# FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG BABIES BORN AT OSHAKATI INTERMEDIATE HOSPITAL, OSHANA REGION, NAMIBIA

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE IN APPLIED FIELD EPIDEMIOLOGY AND LABORATORY MANAGEMENT

OF

THE UNIVERSITY OF NAMIBIA

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OCTOBER 2022

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**ABSTRACT**

Low Birth Weight (LBW) is a preventable public health concern. By 2015, the global prevalence of LBW was estimated at 15% - 20% with Sub Saharan Africa standing at 13%. The 2013 Namibia Demographic Health Survey recorded a 13% LBW prevalence, with Oshana region leading by 16%. LBW is coupled with serious health problems e.g., impaired mental development and increased risk of morbidity and mortality. We investigated maternal and sociodemographic factors associated with LBW new-borns in Intermediate Hospital Oshakati, to develop recommendations aimed at reducing LBW.

We conducted an unmatched 1:2 case-control study between September and November 2020. Cases were mothers who delivered singleton full term babies weighing less than 2500g. Controls were mothers who delivered singleton full term babies weighing 2500g or more. An interviewer administered structured questionnaire was used for data collection. We reviewed maternal records for clinical information. We used multivariable logistic regression to identify risk factors of LBW and reported odd ratios with 95% Confidence Intervals (CI).

A total of 103 cases and 206 controls were interviewed. The mean age of mothers was 27.13 ±7.23 years and the mean birth weight of babies was 2875.13±570.88g. Independent risk factors for delivering LBW new-borns were gestation age <38 weeks (aOR 4.1, 95%-CI 1.86-9.35); history of LBW or prematurity (aOR 2.4, 95%-CI 1.12-5.43) as well as rural residence (aOR 2.5, 95%-CI 1.44 – 4.57).

LBW is more associated with some socio demographic and obstetric factors than socio-economic and nutritional factors. Expecting mothers with known risk factors (e.g., history of prematurity or LBW) need close monitoring during Ante Natal Care (ANC). Maternal health services in rural areas needs strengthening in terms of skilled personnel, equipment, and awareness creation at community level.

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## LIST OF ABBREVIATIONS AND ACRONYMS

**ANC** – Ante Natal Care

**ART** –Anti-Retroviral Therapy

**AOR** – Adjusted Odd Ratio

**BMI** – Body Mass Index

**C/S** – Caesarean Section

**DHS** – Demographic Health Survey

**DHIS** – Demographic and Health Information System

**FANC** – Focused Antenatal Care

**HB -** Haemoglobin

**HIV** – Human Immunodeficiency Virus

**HPT** – Hypertension

**HREC** – Human Research & Ethical Committee

**IHO** – Intermediate Hospital Oshakati

**IUGR** – Intra Uterine Growth Retardation

**LBW** – Low Birth Weight

**L & D** – Labour and Delivery

**LMIC** – Low & Middle Income Countries

**MoHSS** – Ministry of Health & Social Services

**MUAC** – Mid Upper Arm Circumference

**NHRU** – National Health Research Unit

**NMR** – Neonatal Mortality Rate

**NVP** – Nevirapine

**OR** – Odd Ratio

**PNC** – Post Natal Care

**PROM** – Premature Rupture of Membranes

**SDG** – Sustainable Development Goals

**SGA** – Small for Gestational Age

**UNAM** – University of Namibia

**USA** – United States of America

**95% CI** – 95% Confidence Interval

**WHO** – World Health Organisation

## ACKNOWLEDGEMENTS

Firstly, I would like to appreciate the grace and favour the almighty God has bestowed upon me during my entire studies. I further extend my sincere gratitude to the Ministry of Health and Social Services (MoHSS) for granting me an opportunity to pursue my studies. A special appreciation to the Centre for Disease Control and Prevention (CDC) in collaboration with the MoHSS for the financial support rendered during my field placement.

My sincere gratitude goes to my supervisor **Dr. Penehafo Angula** for the guidance, and her valuable inputs in my study. Thank you for pushing me to the realization of my potential. Not forgetting our resident advisor **Professor Kofi Mensah Nyarko**, for his support throughout my studies. A special thanks goes to **Dr. Hendrik Camphor** for his guidance on data analysis. Thank you so much for mentoring me. May God bless you all and reward you with more wisdom.

I am entirely grateful to the Oshana Regional Health Directorate and the management of Intermediate Hospital Oshakati for permitting me to carry out this study in their hospital. The support of the entire staff of Ward 14 (Post Natal Ward) was amazing and appreciated. A special acknowledgement goes to **Ms. Ngwenya** for her dedication and assistance during the data collection.

My lovely husband, **Mr. Theofillus Kadhimo** for the immense love and support during my studies. Thank you for your patience and for taking care of our children during my stay away from home. My children, **Grace, Ousty, Glob** and **Gloria**, I appreciate your unconditional love and understanding.

I appreciate the support rendered by my entire family, especially my lovely mother **Ms. Scholastika Shamate** for covering me in prayers. And finally, I acknowledge my classmates of NAMFELTP Cohort 5 **(Gabriel, Esther, Henock and Ester)** for the support and encouragement you offered me.

**May God bless you all!**

## DEDICATIONS

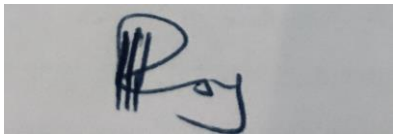
To my lovely parents, my late father **Faustinus Ndjengwa Mushongo** and my mother **Scholastika Shamate Viyavo** for your sacrifices and for laying a strong foundation for me. This thesis is dedicated to you in realization of your wish to see me excel in life.

To my children **Grace, Ousty, Glob and Gloria**, may this study be an inspiration for you to fulfil your future endeavours.

**DECLARATIONS**

I **Roswitha Mukanga Ndjengwa**, hereby declare that this study is my own work and is a true reflection of my research, and that this work or any part thereof has not been submitted for a degree in any other institution of higher learning.





October 2022

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# CHAPTER 1: INTRODUCTION AND BACKGROUND OF THE STUDY

## 1.1 INTRODUCTION

It is every mother's hope and expectations that the child will be born safely and healthy. However, this is not always the case in some instances. Some babies are born with normal weight while others are born rather too small.

Birth weight is defined as the first weight of the new born obtained after birth(1). Similarly, Low birth weight (LBW) is defined by the World Health Organization (WHO) as the weight of an infant at birth, which is less than 2500 g(1). The birth weight of an infant is the first weight recorded after birth, ideally measured within the first hours after birth, before significant postnatal weight loss has occurred. Birth weight is dependent on the length of gestation and the intra-uterine growth of the foetus, hence it is very important to correctly estimate the gestational age of the new born(2). The correct estimation of gestational age is dependent on the knowledge and skills of health care workers and the availability of the needed equipment for such an activity.

Low Birth Weight is mainly caused by preterm births and Intra Uterine Growth Retardation (IUGR). Preterm babies are those born before 37 weeks of gestation, while babies with IUGR can be born at term but are Small for Gestational Age (SGA). However, these two causes of LBW exhibit vast differences in prognosis. Some literature clearly states that prematurity is more prevalent in developing countries while IUGR is predominant in the developed countries (3). In addition, the medical causes of LBW are quite complex, and they are largely related to

foetal, placental as well as maternal factors. According to some researchers, the determining factors of LBW is usually not the same in different populations as it solely depends on whether it is caused by growth restriction or prematurity (4). Furthermore, the risk factors associated with LBW varies from socio-economic, nutritional, reproductive, and maternal factors as well as environmental factors.

LBW remains a diverse problem which involves a wide spectrum of health related problems from its origin to the consequences later in life(2). Also, low birth weight continues to be a significant public health problem globally and is associated with a range of both short- and long-term consequences(5).

## 1.2 BACKGROUND OF THE STUDY

Overall, the global prevalence of LBW is estimated at 15% to 20% representing more than 20 million births a year, of which 96.5% of them occurring in developing countries (the low- and middle-income countries) and most especially in the most vulnerable populations. According to the WHO, Sub Saharan Africa reported an estimated 13% of LBW, second to South Asia (28%) in 2014 (5).

The 2011 housing and population census profile for Oshana region of Namibia projected that the number of women of child bearing age for the 2018/2019 financial year is 60 319 of which 8529 represents expected deliveries (pregnant women)(6). Moreover, the Demographic Health Survey (DHS) conducted in 2013 by the Ministry of Health and Social Services (MoHSS) revealed that nationally about 13 % of infants had low birth weight in Namibia, with Oshana

region recording the highest percentage of LBW with 16%, while Zambezi region recorded the lowest in the country with 10%(7).

Although there is a remarkable decline in under 5 mortality rates by almost 50% (from 90 deaths per 1000 live births in 1990 to 48 deaths per 1000 in 2012), the Neonatal Mortality Rate (NMR) only decreased by 37% (from 33 deaths per 1000 livebirths to 21 deaths per 1000 livebirths) over the same period. Despite this slight decline, the contribution of Low Birth Weight to neonatal morbidity and mortality cannot be ignored since neonatal deaths still account for 44% of under-five mortality globally (8). Considering the above facts, one of the sub goals under Sustainable Development Goal no.3 is to end preventable deaths of new-borns and children under the age of five. Hence, neonatal mortality is targeted at 10 or less per 1000 livebirths by the year 2035, and under 5 mortality to be reduced to 20 or less per 1000 livebirths by 2035(9)(8).

## 1.3 STATEMENT OF THE PROBLEM

Birth weight remains the most important indicator for assessing the health status of a child in relation to morbidity and mortality. According to the Demographic Health Information System (DHIS) for 2018, Intermediate Hospital Oshakati (IHO) reported a total number of 8038 deliveries, of which 7790 were live births and 849 (11%) had birth weight less than 2500g. Intermediate Hospital Oshakati is the only referral hospital in the Oshana region where most of the deliveries are conducted. The region reported the highest prevalence of LBW in the country (16%) during the 2013 Demographic and Health Survey. It is also one of the

hospitals in the country which has a high number of premature births, 787(10%) out of 7790 livebirths recorded in 2018.

Children born with Low Birth Weight are known to have immature immune function, hence they are prone to have increased risk of early childhood morbidity and mortality as compared to those with normal birth weight(10). In addition, LBW is an important indicator for maternal health, nutrition, health care delivery and poverty. Low birth weight has been reported to be the second leading cause of mortality among children under the age of 5, and together with prematurity the first leading cause of mortality among children under the age of one (11). Furthermore, LBW is associated with long term effects such as neurologic disability, impaired language development, impaired academic performance including lower IQ and cognitive abilities and increased risk of chronic diseases such as cardiovascular diseases(12).

From the paediatric and obstetric point of view, it is very important to identify the maternal and socio demographic factors associated with LBW for the purpose of adding to the current body of knowledge and to develop control strategies to reduce the incidence and prevalence of LBW.

There are limited studies conducted on low birth weight in Namibia, and there is insufficient documentation of data on LBW in the study area, therefore this study will be useful in filling the gap. Hence, this study aimed to investigate the maternal and sociodemographic factors associated with low-birth-weight babies in IHO.

## 1.4 PURPOSE AND OBJECTIVES OF THE STUDY

### 1.4.1 Purpose of the study

The study aimed at investigating the maternal and sociodemographic factors associated with low-birth-weight babies in Intermediate Hospital Oshakati.

### 1.4.2 Study objectives

The objectives of this study were to:

- determine the prevalence of Low Birth Weight in Intermediate Hospital Oshakati
- identify maternal and socio demographic factors associated with LBW in Intermediate Hospital Oshakati
- assess the association, if any, between maternal & socio - demographic factors and birth weight.

## 1.5 SIGNIFICANCE OF THE STUDY

Currently there is no epidemiological data or publications on the factors associated with LBW in the study setting. The only known information in the study setting is the prevalence of LBW derived from the Demographic Health Survey. This necessitated the need to investigate the maternal and socio-demographic factors associated with LBW babies. The study findings might inform programme managers at national level and policy/decision makers to review and update the guidelines on focused antenatal care for pregnant women at risk of having LBW babies and facilitate targeted interventions to reduce

perinatal morbidity and mortality. The findings might further facilitate resource allocation such as availing equipment and personnel as well as guiding on formulation of policies related to maternal and child health. To add on, the study findings may assist in creating community awareness and aid in the development of locally appropriate interventions to prevent LBW.

## 1.6 DEFINITION OF OPERATIONAL CONCEPTS

***Low Birth Weight*** - Refers to the weight of an infant at birth, which is less than 2500 g(1).

***Birth weight -*** Refers to the first weight of the foetus or new born obtained after birth(1).

***Intra Uterine Growth Retardation*** - Is a condition whereby a baby's growth slows down or ceases when it is in the mother's womb (13).

***Small for Gestational Age*** – when an infant is born with a birth weight less than $10^{th}$ centile(13) .

***Premature birth*** – refers to birth of an alive baby before completing 37 weeks of gestation(14).

***Risk Factors –*** Any attribute, characteristic or behaviour that increases the likelihood of someone to develop a disease/condition or injury (15),

***Prevalence –*** The proportion of individuals in a population who has a condition or disease(16),

***Full term Birth*** - is defined as babies born after 37 weeks of pregnancy are completed (1)

## 1.7 SUMMARY

It is a known fact that LBW is prominent in Low- and Middle-Income Countries (LMICs) including Namibia. Oshana region observed the highest burden of LBW as recorded in the DHS conducted in 2013. This introductory chapter presented the background of LBW at all levels, the purpose and significance of the study as well as the definitions of operational concepts. The following chapter will focus on the review of literature regarding the subject matter.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 INTRODUCTION

It is imperative to obtain information on the existing knowledge on the topic of concern. The purpose of reviewing literature is to summarise what is already known and identify knowledge gaps from various studies. It involves a critical review of various sources to compare how they relate to each other and contribute to a certain subject or topic area (17). This chapter will generate the review of prevailing LBW literature in respect of the prevalence of LBW, the causes of LBW as well as the determining factors thereof at global, regional, and local levels.

## 2.2 DEFINITION OF LOW BIRTH WEIGHT

According to the WHO, any neonate with a birth weight less than 2500g is considered as Low Birth Weight(5)(18). It remains a significant public health concern both globally, regionally, and locally.

## 2.3 PREVALENCE OF LOW BIRTH WEIGHT

On a global perspective, the prevalence of LBW is estimated at 15% to 20% representing more than 20 million births a year, of which 96.5% of them occurring in developing countries (the LMICs) and most especially in the most vulnerable populations (19). The prevalence of LBW is twice as higher in developing countries as compared to developed countries(20). Interestingly some

literature have indicated that amongst the developed countries in the world, the United States of America (USA) has the highest number of LBW babies as compared to other countries, this is despite the country being industrialized(2).

