI less than 18.5 kg/m^2 is an indicator for small tissue nutrients backup for the foetus, hence mothers of these newborns are at risk of delivery LBW babies(Habib et al., 2017). The same study found that 50% of LBW babies were born to underweight mothers. Mothers with low BMI have poor maternal calories reserve and this, in turn, affects the weight of the unborn baby because of insufficient supply of nutrients from mothers.

2.2.2 Mother's weight

The maternal weight during pregnancy has significant role in the outcome of the pregnancy. The weight of a pregnant mother influences the weight of the unborn baby. A pregnant mother weighing less than 50 kilograms is four times greater at risk to deliver LBW baby compared to pregnant mother weighing 50 kilograms or more(Wachamo et al., 2019).

2.2.3 Mother's height

The height of a pregnant mother is a key indicator in determining the outcome of the pregnancy. Some studies revealed that shorter maternal height is associated with reduced foetal development and LBW deliveries (Inoue et al., 2016).The same study concluded that shorter mothers have higher possibility to deliver about 11.4% babies of LBW and maternal undernutrition was known to be the primary cause for this association.

2.2.4 Parity

Parity is the number of times a woman has given birth in 24 weeks or more gestational age, regardless of alive or stillbirth baby(Chloe, Colin, & John, 2014). In a case-control study, multiparous mothers were known to give birth to about 42% of LBW babies compared to their controls (Prudhivi & Bhosgi, 2015). On the other hand, studies also identified mothers who are nulliparous to be more at risk in delivering LBW babies compared to multiparous and grand multiparous mothers (Habib et al., 2017). This relationship was attributed to the biological immaturity of the pregnant mothers and the maternal foetal struggle for nutrients in mothers trying to achieve their growth.

2.2.5 Gravidity

Gravidity is the number of pregnancies a woman has experienced in her lifetime. Multiple pregnancies are an obstetric factor associated with the delivery of LBW baby. Studies have shown that a woman who had two to four pregnancies (gravidity) is less likely to give birth to LBW baby than a woman who had first pregnancy (Wachamo et al., 2019).

2.2.6 Abortion

Abortion is the early exit of the products of conception (the foetus and placenta) from the uterus. The risk of a mother to deliver LBW baby increases with the number of abortions she experienced in her childbearing age. A study in Pakistan discovered that, mothers with history of abortion had increased risk of LBW compared to those with no history of abortion(Habib et al., 2017). The mechanisms known for this relationship was cervical inadequacy due to damage caused during dilatation and curettage of the cervical canal and after abortion complications. This may lead to cervical incompetence and uterine defects resulting in restriction of intrauterine growth, and hence, LBW delivery.

2.2.7 Antenatal care (ANC) status

This is the total number of ANC visits done by the pregnant woman for care before she delivers. A pregnant woman is expected to have a maximum of four ANC visits and eight total contacts (1st trimester: one contact, 2nd trimester: two contacts and 3rd trimester: five contacts) before term delivery for better care(WHO, 2018). In Ethiopia it was discovered that mothers who had four times and above ANC visits were 71% less likely to give birth to LBW baby (Gebrehawerya et al., 2018).Sierra Leone noted a 97% coverage of pregnant women who received complete ANC visits from skilled health care providers (SLDHS, 2013). This finding also explained the utilization of the current ‘Free Health Care’ services for pregnant women and children under five years old. The inadequate number of ANC visits has increased risk of LBW babies as the foetus position or its progress will not be monitored before birth(WHO, 2018).

2.2.8 Gestational age at delivering

The gestation age at which a baby is born influenced the baby's birth weight. Gestational age less than 37 weeks has a significant effect on LBW delivery. Mothers who deliver before the 37th week gestational age are known to be 18 times at risk of delivery a baby as compared to those who deliver at 37 weeks gestation and above (Adane & Dachew, 2018). A baby born before 37 weeks has less time in the mother's womb to develop and gain weight. The baby gains weight during the latter part of the mother's pregnancy.

2.2.9 Birth interval

Mothers with a birth interval fewer than two years are more likely to give birth to low birth weight baby compared to mothers who give birth to an interval of two or more years (Demelash et al,2015).This could be attributed to the short interval between pregnancies which might result in the insufficient replacement of maternal nutrient used-up in the preceding pregnancy and leading to reduced foetal growth.

2.2.10 Anaemia

Anaemia during pregnancy or maternal anaemia has been identified as a risk factor for LBW. Pregnant mothers with haemoglobin concentration <11.0g/dl are known to have 2-5 increased fold risk of delivering LBW babies(Oladeinde et al., 2015). Similar studies also described that poor maternal nutrition before and during pregnancy in low-income countries accounted for over 50% cases of LBW. Anaemia affects the delivery of oxygen to the foetus which in turn impede normal intrauterine growth, hence LBW deliveries(Girma et al., 2019).

2.3 Maternal health status, lifestyle or environmental factors

2.3.1 Diabetes

A mother with a history of diabetes mellitus during pregnancy is noted to have a negative relationship with the delivery of LBW babies. Gebremedhi et al.,(2015) pointed out that babies

delivered by mothers with diabetes mellitus were 72% high risk of giving birth to LBW babies compared to mothers with no a history of diabetes mellitus.

2.3.2 Hypertension

Maternal hypertension means a pregnant mother blood pressure readings above 140/90 mmHg. Findings of a matched case-control study in Malaysia pointed out that mothers with hypertension are four times more likely to deliver LBW babies (Gebrehawerya et al., 2018). Another case-control study discovered that pregnant mothers who suffered hypertension are 11% more possibly to deliver LBW babies (Kumar, Kumar, Jayaram, & Kotian, 2010). The above findings indicated that maternal hypertension plays a crucial part in the occurrence of LBW deliveries. The same study revealed that a reduction of blood flow to the placental will leads to a drop in foetal growth and this increase the chances of intrauterine development and hence, LBW babies.

2.3.3 Heart Disease

Maternal heart disease is a life threaten condition for both the mother and the unborn baby during pregnancy. Maternal heart disease is one among the causes of LBW delivery. Research findings show that 15.7% of mothers with heart diseases delivered LBW babies(Khan, Arbab, Murad, Khan, & Abdullah, 2014). Mother with heart disease tends to have a reduce blood flow and this may cut off essential nutrients to the foetus. This will also reduce placenta development and intrauterine growth retardation (IUGR) resulting in LBW.

2.3.4 Infection

Maternal infections are well known to increase the frequency of LBW babies. Khan et al.,(2014) found that 77.1% of mothers with LBW delivery suffered at least one infection. Such infections including urinary tract infection (UTI), Trichomonas vaginalis, syphilis and kidney infection, sexually transmitted infections (STI), Pelvic inflammatory disease (PID), chest infection and HIV. Some of these infections during pregnancy obstruct the normal growth of the uterus and this may lead to LBW baby. Besides, certain contagious agents have the power

to infiltrate through the uterus and cause uteroplacental inflammation. In response to the inflammation, high cytokines are released by the immune system, which may account for preterm labour resulting in LBW.

2.3.4.1 Human Immunodeficiency Virus (HIV)

A woman infected with HIV have increase chance to deliver LBW (Id et al., 2019). Antiretroviral treatments (ART) are the drug of choice for HIV infected mothers and its effect increases the risk of delivering LBW babies. Moreover, HIV modify the immune status of an individual, hence exposure to different diseases and undernutrition, which are risk factors for LBW. Therefore, malnutrition might predispose HIV infected woman to deliver LBW babies.

2.3.4.2 Trichomonas vaginalis (TV)

Trichomonas vaginalis (TV) infection is known to associate with LBW and premature delivery. A Trichomonas vaginalis is a sexually transmittable infection and it is sometimes related to low socioeconomic status. In addition to LBW babies, TV is also related with early rupture of membranes, infertility and abnormalities of the cervix which give rise to preterm delivery and hence LBW delivery(Miranda, Pinto, & Gaydos, 2014).

2.3.4.3 Syphilis

Syphilis is a sexually transmitted infection (STI) and if not properly treated during pregnancy will lead to adverse pregnancy outcomes like delivery of low birth weight baby. This may increase the burden of hospital admissions for LBW neonates to about 13.5%(Gomez et al., 2013). Findings from Kenya noted that the incidence of LBW deliveries amongst mothers infected with Syphilis was four times higher in those infected compared to those not infected(Temmerman et al., 2015).

2.3.4.4 Malaria

Malaria infection during pregnancy has high risks of delivery of low birth weight babies. Globally, it contributes to an estimated 900,000 low birth weight babies and 100,000 infant deaths annually(Beeson, Scoullar, & Boeuf, 2018). Evidence shows that malaria infection in

the initial phase of the pregnancy may disturb the development of a baby due to maternal hormonal imbalance and inflammation. This may affect vascular development and cause early-onset foetal growth restriction. Stressors occurring during pregnancy, such as malaria infection, may cause fetal growth restriction hence, impairing placental function.

2.3.5 Iron and folic acid use

Iron and folic acid used during pregnancy are known to contribute meaningfully in lowering the incidence of LBW. Girma et al., (2019) found the risk of LBW babies in mothers who do not use iron and folic acid is two times more compared to those who use iron supplements. In another controlled trial studies, regular use of folic acid supplements during pregnancy was found to be 41% decline in the prevalence of intrauterine growth retardation(Christian et al., 2010).

2.3.6 Alcoholism

Drinking alcohol during pregnancy is now known to have a damaging effect to the mother and particularly to the unborn baby. This was evidenced in a study which discovered 7.7% LBW babies among mothers who drank alcohol during pregnancy (Miyake, Tanaka, Okubo, Sasaki, & Arakawa, 2014). In the United Kingdom, the Department of Health (DH) recommends that pregnant women and those planning to give birth should avoid drinking alcohol. This resulted due to a survey finding which demonstrated that 52% of women of childbearing age take alcohol and this had negative effects on the birth outcomes(Nykjaer et al., 2014).

2.3.7 Smoking

The use of tobacco during pregnancy is believed to influence normal birth weight. A study conducted in Brazil identified higher chance of smoking during pregnancy in multiparous women with inadequate ANC visits which had an association with LBW deliveries (Kataoka et al., 2018). The study also found that smoking during pregnancy has a relationship with cognitive impairment of the newborn, delayed foetal growth, abortion and preterm delivery. However, the pathways resulting in the negative effects of smoking during pregnancy is yet to be fully understood. However, nicotine is implicated as one of the predisposing factors for

LBW baby. Nicotine causes decrease circulation of blood in the uteroplacental, thereby leading to low parental weight gain and this in turn, negatively influence the foetal outcomes, including LBW and poor foetal growth.

2.3.8 Water source

Contaminated drinking water sources may affect the well-being of an individual. A pregnant mother exposed to contaminated drinking water may suffer diarrheal diseases like cholera that may lead to poor pregnancy outcomes like LBW and feotal distress (Demelash et al., 2015). This may be attributed to the depletion of maternal nutrients and body fluids due to dehydration.

