THE DIETARY DIVERSITY, HOUSEHOLD FOOD SECURITY STATUS AND PRESENCE OF DEPRESSION IN RELATION TO PREGNANCY PATTERN OF WEIGHT GAIN AND INFANT BIRTH WEIGHT, PIETERMARITZBURG

BY

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ABSTRACT

Introduction: Maternal malnutrition is a risk factor for pregnancy related complications and is associated with many negative implications for foetal growth, infant and child health and development. Great progress has been made to decrease maternal and infant mortality rates in South Africa however more strategies are needed to tackle these problems. Possible causes of maternal and infant malnutrition and mortality include: poor dietary quality, lack of access to food, presence of depressive symptoms and inadequate or excessive weight gain during pregnancy. The mentioned causal factors are associated with adverse infant birth weight (IBW) outcomes such as low birth weight (LBW). Low birth weight infants have greater risk for mortality, stunting in childhood and development of chronic diseases of lifestyle in adulthood. The South African statistics show that prevalence of LBW infants is still relatively high. Hence investigating and developing strategies to address the underlying causes of maternal malnutrition is important for optimising infant birth weight outcomes.

Aim: The aim of this study was to investigate the relationship between IBW and the following: maternal nutritional status, dietary diversity, household food security and presence of antenatal depression.

Objective: The objective of the study was to assess the dietary diversity, household food security status, presence of depression, weight gain during pregnancy and infant birth weight of women attending antenatal care at a township community health care centre in Pietermaritzburg.

Study design: This was a cross-sectional descriptive survey.

Setting: A community health centre in an urban settlement in Pietermaritzburg, KwaZulu-Natal.

Subjects: One hundred and seventy-two black women between the ages of 18 and 41 years.

Outcome measures: A socio-demographic questionnaire was developed to collect data regarding age, obstetric history, level of education, financial status, living arrangements, employment status and access to resources. In addition, the anthropometric status of participants was measured. A non-quantified nine food group dietary diversity score (DDS) questionnaire was used to assess the nutritional adequacy of pregnant women while the household food insecurity access scale (HFIAS) questionnaire was used to assess the household food security status. The Edinburgh postnatal depression scale (EPDS) was used to screen for risk for depression during pregnancy.

Results: The mean DDS for the study sample of 5.39 ± 1.36 indicated that the majority of pregnant women had an average dietary diversity. The mean HFIAS was 4.26 ± 5.26 with 80% percent of the subjects classified as food secure, 13% at risk for food insecurity, 6% food secure and 2% severely food insecure. The mean EPDS score of 10.94 ± 6.35 was indicative of a moderate risk for depression in the group as a whole. The mean pre-pregnancy body mass index (BMI) of participants' was 26.3 ± 5.35 kg/m^2, indicating that the majority of pregnant women were overweight at the first antenatal visit. Mean total weight gained during pregnancy was 11.03 ± 5.08 kg. Accordingly, 26% women had inadequate weight gain, 40% had adequate weight gain and 34% had excessive weight gain during pregnancy using the World Health Organisation (WHO) classification and the Institute of Medicine (IOM) guidelines. Eighty-six percent of infants were born with a normal birth weight, whereas 5% were of a LBW, 6% preterm, and 3% were large-for-gestational-age (LGA). There was a weak but significant negative correlation between subject dietary diversity and IBW ($r = -0.16$; $p = 0.04$). No relationship was measured between the level of household food insecurity ($r = -0.07$; $p = 0.39$), prevalence of antenatal depression ($r = 0.01$; $p = 0.95$) and IBW. Infant birth weight was also positively associated with maternal delivery weight ($r = 0.17$; $p = 0.02$). A significant positive correlation was also measured between total weight gain during pregnancy and IBW ($r = 0.32$; $p < 0.00$).

Conclusion: A greater dietary diversity in pregnant women may potentially improve infant birth weight. Although food insecurity levels were low, food insecurity meant undiversified diets in pregnant women and led to both inadequate and excessive weight gain during pregnancy. Inadequate maternal weight gain was associated with LBW and preterm delivery. Overweight/obese pre-pregnancy BMI and excessive weight gain was associated with LGA infants. Overweight and obese women may

benefit from having low weight gain during pregnancy to prevent preterm delivery, LBW and LGA infants. Monitoring weight gain during pregnancy can be beneficial in preventing inadequate weight gain in women with underweight pre-pregnancy BMI and excessive weight gain in women with normal pre-pregnancy BMI. Gestational weight gain within the IOM guidelines reduced risk for delivering a LBW infants for women with underweight pre-pregnancy BMI. Household food security status and high prevalence of antenatal depression in pregnant women did not appear to significantly affect IBW.

