PSYCHOLOGICAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG POST NATAL MOTHERS IN KILIFI COUNTY, KENYA

BY

MARY GORETTY AMONDI

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR DEGREE IN MASTER OF PUBLIC HEALTH (EPIDEMIOLOGY AND POPULATION HEALTH)

SCHOOL OF PUBLIC HEALTH AND COMMUNITY DEVELOPMENT

MASENO UNIVERSITY

DECLARATION

This thesis is my original work and has not been presented to any other University for a degree or any other award.

Signature ……. Date …….

Mary Goretty Amondi

(MPH/PH/00012/2017)

The thesis has been submitted with our approval as supervisors:

Signature ……. Date …….

Dr. Patrick Onyango

School of Physical and Biological Sciences

Department of Zoology, School of Physical and Biological Sciences

Maseno University

Signature ……. Date …….

Dr. Dickens Omondi

Jaramogi Oginga Odinga University,

Department of Public and Community Health, School of Health Sciences,

Bondo, Kenya.

ACKNOWLEDGEMENT

I thank God for the strength and his grace that enabled me to complete this work.

Heartfelt appreciation to my supervisors, Dr. Patrick Onyango, and Dr. Dickens Omondi, for their guidance and support in shaping this thesis, for their insightful comments, patience, time, and the encouragement to stay the course and do better throughout the process.

I acknowledge the people of MoH-Kilifi County, Rabai and Kaloleni Sub-County, Rabai and Mariakani Sub-County Hospital staff, and the Research Assistants without whom, this research would have not been done. Their collaboration and participation made all this possible.

Sincere thanks to my family for their support that came in handy at every stage of this journey. I am eternally grateful for their unwavering love and counsel and prayers.

DEDICATION

This thesis is dedicated to my parents and siblings for their endless love support and encouragement that you only fail when you stop trying, so keep Going

ABSTRACT

Worldwide, low birth weight (LBW, <2500gms) remains pervasive despite focused antenatal care interventions. Children with LBW have increased risk for death and multiple morbidities whose consequences track through life span. They require advanced medical care to manage effectively yet, these are often meagre in the high burden regions. Maternal psychosocial stress and determinants are insidious and subtle risk factor for LBW but is not routinely screened for during antenatal visits, indicating missed opportunities in the care continuum. By 2019, the global prevalence of was approximately 20 million comprising 14.6% of live births. Of these 95% were born in the developing countries with 13.7% being in Africa, 13.4% in East Africa and 11.5% in Kenya. Coastal region in Kenya is leading with a prevalence of 12.7%. Understanding the occurrence and predictors of maternal psychosocial stress could enable early identification and referral for definitive care to improve health outcomes. The current study aimed to investigate the antenatal psychological stress predictors of LBW among postnatal mothers in Kilifi County, Kenya. Specifically, the study determined prevalence of LBW infants among mothers who had psychological stress during antenatal period; socio-demographic characteristics of mothers with LBW infants; the association between antenatal psychological stress and LBW infants. Througha cross-sectional design, data was obtained from 387 postnatal mothers at Rabai and Mariakani Sub-County Hospitals. Eligible participants were identified through simple random sampling from the postnatal clinic. Structured questionnaires were used alongside perceived stress scale (PSS) and Edinburgh depression scale (EDS). The PSS has 10 items, each scored between 0-4. Iindividual scores range from 0 to 40 with higher scores indicating higher perceived stress; EDS has 10 items each scored between 0-3, with summated scores of 10 or more indicating possible depression. Data was analysed descriptively with chi-square test of association employed to establish the association between categorical variables. Statistically significant variables were modelled using logistics regression with crude and adjusted odds ratios estimated. The mean age was 25.9 years (±5.1); 30(7.8%) had no formal education, 160(41.3%) had primary level education, 125(32.3%) had secondary level education and 72(18.6%) had tertiary education. Majority (86.8%, n=336) were married;50.4% (n=195) were unemployed, 59.4%(n=230) were multiparous and 47.8%(n=185) had attended at least four antenatal care visit. The overall prevalence of low birth weight was 25.1% with 54.3%(n=19) of the births being from mother with psychosocial stress. Mothers with tertiary level of education (OR 0.32; 95% CI=0.12,0.89, *p*=0.028) and those who were formally employed(OR 0.35; 95% CI=0.14,0.86, *p*=0.022) had lower odds of delivering infants with low birth weight. Maternal age-group25-34 years was a significant predictor of low birth weight(95%CI=1.05, 3.46, *p*=0.035).Frequency of ANC visit did not reach statistical significance, although the odds of giving birth to LBW child was lower among mothers who attended at least 4 ANC visits (OR=0.58, 95% CI=0.21, 1.61). Bivariate analyses were performed to determine the association between prenatal psychological stress and LBW. Women with moderate (OR=2.30, 95%CI=1.41, 3.78, *p*=0.001) or high stress levels (OR=9.94, 95%CI=1.74,56.64, *p*=0.01) and those with depression (AOR=1.87, 95%CI=1.15-3.04)) had higher odds of giving birth to LBW infants. The burden of LBW associated with stress, and depression were considerable in this population. Findings from this study highlight the need for routine early screening for antenatal psychosocial stress and depression during routine visits as well as providing program postnatal monitoring interventions to aimed to reduce the risk of LBW.

TABLE OF CONTENT

LIST OF ABBREVIATIONS AND ACCRONYMS

ANC	Ante-Natal Clinic
HADS	Hospital Anxiety Depression Scale
IPV	Intimate Partner Violence
HICs	High Income Countries
IUGR	Intra-Uterine Growth Retardation
KDHS	Kenya Demographic and Health Surveys
LBW	Low Birth Weight
LMICs	Low- and Middle-Income Countries
NCPD	National Council for Population and Development
PTB	Preterm Birth
USAID	United States Agency for International Development
WHO	World Health Organisation
WHA	World Health Assembly

OPERATIONAL DEFINITION OF TERMS

Maternal psychological stress –Evidence of antenatal maternal distress specifically through presentation of high score in Hospital anxiety, Edinburgh depression scale and depression scale-anxiety and perceived stress scale testing tools.

Birth weight-Infant weight at birth in grams (LBW <2500g Normal weight ≥2500g)

Chronic health problem- For this study, a disease/ condition that has persisted for 3 months or more

Gestational age - how far along the pregnancy was at time of delivery, > 37weeks gestation was recruited for this study.

Intimate Partner Violence(IPV)- reported violent behaviour in a close relationship experienced by study participant occurring during the antenatal period (from conception to delivery) that caused any form of harm

Intimate relationship: defined as marital or sexual relationship with partner

Level of education- Education level attained by the mother at the time of the interview

Low Birth Weight (LBW) –New-born weight at birth that is<2500g

Maternal age- Age of a mother at time of the interview

Occupation- Type of gainful activity one engaged in for livelihood

Parity - The number of times the participant had been pregnant.

Prenatal/ Antenatal – This is the period from conception to delivery of an infant. The period during which the woman was pregnant.

Preterm Birth (PTB)–Delivery of a baby before 37 weeks of gestation.

Pregnancy complication- Any health problem in pregnancy or related to pregnancy

Stress Predictor- Stress factors that can show the occurrence of low birth weight. In this study these will be predictors of depression, anxiety and perceived stress which are all classified under psychological stress**.**

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Perinatal period is a critical developmental window for the infant's health and outcomes not only in the short-term and over the life course but also across multiple generations. Maternal experiences of adverse life events during pregnancy are known to impact negatively on the fatal growth processes as well as stress response systems through complex biological mechanisms involving the neural, endocrinal, and genetic pathways. Research has shown that morbidity and mortality burdens attributable to maternal psychological stress, premature births and LBW are increasing in Africa (Dadi et al., 2020).Worldwide, approximately 20 million LBW new-born are born annually, 96.5 % of them in LMICs. Out of these at least 50% are born in Asia versus 26.5% in Africa (Blencowe et al., 2019).In Kenya, the prevalence of LWB is 11% WHO, 2019) and Kilifi County has one of the highest prevalence of LBW estimated at 13% (KDHS, 2022) despite scaled up interventions. This is comparable to a recent studies conducted in Kenya, whose prevalence was higher than the national prevalence; In a study conducted in Kenya and Tanzania by K'Oloo et al., (2023), the prevalence was 12.6% while Mutwika, Onyango, & Okeyo, (2023) reported a prevalence of 13.7% from a study conducted in Jaramogi Odinga Oginga Teaching and Referral Hospital in Kisumu, Kenya. Low birth weight is significant because it is associated with increased risk for early mortality and morbidity as well as multiple adverse life-course outcomes(Blencowe et al., 2019). Whereas majority of causes of prenatal LBW are preventable, their occurrence is frequently obscure, thus delaying timely interventions(Blencowe et al., 2019).In Kenya, there is paucity of recent studies that have been done to establish the prevalence of LBW in both Kilifi and other counties.

Low birth weight indicates the health of both the infant and maternal health during pregnancy including antenatal nutrition, infections experienced in pregnancy and utilization of health care services during pregnancy (Musau et al., 2023) and has been significantly associated with various sociodemographic factors like maternal age, sex of the child, previous history of LBW infant, desirability of pregnancy and marital status(Falcão et al., 2020).In a study done across 35 countries in sub-Sahara Africa with Kenya included, Female gender, women uninvolved in healthcare decision making, and divorced/ separated women, and twin pregnancies were had an

increased occurrences of low birth weight, while level of education, antenatal care visits, older maternal age, and multiparity associated with reduced occurrence low birth weight (Tessema et al., 2021). Recent studies done in Kenya have documented extreme maternal age, parity, level of education, numbers of ANC visit as the predictors of LBW (Jumbale, 2018; Kenyanya et al., 2023)The scope and contextual factors that account for the increasing and disparate morbidities as well as health outcomes in different population groups across regions in Kenya remain poorly understood. Interventions to reduce LBW require an understanding of maternal socio-demographic factors that describes the unique characteristics of these postnatal mothers(Musau et al., 2023). Antenatal psychological stress which includes depression, anxiety and stress have various predictors categorized into social, biological, and psychological factors. These act in more intricate ways and may be important risk factors to the burden of LBW in Kenya(Li, Zeng, Zhu, Cui, & Li, 2016).

The perinatal period is a critical developmental window for the infant's health and health outcomes not only in the short-term and over the life course but also across multiple generations. Maternal experiences of adverse life events during pregnancy are known to impact negatively on the fetal neuro-developmental and growth processes as well as stress response systems through complex biological mechanisms involving the neural, endocrinal and genetic pathways (DeSocio, 2018) Chronic high levels of prenatal maternal psychosocial stress, especially those occurring early in pregnancy, have been consistently observed to be associated with preterm births and low birth weight (Dadi, Miller, Woodman, Azale, & Mwanri, 2020). Higher prevalence is consistently observed among low and middle-income countries. Recent studies have shown that the morbidity and mortality burdens attributable to maternal psychosocial stress as well as preterm births and low birth weight are expanding in Africa (Dadi, Wolde, et al., 2020). However, there is still insufficient information on why this is so. Knowledge of other potential life pressures which also predict chronic psychosocial stress may help explain some of the variations. This understanding would inform antenatal interventions provided to the mothers towards improving birth, survival, and health outcomes of new-borns.

1.2 Problem Statement

LBW and premature births are not only main predictors of perinatal morbidity and mortality but are also associated with devastating health outcomes and indicators of significant underlying

factors which hinder the expected growth and development of the foetus. The increasing prevalence of LBW globally and in Kenya pose considerable public health concerns, yet there is still lack of evidence to guide optimal intervention planning. Pooled evidence from systematic reviews and meta-analysis of relevant research in Africa have indicated that at least one in four postnatal mothers have depression but showing wide disparities by magnitude and associated factors across contexts (Devisree et al., 2018). Chronic antenatal maternal psychological stress is a known indicator of exposures to persistent or recurring adverse life and livelihood events, yet there is still little consensus about whether it is independently associated with LBW and preterm births. While its necessary to contextualize the issue per region due to its spatial variations across counties in Kenya as recommended by Musau et al., (2023), there is paucity of data published in that regard for Kilifi County which has a high prevalence of LBW in Kenya. It is important to understand the spatial variations in health outcomes like LBW since they are essential aspects considered when designing effective public health strategies.

There is therefore a need to investigate and characterize psychological stress and clarify its association with given birth outcomes in specific contexts. In addition, there is need to understand the scope and magnitude of contextual factors associated with antenatal psychological stress that may account for increased risks for LBW and preterm births and disparate health outcomes among postnatal mothers identified to have experienced antenatal psychological stress. In this thesis, it is postulated that antenatal maternal stress has an important function in LBW causation and preterm deliveries through complex individual level mechanisms. Independent role of antenatal psychological stress especially in a high disease burden area with simultaneously high prevalence of LBW, such as in Kilifi County has not been studied. The study will allow the health authorities to target the available limited resources to maximize impact.

1.3 Study Objectives

1.3.1 Broad objective

This study aimed to investigate the antenatal psychological stress predictors of LBW among postnatal mothers in Kilifi County, Kenya.

1.3.2 Specific Objectives

i. To determine the prevalence of LBW in Kilifi County, Kenya.
ii. To determine the association between socio-demographic factors and LBW among postnatal mothers in Kilifi County, Kenya
iii. To determine the association between prenatal psychological stress and LBW among postnatal mothers in Kilifi County, Kenya

1.3.3 Research Questions

i. What is the prevalence of LBW in Kilifi County, Kenya?
ii. What is the association between socio-demographic factors and LBW among postnatal mothers in Kilifi County, Kenya?
iii. What is the association between antenatal psychological stress and LBW among postnatal mothers in Kilifi County, Kenya?

1.4 Significance of the Study

The goal of this study was to explore and characterize the psychological stress and socio-demographic factors and clarify their association with LBW. In addition, there was need to understand the scope and magnitude of antenatal psychological stress factors that may account for increased risks of LBW and preterm births. The study which was hospital based was implemented in the two main Sub-County referral hospital in Rabai and Kaloleni Sub-County, Kilifi County, Kenya. Kaloleni and Rabai Sub-Counties formerly making up the Kaloleni District before devolution has been documented to be among the poorest regions of Kenya with approximately 70% of the population living below the poverty line (Ngugi et al., 2020). The two sub-counties have been selected by the County government of Kilifi for maternal health research due to unavailability of population level health data and poor population health indicators relative to other parts of Kilifi County. The two Sub-Counties have a few health indicators data specific to the area and maternal neonatal and child health indicators that are poorer than the national average. The region has also been listed by USAID as a high priority area due to widespread poor performing maternal health indicators and low socio-demographic and economic disparities.

Studying the socio-demographic factors provided insight on life-course stressors which influenced the individual's exposure to antenatal psychological stress in this setting**.** The results highlighted the individual socio-demographic and psychological stress factors associated with LBW highlighting the respective areas to concentrate on in the interventions programs. It also emphasized the importance of the ongoing programs like the Focused ante-natal clinic that requires pregnant mothers to attend a minimum of 4 antenatal clinic visit during their pregnancy since failure to do so increases the risk of delivering a LBW infant. The findings highlighted the need for early screening, monitoring, and program intervention for common antenatal mental disorders to reduce the risk of LBW.