2.3.9 Herbal use/traditional medication

A mother using herbal or traditional medicine during pregnancy has an increased risk of delivering LBW baby. Mothers who take herbal/traditional medicine during pregnancy are known to be 35.7 times greater risk in delivering low birth weight baby compare to mothers who did not take herbal or traditional medication(Lake & Fite, 2019).This may be due to the negative adverse effects of the herbal medications. The use of herbal or traditional medicine during pregnancy may lead to malnutrition, congenital abnormality or renal failure that has direct effect on intrauterine growth retardation.

CHAPTER 3

METHODS

3.1 Study design

This is a hospital-based unmatched 1:2 case-control study which was conducted from November 2019 through February 2020 among mothers who gave birth to a singleton live baby in four Government hospitals and one Non-Governmental Organization (NGO) supported hospital within the Western Area Urban District of Sierra Leone. For each mother who gave birth to a case, two mothers who subsequently delivered normal weight babies in the same hospital as controls were selected.

3.2 Study Area

Sierra Leone is located on the West coast of Africa. It is bordered to the northeast by Guinea, Liberia to the southeast, and the Atlantic Ocean to the south-west. It was a British Colony but gained independence on April 27, 1961. Sierra Leone covers an area of 71,740 sq. km with an estimated population of 7.8 million and a growth rate of 3.5%.The sex ratio is 96.8 males per 100 females. Sierra Leone has a young population demographic profile, 40.9% are less than 15 years old, 3.5% are 65 years and above. The age group 15-64 years represents 55.6%, which is the working population in the country (Census, 2015). The maternal mortality rate in Sierra Leone is 1,165 deaths per 100,000 live births, the infant mortality rate is 92 deaths per 1,000 live births and neonatal mortality is 39 deaths per 1,000 live births (SLDHS, 2013). In Western Area Urban District, the neonatal mortality is 54 deaths per 1,000 live births with 17.5% LBW deliveries (SLDHS, 2013). Sierra Leone is a low-income country and is divided into five regions and 16 districts. Each district has a referral hospital and several peripheral health unites (PHUs). The study was conducted in Western Area Urban district (Fig 2). This district houses the capital city Freetown. It is bordered to the north-west by the Atlantic Ocean, northeast by

Port Loko district and southeast by Western Area Rural District. The District has a projected population of 14.9% of the total population (Census, 2015).

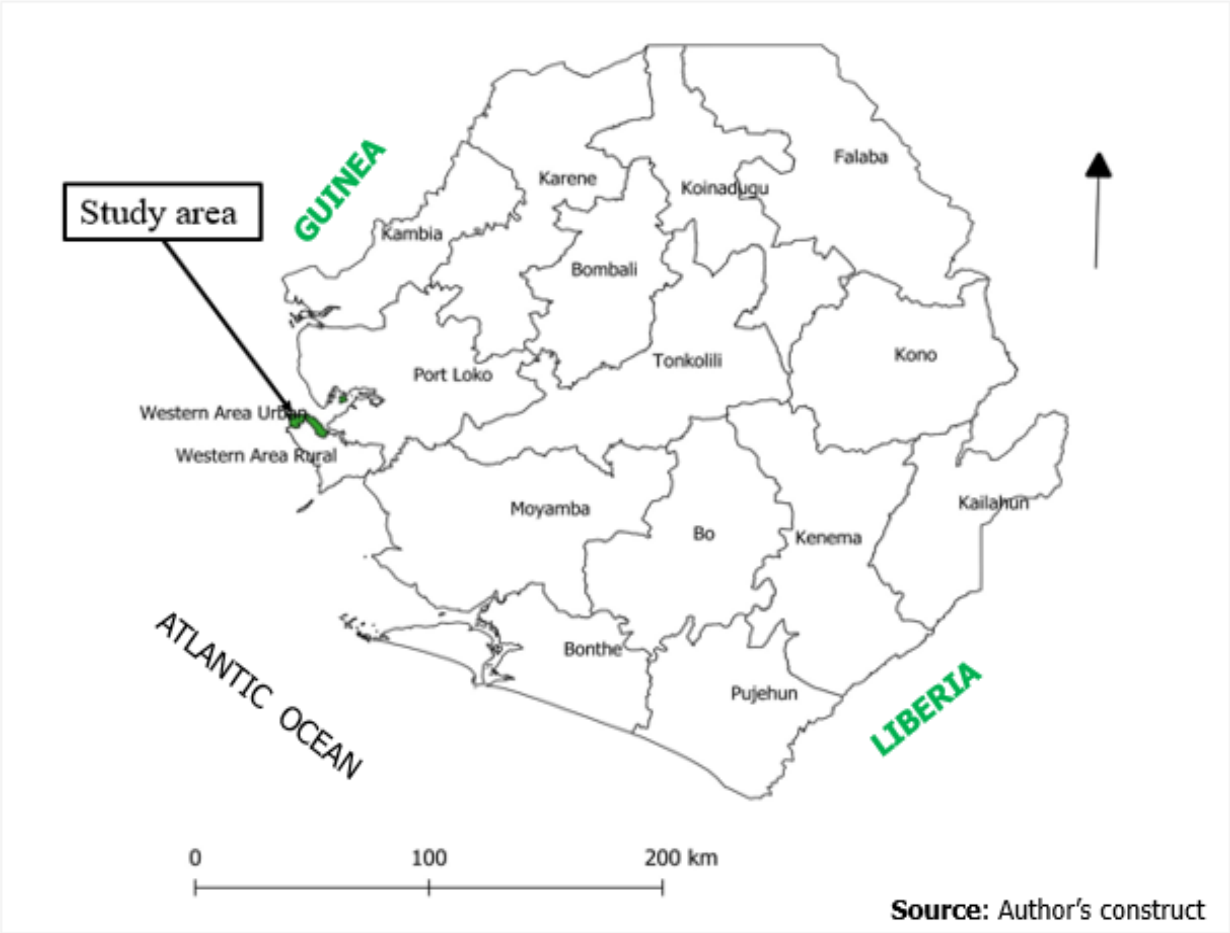


Figure 2: Map of Sierra Leone showing study area

3.3 Study sites

The study was conducted in Government and Non-Governmental Organization (NGO) supported hospitals offering free maternal services. These hospitals include Princess Christian Maternity Hospital (PCMH), Lumley Government Hospital, King Harman Road Government Hospital, 34 Military hospital and Aberdeen Women's Centre (NGO hospital). The hospitals were purposely selected as they offer medical, maternal, child health, and various inpatient and outpatient healthcare services for a catchment population of about 1,162,200.

3.4 Study variables

3.4.1 Outcome variable

The outcome variable was low birth weight (<2500g).The measurement scale was ordinal.

3.4.2 Independent variables

The independent variables as socio-demographic factors, obstetric factors, maternal or lifestyle or environmental factors (Table 1) were categorized.

Table 1: Independent variables

Socio-demographic	**Obstetric variables**	**Maternal health status & Lifestyle variables**
Mother's age	Mother's BMI	Disease/condition
Education	Mother's weight	Iron & folic acid use
Occupation	Mother's height	Alcoholism
Ethnicity	Parity	smoking
Marital status	Gravidity	Drinking water Source
Religion	History of abortion	Herbal use
Baby sex	Number of ANC visit	
Income level	Gestation at delivery	
	Birth interval	
	Anaemia	

Table 2: Operational definitions of Socio-demographic independent variables

Variable	Operational definitions	Measurement Scale	Source of data
Age	Mother's age at the time of the index pregnancy	continuous (years)	interview
	Mother's educational level:		
Education	no formal education	ordinal	interview
	primary		
	secondary		
	tertiary		
	Mother's occupation:		
Occupation	unemployed	nominal	interview
	employ/self-employed		
	student		
	Mother's ethnic group:		
	Temne		
Ethnicity	Mende	nominal	interview
	Limba		
	Others		
	Mother's marital status:		
Marital status	Single	nominal	interview
	Married/cohabiting		
	Mother's religion:		
Religion	Christian	nominal	interview
	Muslim		
	None		
	Baby sex:		
Baby sex	Male	nominal	interview
	Female		
Income level	**Mother's monthly income:**		
	< Le 500,000	ordinal	interview
	≥ Le 500,000		

Table 3: Operational definitions of obstetric independent variables

Variable	Operational definitions	Scale of measurement	Source of data
Weight	**Mother's weight:** <50kg ≥50kg	Ordinal	ANC card
Height	**Mother's height:** < 1.5m (short) ≥ 1.5m (normal)	Ordinal	ANC card
BMI	**Mother's BMI (kg/m^2):** <18.5 (underweight) 18.5-24.9 (normal) 25-29.9(overweight) ≥30 (obese)	Ordinal	calculate
Parity	**Mother's parity:** Primiparous (1) Multiparous (>1)	Nominal	ANC card
Gravida	**Mother's gravidity:** primigravida multigravida	Nominal	ANC card
Abortion	**History of abortion:** Ever had Never had	Binary	interview
ANC	**Number of ANC visit:** < 4 times ≥ 4 tomes	Ordinal	ANC card
Gestation	**Gestational age at birth:** Preterm(<37 weeks) Term(37- 40 weeks) Post term(>40 weeks)	Ordinal	ANC card
Birth	**Birth interval:** < 2 years ≥ 2 years	Ordinal	interview
Anaemia	**Hb during first ANC visit:** Anaemia(<11.0g/dl) No anaemia(≥11.0g/dl)	Ordinal	ANC card

Table 4: Operational definitions of maternal/lifestyle/environmental independent variables

Variable	Operational definitions	Measurement scale	Source of data
Diabetes	**Diabetes during pregnancy**: Diabetic Not diabetic	Binary	ANC card
Hypertension	**Hypertension in pregnancy**: Hypertensive Not hypertensive	Binary	ANC card
Heart disease	**Heart disease in pregnancy:** Has heart disease No heart disease	Binary	interview
Infection	**Infection during pregnancy** **HIV:** Has HIV No HIV **Syphilis:** Has syphilis No syphilis **Malaria:** Has malaria No malaria	Binary	ANC card
Iron & folic acid	**Iron & folic acid use:** < 3 months ≥ 3 months	Ordinal	interview
Alcohol	**alcoholism in pregnancy:** Takes alcohol Does not take alcohol	Binary	interview
Smoking	**Smoke during pregnancy:** Smokes Does not smoke	binary	interview
Water source	**water use during pregnancy:** Protected Unprotected	Nominal	interview
Herbal use	**Herbal use during pregnancy** Take herbs Dose not take herbs	binary	interview

HIV: Human Immunodeficiency Virus

3.5 Sampling

3.5.1 Study population

The source population were women who gave birth to live singleton babies in each of the five study hospitals in the Western Area Urban District. The study population were mothers who delivered live singleton babies during the data collection period (i.e. November 2019 to February 2020).