More than half of the LBW babies in the world were born in Asia. While Africa was home to nearly a quarter of all low birth weight neonates, with the majority being born in eastern and western Africa(19). Sub Saharan Africa reported an estimated 13% prevalence of Low Birth Weight, second to South Asia with (28%)(5). The Demographic Health Survey (DHS) conducted in 2013 by the Ministry of Health and Social Services (MoHSS) in Namibia reported that nationally about 13% of infants had low birth weight. Interestingly, Oshana region reported the highest percentage of LBW with 16%, while Zambezi region recorded the lowest in the country with 10% (7).

Low Birth Weight was reported by several researchers in Sub Saharan Africa. For instance, a study conducted in Namibia titled: ‘’The experiences of mothers during the hospitalisation of their low birth weight babies in neonatal unit at Windhoek Central Hospital’’ found that of the 1124 babies admitted to the unit between April 2014 and March 2015, about 60% were having a birth weight of 2500g and less despite them being full term (21).

In a study conducted in Tamilnadu India in 2014 on prevalence and risk factors associated with LBW, it was found that the prevalence was 11.67% (22). Similarly, a study in Ethiopia reported a LBW prevalence of 10% (20). Some

African countries like Kenya reported a LBW prevalence of 12.3% in a study conducted in Olkalou District Hospital in 2014(23) and a 6.2% LBW prevalence was reported in a study conducted in Ghana(24). Furthermore, a study done in 2019, Tshwane District in South Africa found that out of 1069 deliveries, 517 (48.3%) were LBW which is a clear picture in Sub-Saharan Africa and low resource settings (25). The above findings from previous studies clearly indicates that Low Birth Weight is quite prevalent in developing countries.

## 2.4 CAUSES OF LOW BITH WEIGHT

Some literature has pointed out that prematurity and IUGR are the main causes of LBW (24)(23)(2). According to the WHO, evidence has proven that the main cause of LBW in developed countries is prematurity, while IUGR is prominent in developing countries (5). Both preterm, IUGR and SGA can have the worst of outcomes. Each of them can be linked to different causative factors and long term effects and their spread across different populations is solely dependent on the prevalence of their underlying causal factors(5). Several studies (26)(20)(22) have proven that the relationship between LBW and lifestyle risk factors are quiet diverse, and have been influenced by psychosocial, socio-demographic factors, maternal factors, environmental factors, nutritional as well as socio economic factors. The main causes of LBW are detailed below.

### *2.4.1 Prematurity*

Preterm is defined as babies born alive before 37 weeks of pregnancy are completed. To add on, the WHO defines preterm birth as those births before 37 weeks of gestation or less than 259 days since the first day of the last normal menstruation of a woman. It is usually caused by various sources but two sub causes have been singled out: spontaneous preterm birth caused by spontaneous onset of labour or premature rupture of membranes as well as provider initiated preterm birth which normally occurs due to induction of labour, or when an elective caesarean section has to be conducted whether for medical or non-medical reasons(14)(27).

Preterm is a major cause of mortality and a significant cause of long term loss of potential amongst those who survives complications thereof(27). It is further broken down into three subcategories based on gestational age: extremely preterm (being babies born less than 28 weeks of gestation); very preterm (babies born from 28 to 32 weeks of gestation); moderate to late preterm (babies born from 32 to 37 weeks of gestation). Prematurity can have devastating effects in terms of morbidity, and it is known to be the leading cause of mortality among children under the age of five globally (14). Some determinants of prematurity includes genitourinary infections, multiple birth, pregnancy induced hypertension, low Body Mass Index, incompetent cervix, previous history of preterm deliveries, placenta abraptio, strenuous work as well as cigarette smoking(28).

### *2.4.2 Intra Uterine Growth Retardation*

This is a condition whereby a baby's growth slows down or ceases when it is in the mother's womb(13). Furthermore, Intra Uterine Growth Retardation (IUGR) is a condition whereby the rate at which the foetus grows in the mother's womb is below normal in light of the expected growth rate of a specific infant (17). Intra Uterine Growth Retardation is further classified into three categories: asymmetrical IUGR characterised by malnourished babies, symmetrical IUGR (hypoplasstic small for dates), as well as mixed IUGR consisting of both two conditions(17). The causes of IUGR are centred on three factors being foetal, placental or mothers' health. If the placenta is infected, it will inhibit the flow of essential nutrients for the foetus to grow, hence causing IUGR (13). Furthermore, neonates with IUGR are usually born with clinical features of malnutrition and in-utero retardation notwithstanding their birth weight percentile (17). In addition, IUGR is also determined by factors such as low gestational weight gain, low energy intake, low BMI, short stature, infections such as malaria in pregnancy, cigarette smoking, primi parity, pregnancy induced hypertension, congenital anomalies and other genetic factors(28).

### *2.4.3 Small for Gestational Age*

A normal birth weight of an infant falls between $10^{th}$ and $90^{th}$ percentile. When an infant is born with a birth weight less than $10^{th}$ centile, it is considered as Small for Gestational Age (SGA). There are sometimes severe cases of SGA when an infant is born with a birth weight below the $3^{rd}$ centile(13).

Some literature points out at three different categories of SGA:

- When foetal growth has been low throughout the pregnancy, such infants are likely to be born small but literally healthy(29).

- In early pregnancy, foetal growth has been normal but due to IUGR, there is a slow in growth by at least two standard deviations, causing such infants to be characterized by wasting as well as little subcutaneous fat (29).

- Factors such as chromosomal abnormalities, metabolic errors as well as foetal infections usually causes growth retardation (29).

Other literature argues that the two concepts IUGR and SGA are used simultaneously despite them being different in meaning. With SGA, only the birthweight is considered without minding about the physical characteristics of the infant whilst with IUGR, it is defined by the clinical features of malnutrition and in utero growth restriction irrespective of the birth weight's percentile. To add on, a neonate may not be SGA but maybe having IUGR provided there are clinical features of in utero growth restriction and malnutrition at the time of birth(13).

## 2.5 DETERMINING FACTORS OF LOW BIRTH WEIGHT

### *2.5.1 Socio-demographic/economic factors*

Some predictors of LBW related to socio-demographic and socio-economic characteristics have been identified to include the following: maternal age

(younger or older), place of residence, level of education for both the mother and her partner, employment status and income level of both mother and partner and marital status of the mother. Some studies have revealed that the low maternal age , low educational level are some of the factors associated with LBW (30)(31).

Giving birth at a very young age is known to have adverse effects on the wellbeing of both the mother and her baby. To add on, adolescents who become pregnant at a very young age also experience problems providing for themselves and their babies(32), hence resulting in LBW due to nutritionally related factors among others. A case control study conducted in Ethiopia revealed an association between LBW and maternal age being younger than 20 years, lack of formal education as well as residing in rural areas(31). This was consistent with the findings from a study in Karnakata, India which found that being younger than 20 years was significantly associated with giving birth to a Low Birth Weight infant(33). Furthermore, another study carried out in Tanzania revealed that adolescent mothers were at risk of having LBW babies compared to those who were 35 years and older (34).

Literature has shown that the place of residence is one of the determining factors of the birth weight of the infant. Women residing in rural areas find it difficult to access timely medical care such as early initiation of ANC, treatment of various infections and care in case of complications. Whereas women of urban residence have easy access to medical care and treatment, hence LBW was found to be

more prone in mothers residing in rural areas compared to those residing in urban areas(35).

Various literatures have concluded that the more educated the mother is, the less the chance of having a LBW infant(32)(26)(36). For instance, the study conducted in Pakistan by reported that 27.8% of mothers were educated up to junior secondary, 15% went up to matric, 7.8% were holders of intermediate qualifications i.e. Certificates & Diplomas, 5% were holders of bachelor degrees and only one mother went up to Master level(32). The above findings can be because uneducated mothers lack knowledge regarding the importance of pre-natal care, essential diets in pregnancy as well as nutritional information, whereas educated mothers are more aware of their health status and know when to seek medical help as well as knowledge on nutritious requirements during pregnancy. Contrary to the above findings, some of the literature we reviewed did not find mother and partner's level of education as well as their occupation statuses to be significantly associated with LBW(37)(23).

Mothers' employment status influences the birth weight of their infants. This is due to a well-known fact that if a mother is employed, she can afford expenditures related to food and healthcare. In other instances, despite the mother being employed and affording to cater for her necessities, the birth weight of the infants also depends on the nature of the mother's work. Previous studies revealed that those who perform physical work are more at risk of delivering LBW babies as compared to those who work in offices(35)(38). Similarly, the level of income of the family impacts the birth weight of an infant.

It is easy for a rich family to meet demands of pregnant woman in terms of medical and other related costs such as food whereas a poor person cannot afford such amenities, hence the risk of LBW children is more evident in low income families(35)(38).

A study in Ghana found a significant association between marital status of the mother and low birth weight, whereby single mothers were found to be prone to have LBW babies as compared to their married counterparts(24). A possible explanation to this could be that single mothers usually do not plan to have the pregnancy, therefore may not attend ANC adequately resulting into poor birth outcomes such as LBW(39). On the other hand, a finding from a study conducted in Ethiopia did not find a significant association between marital status and delivery of a LBW infant(40).

### *2.5.2. Maternal obstetric and medical factors*

Maternal risk factors are those aspects related to the pregnancy and affects both the mother and the baby. The maternal environment plays a big role in the development of the unborn foetus and subsequently the birth weight. Illnesses during pregnancy leading to poor blood circulation across the placenta (nutrient and oxygen deficiency) restricts foetal growth. It also includes among others child spacing, parity, delivery type as well as ANC attendance (26)(34). To add to this, inter pregnancy intervals between the birth of one child and the conception of another child is also a predictor of LBW. History of preterm

deliveries and history of previous LBW babies also increases chances of subsequent LBW deliveries(41). This is further echoed by a finding from a study conducted in Kenya which revealed that mothers who had delivered LBW infants in their previous pregnancies were 5 times more likely to deliver LBW babies with their subsequent pregnancies in comparison to those who had normal birth weight babies(23).

Maternal medical conditions such as HPT, Cardio vascular diseases, renal diseases obstetric complications such as Eclampsia and Pre-Eclampsia as well as premature rupture of membranes (PROM) are some of the risk factors for delivering a baby with LBW(41)(42). A finding from a study in Morocco also found that morbidities in pregnancy was a significant risk factor for LBW(43). Interestingly, a study conducted in Tanzania found that deliveries by caesarean section was protective of getting LBW infants(34).

Antenatal care visits are a vital activity that each expectant mother needs to undertake in order for the medical experts to easily identify any health-related problems that might hamper the growth of the foetus. It has been found in a study conducted in Nigeria that starting ANC in the third trimester is a risk factor for LBW. Moreover, the study found that women who started ANC in their first trimester and had more than 6 ANC visits were unlikely to deliver LBW babies as compared to mothers who had fewer ANC visits and started ANC in their last trimester of pregnancy(26). To add to this, a finding of a study in Ethiopia

revealed that women who had not attended any ANC had delivered LBW infants(31).

### *2.5.3 Nutritional factors*

Like adults, unborn babies also need nutritious food for their growth and development. Maternal and foetal nutrition are best measured by the birth weight of the baby. Maternal nutritional factors include calorie intake, consumption of alcohol & cigarette smoking, use of pre-natal supplements, maternal weight and height and BMI of less than 18kg/m2.

Maternal undernutrition as characterised by low calorie intake, low gestational weight gain, low pre-pregnancy Body Mass Index (BMI) and short stature accounts for larger proportions of LBW in developing countries. It is common knowledge that maternal dietary intake influences foetal growth. Mothers with inadequate nutrition have a tendency of delivering LBW because they are undernourished. It has been reported that woman in developing countries wilfully restrict themselves from high calorie intake in order to avoid delivery complications associated with large infants, but there is no sufficient data available to ascertain how significant such beliefs and practices are in relation to the birth weight of an infant(28). It has been documented in a study conducted in Nigeria that women who lacked prenatal supplements and those who had restricted diet due to cultural beliefs had babies with LBW(26).

Some studies found that as the mother's weight and height increases, the babies' weight also increases, hence woman of smaller stature are at risk of delivering LBW infants compared to woman of normal stature (26)(44). A study in Ghana found that the BMI for mothers who delivered LBW infants were lower than the BMI of mothers who delivered normal birth weight babies, but this difference was not statistically significant(45).

### *2.5.4 Environmental factors*

Exposure to environmental contaminants can affect the growth of a baby in utero. This was evident in south east Ethiopia and Nigeria where exposure to smoke through cooking on firewood was a significant association for LBW(31)(26). Some literature has pointed out consumption of alcohol and maternal cigarette smoking as some of the causes of IUGR (28). Furthermore, heavy alcohol consumption leads to foetal alcohol syndrome of which IUGR is a result thereof (46).

A review of various literature carried out in London revealed that air pollution is inversely associated with a number of birth outcomes including LBW. However, further studies are needed to draw proper conclusions on the effects of various air pollutants on birth weight(47).

## 2.6 CONSEQUENCES OF LOW BIRTH WEIGHT

Low birth weight is often accompanied by short term and long-term consequences. In comparison to normal birth weight babies, LBW babies have a

40% risk of mortality as well as health problems such as impaired infant growth, risk of high morbidity and as well as increased risk of impaired mental development (19). Moreover, many of the LBW children who survive infancy have a high risk of suffering from cognitive and neurological impairment(48). In addition, LBW children tend to be stunted during adolescence and adulthood and as a result have a high incidence of LBW due to undernourishment in pregnancy(49).

In the developed world, LBW babies attain normal anthropometric measurements within their first years of life and continues to grow normally thereafter. This is contrary to LBW infants born in developing countries who do not attain their catch up growth and thus remain stunted throughout their childhood (50). Furthermore, it has been reported that low birth weight infants face a risk of adulthood diseases such as hypertension and other metabolic diseases (18)(32)(19).

Findings from a study carried out in Northern Tanzania revealed that LBW infants had a greater risk of having low Apgar Score, being born before term and demising during the neonatal period. However the same study did not find any association between being born with a birth weight less than 2500g and developing neonatal jaundice or other neonatal morbidities(51).

In an article titled ‘’the health consequences of low birth weight: literature review and critique’’ (48), it was concluded that the cost incurred by the family of an LBW infant in striving to keep them alive is quite immense. For example, the cost of hospital admissions, out of pocket expenses costs related to the

special care of the child such as enrolment in a special school. In addition, there are hidden costs involved such as the mother of the infant might not be able to work again in order to care for the sickly child or reduce her working hours, hence reduction in the family income(48).

## 2.7 POTENTIAL INTERVENTIONS TO PREVENT LOW BIRTH WEIGHT

In order to reduce the incidence of LBW, a comprehensive global strategy is required which must include various elements such as improvement of maternal nutrition; treatment and management of pregnancy related disorders such as pre-eclampsia; provision of adequate maternal care at all levels as well as perinatal clinical services and social support (5).