1.5 Scope of the Study

This research was done at Kaloleni and Rabai Sub-Counties of Kilifi County, Kenya, among postnatal mothers aged 15 to 49 years to ascertain the sociodemographic, and antenatal psychological stress predictors of LBW among postnatal mothers with LBW babies.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter explores the write up and publications on association between socio-demographic and antenatal psychological stress factors with LBW

2.2 Prevalence of Low Birth Weight

WHO (2019) defines LBW as weight at birth of <2,500g,regardless of the gestational age.LBW may result from either restricted foetal (intrauterine) growth or preterm delivery before37 weeks of gestation(Anil et al., 2020; Blencowe et al., 2019; Organization., 2019) and is an important public health problem with related unlimited sequel. LBW infant have an increased risk of morbidity, unwavering developmental and physical ill health and stunting in childhood, (Blencowe et al., 2019). LBW is more prevalent in the developing countries despite the variability across regions (Zemenu et al., 2021).

The prevalence of LBW globally is approximated at 14.6% of new-born delivered annually, 95% from developing countries out of which 17.3% are born in Asia, 13.7% in Africa, 13.4% in East Africa and the prevalence in Kenya is 11.5% LBW babies (WHO., 2019). Prevalence of LBW has a wide variation across regions in the world and most hospital based cross sectional studies have shown higher prevalence rates than the national prevalence (Thapa et al., 2022). According to a study conducted by Marete et al., (2020), there was no significant change on birth weight by global region in the years between 2013 to 2018. Infants delivered in Africa showed a higher birth weight means across the study period. Incidence of LBW globally was highest in Asia as compared to Africa and central American sites. The mean birth weight was found to be highest in African regional sites in Zambia and Kenya as compared to other regional sites in South Asia and Central America(Marete et al., 2020). Prevalence of LBW in Africa was 4% a figure that is lower than what had been reported by WHO (2019) since data used for UNICEF and WHO were from multiple sources and subjected to modelling (Marete et al., 2020).

In more recent studies conducted in Kenya, the prevalence has been reported to be higher than the national prevalence; In a study conducted by K'Oloo et al., (2023), in Kenya and Tanzania, the prevalence was 12.6% while Mutwika, Onyango, & Okeyo, (2023) reported a prevalence of

13.7% from a study conducted in Jaramogi Odinga Oginga Teaching and Referral Hospital in Nyanza Kenya. The Kenyan Coast region has reported a prevalence of 29% in a study done at the Coast General Hospital (Jumbale et al., 2018) while the prevalence in Kilifi county is at 7% (County Government of Kilifi, 2018). There has been no recently published data on the prevalence of LBW in Kilifi County despite the ongoing interventions rolled out by the government. Efforts to reduce LBW has been standing since 2000, more specifically theperiod 2010and 2015. The world is off course in the aim to achieve the World Health Assembly goal on LBW and without an expedited prevention efforts, the achievement of a 30% reduction in LBW by 2025 will not be possible (WHO, 2019).

2.3 Maternal socio-demographic factors and its association with LBW

The causes of LBW are multifactorial, genetic, and environmental factors play a major role. Despite the known risk factors like parity, low socio-economic status, marital status, maternal age, nutritional status, maternal body mass index, maternal health status, smoking, alcohol intake and infections that have been associated with LBW, there is a regional difference in prevalence of the risk factors which can further increase the odds of LBW delivery across regions (Potpalle et al., 2023; Marete et al., 2020). The determinants of birth weight vary across various ethnic populations and it is still unclear to what extent the LBW of some ethnic groups can be explained by these factors (Marete et al., 2020). Risk factors of LBW are varied and have been associated with a complex cluster of overlapping social, biomedical, and psychological factors. Some of the socio-demographic factors associated with LBW include Primiparity, maternal age and race(Agorinya et al., 2018; Zemenu et al., 2021). Multiple factors affect the growth of the foetus, its duration of gestation and birth weight not limited to extremes of maternal age; <16years and >40years, multiple pregnancy, environmental exposures like pollution of air, tobacco use, and smoking(Blencowe et al., 2019). Significant association was also found between marital status, alcohol intake, pregnancy intention and unwanted birth outcome however after adjustment for confounders using multiple logistics regression to adjust for maternal stress, these factors were found not to be significantly related to poor birth outcome leading to disparities across various findings on the socio demographic factors associated with birth outcomes (Tanpradit & Kaewkiattikun, 2020).Postnatal mothers from poor socio-economic backgrounds often give birth to LBW infants due to prolonged poor maternal health and nutrition, lifestyle and engaging in

physically demanding work in pregnancy which can impact the growth of the foetus(Agorinya et al., 2018; Mohammed et al., 2019). In a study conducted in Tanzania, high prevalence of LBW was associated with extreme maternal age, grand multiparity, extreme maternal age, low level of education, low numbers of ANC visits and obstetric risk factors and complication (Kamala et al., 2018).

LBW in Kenya has been significantly associated with maternal nutrition, maternal age, sex of the child, previous LBW baby and premature rupture of membranes. Shorter postnatal mothers tend to deliver LBW babies, female infants tend to be small in size and multiple deliveries are likely to have small infants in comparison to singleton deliveries(Jumbale et al., 2018; Murage et al., 2018; Supra et al., 2022). LBW has been demonstrated to be linked to desirability of pregnancy, marital status, accessibility to medical services, inadequate antenatal clinic visit and use of contraceptives in a study to explore the pathway of the causes of unfavourable outcomes of birth and antenatal care was found to constitute the link between LBW and several socio-demographic factors(Jumbale, 2018).Several studies have consistently reported the various determinants of LBW, however, there has been few publications focussing on the socio-demographic determinants that are unique to postnatal mothers within the Kilifi County population which has consistently reported a high prevalence rate of LBW. Interventions to reduce LBW in this region will require an understanding of the maternal socio-demographic factors.

2.4 Association between prenatal psychological stress and LBW

Prenatal psychological stress is the variation a pregnant woman feels when unable to get along with the pressure conveyed physiologically and through her behaviours(Bernard et al., 2022).It includes anxiety, maternal depression, and stress and the impact depends on how a mother reacts to the situation based on her coping skills, her feelings of self-esteem, and her experience with the event (Hechler et al., 2019). The impact is also mediated by the support available to her (Omidvar et al., 2018). Predictors of psychological stress can be categorised into social, biological, and psychological factors. Women with mental disorder have an increased risk of adverse obstetric outcomes and the risks are greater among women in the LMICs than their counterparts in HICs (Howard, 2020).

Social factors include deficient socio-economic status, stressors and absence of social assistance like unplanned pregnancies and economic deprivation(Agorinya et al., 2018). Mothers with low socio-economic status have insufficient and few financial resources to meet their financial needs, challenges with realization of health care, social isolation resulting to depression(Li et al., 2020). Social support from a woman's close web can alleviate unwanted effects of antenatal stress and absence of support during pregnancy is a risk to having low birth weight (Mondragón et al., 2019; Westby et al., 2021). In Ethiopia, depression and psychological risk factors was found to have important indirect negative effect, while a positive effect on the poor birth outcome is provided by partner support (Dadi et al., 2020). Some biological factors include obstetric complications. Postnatal mothers tend to experience stress and depression in their first trimester than in third trimester. This is ascribed to symptoms in the first three months which are difficult to cope with for most mothers (Mirieri et al., 2020). History of still birth or miscarriage may result to anxiety and depression in their subsequent pregnancies(Westby et al., 2021; Gravensteen et al., 2018). The main psychological predictor is history of mental disorder (Murauskienė et al., 2020). The risk to maternal mental health disorder may be related to substance abuse, mother's lifestyle like self-care and diet, inactive lifestyle, general poor health habits due to the perilous socio-economic standing leading to minimal social and material resources. These could also be as a result of pre-existing mental health disorder (Sūdžiūtė et al., 2020; Howard, 2020).

Postnatal mothers with prenatal mental disorders may not be concerned with their wellbeing, experience challenges in adhering to medical orientation and difficulty in obtaining proper antenatal care which lead to an increased neonatal mortality and morbidity risk especially in developing countries(Westby et al., 2021; Howard, 2020). Prenatal and post-natal period has the highest prevalence of mental disorder and more frequent is depression affecting 20% of postnatal mothers. Parity of more than 2 presented with a higher risk of depressive symptoms during the first year post-partum(Pereira da Silva et al., 2022). Neuropsychiatry disorders resulting from depression and other common mental health disorders attribute to 15.3% burden,2.8% depression and 15.1% anxiety disorder drawing attention to its importance in public health and the need to integrate screening of mental disorders during routine ANC visits (Shreya et al, 2021). Global prevalence of prenatal depression is approximated at10%. Postnatal mothers in LMICs have

presented a higher prenatal point prevalence of 15.6% and 19.8% after delivery(WHO, 2019). There is scarcity of prevalence data of common prenatal mental disorders in Sub Saharan African. In Addis Ababa, Ethiopia, prevalence of common mental disorders was 45.2% (Gizachew et al., 2020),antenatal depression had a prevalence of 24.94%,3 times higher among postnatal mothers who had depression in the pastas compared to postnatal mothers who have never had depression. (Biratu & Haile, 2015).A longitudinal research on prenatal postnatal mothers at the Maternal Child Health Clinic had a prevalence of 18% of depression and 21% postpartum depression in Kenya (Otieno et al., 2016). Loss of loved ones, unwanted pregnancy, history of chronic illness and obstetric complication were associated with antennal common mental disorders (Gizachew& Biks, 2020)

Poor maternal and birth outcomes like Intra Uterine Growth Restriction(IUGR), premature birth, LBW, still birth, neonatal death, pre-eclampsia, caesarean section, and premature rapture of membranes has been associated with psychological stress(Devisree et al., 2018). Prenatal psychological stress has been shown to indirectly affect the health behaviour of a pregnant woman consequently leading to delay in seeking prenatal care and affecting her ability to assimilate the health education she receives(Glover, 2020). Behavioural responses to psychological stress may also come in the forms of changes in use of prenatal services, exercise, nutrition, substance abuse, and tobacco use and the physiological responses to this kind of stress may present in form of immune and neuroendocrine responses that may result to LBW(Pope et al., 2022). Prenatal psychological stress is missing from the routine measurements in daily obstetric exercise, and this may predict a mother's keenness to personal health issues. It is important to screen all pregnant postnatal mothers for issues of psychological stress like depression, anxiety and perceived stress(Luciano et al., 2022).

Moderate to severe life events and anxiety experienced by pregnant woman increases the risk of premature delivery, foetal distress and LBW(Lim et al., 2020; Li et al., 2020). Against this background, the relation between antenatal psychological stress and birth outcomes have been a subject of interest to many scholars. A study involving more than 2000 postnatal mothers in the U.S. found exposure to stressors significantly linked to many behavioural and clinical risks associated with LBW among Caucasian and African American postnatal mothers. Maternal stress increases the likelihood of having LBW(Li et al., 2020). Analysis of data drawn from

7,740 pregnant postnatal mothers, grouped into five clusters depending on the patterns of psychological stress displayed, new-borns of postnatal mothers characterised by high anxiety, moderate job strain and high depression had LBW infants while those born to postnatal mothers in the cluster characterised by high anxiety, high depression and unemployed were likely to be born preterm. Pregnant postnatal mothers who had increased levels of depressive and anxiety symptoms had a high chance of having poor birth outcomes (Loomans et al., 2013). Antenatal psychological stress can result to low weight gain among prenatal postnatal mothers due to reduced efficiency of calorie utilization. Poor weight gain in prenatal postnatal mothers in turn affects the placenta weight, the length of gestation, and the weight of the foetus(Lim et al., 2020; Li et al., 2020).

Study by Tanpradit & Kaewkiattikun, (2020) conducted in Thailand found no link between serious life events and the increase in the risk of preterm birth and birth outcomes. The study however found that perceived stress scale and stress level were significant predictors of poor birth outcome. The study did not review various intervening factors that might affect psychological stress like social support which are essential factors when assessing any form of psychological stress issues**.**(Tanpradit & Kaewkiattikun, 2020). With different studies eliciting different results, the relationship between antenatal psychological stress and LBW remains inconclusive and hence the need for further investigation Furthermore a review of the empirical literature has shown that many of the research on relationship between LBW and antenatal psychological stress focused on the developed countries and less in the LMICs (Mirieri et al., 2020). More attention has also been on the physical health for the mother and foetus than on prenatal mental health with an assumption to disregards emotional episodes due to hormonal imbalance in pregnancy hence leading to the depression persisting silently resulting to poor birth outcome (Mirieri et al., 2020). Findings on association between birth outcome and psychological stress are inconsistent (Loomans et al., 2013). In Ethiopia, prenatal stress was found to be a predictor of LBW linked to moderate to high levels of stress among pregnant women (Feyisa et al., 2023).

In Kenya, perinatal period has been shown as predictors for depression which was found to be an antepartum risk factor associated with poor birth outcome and postpartum depression (Ongeri et al., 2018). 32.5% of adolescent mothers have reported to have clinically elevated depression and

25.9% had severe depression in pregnancy with the risk factors linked to extremely stressful life context in a younger age and lack of partner or family support. Family support was found to be a protective mechanism in mitigating depression and mental health problems in pregnancy. Most evidence based perinatal depression intervention in LMICs are focused on adults with limited understanding of depression related risk in depressed pregnant or parenting adolescents. This needs further research on the respective regions to understand the unique attribute of the contribution of depression in different populations for custom made intervention specific to the individual populations needs (Osok et al., 2018a).

2.5 Theoretical Framework

Biopsychological theory is a model that discusses the social, environmental, biology and psychological factors in a way to understand how health conditions are affected by multiple levels of organizations that needs to be considered when addressing a health issue (Kusnanto& Agustian, 2018; Xiao et al., 2021).A major focus concerns the stress process in pregnancy which is composed of three fundamental mediators and outcomes outlined in the conceptual framework and the resultant effect of LBW(Flannery et al, 2019; Ramiro-Cortijo et al., 2021). In pregnancy, current and historical medical condition, and behaviour (emotions and coping behaviours, style, and resources) are some of the medical individual level factors that may impact the outcome of pregnancy if not taken care of. Intergenerational partner relationship, social support, family, and social network are some of the relationship level analyses. Socio-cultural level analysis includes cultural norms and values, ethnicity/race, and socio-economic status. Community level analysis include access to quality health, geographical factors and physical environment(Flannery et al., 2019. For this study we narrowed down to studying the medical individual factors like current and historical medical condition, behaviour (emotions and coping behaviours), sociodemographic status under socio-cultural analysis, access to quality health during the ANC visits under community level factors (Independent variable), social support which falls under relationship level analysis was reviewed as an intervening variable and low birth weight which is the outcome for the study (Dependent variable). All these factors either fall under the social, biology or psychological factors that can result to LBW as indicated in figure 2.1 below.