3.5.2 Case selection

3.5.2.1 Case

A case was defined as a mother who lived in Western Area Urban district since conception of the recent pregnancy and delivered a live singleton baby weighing less than 2500g in any of the five hospitals from November 2019 to February 2020

3.5.2.2 Control

A control was a mother who stayed in Western Area Urban since the conception of the recent pregnancy and delivered a live singleton baby weighing between 2,500g to 4,000g in the same hospital where the case was delivered from November 2019 to February 2020 and whose residence is in the same zone of the case.

3.5.3 Inclusion criteria

Mothers who delivered live singleton babies weighing 4,000g or less within an hour after delivery. Mothers who consented to take part in the study.

3.5.4 Exclusion criteria

All mothers with singletons with unknown last normal menstrual period, caesarean birth, congenital deliveries or stillbirths, and mothers who are seriously ill.

3.5.5 Sample size determination

An online OpenEpi, version three statistical software for unmatched case-control was used to calculate the required sample size assuming a minimum detectable odds ratio of 2 and 67.6% control group to be exposed and thus the exposure was birth spacing in a study conducted in

Ethiopia(Alemu et al.,2018). A case to controls ratio of two with a 95% confidence level and 80% power was used. The required sample size for the study was 438 (146 cases and 292 controls).

3.5.6 Sampling procedure

Five hospitals and the distribution of sample size among the five study hospitals was done proportional to size .This was done using the number of cases per hospital divided by the total number of singleton live births with LBW recorded in the five hospitals from November 2018 to February 2019 multiply by the number of desired cases(table 5). Participants were enrolled consecutively into the study. Any mother who delivered a singleton live baby with birth weight < 2500 grams was interviewed as a case and two mothers who subsequently delivered singleton live babies weighing 2500g to 4000g, whose residences are in the same zone of the case were interviewed as controls. In a situation where a case or control refused to be part of the study, the next mother who delivers a live singleton baby was selected as a replacement.

Table 5: Proportional distribution of cases and controls by hospitals (study sites)

Name of hospitals (study sites)	**Required sample size**	**LBW delivered in Nov 2018 to Feb 2019**	**Proportional distribution**	
	Desired cases	cases	cases	controls
Princess Christian Maternity Hospital (PCMH)		138	80	160
KingHarman Road Government Hospital		3	2	4
Lumley Government Hospital		15	8	16
34 Military hospital		8	5	10
Aberdeen Women's Centre		87	51	102
Total	**146**	**251**	**146**	**292**

3.6 Data collection technique and tools

3.6.1 Ethical clearance

Ethical clearance from the Sierra Leone Ethics and Scientific Review Committee (SLESRC). A letter of approval to interview mothers in the eight hospitals (5 study and 3 pilots) from the Chief Medical Officer, Ministry of Health and Sanitation (MoHS), Sierra Leone was obtained. The consent of each mother was sought. The possible risk of the study was the participant's time and privacy. Mothers who agreed to participate in the study were made to understand that their involvement in the study was voluntary. They had the right to choose not to participate, refused to answer a question or terminate the interview. The researcher noted their decision and this had no effects on the mother receipt of care for which she came to the health facility. Information collected for this study was treated as confidential. Participant names and other key personal information were not captured in the questionnaire.

3.6.2 Training of research assistants

The researcher recruited and trained 15 research assistants (i.e. three in each hospital and one per shift) with midwifery experience working at the same hospital. They were trained one week before the beginning of the data collection exercise. The training contents included the aim and objectives of the study, data collection procedures, questionnaires and ethical guidelines. We conducted simulated practices to make sure the research assistants' understand the data collection tools and collect the appropriate information based on the study objectives. The research assistants' were then introduced to the heads of the maternity wards where they collected data among mothers with LBW babies.

3.6.3 Pre-test

The questionnaire in three hospitals in the Western Area Urban District to 2% (3 cases & 6 controls) of the total number of the sample size (cases) was pre-tested. Cases and controls for

the pilot study from Government and NGO supported hospitals, and these were excluded in the study. Findings of the pilot study provided the researcher an insight on the strengths, weaknesses and gaps in the questionnaire. This enable the researcher to finalize the questionnaire and prepare for fieldwork.

3.6.4 Data collection

A questionnaire and record review were used to collect data. Socio-demographic data were first collected from mothers and then their obstetric and maternal factors likely to influence LBW delivery collected by reviewing their ANC cards or hospital records.

Calibrated clinical weighing scales were used by midwives to measure the weights of the newborn babies within one hour after delivery. We extracted mothers' weights and heights during their recent pregnancy from their ANC cards or clinic record books post-delivery. The weight and height were used to calculate the body mass index (BMI). The research assistants visited the labour wards and post-delivery wards in the morning, afternoon and evening to identify study participants. Besides, the staff on duty at the labour wards and post-delivery wards alerted the research assistants each time a delivery was made that met the inclusion criteria. A semi-structured questionnaire was used by trained research assistants (nurses or midwives) working in the same hospital to interview and collect information from mothers' (cases & controls) ANC cards or clinic record. The questionnaire was categorized as socio-demographic factors, obstetric factors and maternal health status or lifestyle or environmental factors. Data was collected from November 2019 to February 2020. The research assistants administered the questionnaire to mothers within 24 hours post-delivery or when the midwife or doctor deems it convenient for the mother to be interviewed. Data collection was done through face-to-face interview in the common language -'Creole'.

3.6.5 Quality control

We trained the research assistants with midwifery experience. The researcher supervised the research assistants during the data collection to ensure that the appropriate information

collected were in line with the objectives of the study. To avoid mistakes and missing values, the researcher crosschecked the completed questionnaires daily before final entering into SPSS version 22 software. This was to maintain consistency and soundness of the results.

3.7 Data processing and analysis

The coded data were entered into Statistical Package for Social Sciences (SPSS version 22), cleaned, imported and analyzed using Stata 15.0 (Stata Corp, College Station, TX USA). Histogram-normal curve was used to check the normality of continuous data and categorized for frequencies and percentages. A descriptive analysis i.e. summary statistics, mean (SD) and proportions was performed. An inferential analysis to identify associations between LBW and independent variables using bivariable and multivariable logistic regression analysis was used. The stepwise backward elimination method with a restricted alpha level of 0.1(10%) to determine variables to be included in the multivariable logistic regression model employed. A post estimation command ("testparm i.variablename") to determine which variable met the criteria for inclusion into the multivariable logistic model was used. A multivariable logistic to examine potential confounder was used. Odds ratio (OR) was computed and variables with a P-value <0.05 (95% CI) were considered statistically significant.

3.8 Limitations

Mothers were asked about their former maternal characteristics, and this might introduce bias in the study. The haemoglobin level used to assess the risk of anaemia in the study was a record from the mothers ANC cards. Since the mothers attend ANC clinic at diverse gestation during their pregnancy, technically it would have been reasonable to monitor their level of haemoglobin during the antenatal period to delivery to best estimate the association of anaemia and LBW.

Besides, this study is a hospital-based and some potential confounders may not be controlled because of the unmatched recruitment of the mothers into the study, hence it may not be

possible to take a broad view on the results to a specific population as related to a population-based study.

Regardless of the limitations, this study made a significant contribution on the socio-demographic, obstetric and maternal health status factors associated with the delivery of LBW baby in Freetown, Sierra Leone.

CHAPTER 4

RESULTS

4.1 Socio-demographic factors of mother and newborn characteristics

A total of 146 cases and 292 controls in five referral hospitals in Freetown, Sierra Leone were enrolled. A higher proportion of newborn cases and controls (54.8%) were delivered at the Princess Christian Maternity Hospital (PCMH). Out of the 146 cases, 50.7% were females, with 53.1% of the 292 controls also being females. About 56.2% of case mothers and 65.1% of mothers in the control group were in the age group 20 - 29 years. A greater proportion of case mothers (43.8%) had no formal education compared to the controls (33.6 %). Sizeable proportion of case mothers (43.2%) and that of the controls (17.1%) were not employed. A large proportion of case mothers and controls (82.9%, 77.4%) respectively had household monthly income less than 500,000 Leones. The majority, 34.9% of cases 33.2% of control mothers belong to the Temne ethnic group and 58.9% cases and 62.3% controls were Muslim religion followers (Table 6).

Table 6: Socio-demographic characteristics of mothers and newborn cases

Characteristics	No. (%) of cases (n = 146)	No. (%) of Controls (n = 292)
Hospital mother delivered		
King Harman Road Government Hospital	2 (1.4)	4 (1.4)
Lumley Government Hospital	8 (5.5)	16 (5.5)
34 Military Hospital	5 (3.4)	10 (3.4)
Aberdeen Women's Centre	51 (34.9)	102 (34.9)
PCMH	80 (54.8)	160 (54.8)
Sex of baby		
Male	72 (49.3)	137 (46.9)
Female	74 (50.7)	155 (53.1)
Mother's age (years)		
< 20	36 (24.6)	30 (10.3)
20-29	82 (56.2)	190 (65.1)
≥ 30	28 (19.2)	72 (24.6)
Mother highest educational level		
No formal education	64 (43.8)	98 (33.6)
Primary	23 (15.8)	40 (13.7)
Secondary/Tec-Voc	42 (28.8)	113 (38.7)
Tertiary	17 (11.6)	41 (14.0)
Mother employment		
Student	20 (13.7)	39 (13.4)
Unemployed	63 (43.2)	50 (17.1)
Employed/self-employed	63 (43.1)	203 (69.5)
Mother/household monthly income		
< Le 500,000	121 (82.9)	226 (77.4)
≥ Le 500,000	25 (17.1)	66 (22.6)
Mother's Tribe		
Limba	24 (16.4)	50 (17.1)
Temne	51 (34.9)	97 (33.2)
Mende	26 (17.8)	53 (18.1)
Others	45 (30.8)	92 (31.5)
Marital status		
Single	55 (37.7)	75 (25.7)
Cohabiting/married husband unemployed	15 (10.3)	15 (5.1)
Cohabiting/married husband employed	76 (52.0)	202 (69.2)
Religious affiliation		
Muslim	86 (58.9)	182 (62.3)
Christian	60 (41.1)	110 (37.7)

4.2 Obstetric characteristics of mothers

Majority of the mothers' weights during delivery were 50 kg or more (97.2% among cases and 96.9% among controls) and their heights were 1.5 meters or more among cases (67.8%) and (82.2%) among controls. Most of the mothers were overweight with BMI ranging from 25-29.9 kg/m^2 among cases (55.5%) and controls (55.1%). The proportion of primiparous mothers were high in both cases (56.8%) and controls (50.7%) while there was a higher proportion of primigravida mothers among cases (54.8%) compared to controls (40.1%). Most of the mothers made four ANC visits or more (58.9% and 79.5%) respectively among cases and controls. The proportion of preterm babies delivered at gestational age 37 weeks or less were 91.8% among cases with 72.9% among controls. Mothers who had anaemia during their term pregnancy were higher among cases (56.2%) compared to controls (21.9%). The proportion of mothers with an interpregnancy interval of two years or more in cases and controls were 70.7% and 84.6% respectively. Newborn babies delivered by mothers who never had previous abortion were almost similar among cases (71.2%) and controls (75.0) (Table 7).