LBW can be prevented by implementing various interventions at different levels of care. Community level interventions includes adequate nutrition for adolescent girls, smoking cessation programs, referrals of pregnant woman for early initiation of ANC aiming at assisting in the detection and treatment of certain infections during pregnancy. Furthermore, counselling on the benefits of adequate birth spacing, provision of calcium and iron folate during pregnancy, malaria prophylaxis as well as provision of antibiotics for treatment of infections(5). Additionally, the interrelationship between maternal, socio-cultural risk factors needs to be investigated for the development of appropriate interventions.

In their book titled ‘’Every New born Action plan’’ the WHO and UNICEF resolved that there is a need for health services integration for the purpose of dealing with risk factors for poor birth outcomes such as adolescent pregnancy, short birth intervals, malnutrition, chronic diseases, infectious diseases, substance abuse, as well as poor psychological health(8). Furthermore, they emphasise that it is important for workplaces to be environment friendly for pregnant woman to prevent them from physically demanding work. Behavioural and community interventions must be in place in reducing exposure to harmful pollutants such as, second hand tobacco smoke, use of traditional firewood for cooking(8).

## 2.8 SUMMARY

Drawing from various literatures reviewed, LBW remains a worrisome public health problem globally and in Namibia in particular. Developing countries are more affected as compared to the developed world. There are less efforts geared towards the combating of LBW as a public health issue despite it having detrimental effects towards neonatal health. A review of various sources has pointed to the following factors as being associated with LBW to some degree; sociodemographic/economic factors such as maternal age, place of residence, level of education, marital status as well as employment status; maternal reproductive, obstetric, and medical factors such as parity, gravidity, presence of illnesses or medical conditions in pregnancy and ANC attendance. Nutritional

and environmental exposures are also some of the identified factors associated with LBW. There are some effects of LBW on the infant such as the risk of morbidity and mortality as well as the risk of suffering from chronic medical conditions in adulthood in comparison to their normal birth weight counterparts. LBW needs combined efforts for it to be prevented. Maternal health services to be strengthened in the areas of ANC, nutritional counselling as well as community awareness. Even though the studies on factors associated with LBW are well documented globally, the researcher identified very few studies done in Namibia, therefore more studies are deemed necessary.

# CHAPTER 3. RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

This chapter is aimed at describing the research design utilized for this study. Furthermore, the chapter outlines the implementation of the research process. This includes the research setting, study population, the sampling method and sample size. To add on, the chapter further explains the research instruments and their validity and reliability, the data collection procedure, data analysis as well as research ethics. The study aimed at investigating the maternal and sociodemographic factors associated with LBW babies in Intermediate Hospital Oshakati.

## 3.2 RESEARCH DESIGN

To meet the research objectives, a quantitative approach using an analytical facility based unmatched 1:2 case control study design was used. This study design was deemed appropriate for this particular study because it has the ability to determine if an exposure, in this case the factors, is associated with an outcome which is LBW for this study (52).

## 3.3 RESEARCH SETTING

The research was conducted at Intermediate Hospital Oshakati's Post Natal Ward which is situated in Oshana region in the northwest part of Namibia. Oshana

region is one of the only 3 regions in Namibia without either a coastline or a foreign border. It shares borders with the Ohangwena region in the north, Oshikoto region in the east, Kunene region in the south and Omusati region in the west. It is home to the Oshiwambo speaking people but due to urbanization, one can find people from diverse cultural background residing in the region. According to the 2011 Namibia Population and Housing Census projections, by the year 2020 the region had a total population of 211 681 inhabitants, estimated at 0.9% annual growth rate. It is estimated that 29.7 % (62 869) of its inhabitants are the Women of Childbearing Age (WCBA) and 4.2 % are pregnant women / expected deliveries.

The region has only one district namely Oshakati District comprising of 17 health facilities: 1 Intermediate Referral hospital, 5 Health Centres and 11 Clinics.

### 3.4 RESEARCH POPULATION

Records from the 2019 District Health Information System (DHIS) for Intermediate Hospital Oshakati indicated a total number of 7062 deliveries, of which 6326 were live births and 770 (11%) were of birth weight less than 2500g. The target population for the study was the total deliveries, out of which a sample size was drawn with focus on the mother-baby pairs who presented at the Post Natal Ward (PNW) of Intermediate Hospital Oshakati, with the mothers having delivered singleton babies.

## 3.5 SAMPLING

### *3.5.1 Definition of sampling*

Sampling can be defined as the technique or process of selecting a suitable representative part of a whole population in order to determine the characteristics of the whole population (16) (53).

### *3.5.2 Sampling method and sample size*

The sample size was calculated using Epi info 7.2 statistical software for unmatched case control studies. The basic parameters assumed for calculating the sample size was 2-sided significant level as 0.05 (95% Confidence Interval), power of study 80%, ratio of control to case 2:1, proportion of controls with exposure as 0.5 (50%) and 2 as anticipated odds ratio. The calculated sample size was 309, 103 cases and 206 controls as shown below (Fleiss):

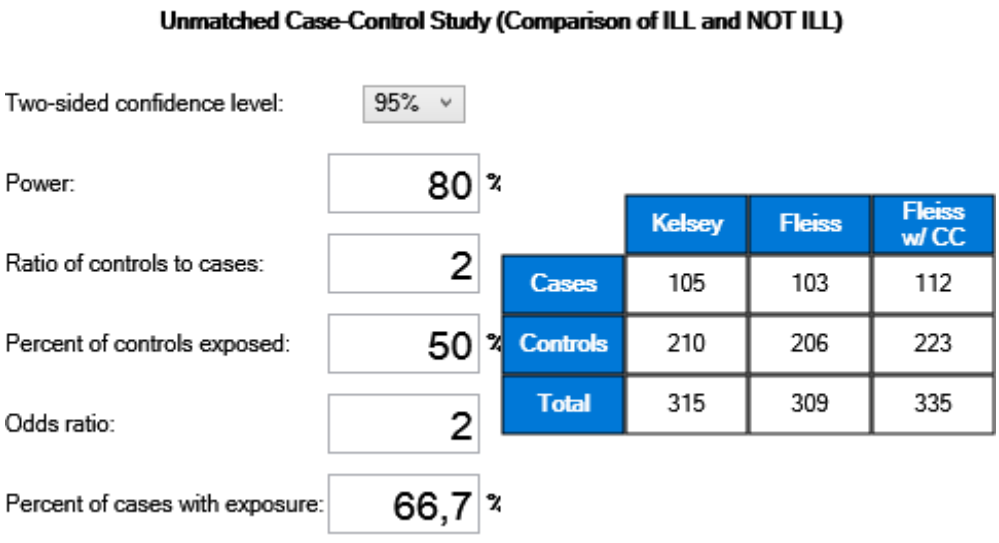



**Figure 3.1: Sample size calculation for unmatched case control studies**

A systematic random sampling technique was used to draw the sample size. The first study respondent was randomly selected and there after an interval of selecting every 2nd eligible respondent was utilized until the sample size was reached.

### *3.5.3 Case Definitions*

**Cases** were defined as mothers admitted to the postnatal ward of Intermediate Hospital Oshakati having delivered live singleton full term babies with birth weight less than 2500g during the study period.

**Controls** were defined as mothers admitted to postnatal ward of Intermediate Hospital Oshakati and delivered live singleton full term babies with birthweight of 2500g or more during the study period.

### *3.5.4 Inclusion criteria*

For a participant to be part of the study population, they must possess certain characteristics. The inclusion criteria for this study were as follows:

- A mother who had given birth to a singleton live full-term neonate at Intermediate Hospital Oshakati and willing to consent to participate in the study was considered.

### *3.5.5 Exclusion criteria*

- A mother with multiple births or stillbirths, premature births as well as those with complications such as serious illness making the mother unable to respond.

- A mother who did not give consent to participate in the study

### 3.6 RESEARCH INSTRUMENTS

Pre - tested structured interviewer administered questionnaires were used to collect information on the variables of interest from the study population (cases and controls). The domains included in the questionnaire are as follows: demographic characteristics (Mother's age, residence, marital status, sex of baby); socio-economic characteristics (employment status, educational level,) ; obstetric and gynaecological history ( gravidity, parity, birth order, birth interval, ANC visits, medical condition); anthropometric measurements [Weight, height, BMI]; environmental and lifestyle factors (Alcohol use, smoking, mode of transport, type of work (physical or office based) as well as nutritional factors (number and frequency of meals per day).

ANC passports, Labour and Delivery (L&D) registers as well as Post Natal Care (PNC) records were reviewed to ascertain some obstetric and gynaecological history during pregnancy, labour and post-delivery.

### 3.7 DATA COLLECTION PROCEDURE

The data collection was carried out from 15 September 2020 to 30 November 2020. Research assistants were trained by the principal researcher a day before data collection commenced, and due to language barrier, these research assistants were utilised in interviewing the mothers using the local language (Oshikwanyama). Mothers were interviewed on a face-to-face mode by using

pre-tested structured questionnaires. Each mother was interviewed and examined for about 20 minutes. Anthropometric measurements such as weight, height and BMI were taken on the mothers by using equipment such as weighing scales, height meters and Mid Upper Arm Circumference (MUAC) tapes. Since the data were collected during the Covid-19 pandemic, the researcher observed the covid-19 protocols by ensuring that both the research respondents and the interviewers wore face masks appropriately; both the research respondents and the interviewers used alcohol-based hand sanitizers; equipment used for data collection such as weighing scales, height boards and MUAC tapes were cleaned with instrument disinfectant between research respondents. Furthermore, a one metre physical distance was maintained between the interviewer and the research respondents whenever physical examination was not necessary. The weight of the newborn babies was extracted from delivery records. Records such as ANC passports, delivery notes and postnatal registers were reviewed for more information on the medical conditions of the mothers and their neonates.

### *3.7.1 Validity of data collection instrument*

The research data collection tool (the questionnaire) was reviewed by the research supervisor for content and face validity and made adjustments/conclusions. The questionnaire was then edited according to the supervisor's comments before submission to the Human Research & Ethical Committee of the University of Namibia. The questionnaire was translated into Oshikwanyama language and back to English. Face to face interviews were administered. Prior to the actual data collection, a pilot study was conducted in

Intermediate Hospital Rundu's maternity ward among a similar target group to assess for acceptability, relevance as well as sensitivity of the questions. The pre-testing of the data collection instrument through a pilot study also assisted in determining the time required per individual respondent. Thus, it was ascertained that the interview and physical assessment can take approximately 20 minutes per study participant. The pilot study further revealed that some questions such as Section C, Question 32 was quiet sensitive, hence the need to have an option of ''prefer not to answer'' instead of just having ''yes'' or ''no''. Alterations were also made to the response options for Section F, question 50. This was necessitated by the responses given by respondents to the question ''where do you obtain your food?'' whereby almost everybody gave more than one response mainly from the fields and from the shop. The altered response options now included a combined answer ''Field/Shops'' instead of ticking two boxes. Overall, the data collected from the pilot study assisted in establishing the validity of the instrument.

### *3.7.2 Reliability of the data collection instrument*

Reliability refers to the level of stability demonstrated when a measurement is repeated under similar conditions. It also refers to the magnitude of consistency and accuracy with which an instrument measures a variable (16). The data collection tool was tested and retested on same individuals at the pilot site whereby it was ascertained that it was reliable because it yielded the same results.

### 3.8 DATA ANALYSIS

Data were entered, cleaned, and recoded in Microsoft Excel. The analysis was done using Epi info 7.0 statistical software. BMI was determined by taking the mother's weight in kilograms dividing it by the mother's height in metres squared. The WHO BMI reference chart was utilized to categorise the nutritional status of mothers as follows: those below 18.5 $kg/m^2$ were classified as underweight; 18.5 - 24.9$kg/m^2$ were classified as normal weight, 25.0 - 29.9$kg/m^2$ were classified as overweight and those at =/>30.0$kg/m^2$ as obese. The prevalence of LBW was calculated by expressing the total number of LBW out of the total recorded births as a percentage. The categorical data were analysed descriptively i.e., frequencies, proportions and percentages, while continuous variables were described using means and standard deviations.

Bivariate associations between independent variables (demographics; socio-economic; gynaecological & obstetrics; environmental and nutritional factors) and the dependent variable (LBW) were analysed using simple logistic regression, and Crude Odds Ratios and 95% CI were calculated. A multivariate logistic regression model was used to examine the relationship between the independent variables which were significant in the bivariate model and the dependent variable being LBW. Independent associations between variables in the multivariate regression model were characterized by Adjusted Odds Ratios (AOR) and 95% CIs. Statistical significance was determined at a p-value of <0.05 and a 95% CI not containing 1.

## 3.9 RESEARCH ETHICS

### *3.9.1 Permission and informed consent*

Upon approval of the study, the Human Research and Ethics Committee (HREC) of the University of Namibia (UNAM) granted the researcher ethical clearance and permission to conduct the study. Thereafter, the permission to obtain data from human participants was granted by the National Health Research Unit (NHRU) of the MoHSS as well as from the management of Intermediate Hospital Oshakati. Study respondents were asked to sign a written consent form affirming their willingness to be enrolled in the study and mothers gave informed consent for their new-born babies.

### *3.9.2 Respect for persons*

Autonomy refers to the right of an individual to decide what activities they will or will not participate in (54). The researcher ensured adherence to the ethical principles of anonymity by using unique identification numbers without linking them to the study participants. Moreover, the research respondents were treated as autonomous. Interviewers introduced themselves to the research respondents before initiating data collection. Furthermore, they provided comprehensive information to the respondents regarding the study to allow them to ask questions and to decide whether they will voluntarily agree to participate or not. To prevent exposure to physical discomfort i.e., cold scale, the existing delivery records were used to obtain the babies' weight.

### *3.9.3 Beneficence*

The researcher has an obligation to observe the well-being of research participants(55). In this study, the research respondents were informed that there are no individual benefits from the study, but it is expected that the study findings will be availed to the MoHSS for the purpose of improving the maternal and child health program where necessary.

### *3.9.4 Non-maleficence*

It is defined as the obligation of the researcher not to harm the research respondent (55). The research respondents were informed that there will be absolutely no risk on their side since their identities were not revealed. The study did not inflict any harm on the research respondents.

### *3.9.5 Justice*

This principle entails fair, equitable, and appropriate treatment of persons (55).

The research respondents were free from coercion or favouritism. Selection of the respondents was based on the research problem and not because they could easily be manipulated. The contact details of study supervisors and coordinators were provided to the respondents.