Additional stressors affecting prenatal postnatal mothers include strained intimate relationships, financial difficulties, family burden, employment status and pregnancy related worries(Blount et al., 2021). According to a past study by Bizuayehu (2021), foetal growth and birth weight signify the part of depressive symptoms in pregnancy relating to psychological factors (Bizuayehu et al., 2021). The behavioural pathways of adverse birth outcomes involve lifestyle like smoking and substance abuse implicated with PTB, physical activity, use of tobacco and malnutrition which are the common risk factors for LBW. Currently it may seem that LBW is more frequent with psychopathology consistent with other research however, there is need for follow up to establish whether psychological stress consequence of childbirth outcome is true.

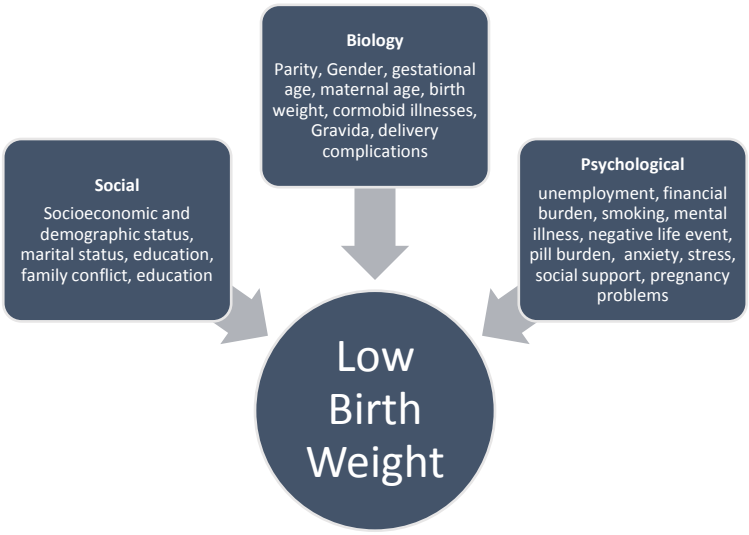


Figure 2.1:Biopsychological model of socio-demographic and psychological stress in pregnancy

Adapted from Biopsychological model of health: a tool to guide the assessment of psychological stress in pregnancy. Retrieved June 2020.(Schneider et al., 2017)

2.6 Conceptual Framework

The conceptual framework for this study was adopted from path model of antenatal stress and depressive symptoms among Chinese primipara in late pregnancy (Li et al., 2016). Antenatal wellbeing of a mother has direct consequence on the birth outcome. This framework has three concepts that was used to describe the entire process. Stressors which are the independent variable included Socio-demographic factor like age, education level, Occupation Parity, marital status, gestational age, smoking, alcohol use, Gravida, religion and psychological stress factors like depression, anxiety, and perceived stress were the stressors. The mediator was the social

support which was analysed as an intervening variable and birth weight classified under stress outcome. By accounting for the intervening variable which in this study was social support, the outcome was either weight >2500g or <2500g which was classified as low birth weight. The original Added socio-demographic factors under the stressors section which are the independent variable and removed the personal resources like coping styles which was not assessed in this study instead the results adjusted for social support as an intervening variable. The original framework was adopted and adjusted for this study by adding socio-demographic factors under the stressors section which are the independent variable and removed the personal resources like coping styles which was not assessed in this study instead the results adjusted for social support as an intervening variable.

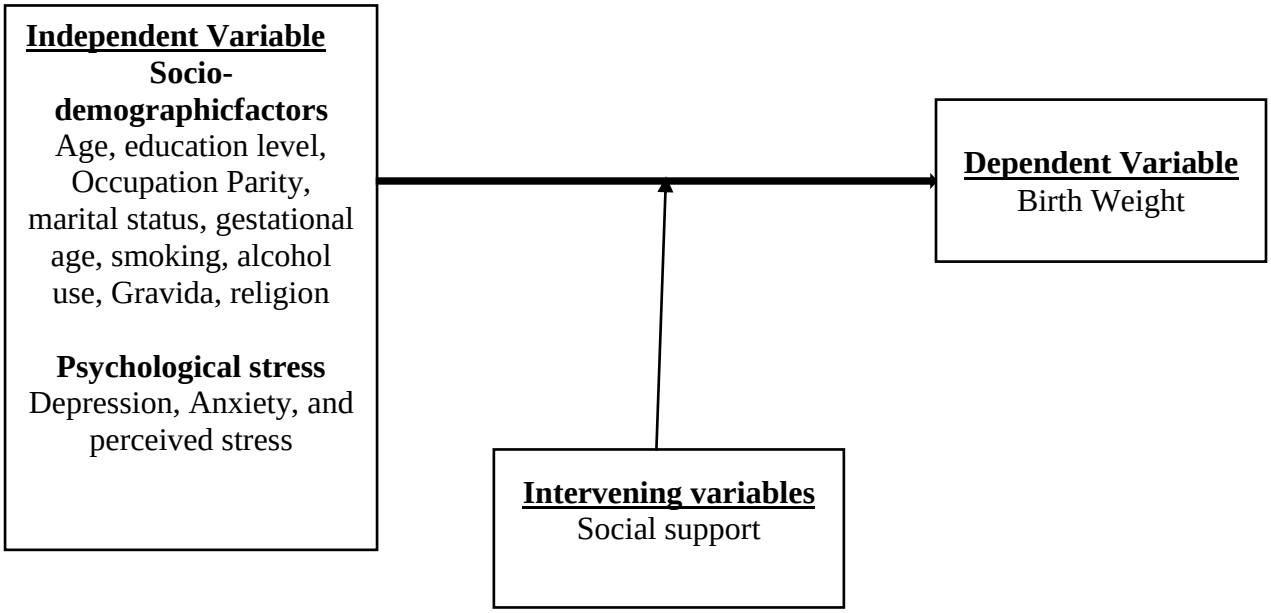


Figure 2.2: Path model for socio-demographic factors and prenatal psychological stress to LBW. Adopted from path model of antenatal stress and depressive symptoms among Chinese primipara in late pregnancy. Retrieved on 17June2020 Li et al., (2016).

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study Area

The research was conducted in Kilifi County whose location is to the northwest of Mombasa. The study site was at Rabai and Kaloleni Sub-Counties which lie between latitudes 3° 38' and 3° 59'*south and longitudes39° 21' and 39° 39'*east (Kenya National Bureau of Statistics, 2022). A map showing the sub-counties within Kilifi County is presented in appendix II. Recruitment of study participants was conducted at Mariakani Sub-County Hospital and Rabai Health Centre which are public facilities managed by the Kilifi County Department of Health Services. These two facilities not only attend to mothers from the sub-counties but also from the neighbouring sub-counties that are closer to them geographically. The Mariakani Sub-County Hospital is a level 4 hospital that serves as a referral hospital for the surrounding community health units, dispensaries, and health centres. Kaloleni and Rabai Sub- Counties have 2 health centres, 2 sub-county hospital, 15 dispensaries and 19 community units all of which refer participants to Mariakani Sub-County Hospital (Ngugi et al., 2020).

3.2 Population

According to strategic purchasing for primary health care in Kilifi County report, the proportion of postnatal mothers with at least four ANC visit was at 54% while proportion of skilled birth attendance was 69%. Over 90% of births in Kaloleni Sub-County were attended by skilled birth personnel at the end of the financial year 2019/ 2020(County Government of Kilifi, 2018). There were 44 maternal deaths in Kilifi County in 2019. No maternal death was reported in Rabai Sub-County however, 10 maternal deaths were reported in Mariakani Sub-County Hospital(County Government of Kilifi, 2019).Target population for this study was constituted by the number of deliveries at the two facilities. Records from the two facilities had an average of 415 infants with LBW out of 5,812 births in 2019 (Rabai and Mariakani Sub County Hospital maternity registers, 2019). It is estimated that in a period of six months, 207 babies with LBW are born to mothers of equal number, in total of 2,906 deliveries.

3.3 Study Design

A retrospective hospital-based cross-sectional study design was used to establish the association between prenatal psychological stress and socio-demographic factors with LBW retrospectively. A hospital-based design was selected owing to convenience of recruiting post-natal mothers either presenting to the Maternal Child Health (MCH) clinic or still in the maternity ward for those who have just delivered. They are more likely to be more motivated and willing to participate; have homogenous health seeking traits; have been observed by skilled medical staff as required, hence information obtained from records and self-report likely to be more objective since the need to ensure that the information bias that affect mothers is similar (Ruano-Ravina & Pérez-Ríos, 2008). A population-based study would however maximize external validity. The design enabled me to retrospectively assess exposure to psychological stress and determine its association with LBW.

3.4 Study variables

Table 3.1: Independent and Dependent Variables and Measures

Variable	Variable definition	Variable measurement
Independent Variables		
Psychosocial stress	An imbalance between demands placed/ experienced by a pregnant woman and her ability to manage them or meet the expectation.	Likert scale: "*0 – never, 1 - almost never, 2 – sometimes, 3 - fairly often, 4 - very often*" response to the respective questions in the perceived stress scale. Scores graded as *Low stress, Moderate stress, or High perceived stress*
Maternal age	Length of time lived in years	• Years
Level of Education	Status defined by formal schooling	Highest level of education attained • No school • Primary • Secondary • Tertiary or post-secondary
Marital status	Partnership or union	• Single (Never been married, widowed, divorced, separated) • Married (Monogamous) • Married (Polygamous)
Occupation	Type of gainful activity one engages in for livelihood	• Formal • Informal • No employment or occupation
Use of alcohol, tobacco, and other hard drugs	Use and consumption of alcohol, cigarette, and other substances such as Marijuana, injectable drug use	• YES • NO
Domestic Violence	Violent or aggressive behaviour within the home, typically involving the violent abuse of a spouse or partner.	• YES • NO
Chronic health problems	A disease that persists for 3 months or more,	• YES • NO
History of pregnancy complication	Any health complication in pregnancy or related to pregnancy	• YES • NO
Dependent Variable		
Birth Weight	Weight of an infant at birth in grams (LBW <2500g Normal weight ≥2500g)	• Birth weight by child welfare card in grams •
Intervening variable		
Social support	Any form of help from the family, friends or community members closes to her	• YES • NO

3.5 Sampling Design

3.5.1 Sample size determination

The sample size was determined as follows:

i) Population Size of target group:

The target population used in this study for sample size determination was derived from the approximate 5812 deliveries recorded in 2019 at the two facilities (Rabai and Mariakani Sub-County Maternity Register, 2019).

ii) Sample size determination

The annual number of deliveries constituted the sampling frame from which an appropriate sample size was obtained using the Yamane formula for sample size calculation(Yamane, 1967):

$$\boldsymbol{n = \frac{N}{1 + N(e)2}}$$

which is $\boldsymbol{n = \frac{5812}{1+5812(0.05)^2}}$

$$\boldsymbol{n = \frac{5812}{1 + 5812(0.0025)}}$$

$$\boldsymbol{n = \frac{5812}{1 + 14.53}}$$

$$\boldsymbol{n = \frac{5812}{15.53}}$$

n = 374.2434

n = 374

Where:

n = minimum sample size required,

N = Population size,

e = the level of precision

3.5.2 Finite Population correction

Sample size adjusted for finite population because the target population of annual deliveries was less than 10,000. *Sample size after correction is **352** as indicated below*

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Where n is the sample size and N is the population size.

$$\boldsymbol{n = \frac{374}{1 + \frac{(374-1)}{5812}}}$$

$$\boldsymbol{n = \frac{374}{1.064}}$$

n = 351.5

n = 352

The sample is further adjusted by 10% for possible non-response
10% of 352 = 35.2 =35
=352+35 which is 387
The Ideal sample size for this proposed study is therefore 387

Margin of Error (Confidence interval: **5%);** Confidence level: **95%**

3.6 Inclusion and Exclusion Criteria

3.6.1 Inclusion Criteria

i) Post-natal mothers aged 15 to 49 years
ii) Mother with term delivery (≥37 weeks of gestation)
iii) Willingness and ability to give informed consent

3.6.2 Exclusion Criteria

Postnatal mothers who delivered multiple babies because delivery of multiple babies is a risk factor for LBW

3.7 Sampling procedure

Simple random sampling was used to select eligible study participants from the two health facilities. The postnatal list from the maternity and antenatal register bearing details of the mothers who attended the clinic or delivered on that day was generated. Simple random sampling was applied. Each member was assigned a unique number and selected using a random

number generator. Postnatal mothers having the selected numbers were included in the sample. The study research assistants with the help of the nurses then located the participants and approached them for possible participation in the study. The selected mothers were screened for participation and only those who were eligible and willing to proceed with the study activities were assessed for enrolment.

3.8 Pre-testing of data collection tools

Pre-testing of data collection tools was done amongst 38 post-natal postnatal mothers in Rabai Sub-County Hospital. The results from pre-test helped to identify aspects that needed to be modified in the data collection tools.

3.8.1 Validity and Reliability

A pre-test of the questionnaire was done to test both the validity and reliability of the questionnaire.

Face validity- was used to check the extent to which a measurement method appears "on its face" to measure the construct of interest of the study.

Reliability

Cronbach's alpha was computed to test for reliability of the data collection instrument. The pre-test yielded an internal consistency of ≥ 0.7 in the three groups of scale tested

Table 3.2: Reliability table

Scale	Average interitem covariance	Number of items in the scale	Scale reliability coefficient
PSS	0.2406958	10	72.78%
HADS	0.1690058	10	78.15%
(HADS-A)	0. 1996016	7	73.40%

3.9 Data collection, tools, and procedures

The Lead Researcher for the study provided scientific oversight, training, technical support to the research team, oversight on development of participant identification numbers, data analysis and preparation of findings for study reports. Four Research assistants provided administrative and

research support at the sites. Under the supervision of the lead researcher, the research assistant identified participants, obtained informed consent, and enrolled participants in the study.

3.9.1 Data collection tools

Data was collected using a self-report questionnaire (Appendix 1). The questionnaire obtained information on socio-demographic and obstetric history as well as experience of psychological stress (anxiety, depression, and stress) based on the following tools: Perceived Stress Scale (PSS), Edinburgh Depression Scale (EDS) and Hospital Anxiety Depression Scale- Anxiety (HADS-A). Additional information on socio-demographic and obstetric history was abstracted from the antenatal booklet.

Possible risk factors for LBW were assessed using a set of questions looking for information on the mother's obstetric and medical history including LBW history, socio-economic status, parity, and demographic features including marital status, age, education, use of tobacco and alcohol.