Table 7: Obstetric characteristics of mothers

Determinants	No.(%) of cases (n = 146)	No.(%) of Controls (n = 292)
Mother's weight (kg) at delivery		
< 50	4 (2.7)	9 (3.0)
≥50	142 (97.2)	283 (96.9)
Mother's height (m)		
< 1.5 (short)	47 (32.2)	52 (17.8)
≥ 1.5 (normal)	99 (67.8)	240 (82.2)
Mother's BMI (kg/m^2) at delivery		
<18.5 (underweight)	4 (2.7)	9 (3.1)
18.5-24.9 (normal)	35 (23.9)	48 (16.4)
25-29.9 (overweight)	81 (55.5)	161 (55.1)
≥30 (obese)	26 (17.8)	74 (25.3)
Parity		
Primiparous	83 (56.8)	148 (50.7)
Multiparous	63 (43.2)	144 (49.3)
Gravidity		
Primigravida	80 (54.8)	117 (40.1)
Multigravida	66 (45.2)	175 (59.9)
ANC Visits		
< 4 times	60 (41.1)	60 (20.5)
≥ 4 times	86 (58.9)	232 (79.5)
Gestational age (weeks)		
Preterm (<37)	134 (91.8)	213 (72.9)
Term (37- 40)	11 (7.5)	59 (20.2)
Post term (>40)	1 (0.68)	20 (6.9)
Mother anaemia status at term		
Not anaemic (Hb ≥ 11.0g/dl)	64 (43.8)	228 (78.1)
Anaemic (Hb < 11.0g/dl)	82 (56.2)	64 (21.9)
Birth spacing		
< 2 years	24 (29.3)	29 (15.4)
≥ 2 years	58 (70.7)	159 (84.6)
Previous abortion		
Never had	104 (71.2)	219 (75.0)
Ever had	42 (28.8)	73 (25.0)

4.3 Maternal health status and lifestyle factors

Mothers who tested negative for diabetes during their first antenatal (ANC) visit were 143 (97.9%) among cases and 274 (93.8%) among the controls while the proportion of those who were not hypertensive at the time of delivery was lower among cases (67.8%) compared to those among controls (90.4%). Almost equal proportion of mothers (97.9% in cases and 98.3% controls) were screened without heart disease during their first ANC visit while 92.5% among cases and 97.6% among controls tested negative for HIV. The proportion of mothers who tested negative for syphilis during pregnancy were lower among cases (78.8%) compared to controls (93.5%) while those who tested positive for malaria were higher among cases (72.6%) compared to controls (46.9%). Mothers who used iron and folic acid supplements during pregnancy for three or more months were 76.7% in cases and 92.1% in controls. The proportion of mothers who took alcohol during pregnancy was 11.6% among cases and 7.9% among controls. Fifty-two (35.6%) of the mothers who delivered low birth weight babies smoked cigarettes during pregnancy whiles only 29 (9.9%) of the control mothers smoke cigarette. More case mothers (17.8%) used unprotected sources of drinking water during the recent pregnancy compared to their control counterparts (9.2%). The proportion of mothers who took herbal medicine during their current pregnancy was twice as high among the cases (54.8%) as among the controls (26.7%) (Table 8).

Table 8: Maternal health status and lifestyle factors related to low birth weight babies

Determinants	No. (%) of cases (n = 146)	No. (%) of Controls (n = 292)
Diabetes		
Not Diabetic	143 (97.9)	274 (93.8)
Diabetic	3 (2.1)	18 (6.2)
Hypertension		
Not hypertensive	99 (67.8)	264 (90.4)
Hypertensive	47 (32.2)	28 (9.6)
Heart disease		
No Heart disease	143 (97.9)	287 (98.3)
Heart disease	3 (2.1)	5 (1.7)
Infection		
No HIV	135 (92.5)	285 (97.6)
Has HIV	11 (7.5)	7 (2.40)
No syphilis	115 (78.8)	273 (93.5)
Has syphilis	31 (21.2)	19 (6.5)
No Malaria	40 (27.4)	155 (53.1)
Has Malaria	106 (72.6)	137 (46.9)
Iron & folic acid used		
< 3 months	34 (23.3)	23 (7.9)
≥ 3 months	112 (76.7)	269 (92.1)
Alcohol takes		
Not take	129 (88.4)	269 (92.1)
Takes	17 (11.6)	23 (7.9)
Smoking		
Do not smoke	94 (64.4)	263 (90.1)
Smokes	52 (35.6)	29 (9.9)
Living with partner that smoked		
No	78 (53.4)	212 (72.6)
Yes	68 (46.6)	80 (27.4)
Source of drinking water		
Protected	120 (82.2)	265 (90.8)
Unprotected	26 (17.8)	27 (9.2)
Mother herbal intake in pregnancy		
Not take	66 (45.2)	214 (73.3)
Takes	80 (54.8)	78 (26.7)

4.4 Comparison of newborn and mother characteristics

The mean birth weight and standard deviation for cases were 1.9 (± 0.43) kilograms whiles that for the controls was 3.2 (± 0.41) kilograms. The mean age and standard deviation of pregnant mothers were 24.2 (± 5.80) years for cases and 26.1 (± 5.46) years for controls whiles their mean monthly or household income for cases and controls were 3.6(±1.80) and 4.3 (±3.90) Leones, respectively. The mean weight and standard deviation of mothers during their pregnancy was 64.8 (± 10.31) kilograms among cases and 70.1 (± 10.45) kilograms among controls whiles their BMIs were 27.2 (± 4.24) for cases and 28.1 (± 3.80) for controls. This study showed that the mean gestational age at delivery of newborn babies between cases and controls were 35.6 (± 2.92) weeks and 37.3 (± 2.33) weeks, respectively. The mean and standard deviation for the anaemia status in both case and control mothers during their pregnancy period were 10.4 (± 1.26) and 10.9 (± 1.10) grams per deciliters, respectively. In addition, birth spacing in years between cases and controls was 2.9 (± 1.99) and 3.7 (± 2.51), respectively whiles the mean and standard deviation of mothers who took herbal medicine during their current pregnancy were 9.8 (± 1.33) for cases and 10.5 (± 1.14) for controls (table 9).

Table 9: Comparison of newborn and mother basic characteristics between cases and controls

Characteristics	Cases mean (± SD)	Controls mean (± SD)
Baby birth weight (kg)	1.9 (± 0.43)	3.2 (± 0.41)
Mother's age (years)	24.2 (± 5.80)	26.1 (± 5.46)
Mother highest educational level	1.6 (± 1.02)	1.7 (± 1.11)
Mother/household monthly income (Le)	3.6 (± 1.80)	4.3 (± 3.90)
Mother's weight in pregnancy (kg)	64.8 (± 10.31)	70.1 (± 10.45)
Mother's height in pregnancy (m)	1.5 (± 0.11)	1.5 (± 0.10)
Mother's BMI (kg/m^2)	27.2 (± 4.24)	28.1 (± 3.80)
Parity	1.9 (± 1.10)	1.5 (± 1.24)
Gravidity	2.1 (± 1.13)	2.4 (± 1.48)
ANC Visits	3.8 (± 1.59)	5.0 (± 1.82)
Gestational age at delivery (weeks)	35.6 (± 2.92)	37.3 (± 2.33)
Mother anaemia status in pregnancy (g/dl)	10.4 (± 1.26)	10.9 (± 1.10)
Birth spacing (years)	2.9 (± 1.99)	3.7 (± 2.51)
Iron & folic acid used	3.7 (± 1.78)	3.6 (± 2.17)
Mother herbal intake	9.8 (± 1.33)	10.5 (± 1.14)

4.5 Simple logistic regression analysis

Analysis of mother and newborn characteristics using simple logistic regression models showed that female newborn babies were 10% less likely to be LBW than male newborn babies. However, this difference was not statistically significant (p = 0.635). Mothers with ages less than 20 years old are three times more likely to deliver LBW babies compared to mothers with ages 20 or more years old and this was statistically significant (p = 0.001). The odds of delivering LBW babies among mothers who were not employed was 4 times higher than those who were employed (cOR = 4.06, 95% CI 2.54 - 6.47, p = <0.001). Single mothers were 1.94 times more likely to deliver LBW babies compared to mothers who were cohabiting or married

mothers whose husbands were employed. This difference was statistically significant (p = 0.003). See table 10.

Table 10: Bivariable analysis of socio-demographic characteristics of mothers and newborn babies

Determinants	Frequency of cases (n=146)	Frequency of Controls (n=292)	Crude OR (95% CI)	*P*-value
Baby sex				
Male	72	137	Ref	
Female	74	155	0.90 (0.61 - 1.35)	0.635
Mother's age (years)				
≥ 30	28	72	Ref	
< 20	36	30	3.08 (1.60 - 5.92)	**0.001**
20-29	82	190	1.10 (0.66 - 1.84)	0.688
Mother highest educational level				
Tertiary	17	41	Ref	
No formal education	64	98	1.57 (0.82 - 3.00)	0.169
Primary	23	40	1.38 (0.64 - 2.97)	0.401
Secondary/Tec-Voc	42	113	0.89(0.45 - 1.74)	0.748
Mother employment				
Employed/self-employed	63	203	Ref	
Unemployed	63	50	4.06 (2.54 - 6.47)	**< 0.001**
Student	20	39	1.65 (0.89 - 3.03)	0.106
Mother/household monthly income				
≥ Le 500,000	25	66	Ref	
< Le 500,000	121	226	1.41 (0.84 - 2.35)	0.182
Mother's Tribe				
Others	45	92	Ref	
Limba	24	50	0.98 (0.53 - 1.79)	0.951
Temne	51	97	1.07 (0.65 - 1.75)	0.774
Mende	26	53	1.00 (0.55 - 1.80)	0.992
Marital status				
Cohabiting/married husband employed	76	202	Ref	
Cohabiting/married husband unemployed	15	15	2.65 (1.23 - 5.69)	**0.012**
Single	55	75	1.94 (1.25 - 3.01)	**0.003**
Religious affiliation				
Muslim	86	182	Ref	
Christian	60	110	1.15 (0.76 - 1.73)	0.488

P-value < 0.05 is considered statistically significant, OR (odds ratio), CI (Confidence Interval)

Table 11 below shows that the delivery of LBW babies had a statically significant association with the mother's height, BMI, gravidity, ANC visits, gestational age at delivery, anaemia in pregnancy and birth spacing. The odds of a short mother delivering a LBW baby was two times more as compared to a mother with normal height (cOR = 2.19, 95% CI 1.38 - 3.46, p = 0.001) and these odds were almost similar for normal maternal BMI (cOR = 2.07, 95% CI 1.11 - 3.87, p = 0.022). Primigravida mothers were 19% less likely to deliver LBW babies compared to mothers who were multigravidae. This difference was statistically significant (cOR = 1.81, 95% CI 1.21 - 2.70, p = 0.004).The odds of delivering LBW babies in mothers who attended less than four ANC session was two times more compared to those who attended four or more ANC sessions (cOR = 2.69, 95% CI 1.74 - 4.16, P = < 0.001).The odds of giving birth to a LBW baby was 12 times higher among mothers who delivered at <37 weeks gestation compared to those who delivered at ≥40 weeks gestation (cOR = 12.58, 95% CI 1.66 - 94.84, P = 0.014). The odds of LBW babies in mothers who had anaemia during their current pregnancy was 4 times greater compared to mothers with no anaemia during the same period (cOR = 4.56, 95% CI 2.97 - 7.00, P = < 0.001).The likelihood of a mother delivering a LBW baby decreased with increasing interpregnancy interval and the greater risk was found in mothers with interpregnancy interval less than two years. This was statistically significant (P = 0.009).