PREFACE

This dissertation was carried out in the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, from December 2014 to January 2017, under the supervision of Dr Susanna M. Kassier and Professor Frederick J. Veldman.

Signed: ________________________ Date: ___________________

Samukelisiwe Sthokozisiwe Madlala (Candidate)

As supervisors of the candidate we agree to the submission of this dissertation.

Signed: ________________________ Date: ___________________

Dr Susanna M. Kassier (Supervisor)

Signed: ________________________ Date: ___________________

Professor Frederick J. Veldman (Co-supervisor)

DECLARATION

I, Samukelisiwe Sthokozisiwe Madlala, declare that:

1. The research reported in this dissertation, except where otherwise indicated is my original work.
2. This dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
3. This dissertation does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then: a) their words have been re-written but the general information attributed to them has been referenced; b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.
4. This dissertation does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the reference section.

Signed: ___________________________ Date: ________________________

Samukelisiwe Sthokozisiwe Madlala (Candidate)

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1.1 Relevance of study

Developing countries are afflicted by public health problems such as poor maternal, infant and child health. Globally on an annual basis, approximately 358 000 women die during pregnancy while 7.6 million children under five years of age die [The Partnership for Maternal, Newborn & Child Health (PMNCH) 2011]. Optimal maternal health and nutrition are imperative for child survival (PMNCH 2011). Maternal, perinatal and under-five mortality is still significantly high in South Africa [Department of Health (DoH) 2012]. This is despite efforts to achieve the Millennium Development Goals (MDGs), especially MDG 4 (reduce child mortality) and MDG 5 (improve maternal health), which aim to improve the health and well-being of both children and their mothers (DoH 2012).

The first 1000 days of life is a very important period and starts at conception until a child's second birthday (Save the Children 2012). During this stage, epigenetic and early nutritional programming occurs [Nestle' Nutrition Institute (NNI) 2013], as well as when the foundations for a child's future health are laid (Save the Children 2012). Globally many mothers' suffer from malnutrition. Subsequently, they are at a greater risk of death or giving birth to a premature, underweight or malnourished infant. Good nutrition during the first 1000 days is important in laying the foundation for optimal child mental development as adequate nutrition allows children to have better cognitive, motor and social skills, be successful at school and be productive members in their communities and country (Save the Children 2012).

Maternal malnutrition is a preventable risk factor for adverse pregnancy outcomes (Abu-Saad & Fraser 2010). Pregnant women with a poor nutritional status have a greater likelihood of having pregnancy related complications such as anaemia, gestational diabetes mellitus (GDM) and pre-eclampsia (Gao, Stiller, Scherbaum, Biesalski, Wang, Hormann & Bellows 2013). They also are at a greater risk for having a foetus with inadequate weight gain, resulting in a low birth weight (LBW) infants (Save the Children 2014; Vorster 2010). Low birth weight infants have a greater risk for mortality and/or to become stunted children if appropriate interventions are not implemented (Vorster 2010; Bradshaw, Schneider, Norman & Bourne 2006; Mostert, Steyn, Temple & Olwagen 2005; Mostert, Steyn, Temple & Olwagen 2005). Maternal malnutrition is associated with foetal programming for chronic diseases of lifestyle during adulthood (Gao *et al* 2013). The United Nations Standing Committee on Nutrition (UNSCN) reports that 50% of childhood stunting occurs in the womb. Therefore, improving the nutritional status of women and girls' of childbearing age is vital (Save the Children 2012).

A lack of dietary variety is predictive of the risk of developing malnutrition, inadequate access to food (one of the pillars of food security) and dietary deficiencies (Kennedy 2009; Steyn, Nel, Nantel, Kennedy & Labadarios 2006). The dietary diversity of South African pregnant women is unknown. The only available data on dietary diversity is that of the South African adult population, black women living in informal settlements and the elderly (Steyn *&* Ochse 2013; Drimie, Faber, Vearey & Nunez 2013; Oldewage-Theron & Kruger 2011; Drimi & McLachlan 2009; Oldewage-Theron & Kruger 2008). It would seem that the majority of pregnant women do not consume adequate amounts of food and nutrients. Especially fruit, vegetables, grains, folate and iron (Nash, Gilliland, Evers, Wilk & Campbell 2013).