Maternal stress was evaluated by a 10-item Perceived Stress Scale Cohen, (1994) to determine the extent a situation during pregnancy had been appraised as stressful. This is a validated scale used in prenatal population and its validity and reliability supported among rural and urban pregnant postnatal mothers from ethnically diverse regions. The questions were easy to understand and alternative responses easy to grasp (Woods et al., 2010). It measures thoughts and feelings about stressful happening, control, mastery of stress and coping with pressure. The scale examines risk factors of behavioural disorder and shows stressful relationship processing. The scoring method is according to the Likert scale survey. Mother who scored 0-13 were considered to have low stress, 14 – 26 had moderate stress and those who scored27-40 had high stress. (Kamarck & Mermelstein, 2015). Scores on the PSS-10 demonstrated adequate internal consistency reliability ($\alpha = .78$); moderate concurrent criterion validity with the amount of stress experienced during an average week ($r = .39$, $p < .001$)Cohen and Williamson (1988)

Edinburgh Depression Scale (EDS) was employed to screen perinatal depression. In Kenya, it has been used as a clinical screening tool(Ongeri et al., 2016) English or Swahili version was issued to the mothers depending on their preferred language through a face-to-face interview by the research assistants. The test was completed in 5 minutes with the responses score at 0, 1, 2 or 3 dependents on symptom severity. The scale has a maximum score of 30 with scoring as

follows: 0-9 scores indicate symptom of distress that may be for a short duration and unlikely to tamper with day today tasks and >10 indicates possible depression with a sensitivity of 100%. The scale has acceptable sensitivity of 94.12% and specificity of 93% (Shoaee1 et al., 2019). The scale has acceptable specificity, sensitivity and positive predictive value. EPDS can be used as a valid tool to screen mothers with depression in health care centres (Cox et al., 1987; Ongeri 2015; Osok et al., 2018)..

Hospital Anxiety-Depression Scale-Anxiety (HADS-A) was applied to assess antenatal anxiety. HADS originally developed by Zigmond and Snaith (1983), is often used by doctors to establish anxiety and depression levels a person is having. It is a commonly validated subjective measures for anxiety in perinatal population Snaith (2003). HADS-A has items measuring worry, panic, and fear with a strong proof of psychometric robustness, in pregnancy (Sinesi et al., 2019). All items have a four-point (0-3) response category with scores ranging between 0-21 with: 0-7 score (Normal); 8-10 borderline anxiety; 11-21 abnormal anxiety, (Zigmond and Snaith, 1983). HADS-A is validated for use among prenatal postnatal mothers. It has a93% sensitivity and 90% specificity for the anxiety subscale (Fadzil et al., 2013).

3.9.2 Data Collection and procedures

Postnatal mothers attending their first ANC visit at 6 weeks and those at the maternity ward were identified by the facility nurses and referred to the Research Assistants for group briefing on the study, its objectives, and the procedures. Thereafter, they were given a chance to ask any questions and asked if they were willing to participate in the study. Those who were willing to take part in the research were issued an informed consent form to read. An assessment of understanding (AoU) tool was then administered to assess their comprehension on study and only those who scored 7 out of 10 marks in the first or second attempt were allowed to participate. Those who scored less than 7 in the first attempt were taken through the consent the second time and allowed to take the assessment of understanding the second time. The participants who scored less than 7 the second time were thanked for their time and released to continue with their regular clinic activities since their comprehension to study activities was not adequate. Those who passed the AoU were asked to confirm their willingness to participate in the study by signing the informed consent document which was counter signed by the Research Assistant.

Copy of the signed consent forms were given to participants followed by administration of questionnaires on google form by trained research assistant. Internet data was provided to all the research assistant to facilitate online data collection and real time submission to the lead researcher who verified them for completeness and accuracy, upon completion of every interview. Each interview lasted approximately 45 minutes and all research activities were held in private rooms.

All consent forms containing participant names were stored securely in locked cabinets at the study facilities. All data was recorded using study identification numbers, rather than participant names in google form and submitted in real time upon completion of every interview. The Research assistants engaged to help in the process, were trained on Data and information security before starting data collection process. No personal identifiable information such as name, locator information, phone numbers or Clinic identification numbers was be used during data collection process. All information was recorded using study identification number that was assigned to each participant at screening. The code was in the format, PSS (Psychological Study) followed by facility digit (00 for Rabai and 01 for Mariakani) and 3-digit sequential number which is the n^{th} participant screened per site.

3.10 Data management and analysis

Field data was coded on Statistical Package for the Social Sciences (SPSS) version 20 software. Before analysis, the data was cleaned to eliminate errors, inconsistencies, and multiple entries in the data set. Descriptive statistics (Mean/ SD and proportions) was employed to characterize participants and estimate the prevalence of LBW. Chi-square test of independence was employed to establish the association between socio-demographic factors and psychological stress and association between LBW and psychological stress. Significant associations (p= 0.05) were subjected to logistic regression with crude and adjusted odds ratios estimated. The analysed data was presented in form of frequencies, percentages, charts, and tables. Test for significance was performed with statistical significance considered at p-values < 0.05.

Table 3.3: Summary of data analysis methods applied

Specific objective	Research question	Statistical test
Objective i: To determine the prevalence of LBW in Kilifi County, Kenya	What is the prevalence of LBW in Kilifi County, Kenya?	Descriptive statistics (Mean/ SD and proportions)
Objective ii: To determine the association between socio-demographic factors and LBW among postnatal mothers in Kilifi County, Kenya	What is the association between socio-demographic factors and LBW among postnatal mothers in Kilifi County, Kenya?	Chi-Square test of independence followed by logistics regression for the statistically significant variables
Objective iii: To determine the association between prenatal psychological stress and LBW among postnatal mothers in Kilifi County, Kenya	What is the association between antenatal psychological stress and LBW among postnatal mothers in Kilifi County, Kenya?	Chi-Square test of independence followed by logistics regression for the statistically significant variables

3.11 Ethical Considerations

The research obtained approval from SGS (Appendix III), ethical approval from Maseno University Ethical Review Committee (Appendix IV) and research permit from National Commission for science, Technology, and Innovation (Appendix V). Additionally, necessary permissions/ approvals were obtained from the Kilifi County (Appendix VI), and the two facilities (Rabai and Mariakani Sub-County Hospitals) (Appendix VII and VIII).

Written Informed consent was obtained from participants selected for the research. All informed consent forms and assessment of understanding questionnaire were translated into local languages and back translated to English to ensure correct use of language. Participant confidentiality and privacy was strictly held in trust by the research team. This confidentiality was extended to the data being collected as part of this study. No personal identifying information was used in data collection tools. Data that could be used to identify a specific study participant was held in strict confidence within the research team. No personal-identifiable information from the study was released to any unauthorized third party without prior written approval of the participant or legal authority. All research activities were conducted in as private a setting as possible.

This study posed minimal risk to participants; there were neither experimental drugs nor procedures used in the study; however minimal level of potentially sensitive information like intimate partner violence information were asked that may have caused discomfort to participant. Participants were advised during consenting that they were free to skip any questions that caused them discomfort. Any participant found to score high for anxiety, distress or depression was referred for specialised care within the facility for further management following the existing facility referral plans in place.

Participation in this study was voluntary. Participants were free to decide whether or they wanted to be in this study. They had the right to stop participating in the study at any time without penalty.

CHAPTER FOUR

RESULTS

4.1 Socio-Demographic and Obstetric characteristics of the respondent

In Table 4.1, a total of 387 postnatal mothers from two health facilities (Mariakani Sub-County hospital and Rabai Sub-County hospital) in Kilifi County participated in the study, yielding a response rate of 100%. The mean age of the respondents was 25.9 ±5.1 years with a modal age of26 years. 32.6% of them were falling between 25 to 29 years old. About 7.8% (n=30) of the postnatal mothers had no formal education, 160(41.3%) were of primary level education, 125(32.3%) were of secondary level education and 72(18.6%) were of tertiary education. Majority (86.8%, n=336) of the respondents were married. About half of the respondents (50.4%, n=195) were unemployed. More than half of the respondents (59.4%, n=230) were multiparous and about half of them (47.8%, n=185) had attended at least four antenatal care visit.

Table 4.1: Socio-demographic and obstetric characteristics of postnatal mothers in Kilifi County (n=387)

Characteristics	Frequency n	Percentage %
Age in years		
Mean ±SD = 25.9 ±5.1		
15-19	43	11.1
20-24	124	32.0
25-29	126	32.6
30-34	72	18.6
35-39	16	4.1
40-44	6	1.6
Level of education		
None	30	7.8
Primary	160	41.3
Secondary	125	32.3
Tertiary	72	18.6
Marital status		
Married	336	86.8
Single (Never been married, widowed, divorced, separated)	51	13.2
Employment Status		
Unemployed	195	50.4
Informal employment	128	33.1
Formal employment	48	12.4
Student	16	4.1
Parity		
Multiparous	230	59.4
Primiparous	157	40.6
Number of ANC visit		
None	21	5.4
1- 3	181	46.8
4 and above	185	47.8

4.2 Prevalence of Low Birth Weight among neonatal mothers in Kilifi County

In Figure 4.1 below, the mean (Sd) of birth weight of the infants of the sampled participants was 2818.5(1119.1) g. The overall prevalence of low birth weight (< 2500 g) was 25.1%.

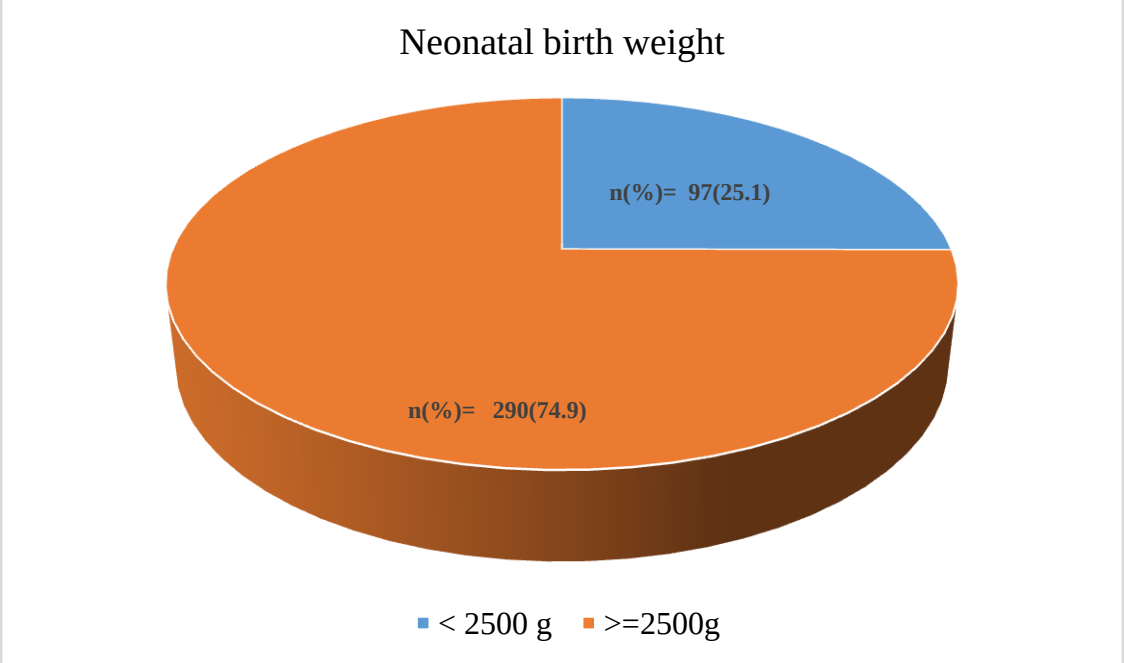


Figure 4.1: Prevalence of low birth weight among postnatal mothers in Kilifi County, Kenya

4.2.1 Prevalence of low birthweight by mothers age and psychological stress

In Figure 4.2, the prevalence of low birthweight was determined by mothers age group. There was high prevalence of low birthweight among mothers aged 15-19 (32.56%) years and 31.25% among mothers aged 35-39 years old. The results in Figure 4.3 reveal that there was high prevalence (66.67%) of low birthweight among mothers who had high perceived stress. Mothers with possible depression had 31.43% prevalence of low birthweight. There was high prevalence (54.29%) of low birthweight among mothers who had abnormal anxiety

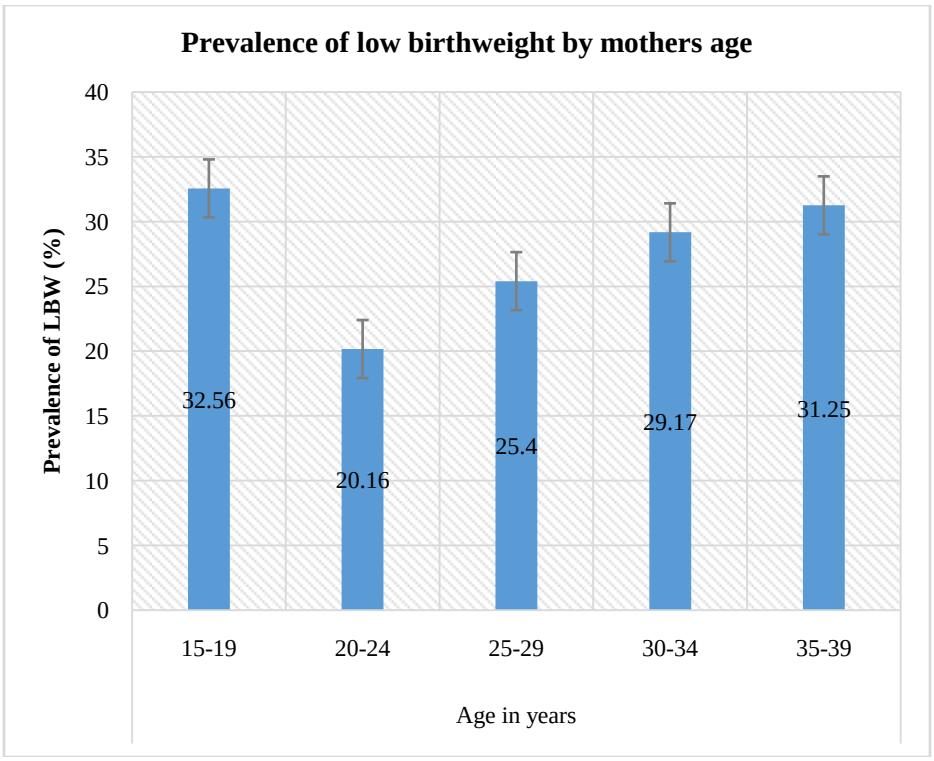


Figure 4.2: Prevalence of low birthweight by age among neonatal mothers in Kilifi County