Table 11: Bivariable analysis of obstetric determinants of low birth weight baby

Determinants	Frequency of Cases (n = 146)	Frequency of Controls (n = 292)	Crude OR(cOR) (95% CI)	*P*-value
Mother's weight (kg)				
≥50	142	283	Ref	
< 50	4	9	0.88 (0.26 - 2.92)	0.842
Mother's height (m)				
≥ 1.5 (normal)	99	240	Ref	
< 1.5 (short)	47	52	2.19 (1.38 - 3.46)	**0.001**
Mother's BMI (kg/m^2)				
≥30 (obese)	26	74	Ref	
18.5-24.9 (normal)	35	48	2.07 (1.11 - 3.87)	**0.022**
<18.5 (underweight)	4	9	1.26 (0.35 - 4.45)	0.715
25-29.9 (overweight)	81	161	1.43 (0.85 - 2.40)	0.176
Parity				
Multiparous	63	144	Ref	
Primiparous	83	148	1.28 (0.85 - 1.91)	0.223
Gravidity				
Multigravida	66	175	Ref	
Primigravida	80	117	1.81 (1.21 - 2.70)	**0.004**
ANC Visits				
≥ 4 times	86	232	Ref	
< 4 times	60	60	2.69 (1.74 - 4.16)	< **0.001**
Gestational age (weeks)				
Post term (>40)	1	20	Ref	
Term (37- 40)	11	59	3.72 (0.45 - 30.72)	0.221
Preterm (<37)	134	213	12.58 (1.66 - 94.84)	**0.014**
Mother anaemia in pregnancy				
not anaemic(Hb ≥ 11.0g/dl)	64	228	Ref	
anaemic (Hb < 11.0g/dl)	82	64	4.56 (2.97 - 7.00)	< **0.001**
Birth spacing				
≥ 2 years	58	159	Ref	
< 2 years	24	29	2.26 (1.22 - 4.21)	**0.009**
Previous abortion				
Never had	104	219	Ref	
Ever had	42	73	1.21 (0.77 - 1.89)	0.399

P-value < 0.05 is considered statistically significant

Table 12 below shows the significant association between maternal health status or lifestyle and the delivery of LBW baby. The odds of a hypertensive mother delivering a LBW baby was four times higher compared to a non-hypertensive mother (cOR = 4.47, 95% CI 2.65 - 7.54, P = < 0.001). A mother with HIV infection was statistically associated with LBW baby (P = 0.015), both syphilis (cOR = 3.87, 95% CI 2.10 - 7.13, P = < 0.001) and malaria infection (cOR = 2.99, 95% CI 1.94 - 4.61, P = < 0.001) were statistically associated with delivery of LBW babies. The odds of delivering LBW babies in mothers who took iron and folic acid supplements for less than three months period during the current pregnancy was 3 times higher than those who took the supplements for three or more months (P = < 0.001). The deliveries of LBW babies by mothers who smoke (cOR = 5.01, 95% CI 3.00 - 8.36, P = < 0.001) and those living with partners that smoked (cOR = 2.31, 95% CI 1.52 - 3.49, P = < 0.001) where both statistically significant. There was a statistically significant association between delivery of LBW babies by mothers who used unprotected source of drinking water compared to those who use protected water (cOR = 2.12, 95% CI 1.19 - 3.79, P = 0.011). The odds of delivering LBW baby by mothers who took herbal medicine during their current pregnancy were three times more compared to those who did not take herbal medicine. This was statistically significant (cOR = 3.32, 95% CI 2.19 - 5.04, P = < 0.011).

Table 12: Bivariable analysis of maternal health status and lifestyle determinants related to low birth weight baby

Determinants	Frequency of cases (n=146)	Frequency of Controls (n=292)	Crude OR(cOR) (95% CI)	*P*-value
Diabetes				
Not Diabetic	143	274	Ref	
Diabetic	3	18	0.31 (0.09 - 1.10)	0.071
Hypertension				
Not hypertensive	99	264	Ref	
Hypertensive	47	28	4.47 (2.65 - 7.54)	< **0.001**
Heart disease				
No Heart disease	143	287	Ref	
Heart disease	3	5	1.20 (0.28 - 5.10)	0.801
Infection				
No HIV	135	285	Ref	
Has HIV	11	7	3.31 (1.25 - 8.70)	**0.015**
No syphilis	115	273	Ref	
Has syphilis	31	19	3.87 (2.10 - 7.13)	< **0.001**
No Malaria	40	155	Ref	
Has Malaria	106	137	2.99 (1.94 - 4.61)	< **0.001**
Iron & folic acid used				
≥ 3 months	112	269	Ref	
< 3 months	34	23	3.55 (2.00 - 6.29)	< **0.001**
Alcohol intake				
Not take	129	269	Ref	
Takes	17	23	1.54 (0.79 - 2.98)	0.200
Smoking				
Not smoke	94	263	Ref	
smokes	52	29	5.01 (3.00 - 8.36)	< **0.001**
Living with partner that smoked				
No	78	212	Ref	
Yes	68	80	2.31 (1.52 - 3.49)	< **0.001**
Source of drinking water				
Protected	120	265	Ref	
Unprotected	26	27	2.12 (1.19 - 3.79)	**0.011**
Mother herbal intake in pregnancy				
Not take	66	214	Ref	
Takes	80	78	3.32 (2.19 - 5.04)	< **0.001**

P-value < 0.05 is considered statistically significant

4.6 Multivariable logistic regression analysis

Table 13 shows the results of multivariable logistic regression analysis among newborn babies weighed at birth and whose mothers ANC records reviewed and interviewed 24 hours after delivery. Statistically significant factors associated with LBW resulting from the simple logistic regression analysis were entered into the multivariable regression model. The most significant determinants of LBW identified include mother's employment status, mother anaemia status, birth spacing, smoking and herbal intake. The odds of LBW increased significantly among mothers who were not employed (aOR = 2.70, 95% CI 1.22 - 5.99, P = 0.014) and those who were students (aOR = 2.89, 95% CI 1.00 - 8.31, P = 0.048) compared to employed mothers. Mothers who had anaemia during their current pregnancy were three times more likely to deliver LBW baby compared to mothers without anaemia (aOR = 3.54, 95% CI 1.70 - 7.38, P = 0.001). Similarly, the odds of having LBW baby among mothers with less than two years interpregnancy interval was twice as high as mothers with two years or more interpregnancy interval, and this was statistically significant (aOR = 2.64, 95% CI 1.15 - 6.05, P = 0.021).

Moreover, cigarette smoking and intake of herbal or traditional medicine during pregnancy have a significant association with the delivery of LBW babies. A mother who smoked cigarette during her current pregnancy was four times more likely to deliver a LBW baby compared to a mother who did not smoke cigarette and the difference was statistically significant (aOR = 4.2, 95% CI 1.84 - 9.59, P = 0.001). The odds of delivering LBW baby by mothers who took herbal medicine during their pregnancy was two times higher than mothers who did not take herbal medicine. This was statistically significant (aOR = 2.11, 95% CI 1.06 - 4.18, P = 0.033).

Table 13: Multivariable analysis of determinants of low birth weight baby in five selected hospitals in Freetown

Determinants	Cases (n=146)	Controls (n=292)	Crude OR (CoR)	Adjusted OR (aOR)	95% CI	*P*-value
Mother employment						
Employed/self-employed	63	203		Ref		
Unemployed	63	50	4.06	2.70	1.22 - 5.99	0.014
Student	20	39	1.65	2.89	1.00 - 8.31	0.048
Mother anaemia status in pregnancy						
not anaemic (Hb ≥ 11.0g/dl)	64	228		Ref		
anaemic (Hb < 11.0g/dl)	82	64	4.56	3.54	1.70 - 7.38	0.001
Birth spacing						
≥ 2 years	58	159		Ref		
< 2 years	24	29	2.26	2.64	1.15 - 6.05	0.021
Smoking						
Not smoke	94	263		Ref		
smokes	52	29	5.01	4.2	1.84 - 9.59	0.001
Take herbal medicine						
Not take	66	214		Ref		
Takes	80	78	3.32	2.11	1.06 - 4.18	0.033

P-value < 0.05 is considered statistically significant

CHAPTER 5

DISCUSSION

5.1 Socio-demographic factors of mother and newborn characteristics

The delivery of a low birth weight baby can be influenced by several factors that occur earlier or during pregnancy. In the sample of 438 mothers, majority (54.8%) of LBW babies were delivered at the Princess Christian Maternity Hospital (PCMH), which is the major maternal referral hospital in the country. However, this has no relationship to a mother's delivery of LBW baby. Findings of this study show that newborn characteristics such as sex was not associated with LBW baby. This result is in contrast to a study conducted in Ethiopia where the risk of LBW was higher among female new-born compared to their male counterparts (Asmare, Berhan, Berhanu, & Alebel, 2018).

Mothers aged less than 20 years had increased odds in delivery of LBW baby. This is because younger mothers may be of lower socioeconomic status and their reproductive system is also not well developed compared to older age groups and this increases their chance of delivery LBW baby. This result is in agreement with similar studies conducted in Ghana (Adam et al., 2019) and Togo (Hamadi et al., 2020). Contrary to this finding, other studies revealed that older mothers are more likely to deliver LBW baby (Tshotetsi, Dzikiti, Hajison, & Feresu, 2019).

In this study, a mother being unemployed had a four-fold increased chance of delivering a LBW baby. This can be attributed to the problems related to deprivation and social insecurity of the mother affecting her livelihood, hence affecting the unborn child resulting in LBW baby. However, findings from a similar study in Ethiopia reported no association between unemployment and LBW (Demelash et al., 2015).