Maternal anthropometric status has a vital impact on infant birth weight (IBW) [Ay, Kruithof, Bakker, Steegers, Witteman, Moll, Hofman, Mackenbach, Hokken-Koelega & Jaddoe*l* 2009; World Health Organisation (WHO) 2003], as maternal height and weight is associated with the weight and length of the infant at birth (Ay *et al* 2009). Short stature and/or underweight are common characteristics of women living in developing countries. These characteristics are an indicator that these women may have been malnourished since childhood and adolescence. This therefore increases the risk of these women giving birth to LBW infants (Save the Children 2012). Underweight women are at a greater risk for still births and premature delivery (Dean, Lassi, Imam & Bhutta 2013), while maternal stunting is a risk factor for overweight pre-pregnancy body mass index (BMI) and having both stunted and underweight offspring (Steyn, Labadarios, Nel, Kruger & Maunder 2011).

An arising phenomenon documented by Jehn & Brewis (2009), is that maternal overweight/obesity and child under-nutrition (underweight and stunting) is increasing in low and middle income countries (LMICs). This phenomenon can also be seen in South Africa, where the prevalence of overweight in women is relatively high (54.9% have a BMI > 25 kg/m^2) (DoH, Medical Research Council & OrcMacro 2003) as well as stunting in children (18%, <2 SD height for age) (Labadarios 2007). A more recent South African study revealed that even though maternal overweight is increasing, women who are overweight or obese have a reduced risk for having an underweight or stunted child whilst those women who are underweight have greater likelihood of having an underweight or stunted child (Steyn *et al* 2011).

According to Sunsaneevithayakul, Titapant, Ruangvutilert, Sutantawibul, Phatihattakorn, Wataganara & Talungchit (2014), ‘’adequate weight gain is one of the cornerstones to optimizing pregnancy outcomes”. Optimal gestational weight gain (GWG) is associated with improved health, reduced maternal obesity, uncomplicated deliveries and increased survival and health of new born infants (Ochsenbein-Ko¨lble, Roos, Gasser & Zimmermann 2007). Many women have an inadequate weight gain during pregnancy (Sunsaneevithayakul *et al* 2014). Perinatal mortality risk is increased fivefold when inadequate weight is gained (Newton 2007). The majority of studies regarding the factors that affect GWG and pregnancy outcomes are on Asian, European and North American population groups (Radhakrishnan, Kolar & Nirmalan 2014; Tanaka Ashihara, Nakamura, Kanda, Fujita, Yamashita, Terai, Kamega & Ohmichi 2014; Koh Ee, Malhotra , Allen, Tan & Østbye 2013; Ay *et al* 2009; Sahu, Agarwal, Das & Pandey 2007).

Birth weight is a predictor of perinatal, neonatal and post-neonatal outcomes (DoH 2007). Adverse birth outcomes include: LBW, preterm birth (PTB), intrauterine growth retardation (IUGR), small-for-gestational-age (SGA) and large-for-gestational-age (LGA) (Abu-Saad & Fraser 2010). Global statistics show that LBW infants have a 20-fold risk of mortality when compared to infants with a higher birth weight (UNICEF 2004). Low birth weight infants form 12% of the 18% of neonatal deaths that occur in South Africa (DoH 2012). Low birth weight infants have four times greater risk of perinatal mortality than infants born with an appropriate-weight-for-gestational-age (AGA) (Vashevnik, Walker & Permezel 2007).

Little is known about the relationship between household food security (FS) and pregnancy outcomes in South Africa. Food insecurity (FI) is associated with a poor nutritional status because of limited quality, quantity and/or frequency of food intake and reduced micronutrient stores (Carmichael, Yang, Herring, Abrams & Shaw 2007). In addition, FI can possibly contribute to poor GWG (Carmichael *et al* 2007). Socio-economic factors are important determinants of infant birth outcomes and can also influence a pregnant woman's dietary intake, resulting in under or over-nutrition (Abu-Saad & Fraser 2010).