### *3.9.6 Confidentiality and Privacy*

Research assistants were trained on maintaining confidentiality and privacy and they signed a clause of confidentiality. The research respondents were

interviewed and examined individually in a private room far from other individuals with no interruptions by staff and other co-workers and their information were kept confidential. The completed data collection tools were stored in a lockable cabinet before analysis to ensure that the data were safe, and only the principal investigator had access to the stored files. The names of research respondents were not recorded on the data collection tools. Each questionnaire was assigned a unique number and was not linked to the individual respondent.

### *3.9.7 Withdrawal from research*

The participation in the study was entirely voluntary and research respondents were explained about their right to withdraw from the research at any time. It was clarified to them that should they wish to withdraw from participating in the study at any time, their recorded information would have been removed or discarded.

## 3.10 SUMMARY

The chapter described the research methodology in its entirety. This included the research setting, research population, sampling technique and sample size, data collection methods and instruments, the type of data analysis as well as the strategies used to ensure ethical standards, reliability, and validity of the study. The next chapter will focus on the main results of the study.

# CHAPTER 4: RESULTS

## 4.1 INTRODUCTION

This chapter summarizes the main results of the study. Data were analysed descriptively as per study objectives. Additionally, logistic regression was used to assess the factors associated with Low Birth Weight. A total of 309 (103 cases and 206 controls) study respondents were interviewed. Analysis was done in the following order:

- Prevalence of LBW in Intermediate Hospital Oshakati
- Socio-demographic characteristics of study respondents (age, residential address, marital status, level of education for mother and partner, employment status for mother and partner)
- Maternal factors associated with LBW in terms of obstetric, reproductive and delivery characteristics of study participants as well as their nutritional and environmental characteristics.
- Bivariate and multivariate analysis of factors associated with LBW

## 4.2 PREVALENCE OF LOW BIRTH WEIGHT

A total of 1989 deliveries were recorded during the study period (15 September to 30 November 2020). Out of these, 207 were babies born with a birth weight of less than 2500g. Hence the prevalence of LBW was 10.4%.

## 4.3 SOCIO-DEMOGRAPHIC/ECONOMIC CHARACTERISTICS OF RESEARCH RESPONDENTS

A total of 309 women who delivered in Intermediate Hospital Oshakati from 15 September to 30 November 2020 participated in the study. The study respondents comprised of 103 cases and 206 controls. Their ages ranged from 14 years to 46 years. Age group 20 -29 years represented the highest frequency with 164 (53.07%), while age group of less than 15 years old had the lowest frequency of 2 (0.64%). The picture is similar when broken down into cases and controls, whereby 53.39% of cases caters for the age group 20 – 29 years and 52.91% of controls represents the same age group. The mean age of study respondents was 27.13 ±7.23 years. The mean age of cases was 26.80±7.08years while that of controls was 27.30±7.32 years.

**Table: 4.1 Socio demographic characteristics of research respondents, Intermediate Hospital Oshakati, Sept –Nov 2020**

| Variable | Cases (n=103) | Controls (n=206) | Total (n=309) |
|---|---|---|---|
| **Age-group** | | | |
| <15 | **0** | 2 | 2 (0.64%) |
| 15 – 19 | 16 | 28 | 44 (14.23%) |
| 20 – 29 | 55 | 109 | 164 (53.07%) |
| 30 – 39 | 27 | 51 | 78 (25.24%) |
| >40 | 5 | 16 | 21 (6.79%) |

| | | | |
|---|---|---|---|
| **Mother's Marital Status** | | | |
| Married/Cohabiting | 12 | 32 | 44 (14.23%) |
| Separated/Divorced | 1 | 3 | 4 (1.29%) |
| Single | 90 | 170 | 260 (84.14%) |
| Widowed | 0 | 1 | 1 (0.32%) |
| **Mother's Employment Status** | | | |
| Employed | 24 | 66 | 90 (29.12%) |
| Unemployed | 79 | 140 | 219 (70.87%) |
| **Partner's Employment Status** | | | |
| Employed | 64 | 131 | 195 (63.10%) |
| Unemployed | 39 | 75 | 114 (36.89%) |
| **Mother's Level of Education** | | | |
| No formal education | 5 | 12 | 17 (5.50%) |
| Primary Education | 17 | 34 | 51 (16.50%) |
| Secondary Education | 68 | 129 | 197 (63.75%) |
| Tertiary Education | 13 | 31 | 44 (14.23%) |
| **Partner's Level of Education** | | | |
| No formal education | 9 | 12 | 21 (6.79%) |
| Primary Education | 10 | 16 | 26 (8.41%) |
| Secondary Education | 64 | 126 | 190 (61.48) |
| Tertiary Education | 19 | 47 | 66 (21.35%) |
| Unknown | 1 | 5 | 6 (1.94%) |
| **Type of residence** | | | |
| Rural | 81 | 110 | 191 (61.81%) |

| | | | |
|---|---|---|---|
| Urban | 22 | 96 | 118 (38.18%) |

Majority of mothers (84.14%, n=260) were single, (14.23%, n=44) were married or cohabiting, four of them (1.29%) were separated / divorced while one of them was widowed. Those who were employed were 90 (29.12%), and the majority (70.87%, n=219) were unemployed. Of their partners, 195 (63.10%) were employed, while 114 (36.89%) of them were unemployed. Most mothers (63.75%, n=197) had secondary education qualification, and 51 (16.50%) of them attended primary education, 44 (14.23%) had tertiary education while 17 (5.50%) of mothers had no formal education. Similar to the mothers, majority of their partners 190 (61.48%) of them had secondary education background, 66 (21.35%) had tertiary education, 26 (8.41%) of them attended primary education while 21 (6.79%) have not attended any formal education. Most of the study respondents 191 (61.81%) resides in rural areas as compared to 118 (38.18%) of them living in urban areas.

## 4.4 MATERNAL MEDICAL, OBSTETRIC, REPRODUCTIVE AND DELIVERY CHARACTERISTICS OF RESEARCH RESPONDENTS

The mean gravidity was 2.52 ±1.68. The majority of mothers (63.43%, n=196) were multi gravid. The respondents mean parity was 1.43±1.63 with the majority (60.84%, n=188) having had less than or equal to one viable pregnancy. Less than half of the respondents (39.80%, n=123) did not intend to have the current

pregnancy while (4.85%, n=15) preferred not to respond to the question of whether they planned to have the current baby.

Majority (66.01%, n=204) used family planning methods before falling pregnant with the current baby. Of those who used family planning methods, 64.72% (n=200) resorted to using modern methods while four (1.29%) of them preferred to use natural methods of family planning. However, it was interesting to note that 66.66% (n=206) of respondents desired to have 3-5 children while a small proportion, seven (2.26%) of the mothers were not sure of how many children would they like to have. The mean birth interval was 2.58±3.08 years. Those with a birth interval greater than or equal to two years were more (55.66%, n=172).

More than half (84.46%, n=261) of mothers attended more than 3 antenatal care visits with the average being 3.71 ±1.33 visits. Majority of women (53.39%, n=165) had their first antenatal care visit in their second trimester of pregnancy. It was important to discover that 21 respondents (6.79%) had not received their tetanus immunization, while 288 (93.2%) of them had their tetanus toxoid immunization.

History of abortion was reported by 31 (10.03%) of mothers while seven of them (2.26%) had a history of stillbirths. A total of 33 (10.67%) respondents had a history of previous LBW, while 22 (7.1%) reported to have a history of Neonatal Death.

**Table 4.2: Medical, obstetric, reproductive and delivery characteristics of research respondents, Intermediate Hospital Oshakati, Sept – Nov 2020**

| Variable | Cases (n=103) | Controls (n=206) | Total (n=309) |
|---|---|---|---|
| **Gravidity** | | | |
| Prim gravida | 45 | 68 | 113 (36.56%) |
| Multigravida | 58 | 138 | 196 (63.43%) |
| **Parity** | | | |
| ≤ I | 67 | 121 | 188 (60.84%) |
| ≥ II | 36 | 85 | 121 (39.15%) |
| **Planned this pregnancy** | | | |
| Yes | 63 | 108 | 171 (55.33%) |
| No | 36 | 87 | 123 (39.80%) |
| Prefer not to answer | 4 | 11 | 15(4.85%) |
| **Used Family planning** | | | |
| Yes | 62 | 142 | 204 (66.01%) |
| No | 41 | 64 | 105 (33.98%) |
| **Type of family planning** | | | |
| Modern | 60 | 140 | 200 (64.72%) |
| Traditional/Modern | 2 | 2 | 4 (1.29%) |
| Never used | 41 | 64 | 105(33.98%) |
| **Desired number of children** | | | |
| 1 – 2 | 26 | 46 | 72 (23.30%) |
| 3 – 5 | 70 | 136 | 206 (66.66%) |
| 5 or more | 5 | 19 | 24 (7.76%) |
| Not sure | 2 | 5 | 7 (2.26%) |
| **Pregnancy interval of previous birth** | | | |
| < 2 years | 49 | 88 | 137 (44.33%) |
| >2 years | 54 | 118 | 172 (55.66%) |

| | | | |
|---|---|---|---|
| **ANC attendance** | | | |
| Yes | 99 | 204 | 303 (98.05%) |
| No | 4 | 2 | 6 (1.94%) |
| **ANC visits** | | | |
| Less than 3 visits | 19 | 23 | 42 (13.59 %) |
| More than 3 visits | 80 | 181 | 261 (84.46%) |
| No ANC | 4 | 2 | 6 (1.94%) |
| **Trimester at 1st ANC visit** | | | |
| First trimester | 28 | 78 | 106 (34.30%) |
| Second trimester | 58 | 107 | 165 (53.39%) |
| Third trimester | 13 | 19 | 32 (10.35%) |
| No ANC | 4 | 2 | 6 (1.94%) |
| **Tetanus Immunization** | | | |
| Yes | 94 | 194 | 288 (93.20%) |
| No | 9 | 12 | 21 (6.79%) |
| **Bad Obstetric History** | | | |
| None | 93 | 178 | 271 (87.70%) |
| Abortion | 9 | 22 | 31 (10.03%) |
| Stillbirth | 1 | 6 | 7 (2.26%) |
| **Previous History of LBW/Prematurity** | | | |
| Yes | 18 | 15 | 33 (10.67%) |
| No | 85 | 191 | 276 (89.32%) |
| **Previous History of NND** | | | |
| Yes | 8 | 14 | 22 (7.11%) |
| No | 95 | 192 | 287 (92.88%) |
| **Medical conditions during pregnancy** | | | |
| None | 90 | 194 | 284 (91.90%) |
| Hypertension | 9 | 11 | 20 (6.47%) |

| | | | |
|---|---|---|---|
| Cardiac Conditions | 3 | 0 | 3 (0.97%) |
| Diabetes Mellitus | 1 | 1 | 2 (0.64%) |
| **HIV status** | | | |
| Positive | 14 | 30 | 44 (14.23%) |
| Negative | 89 | 176 | 265 (85.76%) |
| **Previous surgery on uterus and cervix** | | | |
| Yes | 11 | 22 | 33 (10.67%) |
| No | 92 | 184 | 276 (89.32%) |
| **Premature Rupture of Membranes** | | | |
| Yes | 8 | 4 | 12 (3.88%) |
| No | 95 | 202 | 297 (96.11%) |
| **Pre-Eclampsia** | | | |
| Yes | 6 | 9 | 15 (4.85%) |
| No | 97 | 197 | 294 (95.14%) |
| **Hyperemesis Gravidarum** | | | |
| Yes | 9 | 28 | 37 (11.97%) |
| No | 94 | 178 | 272 (88%) |
| **Referred from another facility** | | | |
| Yes | 35 | 54 | 89 (28.80%) |
| No | 68 | 152 | 220 (71.19%) |
| **Referral centre** | | | |
| District Hospital | 22 | 25 | 47 (15.21%) |
| Health Centre | 10 | 18 | 28 (9.06%) |
| Community Health Worker | 1 | 3 | 4 (1.29%) |
| Private Facility | 0 | 4 | 4 (1.29%) |
| Clinic | 2 | 5 | 7 (2.26%) |
| None | 68 | 151 | 219 (70.87%) |

| | | | |
|---|---|---|---|
| **Gestation at delivery** | | | |
| <38 weeks | 22 | 11 | 33 (10.67%) |
| >38 weeks | 81 | 195 | 276 (89.32%) |
| **Mode of Delivery** | | | |
| Spontaneous | 72 | 136 | 208 (67.31%) |
| Forceps Extraction | 1 | 0 | 1 (0.32%) |
| Caesarean-section | 28 | 69 | 97 (31.39%) |
| Breech | 2 | 1 | 3 (0.97%) |
| **Apgar score at 10 minutes** | | | |
| Less than 9/10 | 3 | 4 | 7 (2.26%) |
| More than 9/10 | 100 | 202 | 302 (97.73%) |

On medical conditions during pregnancy, Hypertension was reported by 20 (6.47%) of mothers. Of all the mothers interviewed, only 44 (14.23%) were positive for Human Immunodeficiency Virus (HIV). A small proportion (28.8%, n=89) of mothers who delivered in Intermediate Hospital Oshakati were referred from other health facilities. Majority of the neonates (98.69%, n=302) had an Apgar score of more than 9/10, ten minutes post-delivery. The mean birth weight of the infants was 2875.13±570.88 grams. As depicted in the graph below, more than half of the neonates were male (164, n=53%) and 145 (47%) were females.