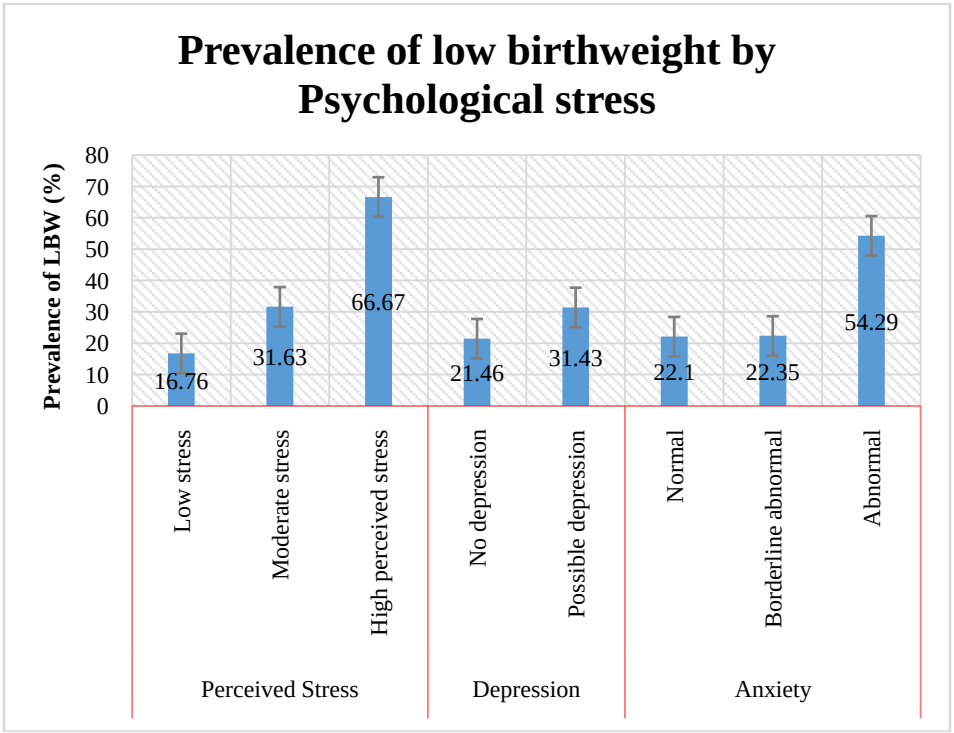


Figure 4.3: Prevalence of low birthweight by psychological stress among neonatal mothers in Kilifi County

4.3 Association between socio-demographic factors and LBW among postnatal mothers in Kilifi County

The association between age of the mother, level of education, occupation, parity, and marital status is shown in **Table 4.2** Level of education and occupation of the mothers were found to be statistically significant in the unadjusted model. Mothers with tertiary level of education were 0.32 times less likely to give birth to children with low birth weight as compared to those with no formal education (95% CI=0.12,0.89, P-value=0.028). For occupation, mothers who were formally employed were 0.35 times less likely to give birth to low-birth-weight children as compared to unemployed mothers (95% CI=0.14,0.86, P-value=0.022). In multivariate analysis, mother's occupation remained significant as odds of giving birth to low-birth-weight infants was low among mothers doing informal jobs as compared to those unemployed mothers (OR=0.55, 95% CI=0.30, 0.96, P-Value=0.045)

Table 4.2: Association between socio-demographic factors and LBW among postnatal mothers in Kilifi County (N=387)

	Birth weight		Unadjusted model		Adjusted model[a]		
Variables	>=2500g n (%)	<2500g n (%)	OR (95% CI)	P-Value	AOR	95% CI	P-Value
Age							
15-19	14(32.6)	29(67.4)	Ref		Ref		
20-24	25(20.2)	99(79.8)	0.52(0.24-1.13)	0.101	0.68	0.28-1.68	0.405
25-29	32(25.4)	94(74.6)	0.71(0.33-1.50)	0.364	1.28	0.49-3.34	0.608
30-34	21(29.2)	51(70.8)	0.85(0.38-1.93)	0.702	1.64	0.57-4.71	0.357
35-39	5(31.3)	11(68.8)	0.94(0.27-3.24)	0.924	1.6	0.38-6.73	0.522
40-44	0(0.0)	6(100.0)	1		1		
Level of education							
None	20(66.7)	10(33.3)	Ref		Ref		
Primary	121(75.6)	39(24.4)	0.64(0.28,1.49)	0.306	0.72	0.30-1.76	0.475
Secondary	87(69.6)	38(30.4)	0.87(0.37,2.0)	0.755	1.16	0.46-2.95	0.749
Tertiary	62(86.1)	10(13.9)	0.32(0.12,0.89)	**0.028**	0.62	0.18-2.09	0.439
Employment type							
Unemployed	138(70.8)	57(29.3)	Ref		Ref		
Informal	100(78.1)	28(21.9)	0.68(0.40,1.14)	0.143	0.55	0.30-0.99	**0.045**
Formal	42(87.5)	6(12.5)	0.35(0.14,0.86)	**0.022**	0.34	0.11-1.12	0.076
Student	10(62.5)	6(37.5)	1.45(0.50,4.18)	0.489	0.83	0.23-3.04	0.776
Parity							
Multiparous	173(75.2)	57(24.8)	Ref		Ref		
Primiparous	117(74.5)	40(25.5)	1.04(0.65,1.66)	0.877	1.09	0.60-1.98	0.779
Marital Status							
Married	257(76.5)	79(23.5)	Ref		Ref		
Single	33(64.7)	18(35.3)	1.77(0.95,3.32)	0.073	1.88	0.86-4.10	0.113

1. [a] All predictors were adjusted for social support in the model, AOR; adjusted odds ratio

4.4 Association between prenatal psychological stress and LBW among postnatal mothers in Kilifi County

In Table 4.3, stress, depression, anxiety, social support, and ANC attendance were found to be statistically significant factors associated with low birth weight (P-value<0.05).

Table 4.3 Factors associated with low birth weight

	Birth weight			
	>=2500g	<2500g		
	n (%)	n (%)	χ^2 Value	P-value
Stress scale			16.83	<0.001
Low stress	154(83.2)	31(16.8)		
Moderate stress	134(68.4)	62(31.6)		
high perceived stress	2(33.3)	4(66.7)		
Depression scale			4.73	0.030
No depression	194(78.5)	53(21.5)		
Possible depression	96(68.6)	44(31.4)		
Anxiety and depression scale			17.50	<0.001
Normal	208(77.9)	59(22.1)		
Borderline abnormal	66(77.7)	19(22.4)		
Abnormal	16(45.7)	19(54.3)		
Tobacco smocking			0.34	0.563
Yes	289(74.9)	97(25.1)		
No	1(100.0)	0(0.0)		
Experienced violence during pregnancy			0.07	0.794
No	263(74.5)	90(25.5)		
Yes	23(76.7)	7(23.3)		
Planned pregnancy			1.91	0.167
No	83(70.3)	35(29.7)		
Yes	207(77.0)	62(23.0)		
Medical condition before pregnancy			1.19	0.275
No	285(75.2)	94(24.8)		
Yes	4(57.1)	3(42.9)		
History of low birth weight			0.51	0.476
No	227(73.2)	83(26.8)		
Yes	23(79.3)	6(20.7)		
Number of ANC visit			7.18	0.028
None	15(71.4)	6(28.6)		
1-3	125(69.1)	56(30.9)		
≥4	150(81.1)	35(18.9)		

In Table 4.4, bivariate and multivariate analyses were used to determine the association between prenatal psychological stress and LBW among postnatal mothers. Stress, depression, anxiety, and ANC visit were found to be statistically significant factors associated with low birthweight. For unadjusted logistic regression, women with moderate stress (OR=2.30, 95%CI=1.41, 3.78, P-Value=0.001) and those with high stress (OR=9.94, 95%CI=1.74,56.64, P-Value=0.01) had higher odds of giving birth to LBW infants as compared to those with less stress. Depressed mothers were 1.68 times more likely to give birth to LBW infant. Using hospital anxiety and depression scale-anxiety to assess the level of anxiety of the participant, the results reveal that majority (54.3%, n=19) of the women with abnormal level of anxiety gave birth to LBW infants. The odds of giving birth to LBW infants were higher on women with abnormal level of anxiety as compared to those with normal level (OR=4.19, 95% CI=2.03, 8.65, P-Value<0.001). Women who attended < 4 ANC visits were more likely to give birth to low-birth-weight infants as compared to those who attended 4 visits and above (OR=1.92, 95% CI=1.92-1.18-3.12, P-value=0.008).

In multivariate analysis, three different models were developed to determine association between psychological stress and low birthweight. Participants with moderate stress and those with high perceived stress were more like to give birth to children with low birthweight as compared to those with no stress (AOR=2.21, 95%CI=1.33-3.67, P-value=0.002) and (AOR=9.18, 95%CI=1.49-56.51, P-value=0.017) respectively. For depression, participants with possible depression symptoms had higher odds of giving birth to children of low birthweight as compared to those with no depression (AOR=1.87, 95%CI=1.15-3.04); those with abnormal anxiety and depression level were also found to be more likely to give birth to children of low birthweight (AOR=5.19, 95%CI=2.44-11.03)

Table 4.4: Association between prenatal psychological stress and LBW among postnatal mothers in Kilifi County (n=387)

	Bivariate analysis		Multivariate logistic regression					
			model1		model2		model3	
	OR(95% CI)	P	AOR(95% CI)	P	AOR(95% CI)	P	AOR(95% CI)	P
Stress scale								
Low	Ref		Ref	-				
Moderate	2.30(1.41, 3.78)	0.001	2.21(1.33-3.67)	0.002				
high perceived	9.94(1.74,56.64)	0.010	9.18(1.49-56.51)	0.017				
Depression scale								
No depression	Ref	-			Ref	-		
Possible depression	1.68(1.05, 2.68)	0.030			1.67(1.00-2.77)	0.049		
Anxiety and depression scale								
Normal	Ref	-					Ref	-
Borderline abnormal	1.01(0.56, 1.82)	0.961					1.04(0.56-1.91)	0.905
Abnormal	4.19(2.03, 8.65)	<0.001					4.44(2.05-9.62)	<0.001
Number of ANC visit								
None	1.71 (0.62-4.73)	0.298	1.45(0.49-4.27)	0.499	1.37(0.49-3.81)	0.547	1.61(0.55-4.69)	0.386
1-3	1.92(1.18-3.12)	0.008	1.79(1.08-2.97)	0.025	1.74(1.06-2.87)	0.029	1.68(1.02-2.79)	0.044
≥4	Ref	-	Ref	-	Ref	-	Ref	-

- OR= unadjusted odds ratio, AOR= adjusted odds ratio, CI=confidence interval
- Stress scale, depression scale and anxiety and depression scale are correlated factors hence could not be included in one model

CHAPTER FIVE
DISCUSSION

5.1 Prevalence of low birth weight

The study found that 25.1% of infants born in Mariakani and Rabai Sub-County hospitals in Kilifi County had birth weight below 2500g (LBW).Mean weight of new-born infants was 2818g. A total of 97 infants had LBW while 290 had weight above 2500g. Birth weight was abstracted from the ANC booklets.

The prevalence of LBW reported in this study was much higher than the estimated prevalence in Kenya (11.5%) and global prevalence (14.6%) (WHO, 2019). This could be because the two facilities are the main referral hospitals with theatre and doctors to handle any obstetrics emergencies and adverse birth outcomes. They are therefore likely to handle more mother with LBW hence the higher prevalence. In one study done at Olkalou district Hospital Central region Kenya, the prevalence of LBW was estimated at 12.3% (Muchemi, Echoka, & Makokha, 2015), in another study conducted in Migori County Kenya by (Olack*et al*, 2021), the estimated prevalence of LBW was 8.0%, while in Kenyatta National Hospital in a study done by Mugambi (2015), the prevalence of LBW was 9.9% and in Kisumu County Hospital from a study by Achieng (2020) the prevalence was 17.5%.It is possible to hypothesize that women from the lower socioeconomic class who are therefore more likely to experience adverse obstetric outcomes, including LBW and pre-term labour would more likely choose these hospitals for their delivery, resulting in a high prevalence of LBW. This prevalence is however lower than the prevalence of LBW reported by a previous study done in the coastal region- 29% in Mombasa (Jumbale, 2018). Unlike previous studies, the present study deliberately disaggregated prevalence of LBW by age, which did not vary much across the reproductive phase of women. Though the reported prevalence is high, there has been several efforts made on focussed antenatal care that has made great impact on lowering the prevalence of LBW in the Country and more of these strategies should be put in place to lower it further and achieve the WHO target.

5.2 Association between socio-demographic characteristics and low birth weight

This study revealed that level of education and occupation were significantly associated with LBW. Mothers with tertiary education, formal and informal employment were less likely to deliver LBW infants. Majority of mothers had no formal employment and had lower level of

education which has a potential to limit their decision-making capacity that directly impacts on their health seeking behaviours during pregnancy. Employment and level of education have been known to be a proxy to sociodemographic status which improved on birth outcome(KDHS, 2022). These results were consistent with the results from studies conducted in Ghana, Ethiopia, Kenya and Ghana(Jumbale, 2018; Falcão et al., 2020; Restrepo-Méndez et al, 2011; Muchemi et al., 2015; Mohammed et al, 2019; Zemenu et al 2021). This result is in line with other studies that link LBW to mothers' educational level.This might be the case because educated women are more likely to be aware of the dangers of LBW and exercise prudence when pregnant to reduce the risk. Women with high level of education are associated with improvement in ANC attendance, better nutritional practice, better health-seeking behaviour, and better maternal experiences with pregnancy and childrearing which may be explanation for the association between level of education and LBW.

Another socio-demographic characteristic associated with LBW was found to be mother's occupation. In bivariate analysis, formally employed women were significantly less likely to deliver a LBW infant as compared to unemployed women while in multivariate analysis, women doing informal jobs were less likely to give birth to LBW infants than unemployed women. Mothers who are employed are less likely to deliver a LBW infant as compared to those who are unemployed (Manyeh et al, 2016). According to Patil et al (2020) women with a high employment uncertainty had a higher risk of LBW delivery than those with a low employment uncertainty (Patil et al, 2020)A possible explanation to this might be financial and non-financial stressors associated with unemployment that contribute to foetus development and hence LBW. In addition to financial stressors, unemployed women could be economically and psychologically dependent on other people thus affecting their concentration to their health and wellbeing of the pregnancy

In this study, there was no significant association between mothers age and low birthweight. However, there was high odds of giving birth to low birthweight children among older women and low odds among women aged 20-25 years as compared to women aged 15-19 years old. This is in line with studies that have revealed a U- shaped relationship between maternal age and LBW, with teenagers and older women having the highest risk of giving birth to LBW infants. An increase in age increases the odds of LBW for women aged ≥36 years.(Jumbale, 2018;

Falcão et al., 2020; Restrepo-Méndez et al., 2011; Muchemi et al., 2015; Mohammed et al., 2019; Zemenu et al., 2021).

Although this study did not find any significant association between ANC attendance and LBW, studies conducted in Brazil (Falcão et al., 2020), UK(Zemenu et al., 2021), Ghana(Agorinya et al., 2018; Mohammed et al., 2019), and Kenya(Nyamasege et al., 2018) have reported the probability of a woman delivering a LBW infant decreases with an increase of the number of ANC attended This could be due to insufficient prenatal care, a lack of iron and folic acid supplements, and inadequate detection and management of infections, as well as inadequate prenatal education and ANC visits. The health of the expectant mother and the growing foetus is strongly suggested by the fact that quality ANC is crucial during pregnancy. This is made possible by crucial actions including the detection and treatment of maternal problems like preeclampsia and tetanus toxoid vaccination, intermittent preventive treatment for malaria during pregnancy (IPTp), and identification and management of infections including HIV, Syphilis, and other sexually transmitted infections (STIs) at the ANC.