Globally, depression is one of four leading burdens of disease for women (Räisänen, Lehto, Nielsen, Gissler, Kramer & Heinonen 2014) with the WHO stating that maternal depression is on the increase in LMICs (WHO 2009). Women of childbearing age are suggested to have the highest risk for depression than other population groups (Evans & Bullock 2012). Physiological and psychological changes that occur during pregnancy may increase the susceptibility of pregnant women to become depressed (Mathibe-Neke, Rothberg & Langley 2014). Without adequate psychosocial support, pregnant women can develop stress, anxiety and depression which can have negative consequences on the health and well-being of a foetus (Mathibe-Neke *et al* 2014). According to Alder, Fink, Urech, Hösli & Bitzer (2011), one in ten pregnant women who receive antenatal care (ANC) will suffer from depression.

Antenatal depression is a mental health problem that is not as well-documented as postpartum depression (Leung & Kaplan 2009). Many studies however, show that antenatal depression is more prevalent than postnatal depression (Reid *et al* 2009; Price & Procter 2009; O'Keane & Marsh 2007; Bennet, Einarson, Taddio, Koren & Einarson 2004). The prevalence of antenatal depression in Sub-Saharan Africa ranges between 8.3% and 39% (Hartley, Tomlinson, Greco, Comulada, Stewart & le Roux 2011; Abiodun, Adetoro & Ogunbode 1993). Antenatal care during pregnancy is an opportunity for screening, prevention and treatment of antenatal depression (Goodman & Tyrer-Viola 2010). However, antenatal depression is rarely diagnosed and treated (Alder *et al* 2011; Goodman & Tyrer-Viola 2010; Perinatal Mental Health Project (PMHP) 2010). In South Africa, ANC involves a routine physical assessment and limited or no psychosocial assessment and care (Mathibe-Neke *et al* 2014). Mental health is an under-funded and under-resourced health priority in South Africa

(Lund, Boyce, Flisher, Kafaar & Dawes 2009a; Lund, Kleintjes, Kakuma, Flisher A & the MHaPP Research Programme Consortium 2009b). South African primary care givers are not trained to screen for mental illness (PMHP 2010). This is an unfortunate gap in health services as maternal depression has an impact on child health, growth and behaviour (Dibaba, Fantahun & Hindin 2013).

1.2 Aim of the study

The aim of this study was to assess the dietary diversity, household food security status, antenatal depression, the pattern of weight gain during pregnancy and infant birth weight.

1.3 Research Objectives

The objectives of this study were to determine the following among urban black women in their third trimester of pregnancy:

1.3.1 The nutritional status by calculating BMI using clinic weight and height and BMI using clinic weight and height measured by research fieldworkers as well as record the mid upper arm circumference (MUAC) taken by clinic staff;
1.3.2 Dietary diversity;
1.3.3 Household food security status;
1.3.4 Presence of antenatal depression;
1.3.5 Pattern of weight gain from the first antenatal visit up until delivery;
1.3.6 Infant birth weight at delivery;
1.3.7 The relationship between IBW and maternal nutritional status, dietary diversity, household food security and presence/prevalence of antenatal depression.

1.4 Research Hypotheses

1.4.1 All pregnant women (regardless of age) with inadequate dietary intake will not gain adequate weight during pregnancy when compared to the Institute of Medicine (IOM) guidelines (IOM 2009).

1.4.2 Inadequate weight gain in pregnant women will not result in LBW infants delivered at term.

1.4.3 Food insecurity of pregnant women will not result in an unsatisfactory pattern of weight gain in pregnant women and LBW of infants.

1.4.4 The presence of antenatal depression will not result in inadequate/excessive weight gain in pregnant women when compared to the IOM guidelines.

1.5 Study parameters

Inclusion criteria

- Pregnant black women (18-45 years) attending Imbalenhle Antenatal clinic, Pietermaritzburg.
- Pregnant women in their third trimester of pregnancy, irrespective of whether this is their first pregnancy or not.
- Singleton pregnancy

Exclusion criteria

- Pregnant women older than 45 years.
- Women pregnant with multiple pregnancy.
- Pregnant women who attended the antenatal clinic for their first ANC visit in the second trimester of pregnancy as it would be difficult to accurately determine their pre-pregnancy BMI. It should also be noted that the majority of weight gain occurs after the first trimester (0 - 13 weeks) (IOM 2009; Strauss & Dietz 1999).