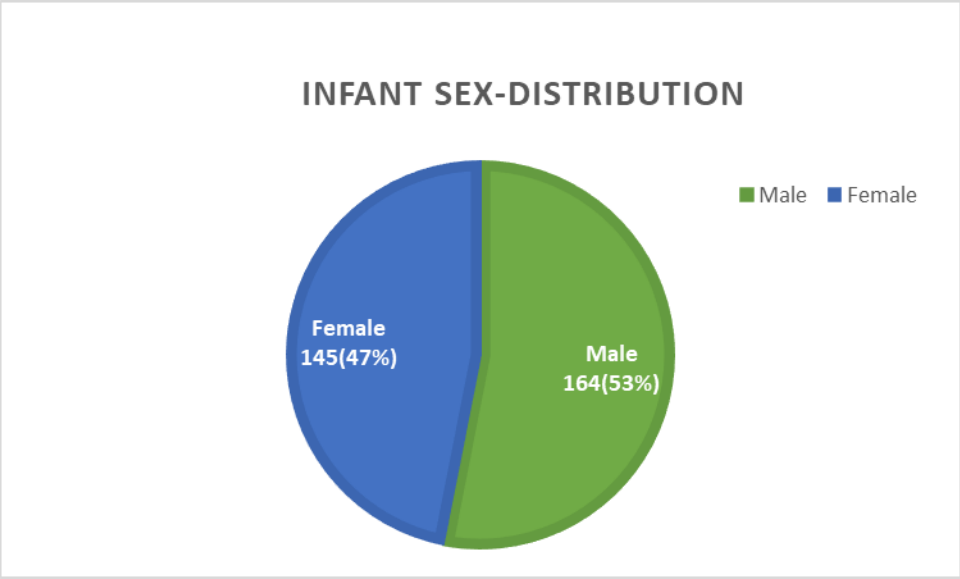
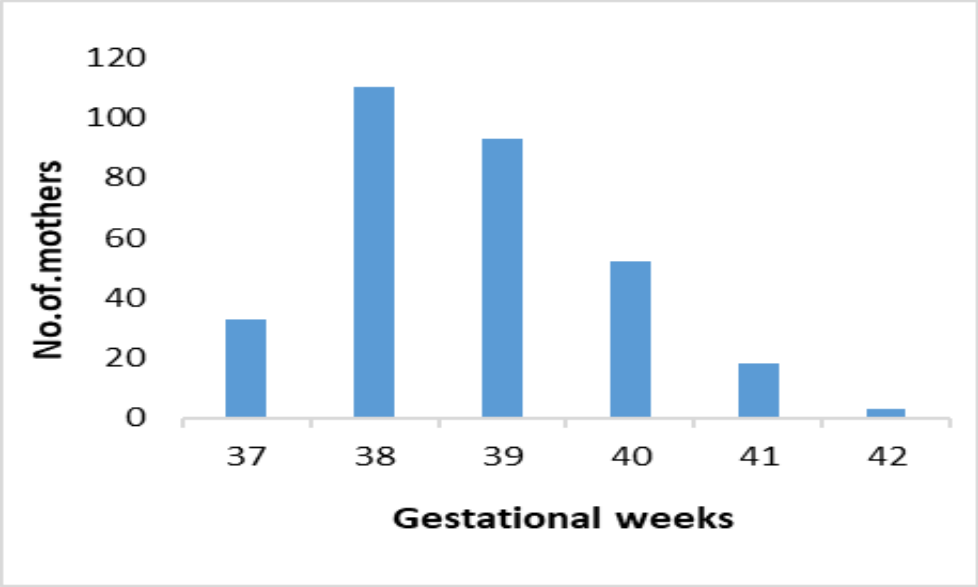



**Figure 4.1: Sex distribution of infants born to research respondents, Intermediate Hospital Oshakati, Sept – Nov 2020**

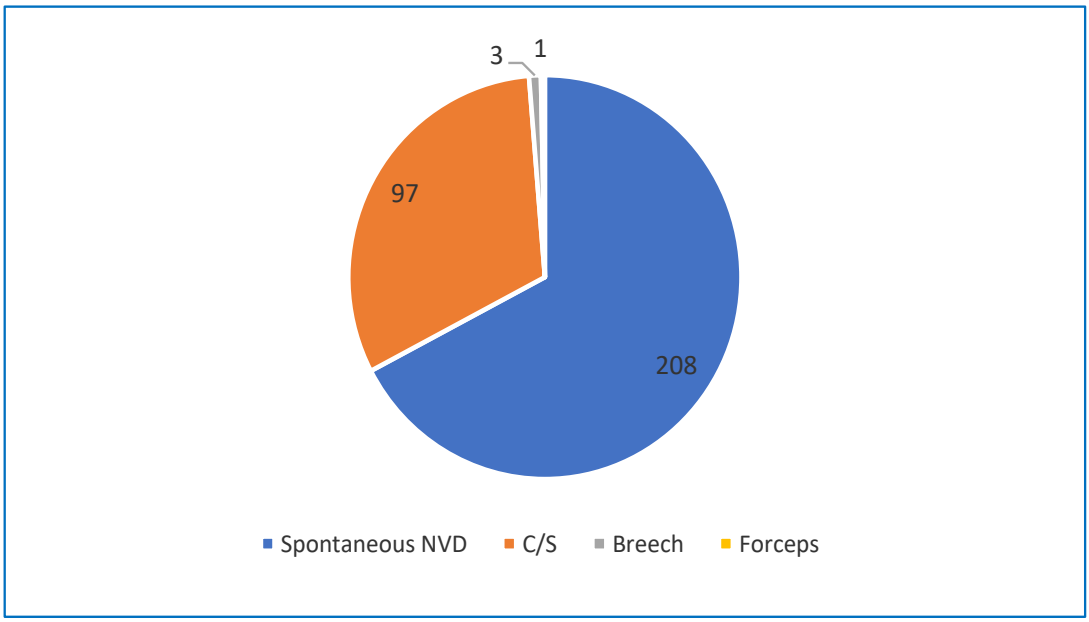
Majority of women (89.32%, n=276) delivered with a gestation of ≥ 38 weeks with the mean gestation being 38.74±1.10 weeks. Figure 4.2 below is an illustration of the gestational weeks of the research respondents.




**$Chi^2$ = 23.52 df = 5 p value = 0.00**

**Figure 4.2: Gestational weeks of research respondents at delivery, Oshakati Intermediate Hospital, Sept –Nov 2020**

The main mode of delivery was through spontaneous vertex delivery constituting 67.31% (n=208). Those who had caesarean section were 31.39% (n=97)




**Chi$^2$ = 4.52 df = 3 p value = 0.15**

**Figure 4.3: Mode of delivery for research respondents, Intermediate Hospital Oshakati, Sept – Nov 2020 (n=309)**

## 4.5 MATERNAL NUTRITIONAL AND ENVIRONMENTAL CHARACTERISTICS OF RESEARCH RESPONDENTS

The mean height was 160.48 ±7.52 cm, mean weight of 63.88 ±12.72 kg and mean HB of 11.50 ±1.39 g/dl. About 48 respondents (15.53%) were undernourished (MUAC <23cm). Those with an HB of <10g/dl were 40 (12.94%). Majority of mothers (91.26%, n=282) received nutritional supplements during pregnancy. Nutritional counselling lacked in 24.27% (n=75) of respondents. About 18.12% (n=56) of mothers reported to having had less than two meals per day during pregnancy while the majority (43.04%, n=133)

consumed more than three meals per day during pregnancy. Those who consumed alcohol during pregnancy represented 22.33% (n=69) of respondents and only two (0.64%) of respondents reported the use of cigarette smoking during pregnancy. Almost all mothers (93.2%, n=288) have been using tap water for daily consumption. Approximately 72.49% (n=224) of respondents reported that their mode of transportation from one place to another was by footing, and about 24.59% (n=76) of them used taxi as the means of transport.

The table below outlines the nutritional and environmental characteristics of study respondents.

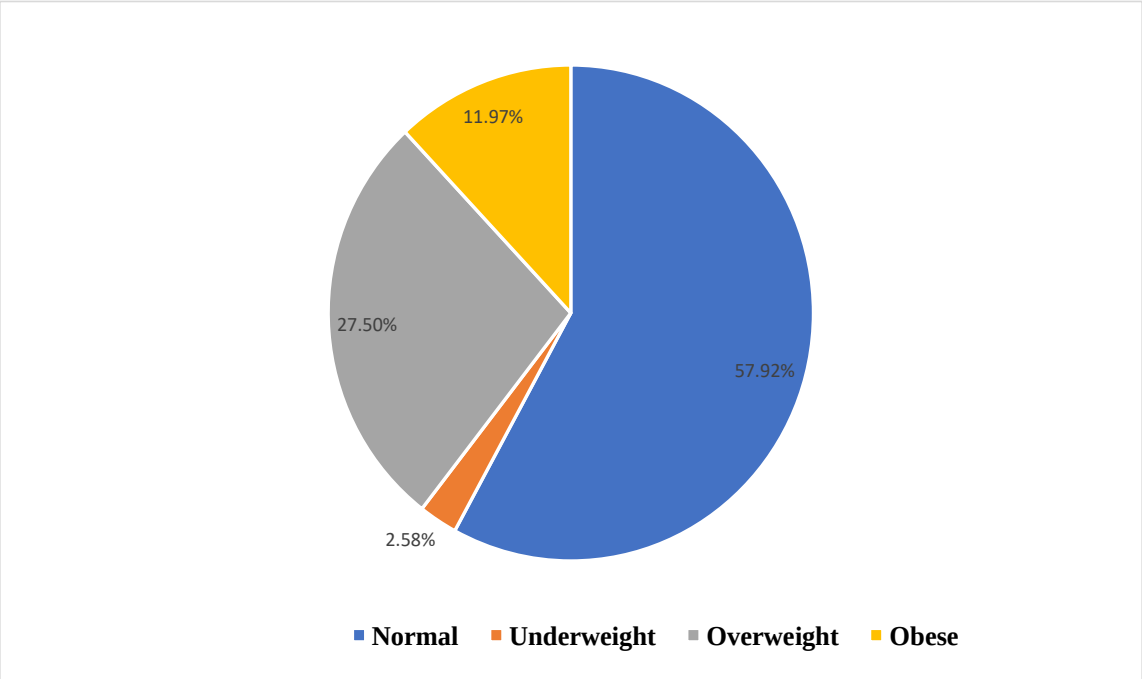
**Table 4.3: Distribution of nutritional and environmental characteristics for research respondents, Oshakati Intermediate Hospital, September – November 2020**

| Variable | Cases n=103 | Controls n=206 | Total n=309 |
|---|---|---|---|
| **Height** | | | |
| <150 cm | 5 | 13 | 18 (5.82%) |
| >150 cm | 98 | 193 | 291 (94.17%) |
| **MUAC** | | | |
| Normal nutrition (> 23 cm) | 94 | 197 | 291 (94.17%) |
| Moderate Malnutrition (18.9 – 21.9cm) | 7 | 9 | 16 (5.17%) |
| Severe Malnutrition (< 18.9cm) | 2 | 0 | 2(0.64%) |
| **HB levels** | | | |
| < 10g/dl | 15 | 25 | 40 (12.94%) |
| >10g/dl | 88 | 181 | 269 (87.05%) |
| **BMI** | | | |

| | | | |
|---|---|---|---|
| Normal (18.5 – 24.9kg/$m^2$ ) | 58 | 121 | 179 (57.92%) |
| Underweight (<18.5kg/ $m^2$) | 4 | 4 | 8 (2.58%) |
| Overweight (25.0 – 29.9kg/ $m^2$) | 33 | 52 | 85 (27.50%) |
| Obese (≥30.0kg/$m^2$) | 8 | 29 | 37 (11.97%) |
| **Received nutritional supplements** | | | |
| Yes | 91 | 191 | 282 (91.26%) |
| No | 12 | 15 | 27 (8.73%) |
| **Received nutritional counselling** | | | |
| Yes | 80 | 154 | 234 (75.72%) |
| No | 23 | 52 | 75 (24.27%) |
| **Number of meals per day** | | | |
| ≤two | 18 | 38 | 56 (18.12%) |
| Three | 44 | 76 | 120 (38.83%) |
| >three | 41 | 92 | 133 (43.04%) |
| **Avoided some foods during pregnancy** | | | |
| Yes | 37 | 68 | 105(33.98%) |
| No | 66 | 138 | 204(66.02%) |
| **Alcohol Consumption** | | | |
| Yes | 24 | 45 | 69 (22.33%) |
| No | 79 | 161 | 240 (77.66%) |
| **Smoking Cigarettes** | | | |
| Yes | 1 | 1 | 2 (0.64%) |
| No | 102 | 205 | 307 (97.73%) |
| **Source of water** | | | |
| River | 4 | 2 | 6 (1.94%) |
| Tap | 91 | 197 | 288 (93.20%) |
| Well/Borehole | 8 | 6 | 14 (4.53%) |
| Harvested Water | 0 | 1 | 1 (0.32%) |

| | | | |
|---|---|---|---|
| **Mode of transport** | | | |
| Footing | 80 | 144 | 224 (72.49%) |
| Taxi | 18 | 58 | 76 (24.59%) |
| Bus | 0 | 1 | 1 (0.32%) |
| Own car | 5 | 3 | 8 (2.58%) |

Majority of mothers (57.92%, n=179) were of normal weight (BMI 18.5-24.9kg/$m^2$), eight of them (2.58%) were underweight with a BMI of <18.5kg/$m^2$, 85 (27.50%) were overweight (BMI of 25.0 – 29.9kg/$m^2$) and 37 of them (11.97%) were found to be obese with a BMI of ≥30kg/$m^2$. This is demonstrated in the graph below:




**Chi$^2$ =4.50 df = 3 p value = 0.20**

**Figure 4.4: Body Mass Index for research respondents, Intermediate Hospital Oshakati, Sept – Nov 2020**

However, as expected from expectant mothers, 105 (33.98%) of them avoided some foods during pregnancy. Slightly more than half of respondents (52.75%, n=163) reported to having experienced nutritional related problems. Most of the respondents, 22% (n=68) reported to have suffered from nausea and vomiting, followed by 32 (10.35%) mothers who reported suffering from heart burn and poor appetite with 9.7%, (n=30). Figure 4.5 below elucidates the types of nutritional problems experienced by study participants while pregnant.

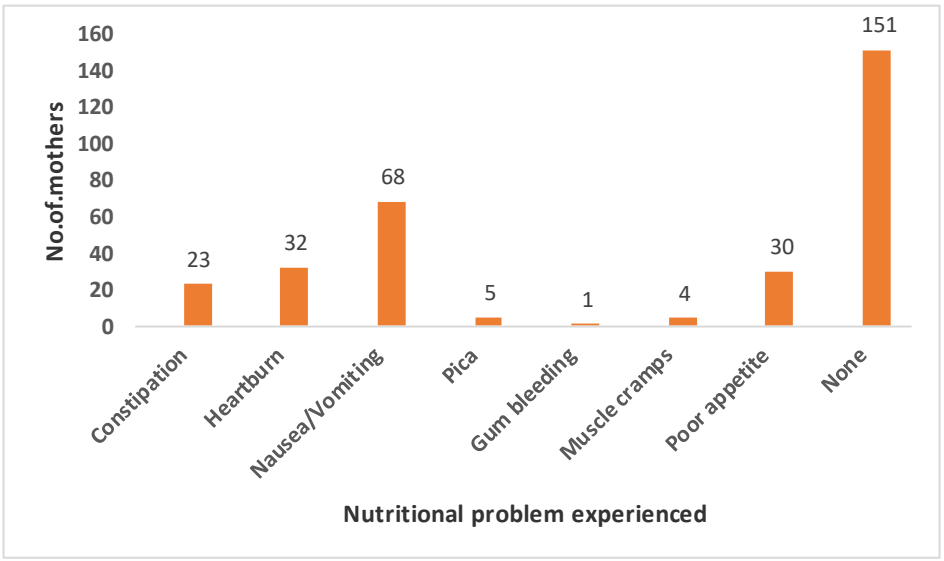



**Figure 4.5: Nutritional problems experienced by research respondents during pregnancy, Intermediate Hospital Oshakati, Sept – Nov 2020 (n=309)**

More than half of the respondents reported having consumed carbohydrates and oils mainly everyday with 233 75% (n=233) and 77% (n=240) respectively.