5.3 Association between prenatal psychological stress and low birth weight

This study reveals that psychological stress (stress, depression, and anxiety) are significant risk factors for LBW. Mothers with perceived stress, anxiety and depression had a higher odd of delivering LBW infants. Mothers who attended less than 4 ANC visits were more likely to deliver LBW infants and mothers who had a form of social support were less likely to have LBW infants. While more women had a form of social support, a few of them had attended the recommended number of ANC visits. This could be translated that lack of adequate access to skilled antenatal care directly impacted on the birth outcome. Low socio-economic status among most women could have been a reason for the increased risk to psychological stress which in turn lead to higher odd of LBW. Most mothers did not attend the required ANC visits hence increasing the possibility to miss out on early diagnosis of psychological stress which in turn could have led to delivery of LBW. It is plausible that the underlying issue could have been lack of adequate comprehensive ANC care though further research should be conducted to ascertain this.

This is consistent with previous studies which reported that women who exhibit possible signs and symptoms of stress, depression and anxiety during pregnancy were at higher risk of giving birth to LBW infants Mondragón et al., 2019; Dadi et al., 2020).Mothers with current or previous exposure to abuse or violence, who lack social support and had a family history of common mental disorder were likely to deliver a LBW infant. Those with depression were 1.49 times likely to deliver a LBW infant(Weber et al., 2020). In a different study, women who experienced antenatal psychological stress delivered infants who were 57.5g lighter and were more likely to deliver LBW infants (Lim et al., 2020) and pregnant women presenting with antenatal depressive symptoms had an elevated risk of delivery LBW infants (Xiuxiu et al., 2020). Antenatal Anxiety and depression have also been shown to cause preterm labour leading to LBW (Luciano et al., 2022). Pregnant women have been observed to have a high prevalence and incidence of anxiety disorder and major neuropsychiatric disorder that was directly associated with poor birth outcome of preterm birth and LBW (Silva et al.,2022; Gravensteen et al., 2018; Shreya et al., 2021)

5.4 Limitation of the study

Since this was a retrospective study, only mothers who had delivered within 6 weeks as at the time of the interview were consented for participation to avoid recall bias. It was not possible to demonstrate variation in low birth weight because the study was cross-sectional in design. The finding may not be generalizable beyond the study area since it was hospital based done in only two facilities. Validity of the findings could theoretically have been affected by the variations in psychological stress measurement however this was minimised using validated tools for assessing prenatal psychological stress, enhanced supervision, refresher trainings, communication, clear feedback, and accountability structures. The self-reported data could have also led to under reporting of sensitive behaviours and emotions necessary to assess exposure to anxiety, depression, and perceived stress during the pregnancy. This was managed using validated tools used to assess prenatal psychological stress. A future longitudinal study would therefore be recommended to address this

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

1. 25.1% of women in this study had LBW.
2. Maternal age, occupation and level of education were sociodemographic predictors found to be significantly associated with LBW.
3. Psychological stress (Perceived stress, anxiety, and depression) was significantly associated with LBW

6.2 Recommendation

1. Population based study to be conducted to establish the prevalence of LBW in the County
2. Interventional programs and health promotion should be encouraged not only in health sectors but also in social welfare programs to address the social needs of pregnant women and encourage attendance of at least 4 ANC visits as required by the guidelines
3. Routine screening for prenatal psychological stress at the antenatal clinics using approved scales for assessing prenatal psychological stress

Further research on prenatal psychological stress to explore the influence of other psychological stress predictors of LBW and the prevalence of psychological stress in different phases of pregnancy

REFERENCES

Anil K. C. ,Prem Lal Basel, S. S. (2020). Low birth weight and its associated risk factors: Health facility-based case-control study. *PLoS ONE*, *10.1371*.

Ashley J. Blount, Charmayne R. Adams, Ann L. Anderson-Berry, Corrine Hanson, Kara Schneider, and G. P. (2021). Biopsychosocial Factors during the Perinatal Period: Risks, Preventative Factors, and Implications for Healthcare Professionals. *Pubmed*, *18*.

Beatrice Olack, Nicole Santos, Mary Inziani, Vincent Moshi, Polycarp Oyoo, Grace Nalwa, Linet Christopher OumaOtare, D. W. & P. A. O. (2021). Causes of preterm and low birth weight neonatal mortality in a rural community in Kenya: evidence from verbal and social autopsy. *BMC Pregnancy and Childbirth*.

Biratu, A., & Haile, D. (2015). Prevalence of antenatal depression and associated factors among pregnant women in Addis Ababa, Ethiopia: A cross-sectional study. *Reproductive Health*. https://doi.org/10.1186/s12978-015-0092-x

Blencowe, H., Krasevec, J., de Onis, M., Black, R. E., An, X., Stevens, G. A., … Cousens, S. (2019). National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis. *The Lancet Global Health*. https://doi.org/10.1016/S2214-109X(18)30565-5

Bruno Pereira da Silva, Alicia Matijasevich, Maíra Barreto Malta, P. A. R., Neves, Maria Cristina Mazzaia, Maria Cristina Gabrielloni, M. C. C., & Cardoso, M. A. (2022). Common mental disorders in pregnancy and postnatal depressive symptoms in the MINA-Brazil study: occurrence and associated factors. *RSP*.

Caragh Flannery, Darren Dahly, Molly Byrne, Ali Khashan, Sheena McHugh, Louise C Kenny, Fionnuala McAuliffe, P. M. K. (2019). Social, biological, behavioural and psychological factors related to physical activity during early pregnancy in the Screening for Pregnancy Endpoints (Cork, Ireland) cohort study. *BMJ Open*, *9*.

Carol Viviana Paredes Mondragón, Hoover Molano Dorado, Sandra Yamile Martínez Gómez, Roberth Alirio Ortiz Martínez, Stephany Arias Linthon, A. C. L. B. (2019). Relationship Between the Absence of Adequate Social Support During Pregnancy and Low Birth Weight. *Pubmed*.

Cèline Lossius Westby, Andrea Røsberg Erlandsen, Sondre Aasen Nilsen, E. V. & J. C. T. (2021). Depression, anxiety, PTSD, and OCD after stillbirth: a systematic review. *BMC Pregnancy and Childbirth*.

Claris Mbodze Jumbale, S. K. and R. U. (2018). Factors influencing low birth weight (LBW) among mother-neonate pairs and associated heath outcomes at Coast General Hospital Mombasa County Kenya.*GJHS*, *3*.

Cohen, Sheldon. (1994). Perceived tress cale. *Perceived Stress Scale*, 1.

County Government of Kilifi. (2018). Republic of Kenya, County Government of Kilifi, County Integrated Development Plan 2018-2022. *County Integrated Development Plan 2018-2022*.

Dadi, A. F., Miller, E. R., Woodman, R. J., Azale, T., & Mwanri, L. (2020). Effect of antenatal depression on adverse birth outcomes in Gondar town, Ethiopia: A community-based cohort study. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0234728

Dadi, A. F., Wolde, H. F., Baraki, A. G., & Akalu, T. Y. (2020). Epidemiology of antenatal depression in Africa: A systematic review and meta-analysis. *BMC Pregnancy and Childbirth*. https://doi.org/10.1186/s12884-020-02929-5

David Ramiro-Cortijo, Maria de la Calle, Vanesa Benitez, Andrea Gila-Diaz, Bernardo Moreno-Jiménez, Silvia M. Arribas, and E. G. (2021). Maternal Psychological and Biological

Factors Associated to Gestational Complications. *Pubmed*.
DeSocio, J. E. (2018). Epigenetics, maternal prenatal psychosocial stress, and infant mental health. *Archives of Psychiatric Nursing*. https://doi.org/10.1016/j.apnu.2018.09.001
Devaguru, A., Gada, S., Potpalle, D., Dinesh Eshwar, M., & Purwar, D. (2023). The Prevalence of Low Birth Weight Among Newborn Babies and Its Associated Maternal Risk Factors: A Hospital-Based Cross-Sectional Study. *Cureus*. https://doi.org/10.7759/cureus.38587
Devisree, R., Nirmala, C., Indu, P. S., & Remadevi, S. (2018). Development of antenatal psychosocial stress scale for pregnant women in Kerala, India. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. https://doi.org/10.18203/2320-1770.ijrcog20181338
Divya Patil, Daniel A Enquobahrie, Trevor Peckham, Noah Seixas, A. H. (2020). Retrospective cohort study of the association between maternal employment precarity and infant low birth weight in women in the USA. *Bmj*.
Feyisa, B. R., Mulatu, Y., Fentahun, F., Biru, B., & Atlantis, E. (2023). Nutrition, stress, and healthcare use during pregnancy are associated with low birth weight: evidence from a case–control study in West Ethiopia. *Frontiers in Public Health*, *11*. https://doi.org/10.3389/fpubh.2023.1213291
Gliedt, J. A., Schneider, M. J., Evans, M. W., King, J., & Eubanks, J. E. (2017). The biopsychosocial model and chiropractic: A commentary with recommendations for the chiropractic profession. *Chiropractic and Manual Therapies*. https://doi.org/10.1186/s12998-017-0147-x
Habtamu Mellie Bizuayehu, Melissa L Harris, Catherine Chojenta, Peta M Forder, D. L. (2021). Low birth weight and its associated biopsychosocial factors over a 19-year period: findings from a national cohort study. *Pubmed*.
Haikel A Lim, Tze-Ern Chua, Rahul Malhotra , John C Allen , Bernard S M Chern, Kok Hian Tan, H. C. (2020). Trajectories of antenatal maternal psychological stress and their association with gestational age and neonatal anthropometry: A prospective cohort study of multi-ethnic Asian women in an urban setting. *Pubmed*.
Hari Kusnanto, Dwi Agustian, and D. H. (2018). Biopsychosocial model of illnesses in primary care: A hermeneutic literature review. *Pubmed*.
Hechler, C., Borewicz, K., Beijers, R., Saccenti, E., Riksen-Walraven, M., Smidt, H., & de Weerth, C. (2019). Association between Psychosocial Stress and Fecal Microbiota in Pregnant Women. *Scientific Reports*. https://doi.org/10.1038/s41598-019-40434-8
Ida Kathrine Gravensteen, Eva-Marie Jacobsen, Per Morten Sandset, Linda Bjørk Helgadottir, Ingela Rådestad, L. S. & Ø. E. (2018). Anxiety, depression and relationship satisfaction in the pregnancy following stillbirth and after the birth of a live-born baby: a prospective study. *BMC Pregnancy and Childbirth*.
Ila R. Falcão, Rita de Cássia Ribeiro-Silva1, M. F. de A., Fiaccone, R. L., Aline dos S. Rocha, N. O., Silva, N. J., , Enny S. Paixao, M. Y. I., & Barreto, L. C. R. and M. L. (2020). Factors associated with low birth weight at term: a population-based linkage study of the 100 million Brazilian cohort. *BMC Pregnancy and Childbirth*, *20:536*.
Isaiah Awintuen Agorinya, Edmund Wedam Kanmiki, Engelbert Adamwaba Nonterah, Fabrizio Tediosi, James Akazili, Paul Welaga, Daniel Azongo, Abraham Rexford Oduro. (2018). Socio-demographic determinants of low birth weight: Evidence from the Kassena-Nankana districts of the Upper East Region of Ghana. *PLoS ONE*.
Jha, Shreya; Salve, Harshal Ramesh; Goswami, Kiran; Sagar, Rajesh; Kant, S. (2021).

Prevalence of Common Mental Disorders among pregnant women—Evidence from population-based study in rural Haryana, India. *JFMPC*.

Johanna Pope, Ellinor K. Olander, Sara Leitao, Sarah Meaney, K. M.-S. (2022). Prenatal stress, health, and health behaviours during the COVID-19 pandemic: An international survey. *Science Direct*.

K'Oloo, A., Godfrey, E., Koivu, A. M., Barsosio, H. C., Manji, K., Ndesangia, V., … Näsänen-Gilmore, P. (2023). Improving birth weight measurement and recording practices in Kenya and Tanzania: a prospective intervention study with historical controls. *Population Health Metrics*, *21*(1), 6. https://doi.org/10.1186/s12963-023-00305-x

Kamala, B. A., Mgaya, A. H., Ngarina, M. M., & Kidanto, H. L. (2018). Predictors of low birth weight and 24-hour perinatal outcomes at Muhimbili National Hospital in Dar es Salaam, Tanzania: a five-year retrospective analysis of obstetric records. *Pan African Medical Journal*, *29*. https://doi.org/10.11604/pamj.2018.29.220.15247

KDHS. (2022). *Kenya Demographic and Health Survey*.

Kefyalew Dagne Gizachew, Gashaw Andargie Biks, A. D. W. (2020). Prevalence and determinants of Common Mental Disorder among pregnant women In Debre Berhan town: Highland in Central Ethiopia. *Research Square*.

Kenya National Bureau of statistics. (2019). 009 POPULATION AND HOUSING CENSUS HIGHLIGHTS. *Population (English Edition)*.

Kenyanya, J. O., Kikuvi, G., Wanzala, P., & Nyagero, J. (2023). Maternal Factors Associated with Low Birth Weight Among Neonates Born at Thika Level 5 Hospital in Kiambu County, Kenya. *International Journal of Health Sciences*, *6*(5), 58–100. https://doi.org/10.47941/ijhs.1464

Kotryna Sūdžiūtė, Greta Murauskienė, Kristina Jarienė, Algirdas Jaras, Meilė Minkauskienė, V. A. & I. N. (2020). Pre-existing mental health disorders affect pregnancy and neonatal outcomes: a retrospective cohort study. *BMC Pregnancy and Childbirth*.

Li, Y., Zeng, Y., Zhu, W., Cui, Y., & Li, J. (2016). Path model of antenatal stress and depressive symptoms among Chinese primipara in late pregnancy. *BMC Pregnancy and Childbirth*. https://doi.org/10.1186/s12884-016-0972-2

Loomans, E. M., Van Dijk, A. E., Vrijkotte, T. G. M., Van Eijsden, M., Stronks, K., Gemke, R. J. B. J., & Van Den Bergh, B. R. H. (2013). Psychosocial stress during pregnancy is related to adverse birth outcomes: Results from a large multi-ethnic community-based birth cohort. *European Journal of Public Health*. https://doi.org/10.1093/eurpub/cks097

Louise M. Howard, H. K. (2020). Perinatal mental health: a review of progress and challenges. *World Psychiatry*.

Marete, I., Ekhaguere, O., Bann, C. M., Bucher, S. L., Nyongesa, P., Patel, A. B., … Esamai, F. (2020). Regional trends in birth weight in low- and middle-income countries 2013–2018. *Reproductive Health*, *17*(S3), 176. https://doi.org/10.1186/s12978-020-01026-2

Mario Luciano, Matteo Di Vincenzo, Carlotta Brandi, Lucia Tretola, Rita Toricco, Francesco Perris, Antonio Volpicelli, Marco Torella, Marco La Verde, Andrea Fiorillo, G. S. (2022). Does antenatal depression predict post-partum depression and obstetric complications? Results from a longitudinal, long-term, real-world study. *Pubmed*.