1.6 Assumptions

- For the purpose of this study, it was assumed that the majority of participants spoke and understood isiZulu. Therefore, all the fieldworkers were fluent in isiZulu and the study participants were interviewed in isiZulu unless they requested otherwise. In addition, it was assumed that their responses to the questions posed would be truthful.
- It was assumed that weight gain during the first 20 weeks of pregnancy is minimal. Therefore, pre-pregnancy BMI can be estimated during the first

trimester of pregnancy. Literature shows that GWG increases weekly and more rapidly in the second trimester (IOM 2009; Strauss & Dietz 1999).

- It was assumed that Imbalenhle Community Health Centre (CHC) (ANC) staff accurately measured weight, height and MUAC of pregnant women and recorded this information in the maternal case record.
- It was assumed that the majority of women participating in the study will deliver their infants at Imbalenhle CHC.

1.7 Definitions

Antenatal: The period of time before birth; during or relating to pregnancy (Oxford Dictionaries.com 2014).

Antenatal care: "The routine health control of presumed healthy pregnant women without symptoms (screening), in order to diagnose diseases or complicating obstetric conditions without symptoms, and to provide information about lifestyle, pregnancy and delivery'' (Backe, Pay, Klovning & Sand 2015).

Antenatal depression: "A major depressive episode which has its onset during pregnancy, this excludes a pre-existing depression which continued following the event of the pregnancy" (Rochat 2011).

Birth weight: The weight of a baby at birth (Oxford Dictionaries.com 2015).

Body mass index: Weight in kg divided by height in meters squared [(weight/height)^2] (WHO 2006).

Dietary diversity: "Refers to the number of food groups or foods which are consumed over a specific period" (Steyn *et al* 2013).

Foetus: A human being in later stages of development before birth. A developing human from usually two months after conception to birth (Merriam-Webster.com 2014).

Food Insecurity:" Limited or uncertain access to adequate food and healthy nutrition, or limited and uncertain ability to acquire acceptable foods in a socially conventional way" (Dibaba *et al* 2013).

Food Security: Food security is defined as a condition that exists when all people, at all times, have physical social and economic access to sufficient safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO 2010).

Gestation: The time from fertilization of the ovum until birth; in humans the length of gestation is usually 38-42 weeks (Lutz & Przytulski 2006).

Gestational weight gain: Amount of weight gained during the pregnancy (National Research Council and IOM 2007).

Inadequate weight gain: "A gain of less than 1kg in any single month for women of normal weight (BMI >19.8 kg/m^2) or a gain of less than 0.5 kg in any single month for obese women (Pesicka *et al* 1996).

Infant: Birth to one year of age (Fagan 2000).

Intrauterine Growth Retardation (IUGR): "IUGR refers to foetal growth that has been constrained by an inadequate nutritional environment *in utero* and, thus characterizes a new born that has not attained its growth potential'' [Administrative Committee on Co-ordination/ Sub-Committee on Nutrition (ACC/SCN) 2000].

Malnutrition: Malnutrition concerns not enough food, too much food, the wrong types of food, and the body's response to a wide range of infections that result in mal absorption of nutrients, or the inability to use nutrients properly to maintain health. Clinically, malnutrition is characterised by inadequate or excess intake of protein, energy, and micronutrients such as vitamins, and the frequent infections and disorders that result (WHO 2008).

Maternal: Relating to a mother, especially during pregnancy or up to six weeks post-delivery (Oxford Dictionaries.com 2014).

Maternal depression: Is used to refer both antenatal and postnatal depression (Rochat 2011).

Under-nutrition: Under-nutrition includes a wide range of effects including: IUGR resulting in LBW being underweight (indicated by low weight-for-age); stunting (low height-for-age); wasting (low weight-for-height); and less visible micronutrient deficiencies. Under-nutrition is caused by a poor dietary intake that may not provide sufficient nutrients, and/or by common infectious diseases, such as diarrhoea (Lancet 2008).

Perinatal depression: "Major and minor episodes during pregnancy (termed antenatal) and/ or within the first 12 months after delivery (termed postpartum or postnatal)" (Leung & Kaplan 2009).