The risk of giving birth to LBW baby in mothers who were single as compared with married ones reflects the significance of socio-economic support on maternal care and birth outcomes. Single mothers may experience more stress than married mothers because of less steady relationships. On the other hand, married mothers may receive socio-economic supports from

their spouses and so they will not be under stress. Findings of this study showed that a single mother had a higher chance to deliver LBW baby and this is in-line with a similar study conducted in Tanzania (Mitao et al., 2016).

5.2 Obstetric determinants of low birth weight baby

Anthropometric measurements have been documented to be associated with LBW. Previous studies have shown that short mothers (< 1.5 m) have an association with LBW(Mulu et al., 2020). This may be because short mothers may have a thin pelvis and this may end up with narrow intra-uterine space that may impede the growth of the foetus, which can lead to low birth weight. This finding is comparable with the finding in this study where a short mother had two times the odds of delivery LBW baby than mothers with normal height (≥ 1.5 m). The mean BMI of case mothers (27.2 kg/m^2) suggests a risk towards overweight. Previous findings by Nazari et al., (2013) and Niknejad, Siassi, & Jazayery, (2020) noted that both underweight and obese mothers were at high risk of LBW babies. However, this is contrary to the finding of this study, which identified normal weight mothers to be two times the odds of LBW babies.

In the present study, the number of pregnancies was a maternal factor associated with LBW. Mothers who were having their first child were 81% more likely to deliver LBW babies than multigravidas. This could be due to placental factors and inadequate nutritional status of the mother, as the placenta needs to adjust to the growing foetus. This shows the need for nutritional counselling to all pregnant mothers and to discourage teenage pregnancy to prevent LBW in this group of mothers. However, this finding was in contrast to a case-control study conducted by Wachamo et al., (2019) and Ta et al., (2015).

According to this study, mothers who had less than four ANC visits were 69% more likely to deliver LBW babies than those who had four or more visits. Similar findings were reported in Ethiopia by Mulu et al., (2020) and Gizaw & Gebremedhin, (2018). This shows that frequent

ANC visits by pregnant mothers are very important to reduce adverse pregnancy outcomes including LBW as they provide the opportunity to evaluate the foetal growth.

Gestational age < 37 weeks from the last menstrual period (LMP) was associated with LBW. A similar observation was made in Togo by Hamadi et al., (2020). They found that the proportion of LBW babies was higher (60%) among mothers with gestational age less than 37 weeks of LMP. Therefore, this could be attributed to premature delivery (i.e. birth before the 37th week of LMP) or delayed foetal growth in babies born at term or post-term. Likewise, mother's anaemia status during pregnancy is associated with an increased odds of LBW(Adam et al., 2019), and our findings support this association in which the odds of mothers with anaemia having LBW baby is four times compared to those with no anaemia.

This study also found that babies born within less than two years birth interval had a higher risk of LBW than those with two or more year's birth interval. A systemic review and meta-analysis by Endalamaw et al.,(2018) observed similar findings. This finding was also in line with a study conducted in Ethiopia which showed birth spacing of fewer than two years was associated with LBW (Demelash et al., 2015). This could be attributed to the fact that shorter inter-pregnancy birth spacing could result in the insufficient replacement of maternal nutrients worn-out in the previous pregnancy and may lead to reduced foetal development.

5.3 Maternal health status and lifestyle determinants related to low birth weight baby

The health status of the mother and her lifestyle were major determinants of LBW babies. This study observed hypertension, HIV, Syphilis, less use of iron and folic acid, smoking, drinking unprotected water and taking herbal medication during pregnancy were found to be associated with LBW.

Previous studies in Tanzania by Mitao et al.,(2016) and by Habib et al.,(2017) in Pakistan reported maternal hypertension to be associated with the delivery of LBW baby. Comparable

to this study, mothers with hypertension during pregnancy had more than fourfold increase risk in delivering LBW babies than mothers who are non-hypertensive. Hypertension causes decrease blood flow due to vasoconstriction of the blood vessels, reduced oxygen and nutrients supply to the uteroplacental which may result in LBW. Hence, early recognition and management of hypertension during pregnancy by front-line health care workers are important.

Findings from this study identified HIV as a risk factor for the delivery of LBW baby. This is similar to a study in South Africa (Id et al., 2019). Findings of a meta-analysis also showed that mothers who have HIV had a high risk of delivery LBW babies due to the effects of the antiretroviral medicines (Xiao et al., 2015). Moreover, HIV is a known immune changing disorder; patients are liable to different illnesses including malnutrition and decreased parental weight, which may lead to LBW.

Although multivariate analysis did not find an association between mothers' infected with syphilis and the delivery of LBW babies, simple analysis identified a possible effect and this is in line with other studies (Id et al., 2019). This shows the need for early screening and treatment of pregnant women attending ANC clinic to prevent congenital syphilis and other negative birth outcomes including LBW.

Furthermore, this study observed that mothers who took iron and folic acid supplement for less than three months were more at risk to deliver LBW babies than mothers who took iron and folic acid supplement for three or more months during the recent pregnancy. This is in agreement with a similar study conducted by Asmare et al., (2018). This is further supported by Girma et al., (2019). Iron and folic acid supplement used during pregnancy play a significant role in preventing anaemia, thus improving the better health outcome for both the mother and the unborn baby (Abu-Ouf & Jan., 2015).

In the current study, a mother's habit of smoking or staying with a partner that smokes during pregnancy is associated with a greater chance of her delivering LBW baby. This finding corresponds with the findings of Patale, Masare, & Bansode-Gokhe, (2018) and Ansarifar,

(2017) studies. A case-control study conducted by Xi et al., (2020) in China observed similar findings. Although our study failed to determine the amount taken and for what period among pregnant mothers, other studies observed that mothers who are heavy smokers (>8-10 cigarettes/day) had a higher risk of LBW babies (Ko et al., 2014). The reduction in the oxygen concentration of the foetus in-utero due to carbon monoxide and the nicotine associated vasoconstriction reduce the uterine and placental blood flow, thereby restricting the growth of the foetus, and hence LBW baby.

A pregnant mother exposed to unreliable sources of drinking water may be susceptible to several infections that may lead to negative pregnancy outcomes. Findings from a bivariate analysis of this study identified the use of unprotected sources of drinking water by pregnant mothers to be associated with LBW. This is contrary to a study conducted in India (Taywade & Pisudde, 2017) in which the use of unprotected drinking water by pregnant mothers was not statistically associated with LBW.

This study assessed the in-take of herbal medicine by mothers during pregnancy and its effects on birth weight of newborn since there is still traditional beliefs about the use of herbal medicine during pregnancy in some part of the capital city. The finding of this study showed that LBW among mothers who took herbal medicine during the recent pregnancy was three times more likely to deliver LBW baby compared to mothers who did not take herbal medicine. This finding was supported by a similar study in Ethiopia (Lake & Fite, 2019). This may be due to the negative effects of herbal medicine. A mother using herbal medicine during pregnancy may increase her chances of malnutrition which may restrict the growth of the unborn baby and hence, LBW.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

This study has established that unemployment, anaemia during pregnancy, less than two years of inter-pregnancy interval, cigarette smoking and herbal use during pregnancy are significant factors for the delivery of LBW babies.

6.2 RECOMMENDATIONS

6.2.1 Ministry of Health and Sanitation

1. To continue regular sensitization of mothers about risk factors of LBW and its preventive measures
2. Educate mothers about the benefit and risk of poor birth spacing
3. To strengthen the existing maternal services especially screening pregnant mothers for anaemia and other conditions at ANC visits

6.2.2 Pregnant mothers

1. To use the existing Free Health Care services and attend the nearest health care facility when they missed their second menstrual period and adhere to pieces of advice given by health care workers
2. To avoid the intake of herbal or traditional medicine as they may be harmful to the mother and the unborn baby

6.2.3 Policymakers

1. To design programs through the Ministry of Youth Affairs to minimize the high rate of unemployment among women in Sierra Leone
2. To ensure effective legislations against cigarette smoking

6.2.4 Researchers

1. To carry out additional studies on the socio-demographic, obstetric, maternal health status and lifestyle determinants to predict the risk of low birth weight baby

REFERENCES

Abu-Ouf, N. M., & Jan, M. M. (2015). The impact of maternal iron deficiency and iron deficiency anemia on child's health. *Saudi Medical Journal*, *36*(2), 146–149. https://doi.org/10.15537/smj.2015.2.10289

Adam, Z., Ameme, D. K., Nortey, P., Afari, E. A., & Kenu, E. (2019). Determinants of low birth weight in neonates born in three hospitals in Brong Ahafo region , Ghana , 2016- an unmatched case-control study, *6*, 1–9.

Adane, T., & Dachew, B. A. (2018). Low birth weight and associated factors among singleton neonates born at Felege Hiwot referral hospital, North West Ethiopia. *African Health Sciences*, *18*(4), 1204–1213. https://doi.org/10.4314/ahs.v18i4.42

Alemu, S., Workicho, A., Nigatu, M., Bokila, T., & Wolde, T. (2018). Determinants of low birth weight in public health facilities, of Kambata Tembaro zone, South Ethiopia. *PONS - Medicinski Casopis*, *15*(2), 66–74. https://doi.org/10.5937/pomc15-17839

Ansarifar, T. (2017). Determining risk factors associated with low birth weight of newborns in Birjand : A case-control study, *1*(1), 30–34.

Asia, S. (2012a). Low Birth Weight Policy Brief, 1–8.

Asia, S. (2012b). WHA Global Nutrition Targets 2025 : Low Birth Weight Policy Brief.

Asmare, G., Berhan, N., Berhanu, M., & Alebel, A. (2018). Determinants of low birth weight among neonates born in Amhara Regional State Referral Hospitals of Ethiopia: Unmatched case control study. *BMC Research Notes*, *11*(1), 1–7. https://doi.org/10.1186/s13104-018-3568-2

Baye Mulu, G., Gebremichael, B., Wondwossen Desta, K., Adimasu Kebede, M., Asmare Aynalem, Y., & Bimirew Getahun, M. (2020). Determinants of Low Birth Weight Among Newborns Delivered in Public Hospitals in Addis Ababa, Ethiopia: Case-Control Study . *Pediatric Health, Medicine and Therapeutics*, *Volume 11*, 119–126. https://doi.org/10.2147/phmt.s246008

Beeson, J. G., Scoullar, M. J. L., & Boeuf, P. (2018). Combating low birth weight due to malaria infection in pregnancy. *Science Translational Medicine*, *10*(431), 5–8. https://doi.org/10.1126/scitranslmed.aat1506

Burdette, A. M., Weeks, J., Hill, T. D., & Eberstein, I. W. (2012). Social Science & Medicine Maternal religious attendance and low birth weight. *Social Science & Medicine*, *74*(12), 1961–1967. https://doi.org/10.1016/j.socscimed.2012.02.021

Chloe, B., Colin, T., & John, C. (2014). Gravidity and Parity Definitions (and their Implications in Risk Assessment). *Patient*, *91*, 1–4. Retrieved from patient.info/doctor/gravidity-and-parity-definitions-and-their-implications-in-riskassessment

Christian, P., West, K. P., Khatry, S. K., Leclerq, S. C., Pradhan, E. K., Katz, J., … Sommer, A. (2003). Effects of maternal micronutrient supplementation on fetal loss and infant mortality: A cluster-randomized trial in Nepal. *American Journal of Clinical Nutrition*, *78*(6), 1194–1202.