Fruits were only consumed by 38.5% (n=116) of respondents daily. Animal proteins were used three times a week by 24.27% of participants (n=75), while 26.86% (n=83) of respondents used it on a daily basis. However, green vegetables were consumed by less than half (29%, n=90) of respondents daily and three times a week by (24.27%, n=75) respondents. Figure 7 below points out the sources of food nutrients consumed by research participants during pregnancy.

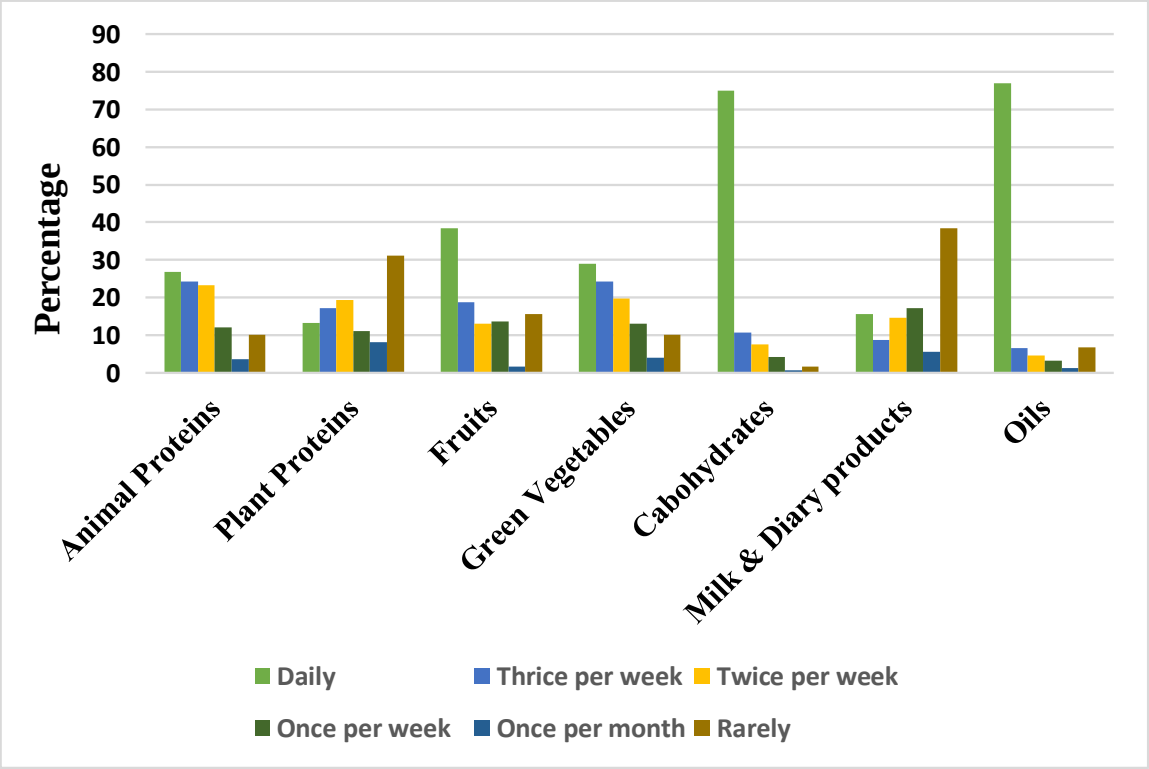



**Figure 4.6: Sources of foods consumed by research respondents during pregnancy, Intermediate Hospital Oshakati, Sept – Nov 2020**

## 4.6 BIVARIATE ANALYSIS OF FACTORS ASSOCIATED WITH LBW

The variables containing values greater than 5 were employed in the bivariate analysis model. The level of significance was determined at a p-value less than 0.05 at 95% confidence interval as well as a confidence interval that does not contain 1.

Below is a table summarising the outcome of the bivariate analysis.

**Table 4.4: Factors associated with LBW among babies born at Intermediate Hospital Oshakati, September – November 2020**

| Variable | Cases (n=103) | Controls (n=206) | cOR | 95% Confidence Interval | P-Value |
|---|---|---|---|---|---|
| **Gravidity** | | | 1.25 | 0.96 – 2.55 | 0.06 |
| Primi-gravida | 45 | 68 | | | |
| Multigravida | 58 | 138 | | | |
| **Parity** | | | 1.30 | 0.80 – 2.13 | 0.28 |
| Parity < I | 67 | 121 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Parity ≥ II | 36 | 85 | | | |
| **Planned pregnancy** | | | | | |
| Yes | 63 | 108 | 1.42 | 0.88 – 2.31 | 0.14 |
| No | 36 | 84 | 0.78 | 0.47 – 1.27 | 0.32 |
| No answer | 4 | 11 | | | |
| **Used Family planning** | | | 0.68 | 0.41 – 1.11 | 0.12 |
| Yes | 62 | 142 | | | |
| No | 41 | 64 | | | |
| **Desired number of children** | | | | | |
| 1 - 2 | 26 | 46 | 1.17 | 0.67 – 2.04 | 0.56 |
| 3 – 5 | 70 | 136 | 1.09 | 0.65 -1.80 | 0.73 |
| >5 | 5 | 19 | 0.50 | 0.18 – 1.38 | 0.17 |
| Not sure | 2 | 5 | | | |
| **Less than 3 ANC visits** | | | 1.79 | 0.92 – 3.48 | 0.07 |
| Yes | 19 | 23 | | | |
| No | 84 | 183 | | | |
| **1st trimester at 1st ANC visit** | | | 0.62 | 0.37 – 2.04 | 0.07 |
| Yes | 28 | 77 | | | |
| No | 75 | 129 | | | |

| | | | | | |
|---|---|---|---|---|---|
| **2nd and 3rd trimester at 1st ANC visit** | | | 1.40 | 0.85 – 2.32 | 0.18 |
| Yes | 71 | 126 | | | |
| No | 32 | 80 | | | |
| **Tetanus Immunization** | | | 0.64 | 0.26 – 1.58 | 0.33 |
| Yes | 94 | 194 | | | |
| No | 9 | 12 | | | |
| **Bad Obstetric History experienced** | | | | | |
| None | 93 | 178 | 1.46 | 0.68 – 3.14 | 0.32 |
| Abortion | 9 | 22 | 0.80 | 0.35 – 1.80 | 0.59 |
| **Previous History of LBW/prematurity** | | | 2.6 | 1.29 – 5.60 | 0.006* |
| Yes | 15 | 13 | | | |
| No | 89 | 192 | | | |
| **Previous History of NND** | | | 1.15 | 0.46 – 2.15 | 0.75 |
| Yes | 8 | 14 | | | |
| No | 95 | 192 | | | |
| **Premature Rupture of Membranes** | | | 4.25 | 1.24 - 14.4 | 0.012* |
| Yes | 8 | 4 | | | |
| No | 95 | 202 | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Hypertension in pregnancy** | | | 1.69 | 0.68 – 4.23 | 0.25 |
| Yes | 9 | 11 | | | |
| No | 94 | 195 | | | |
| **HIV status** | | | 0.92 | 0.46 – 1.82 | 0.81 |
| Positive | 14 | 30 | | | |
| Negative | 89 | 176 | | | |
| **Previous surgery on uterus and cervix** | | | 1.00 | 0.46 – 2.15 | 1.00 |
| Yes | 11 | 22 | | | |
| No | 95 | 184 | | | |
| **Pre-Eclampsia** | | | 1.35 | 0.46 – 3.91 | 0.57 |
| Yes | 6 | 9 | | | |
| No | 97 | 197 | | | |
| **Hyperemesis Gravidarum** | | | 0.60 | 0.27 – 1.34 | 0.21 |
| Yes | 9 | 28 | | | |
| No | 94 | 178 | | | |
| **Referred from another facility** | | | 1.44 | 0.86 – 2.41 | 0.15 |
| Yes | 35 | 54 | | | |
| No | 68 | 152 | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Mode of delivery** | | | | | |
| Spontaneous vertex delivery | 72 | 136 | 1.19 | 0.71 – 1.99 | 0.49 |
| Caesarean section | 28 | 69 | 0.74 | 0.44 – 1.24 | 0.25 |
| Breech | 2 | 1 | | | |
| Forceps extraction | 1 | 0 | | | |
| **Gestation at delivery** | | | 4.8 | 2.23 – 10.38 | 0.000* |
| <38 weeks | 22 | 11 | | | |
| >38 weeks | 81 | 195 | | | |
| **Infant Sex** | | | 0.87 | 0.54 – 1.40 | 0.57 |
| Female | 46 | 99 | | | |
| Male | 57 | 107 | | | |
| **Mother's Height** | | | 0.75 | 0.26 – 2.18 | 0.60 |
| <150 cm | 5 | 13 | | | |
| >150 cm | 98 | 193 | | | |
| **Mother's MUAC** | | | | | |
| Normal nutrition (>22cm) | 94 | 197 | 0.47 | 0.18 – 1.24 | 0.12 |
| Moderate malnutrition (18.9 – 21.9 cm) | 7 | 9 | 1.59 | 0.57 – 4.41 | 0.36 |
| Severe malnutrition (<18.9 cm) | 2 | 0 | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Mother's HB levels** | | | 1.23 | 0.61 – 2.45 | 0.54 |
| < 10g/dl | 15 | 25 | | | |
| >10g/dl | 88 | 181 | | | |
| **Mother's BMI** | | | | | |
| Normal (18.5 – 24.9kg/$m^2$ ) | 58 | 121 | 0.90 | 0.56 – 1.46 | 0.68 |
| Underweight (<18.5kg/ $m^2$) | 4 | 3 | | | |
| Overweight (25.0 – 29.9kg/ $m^2$) | 36 | 53 | 1.55 | 0.93 – 2.58 | 0.09 |
| Obese (≥30.0kg/$m^2$) | 8 | 29 | 0.51 | 0.22 – 1.16 | 0.10 |
| **Received nutritional supplements** | | | 0.59 | 0.26 – 1.32 | 0.19 |
| Yes | 91 | 191 | | | |
| No | 12 | 15 | | | |
| **Received nutritional counselling** | | | 1.17 | 0.67 – 2.05 | 0.57 |
| Yes | 80 | 154 | | | |
| No | 23 | 52 | | | |
| **Number of meals per day** | | | | | |
| ≤two | 18 | 38 | 0.93 | 0.50 – 1.73 | 0.83 |
| Three | 44 | 76 | 1.27 | 0.78 – 2.06 | 0.32 |
| >three | 41 | 92 | 0.81 | 0.50 – 1.32 | 0.41 |

| | | | | | |
|---|---|---|---|---|---|
| **Nutritional problems** | | | 1.10 | 0.68 – 1.77 | 0.68 |
| Yes | 56 | 107 | | | |
| No | 47 | 99 | | | |
| **Avoided some foods during pregnancy** | | | 1.13 | 0.69 – 1.86 | 0.61 |
| Yes | 37 | 68 | | | |
| No | 66 | 138 | | | |
| **Alcohol Consumption** | | | 1.08 | 0.61 – 1.91 | 0.77 |
| Yes | 24 | 45 | | | |
| No | 79 | 161 | | | |
| **Source of water** | | | | | |
| River | 4 | 2 | | | |
| Tap | 91 | 197 | 0.34 | 0.14 – 0.85 | 0.016* |
| Well/Borehole | 8 | 6 | 2.80 | 0.94 – 8.31 | 0.05 |
| Harvested Water | 1 | 0 | | | |
| **Source of food** | | | | | |
| Donations | 1 | 3 | | | |
| Fields & Shops | 64 | 104 | 1.60 | 0.99 – 2.60 | 0.05 |
| Shops only | 38 | 99 | 0.63 | 0.38 – 1.02 | 0.06 |

| **Mode of transport from one place to another** | | | | | |
|---|---|---|---|---|---|
| Footing | 80 | 144 | 1.49 | 0.86 – 2.59 | 0.14 |
| Taxi | 18 | 58 | 0.54 | 0.29 – 0.97 | 0.039* |
| Bus | 0 | 1 | | | |
| Own car | 5 | 3 | | | |

In the bivariate analysis, statistically significant associations were observed between LBW and gestation of ≤38 weeks, history of low birth weight/prematurity, premature rupture of membranes, rural residence, the use of tap water as well as the use of taxi as a means of transport. Mothers who had delivered with a gestation of ≤38 weeks were almost 5 times more likely (OR 4.8, 95% CI 2.23 – 10.38, p value 0.000) to give birth to an LBW compared to those who had delivered with a gestation of more than 38 weeks.

In addition, the odds of delivering a LBW baby among mothers with a previous history of LBW/prematurity were 2.6 times higher than that of mothers with no previous history of LBW (OR 2.6, 95% CI 1.29 – 5.60, p value 0.006).

Premature rupture of membranes was also one of the significant risk factors (OR 4.2, 95% CI 1.24 – 14.4, p value 0.012). Moreover, those who resided in the rural area had 3 times (OR 3.2, 95% CI 1.86 – 5.54, p value 0.000) likelihood of giving birth to a LBW baby as compared to those mothers who resides in urban areas.

Another factor with statistical significance was the use of tap water (OR 0.34, 95% CI 0.14 – 0.85, p value 0.016). This was a negative association indicating that the use of tap water was a protective factor for delivering LBW babies. Similarly, another protective effect was observed between the use of taxi and delivering LBW baby (OR 0.54, 95% CI 0.29 – 0.97, p value 0.039).

## 4.7 MULTIVARIATE ANALYSIS OF FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT

The factors which were found to be statistically significant in the bivariate model were further recruited into the Multivariate model for the adjustment of other factors. The table below depicts the findings of the multi logistic regression analysis.

**Table 4.5: Independent predictors of Low Birth Weight in Intermediate Hospital Oshakati, Sept-Nov 2020**

| Variable | aOR | 95% CI | P value |
|---|---|---|---|
| gestation_38_weeks (Yes/No) | 4.1 | 1.86-9.35 | 0.000* |
| history_of_lbw_prematurity (Yes/No) | 2.4 | 1.12-5.43 | 0.024* |
| premature_rupture_of_membranes (Yes/No) | 3.3 | 0.90-12.54 | 0.069 |
| rural_residence (Yes/No) | 2.5 | 1.44-4.57 | 0.001* |
| tap_water (Yes/No) | 0.43 | 0.16-1.12 | 0.086 |
| taxi (Yes/No) | 0.65 | 0.34-1.24 | 0.198 |

Out of the 6 factors found to have statistical significance in the bivariate analysis, 3 of them remained statistically significant predictors of LBW in multivariate analysis.