Mirieri, H. K., Mweu, M. M., & Olenja, J. M. (2020). Determinants of prenatal depression among women attending the antenatal clinic at a referral facility in Mombasa County, Kenya: a case control study. *F1000Research*. https://doi.org/10.12688/f1000research.22017.1

Musau, M. M., Mwakio, S., Amadi, D., Nyaguara, A., Bejon, P., Berkley, J. A., … Kamau, A. (2023). Spatial heterogeneity of low-birthweight deliveries on the Kenyan coast. *BMC Pregnancy and Childbirth*, *23*(1), 270. https://doi.org/10.1186/s12884-023-05586-6

Mutwika, L. K., Onyango, C. A., & Okeyo, D. O. (2023). Obstetric Determinants of Birth Weight Status of Babies Born at Jaramogi Oginga Odinga Teaching and Referral Hospital, Kenya. *East African Journal of Health and Science*, *6*(1), 9–19. https://doi.org/10.37284/eajhs.6.1.1096

Nathalie Bernard,Yves Giguère ,Joanie Mélançon,Réjean Tessier,George M. Tarabulsy, J.-C. F. (2022). Sex-specific association of high maternal psychological stress during pregnancy on newborn birthweight. *PLoS ONE*.

Ngugi, A. K., Odhiambo, R., Agoi, F., Lakhani, A., Orwa, J., Obure, J., … Temmerman, M. (2020). Cohort profile: The kaloleni/rabai community health and demographic surveillance system. *International Journal of Epidemiology*, Vol. 49. https://doi.org/10.1093/IJE/DYZ252

Nyamasege, C. K. Kimani-Murage, E. W., Wanjohi, M., Kaindi, D. W. M., Ma, E., Fukushige, M., And, & Wagatsuma, Y. (2018). Determinants of low birth weight in the context of maternal nutrition education in urban informal settlements, Kenya. *Cambridge Core*.

Omidvar, S., Faramarzi, M., Hajian-Tilak, K., & Amiri, F. N. (2018). Associations of psychosocial factors with pregnancy healthy life styles. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0191723

Ongeri, L., Wanga, V., Otieno, P., Mbui, J., Juma, E., Stoep, A. Vander, & Mathai, M. (2018). Demographic, psychosocial and clinical factors associated with postpartum depression in Kenyan women. *BMC Psychiatry*, *18*(1), 318. https://doi.org/10.1186/s12888-018-1904-7

Organization., U. and W. H. (2019). Low birthweight estimates. *World Health Organization*.

Osok, J., Kigamwa, P., Stoep, A. Vander, Huang, K.-Y., & Kumar, M. (2018a). Depression and its psychosocial risk factors in pregnant Kenyan adolescents: a cross-sectional study in a community health Centre of Nairobi. *BMC Psychiatry*, *18*(1), 136. https://doi.org/10.1186/s12888-018-1706-y

Osok, J., Kigamwa, P., Stoep, A. Vander, Huang, K. Y., & Kumar, M. (2018b). Depression and its psychosocial risk factors in pregnant Kenyan adolescents: A cross-sectional study in a community health Centre of Nairobi. *BMC Psychiatry*. https://doi.org/10.1186/s12888-018-1706-y

Shamsudeen Mohammed, Irene Bonsing, Ibrahim Yakubu, W. P. W. (2019). Maternal obstetric and socio-demographic determinants of low birth weight: a retrospective cross-sectional study in Ghana. *Bmc*.

Shoaee1, F., Mohsenpour1, Z., Najarzadegan2, M. R., Nekouhi3, S., Razmjouei4, P., Babakhanian5, M., … Hossein Kareshki8. (2019). Sensitivity and Specificity of the Edinburgh Postnatal Depression Scale (EPDS) among Iranian Mothers: A Psychometric Studye. *International Journal of Paediatrics*, *7*.

Sinesi, A., Maxwell, M., O'Carroll, R., & Cheyne, H. (2019). Anxiety scales used in pregnancy: systematic review. *BJPsych Open*. https://doi.org/10.1192/bjo.2018.75

Snaith, R. P. (2003). The hospital anxiety and depression scale. *Health and Quality of Life Outcomes*. https://doi.org/10.1186/1477-7525-1-29

Supra, J. C., Wang'ombe, | Ann, & Otieno, | Vincent. (2022). Pregnancy factors affetcing birth weight of babies born at a private tertiary facility in Nairobi, Kenya: Part. *TNH Med J*.

Tanpradit, K., & Kaewkiattikun, K. (2020). The Effect of Perceived Stress During Pregnancy on

Preterm Birth. *International Journal of Women's Health*, *Volume 12*, 287–293. https://doi.org/10.2147/IJWH.S239138

Thapa, P., Poudyal, A., Poudel, R., Upadhyaya, D. P., Timalsina, A., Bhandari, R., … Adhikari, N. (2022). Prevalence of low birth weight and its associated factors: Hospital based cross sectional study in Nepal. *PLOS Global Public Health*, *2*(11), e0001220. https://doi.org/10.1371/journal.pgph.0001220

Vivette Glover. (2020). Prenatal mental health and the effects of stress on the foetus and the child. Should psychiatrists look beyond mental disorders? *World Psychiatry*.

Weber, K. A., Carmichael, S. L., Yang, W., Tinker, S. C., & Shaw, G. M. (2020). Periconceptional stressors and social support and risk for adverse birth outcomes. *BMC Pregnancy and Childbirth*, *20*(1), 1–9. https://doi.org/10.1186/s12884-020-03182-6

WHO. (2019). Maternal mental health. Retrieved from WHO Publication website: https://www.who.int/teams/mental-health-and-substance-use/promotion-prevention/maternal-mental-health

Xiaohua Xiao, Haidong Song, Tian Sang, Zhihua Wu, Y. X. and Q. Y. (2021). Analysis of Real-World Implementation of the Biopsychosocial Approach to Healthcare: Evidence From a Combination of Qualitative and Quantitative Methods. *Frontiers*, *12*.

Xiuxiu Li, Rui Gao, Xiaowei Dai, Hong Liu, Jinxin Zhang, Xuemei Liu, Dongmei Si, T. D. & W. X. (2020). The association between symptoms of depression during pregnancy and low birth weight: a prospective study. *BMC Pregnancy and Childbirth*.

Yamane, T. (1967). Taro Y. Statistics, And Introductory Analysis, 2nd Ed., New York: *Scottish Journal of Arts, Social Sciences and Scientific Studies*.

Zemenu Tadesse Tessema ,Koku Sisay Tamirat,Achamyeleh Birhanu Teshale, G. A. T. (2021). The impact of advanced maternal age on pregnancy outcome. *PLoS ONE*, *10.1371*.

Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica*. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

APPENDICES

APPENDIX I: DATA COLLECTION TOOLS

INFORMED CONSENT FORM

Title: **PSYCHOLOGICAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG POST-NATAL MOTHERS INRABAI AND KALOLENI SUB-COUNTIES, KILIFI COUNTY, KENYA**

Introduction

(Greetings). I am (name)_____ and I work at this facility. You have come to this health facility today where care is available for you and your baby. I would like to give you information about the research study and invite you to be part of it. I will go through this consent form with you and answer any questions you may have. This should take about 10-20 minutes. The study is taking place at 2 centres, Rabai Health Centre, and Mariakani Sub-County Hospital. The Principal Investigator in charge of this study is Mary Goretty Amondi from Maseno University. She is pursuing a master's degree of public health (Epidemiology and Population Health).

What this study is about?

This research aims to better understand the characteristics of mothers who recently delivered in Rabai Health Centre and Mariakani Sub-County Hospital Kilifi County, identify if they experienced any form of stress during pregnancy, what was their baby's weight at birth, find out their pregnancy experience to determine if those could have been associated with the weight of their new-born baby especially for those who deliver babies who weigh less than 2500g. We hope to improve understanding of the cause of low birth weight and the discovery from this research will aid in the focus on antenatal interventions provided to postnatal mothers as a way of improving birth outcome of new-born and their survival.

Why are we asking you to participate?

We are asking for your permission to be a part of understanding the problem of low birth weight in new-born babies. We are asking postnatal mothers to participate in this study if they are delivered within the last 6 weeks, are aged 16 to 49 years, delivered at 37 weeks or more of pregnancy and are willing to participate by giving a written informed consent

What is involved in the study?

Participation in this study involves collection of information from you and from your antenatal card. We will ask you to provide general and medical information about you and your household. We will also obtain medical information from you and your baby's medical records. This information was entered into a password protected computer or tablet. This will take an average of 45 minutes and is done once.

What will happen to the information collected?

All information obtained is confidential and was stored in electronic format in password protected computers. Access to the information was limited to the research team and approved partners for research into understanding low birth weight. The information was stored using a unique ID number, your name and date of birth will not be used, so that your identity is protected.

What are the possible benefits of taking part?
Taking part in this study will not benefit you or your baby directly, but we hope that it will benefit postnatal mothers and babies everywhere in the future, by helping us better understand more about low birth weight. There is no payment for participating in the study.

What are the possible risks of taking part?
This study poses minimal risk to participants; there is no experimental drugs nor procedures to be used in the study, however minimal level of potentially sensitive information was asked that may cause some discomfort to you and might trigger emotional distress. Some of the discussion during the study may make you feel uncomfortable or raise unpleasant memories. You are free to skip any question or topic at any given time.

Do you have to participate in this study?
Participating in this study is voluntary. You do not have to take part if you do not want to. If you choose not to take part, there was no penalty or loss of health care that you usually receive.

Who has allowed this study to take place?
This research has been reviewed by Maseno University Ethics Review Committees. They have agreed that this research is important, that it was conducted properly, and that participants' safety and rights have been respected.

What will happen to the results of this research study?
It is hoped that the results of this study will help to inform good practices and decisions around health care for pregnant postnatal mothers. At the end of the study, we will share relevant results with communities of postnatal mothers taking part in the study, County officials and local administration officials, County health officials, Sub County health officials as well as community members who participated in the study. The results will also be published to make them widely available to interested parties and your personal details will remain confidential

Whom can you contact if you have questions?
If you have any questions about this study, you may contact the lead investigator, Mary Amondi at 0729421482. You may also contact the Maseno University Ethics Review Committee at + 254 57 351 622 EXT. 3050, which approved this study, for questions about participants' rights and research-related harm.

Consent: What does your signature or thumb print mean?
Your signature or thumbprint below means that you have had this study explained to you and had the opportunity to ask questions and get answers. If you wish to participate in this study, you should sign or place your thumbprint below.

Name of Participant (printed)

Signature or Fingerprint* of Participant	Date

Name of Study Staff Administering Consent (printed)	Position/Title

Signature of Study Staff Administering Consent	Date

*If the participant is unable to read and/or write, an impartial witness must be present during the consent discussion. After the written informed consent form is read and explained to the participant, and after he or she has orally consented participate in this study and has either signed the consent form or provided his or her fingerprint, the witness must sign and personally date the consent form. By signing the consent form, the witness attests that the information in the consent form and any other written information was accurately explained to, and apparently understood by, the participant, and that consent was freely given.

Name of Person Witnessing Consent (printed)	

Signature of Person Witnessing Consent	Date

Thank you for participating!

SOCIO-DEMOGRAPHIC AND OBSTETRIC HISTORY QUESTIONNAIRE

1. How old are you?
   Age in years_____
2. How many ANC visits did you attend? _____

3. Gestational age at delivery
   - ☐≥ 37 weeks
   - ☐< 37 weeks (**Exclude from the study)**
4. What was your baby's birth weight?
   - ☐≥ 2500g
   - ☐< 2500g
5. Parity
   - ☐ Primiparous
   - ☐ Multiparous
6. What is the highest level of school you attended?
   - ☐None
   - ☐ Primary
   - ☐ Secondary
   - ☐ Tertiary
7. What is your current marital status?
   - ☐ Single (Never been married, widowed, divorced, separated)
   - ☐ Married (Monogamous)
   - ☐ Married (Polygamous)
8. What kind of work do you do?
   - ☐ Employed
   - ☐ Unemployed
9. Do you consume alcohol?
   - ☐ Yes
   - ☐ No
10. Do you currently use tobacco?
    - ☐ Yes
    - ☐ No
11. Do you use any substance?
    - ☐ Yes
    - ☐ No
12. Have you ever given birth to an infant who weighed <2500g?
    - ☐ Yes
    - ☐ No
    - ☐ N/A
13. Did you experience any form of violence during pregnancy or currently?
    - ☐ Yes

☐ No

14. Do you have any medical condition diagnosed before this pregnancy?
    ☐ Yes
    ☐ No
15. Do you have any medical condition that was diagnosed during this pregnancy?
    ☐ Yes
    ☐ No
16. Have you ever been told by a doctor or healthcare worker that you have depression?
    ☐ Yes
    ☐ No
17. Have you ever been told by a doctor or healthcare worker that you have anxiety?
    ☐ Yes
    ☐ No
18. Have you ever been told by a doctor or healthcare worker that you have any other mental illness?
    ☐ Yes
    ☐ No
19. Have you ever been told by a doctor or a healthcare worker that you have a disease that will take long to treat (Chronic illness)?
    ☐ Yes
    ☐ No
20. Did you have any form of support currently and during this pregnancy?*(Financial support or counselling from relatives and friends to handle pregnancy issues)*
    ☐ Yes
    ☐ No

21. Did you plan to have this pregnancy?
    ☐ Yes
    ☐ No

PERCEIVED STRESS SCALE

For each question choose from the following alternatives:
0 - Never 1 - Almost Never 2 - Sometimes 3 - Fairly Often 4 - Very Often

_____ 1. In the last 6 months, how often have you been upset because of something that happened unexpectedly?

_____ 2. In the last 6 months, how often have you felt that you were unable to control the important things in your life?

_____ 3. In the last 6 months, how often have you felt nervous and stressed?

_____ 4. In the last 6 months, how often have you felt confident about your ability to handle your personal problems?

_____ 5. In the last 6 months, how often have you felt that things were going your way?

_____ 6. In the last 6 months, how often have you found that you could not cope with all the things that you had to do?

_____ 7. In the last 6 months, how often have you been able to control irritations in your life?

_____ 8. In the last 6 months, how often have you felt that you were on top of things?

_____ 9. In the last 6 months, how often have you been angered because of things that happened that were outside of your control?

_____ 10. In the last 6 months, how often have you felt difficulties were piling up so high that you could not overcome them?

Figuring Your PSS Score

You can determine your PSS score by following these directions:

- First, reverse your scores for questions 4, 5, 7, and 8. On these 4 questions, change the scores like this:

0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.

- Now add up your scores for each item to get a total. **My total score is _____.**

- Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress.