Demelash, H., Motbainor, A., Nigatu, D., Gashaw, K., & Melese, A. (2015). Risk factors for low birth weight in Bale zone hospitals , South-East Ethiopia : a case – control study. *BMC Pregnancy and Childbirth*, 1–10. https://doi.org/10.1186/s12884-015-0677-y

Endalamaw, A., Engeda, E. H., Ekubagewargies, D. T., Belay, G. M., & Tefera, M. A. (2018). Low birth weight and its associated factors in Ethiopia: A systematic review and meta-analysis. *Italian Journal of Pediatrics*, *44*(1), 1–12. https://doi.org/10.1186/s13052-018-0586-6

Fosu, M. O., Abdul-Rahaman, I., & Yekeen, R. (2013). Maternal Risk Factors for Low Birth Weight in a District Hospital in Ashanti Region of Ghana. *Research in Obstetrics and Gynecology*, *2*(4), 48–54. https://doi.org/10.5923/j.rog.20130204.02

Fulda, K. G., Kurian, A. K., Balyakina, E., & Moerbe, M. M. (2014). Paternal race / ethnicity and very low birth weight, 1–8. https://doi.org/10.1186/s12884-014-0385-z

Ganesh Kumar, S., Harsha Kumar, H. N., Jayaram, S., & Kotian, M. S. (2010). Determinants of low birth weight: A case control study in a district hospital in Karnataka. *Indian Journal of Pediatrics*, *77*(1), 87–89. https://doi.org/10.1007/s12098-009-0269-9

Gebrehawerya, T., Gebreslasie, K., Admasu, E., & Gebremedhin, M. (2018). Determinants of Low Birth Weight among Mothers Who Gave Birth in Debremarkos Referral Hospital, Debremarkos Town, East Gojam, Amhara Region, Ethiopia. *Neonatal and Pediatric Medicine*, *04*(01), 1–6. https://doi.org/10.4172/2572-4983.1000145

Gebremedhin, M., Ambaw, F., Admassu, E., & Berhane, H. (2015). Maternal associated factors of low birth weight: A hospital based cross-sectional mixed study in Tigray, Northern Ethiopia. *BMC Pregnancy and Childbirth*, *15*(1), 1–8. https://doi.org/10.1186/s12884-015-0658-1

Girma, S., Fikadu, T., Agdew, E., Haftu, D., Gedamu, G., & Dewana, Z. (2019). Factors associated with low birthweight among newborns delivered at public health facilities of Nekemte town , West Ethiopia : a case control study, 1–6.

Gizaw, B., & Gebremedhin, S. (2018). Factors associated with low birthweight in North Shewa zone, Central Ethiopia: Case-control study. *Italian Journal of Pediatrics*, *44*(1), 1–9. https://doi.org/10.1186/s13052-018-0516-7

Gomez, G. B., Kamb, M. L., Newman, L. M., Mark, J., Broutet, N., & Hawkes, S. J. (2013). La sífilis materna no tratada y los resultados adversos en el embarazo: Revisión sistemática y metanálisis. *Bulletin of the World Health Organization*, *91*(3), 217–226.

https://doi.org/10.2471/BLT.12.107623

Habib, M., Greenow, C., Ariff, S., Soofi, S., Hussain, A., Junejo, Q., … Black, K. (2017). Factors associated with low birthweight in term pregnancies: a matched case-control study from rural Pakistan. *Eastern Mediterranean Health Journal*, *23*(11), 754–763. https://doi.org/10.26719/2017.23.11.754

Hailu, L. D., & Kebede, D. L. (2018). Determinants of low birth weight among deliveries at a Referral Hospital in Northern Ethiopia. *BioMed Research International*, *2018*. https://doi.org/10.1155/2018/8169615

Hamadi, A., Pauline, K. Y., Agballa, M.-E. T. A., Afiwa, W. H., Mouchedou, A. N., Fadima, D., … Laurent, O. (2020). Factors associated with low birth weight at Tchamba District Hospital, Togo: 2014 to 2016. *Journal of Public Health and Epidemiology*, *12*(1), 8–12. https://doi.org/10.5897/jphe2019.1173

Id, L. T., Dzikiti, L., Hajison, P., & Id, S. F. (2019). Maternal factors contributing to low birth weight deliveries in Tshwane District , South Africa, 1–13. https://doi.org/10.1371/journal.pone.0213058

Inoue, S., Naruse, H., Yorifuji, T., Kato, T., Murakoshi, T., Doi, H., & Subramanian, S. V. (2016). Association between short maternal height and low birth weight: A hospital-based study in Japan. *Journal of Korean Medical Science*, *31*(3), 353–359. https://doi.org/10.3346/jkms.2016.31.3.353

J. Patale, P., S. Masare, M., & S. Bansode-Gokhe, S. (2018). A study of epidemiological co-relates of low birth weight babies born in tertiary care hospital. *International Journal of Research in Medical Sciences*, *6*(3), 1006. https://doi.org/10.18203/2320-6012.ijrms20180631

Kataoka, M. C., Paula, A., Carvalheira, P., Ferrari, A. P., Antonieta, M., Leite, D. B., … Lima, G. De. (2018). Smoking during pregnancy and harm reduction in birth weight : a cross-sectional study, 1–10.

Khan, M. W., Arbab, M., Murad, M., Khan, M. B., & Abdullah, S. (2014). Study of Factors Affecting and Causing Low Birth Weight. *Journal of Scientific Research*, *6*(2), 387–394. https://doi.org/10.3329/jsr.v6i2.17090

Ko, T. J., Tsai, L. Y., Chu, L. C., Yeh, S. J., Leung, C., Chen, C. Y., Hsieh, W. S. (2014). Parental smoking during pregnancy and its association with low birth weight, small for gestational age, and preterm birth offspring: A birth cohort study. *Pediatrics and Neonatology*, *55*(1), 20–27. https://doi.org/10.1016/j.pedneo.2013.05.005

Lake, E. A., & Fite, R. O. (2019). Low Birth Weight and Its Associated Factors among Newborns Delivered at Wolaita Sodo University Teaching and Referral Hospital , Southern Ethiopia , 2018, *2019*.

Miranda, A. E., Pinto, V. M., & Gaydos, C. A. (2014). Trichomonas vaginalis infection among young pregnant women in Brazil. *Brazilian Journal of Infectious Diseases*, *18*(6), 669–671. https://doi.org/10.1016/j.bjid.2014.07.002

Mitao, M., Philemon, R., Obure, J., Mmbaga, B. T., Msuya, S., & Mahande, M. J. (2016). Risk factors and adverse perinatal outcome associated with low birth weight in Northern Tanzania: A registry-based retrospective cohort study. *Asian Pacific Journal of Reproduction*, *5*(1), 75–79. https://doi.org/10.1016/j.apjr.2015.12.014

Miyake, Y., Tanaka, K., Okubo, H., Sasaki, S., & Arakawa, M. (2014). Alcohol consumption during pregnancy and birth outcomes : the Kyushu Okinawa Maternal and Child Health Study, 1–7.

Nazari, M., Zainiyah, S. Y. S., Lye, M. S., Zalilah, M. S., & Heidarzadeh, M. (2013). Comparison of maternal characteristics in low birth weight and normal birth weight infants. *Eastern Mediterranean Health Journal*, *19*(9), 775–781. https://doi.org/10.26719/2013.19.9.775

Niknejad, N., Siassi, F., & Jazayery, A. (2020). The Factors Affecting Newborn Birth Weight in Borujerd City: A Case-Control Study. *Journal of Nutrition and Food Security*, *5*(2), 159–167. https://doi.org/10.18502/jnfs.v5i2.2802

Nykjaer, C., Alwan, N. A., Greenwood, D. C., Simpson, N. A. B., Hay, A. W. M., White, K. L. M., & Cade, J. E. (2014). Maternal alcohol intake prior to and during pregnancy and risk of adverse birth outcomes : evidence from a British cohort, 542–549. https://doi.org/10.1136/jech-2013-202934

Oladeinde, H. B., Oladeinde, O. B., Omoregie, R., & Onifade, A. A. (2015). Prevalence and determinants of low birth weight: The situation in a traditional birth home in Benin city, Nigeria. *African Health Sciences*, *15*(4), 1123–1129. https://doi.org/10.4314/ahs.v15i4.10

Othman, S. (2015). Impact of Maternal Marital Status on Birth Outcomes Among Young Malaysian Women : A Prospective Cohort Study. https://doi.org/10.1177/1010539514537678

Prudhivi, S., & Bhosgi, R. (2015). Maternal factors influencing low birth weight babies. *International Journal of Contemporary Pediatrics*, *2*(4), 287–296. https://doi.org/10.18203/2349-3291.ijcp20150783

Singh, S., Shehu, C., & Nnadi, D. (2016). The relationship between maternal body mass index and the birth weight of neonates in North-West Nigeria. *Sahel Medical Journal*, *19*(4), 185. https://doi.org/10.4103/1118-8561.196359

Siyoum, M., & Melese, T. (2019). Factors associated with low birth weight among babies born at Hawassa University Comprehensive Specialized Hospital , *7*, 1–7.

Statistics Sierra Leone (SSL) and ICF Internationa. (2013). *Sierra Leone Demographic and Health Survey*. *Exit Strategies and State Building*. Freetown. https://doi.org/10.1093/acprof:oso/9780199760114.003.0006

Sutan, R., Mohtar, M., Mahat, A. N., & Tamil, A. M. (2014). Determinant of Low Birth Weight Infants : A Matched Case Control Study, (March), 91–99.