Statistically significant association was observed between LBW and gestation <38 weeks (aOR 4.1, 95% CI 1.86-9.35, p value 0.000); history of LBW or prematurity (aOR 2.4, 95% CI 1.12-5.43, p value 0.024) as well as rural residence (aOR 2.5, 95% CI 1.44 – 4.57, p value 0.001).

## 4.8 SUMMARY

This chapter covered the presentation of the study results. The prevalence of Low Birth Weight was estimated for both cases and controls. Frequencies and proportions were tabulated as per study objectives. Bivariate and multivariate analysis was conducted on the factors associated with LBW. Odd Ratios for potential risk factors were presented at 95% CIs and statistical significance was set at p value < 0.05 as well as a Confidence Interval not containing 1. The next chapter (5) focuses on the interpretations of the results from chapter 4.

# CHAPTER 5: DISCUSSION, CONCLUSION, STUDY LIMITATIONS AND RECOMMENDATIONS

## 5.1 INTRODUCTION

The focus of this chapter is on the interpretation of the study results. The results are compared to those of other studies conducted in other countries on the same subject matter. The discussions are thus presented in a similar sequence as the results in the previous chapter. The discussions are summarized in line with the study objectives.

## 5.2 DISCUSSIONS ON THE RESEARCH RESULTS

### 5.2.1. Prevalence of Low Birth Weight

The number of deliveries in Intermediate Hospital Oshakati during the study period was 1989, of which 207 babies were born with a birth weight of less than 2500g, which constitutes to a prevalence rate of 10.4%. This is lower than the national prevalence of 13% as well as the regional prevalence of 16% recorded from the DHS conducted by the MoHSS in 2013 (56). This finding can be attributed to a fact that the DHS focused on a wider population, including other health facilities in Oshana region over a longer period, while the findings of our study was limited to babies being born in Intermediate Hospital Oshakati in the given timeframe of the study. To add on, the prevalence is lower than that found in a study carried out in Kenya where they recorded a prevalence of 12.3%, but

higher than that recorded in Nigeria in 2015 where the prevalence was found to be 6.3% (57). The variations in the prevalence reported by different countries can be attributed to the differences in environmental factors, nutritional factors, social and behavioural factors as well as the general lifestyle factors of mothers in different countries.

### 5.2.2 Socio-demographic/economic characteristics of research respondents

The results revealed that majority of women who participated in the study were between 20 – 29 years of age. This result is consistent with that found by other researchers in different countries (38) (58) (59). Single mothers were also in the majority in this study comprising of 84% of the total participants. However, this is contrary to results from studies done in other countries whereby majority of women who took part in the studies were married women as compared to single mothers (38) (35) (60). Mothers who were unemployed were more than those who were employed, this was similar to a study conducted in Kenya (59). On the contrary, a DHS carried out in Nigeria revealed that majority of the mothers were employed(60). This might be because it was a nationally represented survey carried out in all 36 states, hence comprising of women from all walks of life and diverse populations. Interestingly, our study found that majority of the mother's partners were employed. Most of the mothers and their partners had secondary education representing more than 60% each respectively. A large proportion of study participants resided in rural areas, consistent with a results from a study conducted in Kenya (23). This could be explained by the fact that Intermediate Hospital Oshakati where the women delivered is a referral hospital utilized by

other district hospital which are in the rural areas, hence most of the women who came to deliver in this hospital resides in the rural areas.

### 5.2.3 Factors associated with Low Birth Weight

Several factors were found to be significantly associated with Low Birth Weight on bivariate analysis. These included rural residence, a gestation of ≤ 38 weeks at delivery, a history of previous LBW baby or Prematurity, use of tap water and use of taxi as a means of transport.

***Low birth weight and sociodemographic/economic characteristics***

Among all potential socio demographic/economic factors, this study only found a statistically significant association between LBW and rural residence. The same finding was generated from a study in Tanzania and India where it was found that women who resided in rural areas had greater chances of giving birth to LBW babies (61) (62). This can be attributed to the fact that most rural women have little access to health care services mainly due to inadequate finances, as well as the long distances to their health facilities. Although other literature has reported challenges faced by pregnant women in rural areas, this study did not explore the contributing factors for rural women having high odds of delivering LBW infants. On the contrary, studies conducted in Ghana and Ethiopia found significant associations between LBW and urban residence(63)(64). Other researchers argue that the lifestyle and behaviours portrayed by women residing in urban areas, for example drinking and smoking could have been the possible

reason for the strong association between LBW and urban residence (64). On the other hand, there was no significant association found between LBW and the rest of the socio demographic/socio-economic characteristics which includes maternal age, mother's educational level, partner's educational level, mother's employment status as well as partner's employment status. A study conducted in Kenya revealed that socio-demographic factors can influence birth weight through some interventions such as antenatal care program. This could be the explanation to the insignificant association found in this study (39). It is not new that a study can find no significance in the association between LBW and socio demographic/economic factors. To support our result, a study conducted in Kenya also did not find any significant relationship between LBW and socio demographic factors (23). Opposing our result is the outcome of the DHS conducted in Nigeria which revealed a significant association between LBW and maternal age as well as maternal and paternal education (60). Moreover, a study conducted in Central Ethiopia also found some significant associations between LBW and maternal age (15-24 years of age), maternal education as well as marital status(35).

Another study conducted in Ghana reported maternal educational level as an independent predictor of LBW(63).

***Low Birth Weight and medical, reproductive, obstetric and delivery characteristics***

In the bivariate analysis, no significant association was observed between the following factors and LBW. These factors include gravidity; parity; desired number of children, ANC attendance, trimester at first ANC visit, use of family planning, type of family planning methods, tetanus immunization, history of bad obstetric history; previous history of neonatal death, hypertension in pregnancy, HIV status, previous surgery on uterus or cervix, pre-eclampsia, history of hyperemesis gravidarum, referral from another facility, mode of delivery and infant sex. The lack of association between LBW and some reproductive, obstetric and delivery factors can be explained by some documented evidence that birth outcomes are known to be improved by adequate maternal health, antenatal care in particular (39)(65). To add on to this, mother's maternal health improves positively through antenatal care attendance. In Namibia for instance, during routine antenatal care, all mothers who test positive for HIV are initiated on Anti-Retroviral Treatment the same day of testing positive for the virus. Consequently, this intervention results in the suppression of the mother's viral load and subsequently preventing the mother to child transmission of HIV. It was evident in some studies which have indicated that mothers living with HIV and are consistently taking their Anti-Retroviral Treatments can have good birth outcomes (65). A finding from a study in India demonstrated that having pregnancy induced hypertension was a significant risk factor for delivering a LBW baby (66). However, this is in opposition to the finding in our study.

Moreover, other studies found strong association between sex of the infant and birth weight (67), of which our study found no significance in the association.

In the bivariate model, this study revealed that the odds of delivering a baby with LBW was five times higher in women who presented with a gestation of ≤38 weeks at delivery as compared to those who presented with > 38 weeks gestation at delivery (OR 4.8, 95% CI 2.23 – 10.38, p value 0.000). This result was consistent with a study in Thailand (68). Similarly, the odds of delivering a LBW baby among mothers with a previous history of LBW and prematurity was 2.6 times higher than that of mothers without any previous history of LBW or prematurity (OR 2.6, 95% CI 1.2 – 5.6, p value 0.006). This result aligns with a study in Nepal(58). Another statistically significant association was found between LBW and having premature rupture of membranes (OR 4.2, 95% CI 1.24 -14.4, p value 0.012). This is in agreement with a study carried out in Olkalou hospital in Kenya (69).

***Low Birth Weight and nutritional as well as environmental factors***

None of the nutritional factors were found to be significantly associated with LBW. These factors include mother's height, mothers HB levels, MUAC measurements, BMI, receiving nutritional supplementation, nutritional counselling, the presence of nutritional problems, avoiding some foods during pregnancy as well as alcohol consumption. Contrary to this finding, a study conducted in India revealed that maternal height of ≤145cm and anaemia in pregnancy characterised by low HB levels were independent predictors of LBW

(66). The possible reason for this lack of association could be what some literature points out with regards to some interventions carried out during ANC such as food supplements and nutritional counselling which can result in good birth outcomes (39)(70). To add on, our result revealed that majority of mothers were of normal weight and normal nutrition, this can be explained by the fact that the mothers weight recorded were that taken a few hours to a few days after delivery, without any significant maternal weight loss having occurred.

In Bivariate analysis, statistically significant associations were found between LBW and some environmental factors such as the use of taxi as a means of transport (OR 0.54, 95% CI 0.29 – 0.97, p value 0.039) as well as the use of tap water (OR 0.34, 95% CI 0.14 – 0.85). Both these associations were protective of delivering LBW babies.

***Independent predictors of Low Birth Weight***

The final multivariate analysis revealed that there were three significant predictors of LBW which are gestation of ≤38 weeks, previous history of LBW or prematurity as well as residing in a rural area. The odds of having a gestational age under 38 weeks at the time of delivery were increased in cases by a factor of 4.1 (95% CI: 1.86-9.35, p 0.000) compared to controls, whilst accounting for all other factors. This result is close to that found in a study carried out in Ethiopia whereby it was noted that gestation below 37 weeks was significantly associated with LBW(71). Similarly, the odds of having a history of LBW or premature baby were increased in cases by a factor of 2.4 (95% CI:

1.12-5.43, p 0.024) compared to controls, whilst accounting for other factors. Finally, the odds of residing in a rural area were increased in cases by a factor of 2.5 (95% CI: 1.44 – 4.57, p 0.001) compared to controls, whilst accounting for all other factors. This result is in agreement with that of a study conducted in 2012 by Ghimire et al, which revealed that residing in a rural area increased the mother's risk of delivering a Low Birth Weight Baby (62). However, several studies have found other factors to be independent predictors of LBW. Mahumud et al. in their study on the distribution and determinants of LBW in developing countries found maternal age of 35-49 years, inadequate ANC, illiteracy as well as low BMI as significant risk factors for LBW. A similar pattern was appreciated by a study in Nepal (72).

## 5.3 CONCLUSION

The prevalence of Low Birth Weight in Intermediate Hospital Oshakati was 10.4%. The cut off or threshold level for LBW in Namibia is not well documented, however this prevalence is lower than the WHO estimate for Sub Saharan Africa which is 15% - 20%. Drawing from the previously available data on LBW in Namibia and Oshana region in particular, this prevalence is a clear indication that it still poses a significant risk to adverse neonatal health effects such as risk of morbidities and mortalities.

In conclusion, the independent predictors of LBW in this study were gestational age equal to or less than 38 weeks at the time of delivery, having a history of delivering a previous LBW or premature baby as well as residing in a rural area. Rural residence was dominant in both cases and controls, which calls for the

strengthening of maternal and neonatal health care services in rural areas. Although no association was found between several maternal factors such as ANC visits, trimester of pregnancy at first ANC visits, Tetanus immunisation and LBW, the associated factors such as history of previous LBW and residing in rural settings cannot be disjointed from the quality of ANC. Hence the need for improving maternal health care services in rural areas which should include accessibility to health facilities, skilled personnel as well as the availability of supplies and equipment for use in the delivery of comprehensive maternal health services.

## 5.4 STUDY LIMITATIONS

The study encountered the following limitations:

- The study was limited to Intermediate Hospital Oshakati and the findings obtained could not be generalized to other hospitals in Oshana region or other regions.
- This was an unmatched case control study, where cases were not matched to controls by age, marital status, residential address, and other variables.
- The study only focused on mothers who gave birth during the study period in maternity ward of IHO. Those who delivered in casualty, home or general wards were excluded

## 5.5 RECOMMENDATIONS

Based on the study results, the following recommendations are found to be appropriate:

- The heath facilities in Oshana region should strengthen the implementation of comprehensive & integrated Antenatal Care for early identification of risk factors of LBW such as previous Low Birth Weight /prematurity. Women identified as high risk should be closely monitored.
- The Ministry of Health and Social Services should develop guidelines aimed at strengthening the existing maternal health services in rural areas e.g., capacity building for health care workers as well as provision of needed equipment and supplies to rural health facilities
- The researcher recommends further studies to investigate the factors associated with Low Birth Weight among women residing in rural areas of Oshana region at large.

## 5.6 SUMMARY

The chapter dwelt on the interpretation of the study results in line with the study objectives. The results were compared to that of studies carried out in various countries, some results agreed while some were in opposition with what was found in other settings.

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## APPENDIX 1: RESEARCH PERMISSION LETTER FROM THE UNIVERSITY OF NAMIBIA

UNAM
UNIVERSITY OF NAMIBIA

**ETHICAL CLEARANCE CERTIFICATE**

**Ethical Clearance Reference Number: H-G /578/2020** **Date: 31 August, 2020**

This Ethical Clearance Certificate is issued by the University of Namibia Research Ethics Committee (UREC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the Faculty/Centre/Campus Research & Publications Committee sitting with the Postgraduate Studies Committee.

**Title of Project**: Factors Associated With Low Birth Weight Among Babies Born At Oshakati Intermediate Hospital, Oshana Region, Namibia

**Researcher**: ROSWITHA NDJENGWA

**Student Number** (200329677)

Supervisor: *Dr. P. Angula*

**Campus**: Hage Geingob Campus
Take note of the following:

(a) Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the HREC. An application to make amendments may be necessary.
(b) Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the HREC.
(c) The Principal Researcher must report issues of ethical compliance to the UREC (through the Chairperson of the Faculty/Centre/Campus Research & Publications Committee) at the end of the Project or as may be requested by HREC.
(d) The HREC retains the right to:

(i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
(ii) Request for an ethical compliance report at any point during the course of the research;
*(iii) Cognizance and the observation of Namibia's Research Science and Technology Act, 2004 which makes it compulsory for Non-Namibian based researchers to obtain the compulsory Research Permit from the National Commission on Research Science and Technology (NCRST), FIRST, BEFORE the research can commence.*

HREC wishes you the best in your research.

Dr. J.E. de Villiers HREC Chairperson

Ms. P. Claassen: HREC Secretary

**APPENDIX 2: RESEARCH APPLICATION LETTER TO THE MINISTRY OF HEALTH AND SOCIAL SERVICES**

P.O. Box
2465

Rundu

Namibia

30 July 2020

To: Mr. Ben Nangombe

Executive Director

Ministry of Health and Social Services

Attention: Dr. Hilma Nangombe

Research Unit

Directorate of Policy and Planning

**APPLICATION FOR RESEARCH APPROVAL**

**TITTLE: FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG BABIES BORN AT OSHAKATI INTERMEDIATE HOSPITAL, OSHANA REGION, NAMIBIA**

**Name of the Researcher:** Roswitha Mukanga Ndjengwa

**Study Program:** MSc: Applied Field Epidemiology and Laboratory Training

**Academic Year:** 2018 - 2019

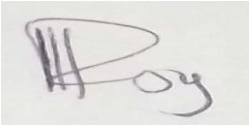
This letter serves to inform your good office that the above mentioned student is intending to conduct a research in accordance with national and institutional guidelines. The details pertaining to the proposed study are elaborated in the attached supporting documents.