► Scores ranging from 0-13 would be considered low stress.
► Scores ranging from 14-26 would be considered moderate stress.
► Scores ranging from 27-40 would be considered high perceived stress.

***Disclaimer**: The scores on the following self-assessment do not reflect any diagnosis or course of treatment. They are meant as a tool to help assess your level of stress. If you have any further concerns about your current wellbeing, you may contact EAP and talk confidentially to one of our specialists.*

EDINBURGH DEPRESSION SCALE

The questionnaire below is called the Edinburgh Depression Scale (EDS) used to screen for depression. Each answer is given a score of 0 to 3. The maximum score is 30.

Please select the answer that comes closest to how you felt in the past 9 months:

1. I was able to laugh and see the funny side of things

- As much as I always could
- Not quite so much now
- Definitely not so much now
- Not at all

2. I looked forward with enjoyment to things

- As much as I ever did
- Rather less than I used to
- Definitely less than I used to
- Hardly at all

3. I blamed myself unnecessarily when things went wrong

- Yes, most of the time
- Yes, some of the time
- Not very often
- No, never

4. I was anxious or worried for no good reason

- No, not at all
- Hardly ever
- Yes, sometimes
- Yes, very often

5. I felt scared or panicky for no very good reason

- Yes, quite a lot

- Yes, sometimes
- No, not much
- No, not at all

6. Things were getting on top of me

- Yes, most of the time I haven't been able to cope at all.
- Yes, sometimes I haven't been coping as well as usual
- No, most of the time I have coped quite well.
- No, I have been coping as well as ever.

7. I was unhappy that I have had difficulty sleeping

- Yes, most of the time
- Yes, sometimes
- Not very often
- No, not at all

8. I felt sad or miserable

- Yes, most of the time
- Yes, quite often
- Not very often
- No, not at all

9. I was so unhappy that I was crying

- Yes, most of the time
- Yes, quite often
- Only occasionally
- No, never

10. The thought of harming myself occurred to me

- Yes, quite often
- Sometimes

Hardly ever

Never

TOTAL SCORE

Administered/Reviewed by _____ Date _____

SCORING

QUESTIONS 1, 2, & 4
Are scored 0, 1, 2 or 3 with top box scored as 0 and the bottom box scored as 3.

QUESTIONS 3, 5-10
Are reverse scored, with the top box scored as a 3 and the bottom box scored as 0.

Maximum score: 30
Possible Depression: 10 or greater
Always look at item 10 (suicidal thoughts)

Adopted from: Cox, J.L., Holden, J.M., and Sagovsky, R. (1987). Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. British Journal of Psychiatry 150:782-786 on 23Jun2020

HOSPITAL ANXIETY AND DEPRESSION SCALE-ANXIETY (HADS-A)
Tick the box beside the reply that is closest to how you felt in the 9 months.
Don't take too long over your replies: your immediate is best.

2. I felt tense or 'wound up':
   3 Most of the time
   2 A lot of the time
   1 From time to time, occasionally
   0 Not at all

3. I got a sort of frightened feeling like 'butterflies' in the stomach:
   0 Not at all
   1 Occasionally
   2 Quite Often
   3 Very Often

4. I got a sort of frightened feeling as if something awful was about to happen:
   3 Very definitely and quite badly
   2 Yes, but not too badly
   1 A little, but it doesn't worry me
   0 Not at all

5. I felt restless as I had to be on the move:
   3 Very much indeed
   2 Quite a lot
   1 Not very much
   0 Not at all

6. Worrying thoughts went through my mind:
   3 A great deal of the time
   2 A lot of the time
   1 From time to time, but not too often
   0 Only occasionally

7. I got sudden feelings of panic:
   3 Very often indeed
   2 Quite often
   1 Not very often
   0 Not at all

8. I could sit at ease and felt relaxed:
   0 Definitely
   1 Usually
   2 Not Often

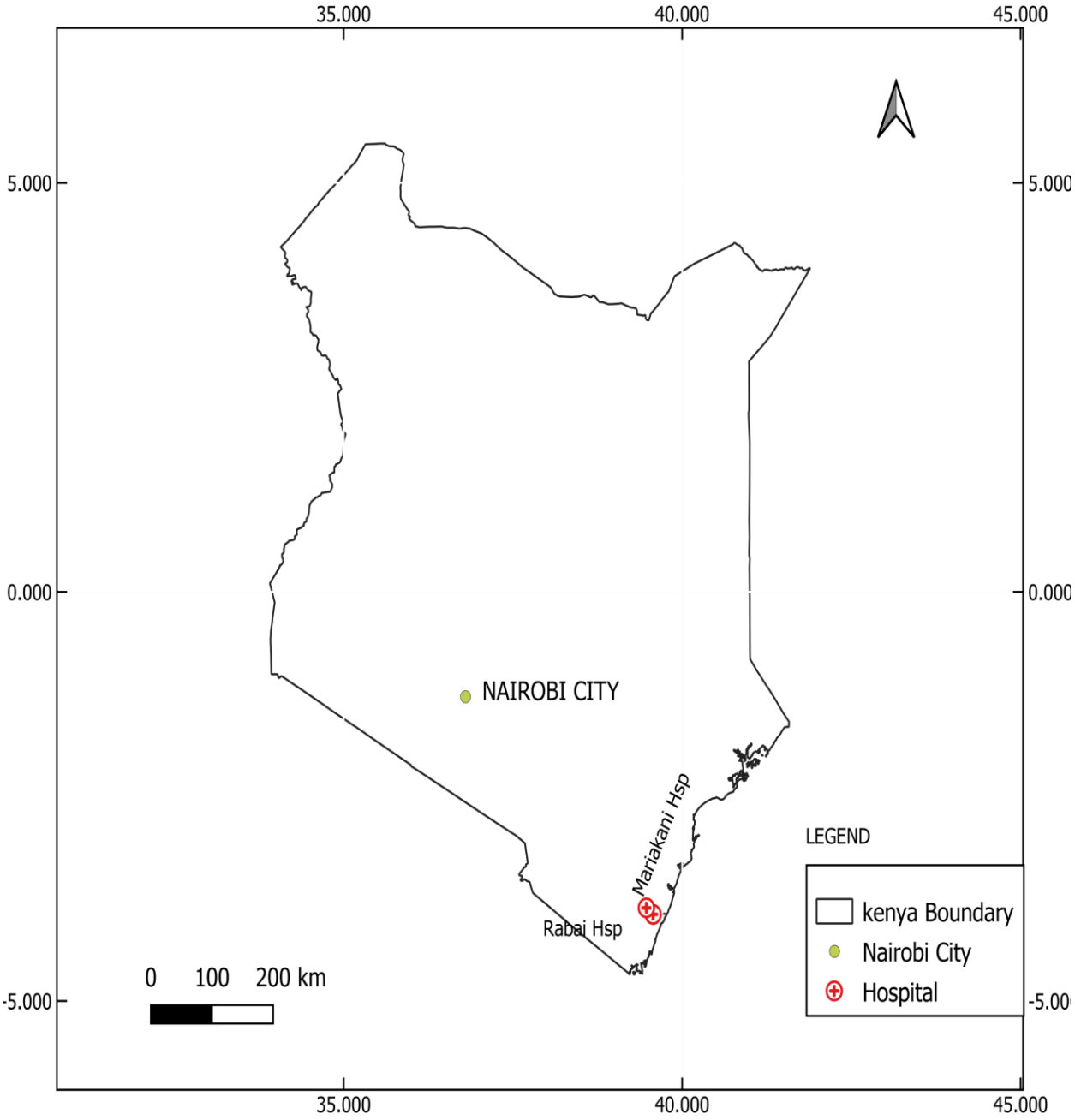
3 Not at all

Please check you have answered all the questions

Scoring:

Total score: Anxiety (A) _____

0-7 = Normal
8-10 = Borderline abnormal (borderline case)
11-21 = Abnormal (case)



APPENDIX II: STUDY AREA MAP

APPENDIX III: SGS APPROVAL LETTER

MASENO UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Office of the Dean

Our Ref: MPH/PH/00012/2017

Private Bag, MASENO, KENYA
Tel:(057)351 22/351008/351011
FAX: 254-057-351153/351221
Email: sgs@maseno.ac.ke

Date: 10th February, 2022

TO WHOM IT MAY CONCERN

RE: PROPOSAL APPROVAL FOR MARY GORETTY AMONDI— MPH/PH/00012/2017

The above named is registered in the programme of Master Public Health in School of Public Health and Community Development , Maseno University. This is to confirm that her research proposal titled "**Maternal Psychosocial Stress Predictors of Low Birth Weight among Mothers in Kilifi County, Kenya**" has been approved for conduct of research subject to obtaining all other permissions/clearances that may be required beforehand.

Prof. J.O. Agure
DEAN, SCHOOL OF GRADUATE STUDIES

SCHOOL OF GRADUATE STUDIES
MASENO UNIVERSITY
21 FEB 2022
P.O. BOX PRIVATE BAG, MASENO

APPENDIX IV: MASENO UNIVERSITY ETHICS AND RESEARCH COMMITTEE APPROVAL

MASENO UNIVERSITY SCIENTIFIC AND ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221
Private Bag – 40105, Maseno, Kenya
Email: muserc-secretariate@maseno.ac.ke

REF: MSU/DRPI/MUSERC/01074/22 **Date**: 21st July, 2022

TO: Mary Goretty Amondi
PG/MPH/PH/00012/2017
Department of Educational Communication,
Technology and Curriculum Studies
School of Education, Maseno University
P.O. Box Private Bag, Maseno, Kenya

Dear Madam,

RE: Maternal Psychosocial Stress Predictors of Low Birth Weight among Mothers in Kilifi County, Kenya

This is to inform you that **Maseno University Scientific and Ethics Review Committee (MUSERC)** has reviewed and approved your above research proposal. Your application approval number is MUSERC/01074/22.The approval period is 21st July, 2022 – 20th July, 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by Maseno University Scientific and Ethics Review Committee (MUSERC).
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to Maseno University Scientific and Ethics Review Committee (MUSERC).

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

21 JUL 2022

Prof. Philip O. Owuor, PhD, FAAS, FKNAS
Chairman, MUSERC

APPENDIX V: NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 554033

Date of Issue: 21/August/2022

RESEARCH LICENSE

This is to Certify that Miss. MARY GORETTY AMONDI of Maseno University, has been licensed to conduct research in Kilifi on the topic: MATERNAL PSYCHOSOCIAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG MOTHERS IN KILIFI COUNTY, KENYA for the period ending : 21/August/2023.

License No: NACOSTI/P/22/19553

554033

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX VI: KILIFI COUNTY APPROVAL

COUNTY GOVERNMENT OF KILIFI

DEPARTMENT OF HEALTH SERVICES

When Replying quote
Email; inforchiefsoffice@gmail.com
REF: COH/DOH/RESEARCH/VOL.2/175

P. O. Box 9-80108
Kilifi
Date: 28th September 2022

OFFICE OF THE CHIEF OFFICER HEALTH SERVICES

Ms. Mary Goretty Amondi
Maseno University.

Dear Madam,

RE: DEPARTMENTAL AUTHORIZATION TO CARRY OUT RESEARCH ON MATERNAL PSYCHOLOGICAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG MOTHERS IN KILIFI COUNTY, KENYA.

The Kilifi County Department of Health Services is in receipt of your letter requesting to conduct a study on "**Maternal Psychological Stress Predictors of Low Birth Weight Among Mothers in Kilifi County, Kenya.**" together with the protocol and ethical and scientific approval from Maseno University MUSERC/01074/22 and NACOSTI permit Ref: NACOSTI/P/22/19553.

The Department is pleased to grant you authorization to conduct your study within Kilifi County in line with ethical consideration and approved study protocol, and within the expiry date of your ERC approval **20th July, 2023.**

It is required that you engage the Hospital administration for Mariakani Sub-County Hospital and Rabai sub County Hospital prior to commencing data collection.

Upon completion of the study, you will be required to share your study findings, conclusion and recommendations with the Department of Health Services, Kilifi County.

Sincerely,

COUNTY GOVERNMENT OF KILIFI
D.O.H
28 SEP 2022
CHIEF OFFICER HEALTH SERVICES

Dr. David Mulewa
Chief Officer Health Servi
KILIFI COUNTY.

Cc.
- CECM- Health Services
- Heads of Divisions

APPENDIX VII: RABAI SUB-COUNTY HOSPITAL APPROVAL

GOVERNMENT OF KENYA

COUNTY GOVERNMENT OF KILIFI
OFFICE OF THE MEDICAL SUPERINTENDENT
RABAI SUB COUNTY HOSPITAL

Ms. Mary Goretty Amondi
Maseno University

Dear Madam

RE: RABAI SUB COUNTY HOSPITAL AUTHORIZATION TO CARRY OUT RESEARCH ON MATERNAL PSYCHOLOGICAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG MOTHERS IN KILIFI COUNTY, KENYA

Rabai Sub-County Hospital is in receipt of your letter requesting approval to conduct a study on "Maternal psychological stress predictors of Low birth weight among mothers in Kilifi County, Kenya" together with protocol ethical and scientific approval from Maseno University, MUSERC/01074/22, NACOSTI Permit Ref. NACOSTI/P/22/19553 and Kilifi County Approval.

We are pleased to grant you authorization to conduct your study at Rabai Sub-County Hospital from 21st November 2022

Upon completion of the study, you will be required to share your study finding, conclusion and recommendation with the facility team.

Sincerely

Dr. Fondo Iha
Medical Superintendent
Rabai SubCounty Hospital

25 NOV 2022

APPENDIX VIII: MARIAKANI SUB-COUNTY HOSPITAL APPROVAL

COUNTY GOVERNMENT OF KILIFI
DEPARTMENT OF HEALTH SERVICES

Telegram "MEDICAL" Mariakani
Telephone: [illegible]
Email: [illegible]
Address all hospitals correspondences to the Medical Superintendent

OFFICE OF THE MEDICAL SUPERINTENDENT
MARIAKANI SUB-COUNTY HOSPITAL
P. O. Box 67
MARIAKANI

REF: MSCH/DOH/CORR.VOL. 1/231

Date 22/11/2022

TO:
MS MARY GORETTY AMONDI
MASENO UNIVERSITY

RE: HOSPITAL AUTHORIZATION TO CARRY OUT RESEACH ON MATERNAL PSYCHOLOGICAL STRESS PREDICTORS OF LOW BIRTH WEIGHT AMONG MOTHERS IN KILIFI COUNTY KENYA.

Further to the Chief Officers' approval letter Ref No. CO1/DOH/Research/Vol .2/175 of 28th September, 2022 on the above subject (copy attached). I wish to confirm that the Management of Mariakani Sub County Hospital has no objection to the above study.

Kindly ensure that the findings, conclusion and recommendations are shared with the Hospital Management Team (HMT) upon completion.

Thank you for considering this facility for this important study.

Dr. Matano Kibwana
For: Medical Superintendent
Mariakani Sub County Hospital

Cc:
Counselling psychologist -MSCH
Psychiatrist nurse -MSCH
HMT members -MSCH