Ta, O., As, S., Ih, S., Ao, E., Co, I., Bo, T., Tinuade, O. (2015). International Journal of Biomedical Research The Contribution of Unsafe Abortions to Gynaecological Emergencies and Mortality-Five Year Experience of Jos University Teaching Hospital, Nigeria. *International Journal of Biomedical Research*, *6*(06), 6. https://doi.org/10.7439/ijbr

Taywade, M. L., & Pisudde, P. M. (2016). ScienceDirect Study of sociodemographic determinants of low birth weight in Wardha district , India. *Clinical Epidemiology and Global Health*, *5*(1), 14–20. https://doi.org/10.1016/j.cegh.2016.07.001

Taywade, M. L., & Pisudde, P. M. (2017). Study of sociodemographic determinants of low birth weight in Wardha district, India. *Clinical Epidemiology and Global Health*, *5*(1), 14–20. https://doi.org/10.1016/j.cegh.2016.07.001

Temmerman, M., Bwayo, J., Gichangi, P., Fonck, K., Apers, L., Claeys, P., Ndinya-Achola, J. (2015). Effect of a syphilis control programme on pregnancy outcome in Nairobi, Kenya. *Sexually Transmitted Infections*, *76*(2), 117–121. https://doi.org/10.1136/sti.76.2.117

Tshotetsi, L., Dzikiti, L., Hajison, P., & Feresu, S. (2019). Maternal factors contributing to low birth weight deliveries in Tshwane District, South Africa. *PLoS ONE*, *14*(3), 1–13. https://doi.org/10.1371/journal.pone.0213058

UNICEF, & WHO. (2019). Low Birthweight Estimates: Level and Trends 2000-2015. *WHO Publications*, Licence: CC BY-NC-SA 3.0 IGO. Retrieved from www.who.int/nutrition

Viengsakhone, L., Yoshida, Y., Harun-Or-Rashid, M., & Sakamoto, J. (2010). Factors affecting low birth weight at four central hospitals in vientiane, Lao PDR. *Nagoya Journal of Medical Science*, *72*(1–2), 51–58. https://doi.org/10.18999/nagjms.72.1-2.51

Wachamo, T. M., Bililign, N., Id, Y., & Bizuneh, A. D. (2019). Risk factors for low birth weight in hospitals of North Wello zone , Ethiopia : A case-control study, 1–15.

WHO. (2018). *2016 WHO Antenatal Care Guidelines Malaria in Pregnancy Frequently Asked Questions (FAQ)*. Retrieved from https://cdn2.sph.harvard.edu/wp-content/uploads/sites/32/2018/04/2016WHOAntenatalCareGuidelines-1.pdf

Xi, C., Xi, C., Luo, M., Luo, M., Wang, T., Wang, T., Lu, C. (2020). Association between maternal lifestyle factors and low birth weight in preterm and term births: A case-control study. *Reproductive Health*, *17*(1), 1–9. https://doi.org/10.1186/s12978-020-00932-9

Xiao, P. L., Zhou, Y. B., Chen, Y., Yang, M. X., Song, X. X., Shi, Y., & Jiang, Q. W. (2015). Association between maternal HIV infection and low birth weight and prematurity: A meta-analysis of cohort studies. *BMC Pregnancy and Childbirth*, *15*(1). https://doi.org/10.1186/s12884-015-0684-z

APPENDICES

APPENDIX A: INFORMED CONSENT FORM

Project Title: Factors Associated With Low Birth Weight Babies Delivered In Selected Hospitals, Freetown-Sierra Leone

Principal Investigator:

David Kabba Kargbo

School of Public Health, University of Ghana-Legon

Email: davidkargbo2015@gmail.com/Cell: +232 78515606

Background of the study

This study is undertaken by David Kabba Kargbo in partial fulfilment of a Master of Philosophy in Applied Epidemiology and Disease Control. It will provide information that would deepen the understanding of factors associated with low birth weight deliveries in the Western Area Urban District, Freetown Sierra Leone. The increasing number of low birth weight (LBW) babies in Freetown is a public health concern and raises questions about the contributing factors, which forms the basis for this study. Findings of this study would provide information that would serve as a baseline to tackle LBW deliveries and to address knowledge gaps in Sierra Leone.

Procedures

Mothers with singleton live birth of weight <2500 grams will be selected as cases (143) while 286 controls (mothers) of singleton live birth weighing ≥ 2500 gram in Freetown would be identified and included in the study. If you are eligible and agree to participate, a questionnaire will be administered to you by either the Principal Investigator or Research Assistants. The interview is expected to last for about 40 minutes.

Possible risks and discomforts

The study may involve some risks. We anticipate some discomfort during the interview process. We will ask you some questions related to your socio-demographic characteristics,

obstetric, maternal and lifestyle factors related to the delivery of low birth weight babies. Some of the questions may centre on your personal life, and you may feel uncomfortable answering them or you may not know the answer to a specific question.

Possible benefits

Your participation in this study has no direct benefit to you in terms of monetary reward. Nevertheless, the information you will provide will contribute to knowledge on factors contributing to the delivery of low birth weight babies that will be generated in this study.

Voluntary participation and right to refuse

Your participation in this study is completely voluntary. At the course of the interview, you can choose not to answer any question(s) that you do not want to answer. Furthermore, you are free to pull out from the study or stop the interview at any time. However, we will encourage you to participate and complete the questions since your ideas are important in assisting us to identify factors associated with low birth weight babies delivered in Freetown, Sierra Leone

Confidentiality

We would guarantee you that any information you provide will be treated as confidential. The information will mainly be used for research purposes. Aggregate data analysis will be done to ensure anonymity. Your name or personal identification will not be captured on the questionnaire and this information will not in any way appear in the report. The principal investigator and supervisor will review the study records and no unauthorized person(s) will access your information.

Compensation

There will be no compensation, financial or material benefit for participating in this study.

Contact for additional information: If you have question(s) later, please contact:

- David Kabba Kargbo
    - University of Ghana, School of Public Health
    - Email: davidkargbo2015@gmail.com
    - Mobile: (+232) 78 515 606 / 77 863 564

- The Ethics Committee administrator
    - Sierra Leone Ethics and Scientific Review Committee
    - Email: efoday@health.gov.sl
    - Mobile: *+23278 366493*

VOLUNTARY CONSENT

This is to confirm that the above document describing the purpose, procedures, risks and benefits of the study titled "factors associated with low birth weight babies delivered in selected hospitals, Freetown, Sierra Leone" has been exhaustively explained to me in Creole/local language. I have been given the opportunity to ask question(s) about the study which have been answered to my satisfaction. I hereby voluntarily agree to participate as a respondent in this study.

_____ _____/_____/_____

Signature or finger mark of participant Date: dd/mm/yyyy

APPENDIX B: QUESTIONNAIRE

CASE [ ] CONTROL [ ] CASE Question number [ ]

Questionnaire: Factors Associated with Low Birth Weight Babies Delivered in Selected Hospitals, Freetown-Sierra Leone

Instructions:

1. This interview and record review will be conducted by a research assistant or by the researcher through a face to face interview with a mother who gave birth to a live singleton baby
2. The interview will be conducted 24 hours post-delivery or when the midwife or doctor deems its convenience for the mother to be interviewed in the same hospital

Respondent consent: Yes [ ] No [ ] If **NO**, end interview **Respondent:** Case [1] Control [2]

Respondent Residence Location/Zone……

Questions		**CODE**	**Questions**	**Code**
Questionnaire ID		**QID**	Interview code	**ICODE**
Question number		**QN**		
Date		**DATE**		
QN	Questions	Coding categories	Skip to	CODES
Name of hospital		King Harman Rd Govt Hosp……...0 Lumley Government Hospital……4 34 Military hospital……3 Aberdeen women's Centre……2 PCMH……..1		HOSP
Section A: Socio-demographic factors of low birth weight deliveries				
1	Baby's birth weight	……grams / kg		BBW
2	Baby's sex	Male……...0 Female……1		BSEX
3	Current mother's age	……years		MAGE
4	Mother's highest Educational level	No formal education……....1 Primary……....2 Secondary/Tec-Voc……3 Tertiary……0		EDU
5	Mother's employment	Unemployed……1 Student……2 Employed/self-employed……0		EMPL
6	Mother/household monthly income	< Le 500,000……1 ≥ Le 500,000……0		INCOME
7	Mother's tribe	Temne……1 Mende……2 Limba……3 Others……..0		MTRIBE
8	Marital status	Single……...1 Married/cohabiting……..0	If married Q9 If single Q10	MSTAT

9	Husband's employment	Unemployed……...1 Employed/self-employed……...0		HEMPL
10	Religious affiliation	Muslim……0 Christian……1		RELG
Section B: Obstetric factors of low birth weight deliveries **The following questions relate to the mother's recent pregnancy .Collect information about the mother from her ANC card or hospital record**				
11	Mother's last weight before delivery	……kilogram		MWT
12	Mother's height	……cm / meters		MHT
13	Mother's parity	……..times		PARITY
14	Mother's gravidity	……..times		GVIDA
15	Total ANC visits for the last pregnancy	……..times		ANC_V
16	Gestational age at delivery	……weeks		GAGE_D
17	Mother anaemia status during pregnancy	anaemic……1 (Hb < 11.0g/dl) Not anaemic……0 (Hb ≥ 11.0g/dl)		ANAEMIA
These are follow-up questions relating to mother recent pregnancy				
18	Have you given birth before this recent pregnancy?	Yes……1 No…….....0	If Yes Q19 If No Q20	BIRTH_B4
19	How many years did it take before you became pregnant?	……. years		SPACING
20	Have you had any spontaneous/planned abortions in any previous pregnancy?	Ever had……1 Never had…….....0		ABORTION
Section C: Maternal health status and lifestyle factors related to low birth delivery ***Verify ANC card or hospital record book for QN 21-24***				
21	Diabetes during the recent pregnancy	Diabetic……1 Not diabetic……....0		DIABETES
22	High blood pressure before or during the recent pregnancy	Hypertensive…..……1 Not hypertensive……....0	BP >140/90 mmHg	HBP
23	Heart disease before or during the recent pregnancy	Heart disease……1 No Heart disease ……....0		HDISEASE
24	Infection before or during the recent pregnancy	Has HIV……1 No HIV …….....0		HIV
		Has syphilis……1 No syphilis……..0		Syphilis

		Has Malaria……1 No Malaria……..0		Malaria
25	During your recent pregnancy, did you use any iron & folic acid supplements?	Used……0 Not used...……..…..1	IF used Q26 If not Q27	VIT_USED
26	How long did you use the supplements?	……months		PERIOD_VIT
27	During your recent pregnancy, did you take any alcoholic beverages?	Takes……1 Not take…….....0	IF takes Q28 If not Q29	ALCOHOL
28	How often did you drink alcohol?	Daily……1 Weekly……2 Monthly……0		FREQ_ALCOHOL
29	During your most recent pregnancy, did you smoke cigarettes or cannabis?	Smokes ……1 Not smoke…….....0	IF smokes Q30 IF Not smoke Q31	SMOKED
30	How often did you smoke?	Daily……1 Weekly……2 Monthly……0		FREQ_SMOKED
31	Were you living with a partner that smokes?	Yes……1 No…….....0		P_SMOKED
32	What is the source of drinking water in your household	Protected water (protected well/borehole, piped) ……0 Unprotected water (unprotected well, pond, stream, river)……1		WATER_SOURCE
33	During your recent pregnancy, did you take any unit of herbal or traditional medication?	Takes……1 Not take…….....0		HERBAL

HIV: Human Immunodeficiency Virus