With this letter I have attached the following documents:

1. Research Proposal (with instruments)
2. Application form
3. Curriculum Vitae
4. Testimonial from University of Namibia on proposal approval
5. Proof of registration for 2020 academic year

For detailed information do not hesitate to contact Ms. Ndjengwa at 0816759659 or at the

following email: nroswitha@yahoo.com



**Ms. Roswitha Ndjengwa**

**FELTP – Resident**

**Cohort Five**

## APPENDIX 3: RESEARCH PERMISSION LETTER FROM THE MINISTRY OF HEALTH AND SOCIAL SERVICES

**REPUBLIC OF NAMIBIA**

*Ministry of Health and Social Services*


Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

Tel: 061 – 203 2507
Fax: 061 – 222558
E-mail: itashipu87@gmail.com


**OFFICE OF THE EXECUTIVE DIRECTOR**

**Ref:** 17/3/3RMN
**Enquiries:** Mr. A. Shipanga

**Date:** 10 September 2020

**Ms. Roswitha M. Ndjengwa**
**PO Box 2465**
**Rundu**
**Namibia**

Dear Ms. Ndjengwa

***Re: Factors associated with low birth weight among babies born at Oshakati Intermediate Hospital, Oshana Region, Namibia.***

1. Reference is made to your application to conduct the above-mentioned study.

2. The proposal has been evaluated and found to have merit.

3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purpose;

3.2 No other data should be collected other than the data stated in the proposal;

3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;

3.4 A quarterly report to be submitted to the Ministry's Research Unit;

3.5 Preliminary findings to be submitted upon completion of the study;

3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry for the publication of the findings.

4. All the cost implications that will result from this study will be the responsibility of the applicant and not of the MoHSS.

Yours sincerely,

**BEN CHIMBE**
**EXECUTIVE DIRECTOR**

*"Health for All"*

# APPENDIX 4: PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

**PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM**

**ANNEX 5**

**TITLE OF THE RESEARCH PROJECT:** FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG BABIES BORN AT OSHAKATI INTERMEDIATE HOSPITAL, OSHANA REGION, NAMIBIA

**PRINCIPAL INVESTIGATOR: MS. ROSWITHA NDJENGWA**

**ADDRESS: P.O.BOX 2465, RUNDU**

**CONTACT NUMBER: +264816759659**

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

1. **What is this research study all about?**

   The study will be conducted in the post-natal ward of Intermediate Hospital Oshakati, with 309 participants. The project aims to find out the relationship between birth weight of babies and the factors related to the mother's health, socio/economic characteristics and the surrounding environment. You will be asked some questions concerning your health in relation to your pregnancy, and the investigator will measure your weight and height as well as your Mid Upper Arm Circumference (MUAC).

2. **Why have you been invited to participate?**

   You have been invited to participate because you meet the criteria for participating in this study (You have delivered a single full term baby)

3. **What will your responsibilities be?**

   You are expected to answer some questions relating to your health and that of your baby and if you will allow the investigator to measure your body weight, your height and your Mid Upper Arm Circumference. This will take approximately 20 minutes of your time

4. **Will you benefit from taking part in this research?**

   This research will help future pregnant woman to better take care of themselves before, during and after pregnancy so that they will deliver healthy full term babies of normal birth weight. The findings and recommendations of the project will also help the ministry to focus on improving the health of women and children

5. **Are there any risks involved in your taking part in this research?**

   There are absolutely no risks involved in participating in this study

6. **If you do not agree to take part, what alternatives do you have?**

   If you do not agree to take part in this study, you can inform the investigator at any time and you will be allowed to be excluded and the information obtained from you will be discarded.

7. **Who will have access to your medical records? (Where applicable)**

   Your medical records will only be availed to the investigator and the health team in the hospital. Information obtained from you and your medical records will be treated with confidentiality, and the findings of the study will not be linked to your names.

8. **What will happen in the unlikely event of some form injury occurring as a direct result of your taking part in this research study?**

   We do not anticipate the occurrence of any physical injuries since we will not use any pharmaceuticals or devices which can cause physical injuries.

9. **Will you be paid to take part in this study and are there any costs involved?**

   Participation in this study is entirely voluntary and there is no payment of any kind for taking part in this study

10. **Is there anything else that you should know or do?**

    a) You can contact the principal investigator Mrs. Roswitha Ndjengwa at cell **0816759659** if you have any further queries or encounter any problems.

    b) You can contact the Centre for Research and Publications **at +264 061 2063061; pclaassen@unam.na** if you have any concerns or complaints that have not been adequately addressed by the investigator.

    c) You will receive a copy of this information and consent form for your own records

**11. Declaration by participant**

By signing below, I ……..…….. agree to take part in a research study entitled *(**Factors associated with Low Birth Weight among babies born at Oshakati Intermediate Hospital, Oshana Region, Namibia**).*

**I declare that:**

a) I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.

b) I have had a chance to ask questions and all my questions have been adequately answered.

c) I understand that taking part in this study is **voluntary** and I have not been pressurized to take part.

d) I may choose to leave the study at any time and will not be penalized or prejudiced in any way.

e) I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) .....…..…….. on (*date*) ……...…….. 2020.

**.....** **.....**

Signature of participant Signature of witness

**12. Declaration by investigator**

I, Roswitha Ndjengwa declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did / did not use an interpreter. (*If an interpreter is used then the interpreter must sign the declaration below.*

Signed at (*place*) .....…..……... on (*date*) ……...……. 2020.

**.....** **.....**

Signature of investigator Signature of witness

3

**13. Declaration by interpreter**

I *(name)* declare that:

a) I assisted the investigator Roswitha Ndjengwa to explain the information in this document to (*name of participant*) ……..…….. using the language medium of (Oshiwambo, Oshiherero, Afrikaans, etc.)

**APPENDIX 5: RESEARCH DATA COLLECTION TOOL**

**QUESTIONNAIRE**

**FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG BABIES BORN AT OSHAKATI INTERMEDIATE HOSPITAL, OSHANA REGION, NAMIBIA**

| Date of interview | Day | | Month | | Year | |
|---|---|---|---|---|---|---|
| | | | | | | |

**IDENTIFICATION**

Questionnaire number

Study participant number

**A) SOCIO-DEMOGRAPHIC DATA**

1. Age
2. Residential address
3. Marital status (*Tick the box corresponding to the response*)

| Single | Separated/divorced | Married/cohabiting | widower/other |
|---|---|---|---|
| | | | |

4. Your Level of education (*Tick the box corresponding to the response*)

| No formal education | Primary education | Secondary education | Tertiary education |
|---|---|---|---|
| | | | |

5. Partner's level of education (*Tick the box corresponding to the response*)

| No formal education | Primary education | Secondary education | Tertiary education |
|---|---|---|---|
| | | | |

6. Your employment status (*Tick the box corresponding to the response*)

| Employed | Self-employed | Student | Unemployed |
|---|---|---|---|
| | | | |

7. Partner's employment status (*Tick the box corresponding to the response*)

| Employed | Self-employed | Student | Unemployed |
|---|---|---|---|
| | | | |

8. Your type of employment (*Tick the box corresponding to the response*)

| Office based | physical work |
|---|---|
| | |

9. Your occupation

10. Partner's occupation

## B) HEALTH STATUS DURING PREGNANCY

Answer the following questions by putting a cross in the provided column next to either **Yes** or **No**.

| **During pregnancy or in labor, did you have any of the following conditions?** | **YES** | **NO** |
|---|---|---|
| 11. Acute illness (urinary tract infection, sexually transmitted infection) | | |
| 12. Malaria | | |
| 13. Diagnosed as HIV positive (Confirm from ANC passport) | | |
| 14. Syphilis positive (Confirm from ANC records) | | |
| 15. Tuberculosis | | |
| 16. Hypertension | | |
| 17. Cardiac Disease | | |
| 18. Renal Disease | | |
| 19. Gestational Diabetes Mellitus | | |
| 20. Previous surgery on uterus and cervix (Myomectomy, removal of septum, cone biopsy, caesarian section) | | |

| | | |
|---|---|---|
| 21. Heavy vomiting during pregnancy | | |
| 22. Pre- Eclampsia/Eclampsia | | |
| 23. Vaginal bleeding | | |
| 24. Premature rapture of membranes | | |

## C) REPRODUCTIVE HEALTH

25. Number of pregnancies including current pregnancy (Gravidity)……

26. Number of previous births excluding current delivery (Parity)……

27. How many living children do you have?.....

28. How old were you when you gave birth to the first child? ……..

29. What is the pregnancy interval of the previous birth? ……..

30. What is the birth weight of your previous baby? …….

31. What is your desired number of children? ……

32. Did you plan to have the current pregnancy?

(*Tick the box corresponding to the response*)

| Yes | No | Prefer not to answer |
|---|---|---|
| | | |

33. Which method of family planning did you use before the pregnancy?

(*Tick the box corresponding to the response*)

| Never used | Traditional/natural | Modern methods |
|---|---|---|
| | | |

34. Bad Obstetric History: (*Tick all that applies*)

| Previous history of abortion | Previous history of stillbirth | Previous retained placenta/PPH | None |
|---|---|---|---|
| | | | |

| **Did you have any history of the following:** | YES | NO |
|---|---|---|
| 35. Previous history of low birth weight/prematurity | | |
| 36. Previous history of neonatal death | | |

**For question 35 to 39, please answer Yes or No**

**D) HEALTH CARE PRACTICE AND BEHAVIOR**

| **Answer the following questions by ticking either Yes or No** | YES | NO |
|---|---|---|
| 37. Do you smoke cigarettes? | | |
| 38. Do you take illegal drugs? e.g. Marijuana | | |
| 39. Do you take alcohol? | | |

**E) HEALTH SERVICES UTILIZATION**

40. Which month of pregnancy did you start antenatal visits?
…….

41. Number of ANC visits attended……..

| **Answer the following questions by ticking either Yes or No** | YES | NO |
|---|---|---|

| | | |
|---|---|---|
| 42. Did you receive tetanus immunization? | | |
| 43. Did you have contact with a community health worker? | | |

**F) NUTRITIONAL STATUS**

44. Hemoglobin level (g/dl) …….

45. Height of woman (cm)……

46. Maternal weight (kg) ……. ……...

47. Mid-upper arm circumference (cm) **(Note- Take left hand if right- handed, and right hand if left-handed)……..**

48. Weight gain during pregnancy (Confirm from maternity record or ANC card) ……

49. How many meals did you take in a day (24hours) during pregnancy?

| One | Two | Three | More than three | None |
|---|---|---|---|---|
| | | | | |

(*Tick the box corresponding to the response*)

50.Where do you obtain your food? (*Tick all that applies*)

| Field/Shops | Shops | Donations | Others |
|---|---|---|---|
| | | | |

If other specify……

| **Answer the following question by ticking either Yes or No** | YES | NO |
|---|---|---|
| 51. Did you receive nutritional counseling from health workers during pregnancy? | | |

52. Did you receive any of the following food supplements during pregnancy? (*Tick all that applies*)

| Iron and Folic acid | Calcium | Multivitamin | Others(specify) | None |
|---|---|---|---|---|
| | | | | |

53. What nutritional problems did you experience during pregnancy? (*Tick all that applies*)

| Nausea and Vomiting | Poor appetite | Constipation | Muscle cramps | Pica | Heartburn | Others | None |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

If others specify: ……

54. How often did you eat the following food sources during pregnancy? (*Tick the box corresponding to the response*)

| **Type of food** | **Daily** | **Three times a week** | **Twice a week** | **Once a week** | **Once a month** | **Rarely** |
|---|---|---|---|---|---|---|
| i) Animal proteins (e.g. red meat, fish, chicken eggs) | | | | | | |
| ii) Plant proteins (e.g. peanuts, beans) | | | | | | |
| iii) Fruits (including local fruits e.g. eembe) | | | | | | |
| iv) Dark green vegetables | | | | | | |
| v)Carbohydrates e.g. whole grains, potatoes, pasta, porridge, bread | | | | | | |
| vi) Milk and dairy products e.g. cheese, butter | | | | | | |
| vii) Oils | | | | | | |

| **Answer the following question by ticking either Yes or No** | YES | NO | |
|---|---|---|---|
| 55. Are there any type of food that you don't eat during pregnancy? | | | |

If yes, give reasons…….

**…….**

## G) EXPOSURE TO ENVIRONMENTAL CONTAMINANTS

56. Where do you obtain water for household use? (*Tick the box corresponding to the response*)

| River | Tap | Well/borehole | Harvested water | Others |
|---|---|---|---|---|
| | | | | |

| **Answer the following question by ticking either Yes or No** | YES | NO |
|---|---|---|
| 57. Does your work involve exposure to agricultural spraying? | | |

If others specify: …….

58. What is your mode of transport to & from work? (*Tick the box corresponding to the response*)

| Footing | Taxi | Bus | Own car | Not applicable |
|---|---|---|---|---|
| | | | | |

## H) LABOUR AND DELIVERY

| **Answer the following question by ticking either Yes or No** | YES | NO |
|---|---|---|
| 59. Were you referred here for delivery? | | |

60. If yes, from where or by whom? (*Tick the box corresponding to the response*)

| District hospital | Faith based facility | Health Centre | Dispensary | Community Health Worker | Private hospital | Private clinic | Others |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

If others specify…….

61. Onset of labor. (*Tick the box corresponding to the response*)

| Spontaneous | Induced | No labor |
|---|---|---|
| | | |

## I) NEONATAL DATA

62. Date of delivery

| Day | | Month | | Year | |
|---|---|---|---|---|---|
| | | | | | |

63. Gestational age at delivery (in weeks): ☐

i) Last Menstrual Period

| Day | | Month | | Year | |
|---|---|---|---|---|---|
| | | | | | |

ii) Expected Date of Delivery

| Day | | Month | | Year | |
|---|---|---|---|---|---|
| | | | | | |

64. Mode of delivery/ assistance for delivery: *(Tick the appropriate box)*

| Spontaneous | Forceps extraction, | Vacuum extraction | Elective C-section | Emergency C-section | Assisted breech/breech extraction | Laparotomy for ruptured uterus |
|---|---|---|---|---|---|---|
| | | | | | | |

65. Apgar score at 5 minutes

| | |
|---|---|
| | |

66. Birth weight (g)

| | | | |
|---|---|---|---|
| | | | |

67. Infant sex:

| Female | Male |
|---|---|
| | |

**THANK YOU**