Pre-pregnancy weight: A women's actual weight prior to pregnancy up to the point that pregnancy is identified (National Research Council and IOM 2007).

Preterm Infants: Preterm infants are babies born alive before 37 completed weeks of pregnancy (WHO 2015).

1.8 Abbreviations

24-H-RQ: 24-hour recall
ACC/SCN: Administrative Committee on Co-ordination/ Sub-Committee on Nutrition
AIDS: Acquired Immunodeficiency syndrome
ANC: Antenatal care
BMI: Body mass Index
CDE: The Centre for Development and Enterprise
CHC: Community health center
DoH: Department of Health
DDS: Dietary diversity score
EPDS: Edinburgh postnatal depression scale
FANTA: Food and Nutrition Technical Assistance
FAO: Food and Agriculture Organisation
FAS: Foetal alcohol syndrome
FI: Food insecurity
FS: Food security
GDM: Gestational Diabetes Mellitus
GWG: Gestational weight gain
HFIAS: Household food insecurity access scale
HIV: Human Immunodeficiency Virus
HSRC: Human Sciences Research Council
IBW: Infant birth weight
IDA: Iron deficiency anaemia
INP: Integrated Nutrition Programme
IOM: Institute of Medicine
IUGR: Intrauterine Growth Retardation
KZN: KwaZulu-Natal
LBW: Low birth weight
LGA: Large-for-gestational age

LMICs: Low and middle income countries
MDGs: Millennium Development Goals
MTCT: Mother-to-child-transmission
MUAC: Mid upper arm circumference
NDoH: National Department of Health
NICU: Neonatal intensive care unit
NICUS: Nutrition Information Centre University of Stellenbosch
NTP: Nutrition Therapeutic Programme
PIH: Pregnancy induced hypertension
PMHP: Perinatal Mental Health Project
PMTCT: Prevention-of-mother-to-child-transmission
PTB: Preterm birth
SANHANES-1: South African National Health and Nutrition Examination Survey
SASH: South African Stress and Health Survey
SB: Stillbirth
SES: Socioeconomic status
SGA: Small-for-gestational age
SID: Sudden Infant death syndrome
UK: United Kingdom
UKZN: University of KwaZulu-Natal
UN-HABITAT: United Nations Settlement Programme
UNFPA: United Nations Fund for Population Activities
UNICEF: United Nations Children Fund
UNSCN: United Nations Standing Committee on Nutrition
USA: United States of America
VLBW: Very low birth weight
WFP: World Food Programme
WHO: World Health Organisation

1.9 Summary

South Africa has a high maternal and infant mortality rate despite the implementation of numerous policies and programmes to improve maternal and child health. Pregnancy is a critical stage of the lifespan making women vulnerable for compromised health. Infant LBW is a major contributor to infant mortality in South Africa. Maternal malnutrition is a risk factor for LBW and pregnancy complications. These pregnancy-related complications are major causes of maternal mortality in South Africa. The first 1000 days is a period of the utmost importance as it is the window of opportunity for creating an environment for optimal foetal, infant and child health and development. Since malnourished mothers' give birth to malnourished infants, addressing malnutrition during pregnancy and infancy can decrease maternal and infant mortality, infectious disease, stunting and impaired physical and mental development.

Monitoring and ensuring adequate GWG can optimise pregnancy outcomes. The literature shows that household FI and low socio-economic status (SES) is associated with poor GWG and poor diet quality. Hence, it can influence IBW. Previous studies show that South Africa has a high rate of antenatal depression. However, it often goes undiagnosed and untreated. The fact that antenatal depression goes undiagnosed is alarming as it has been found to have detrimental effects on foetal and child health and growth. The maternal outcomes of depression are also associated with inadequate nutrition.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, the literature related to the study under investigation will be reviewed. Maternal and infant health as well as that of young children will be briefly discussed from a South African perspective. The United Nations Children Fund (UNICEF) conceptual framework and its relationship to the development of malnutrition across the lifespan will also be addressed. Nutritional requirements for pregnant women, nutrition-related illnesses that occur during pregnancy, studies that have investigated the dietary intake of South African adult women and dietary intake of pregnant women in both developed and developing countries will be explored. In addition, literature regarding the relationship between pre-conception BMI and GWG will be examined, as well as the current position regarding household FS in South Africa. Other aspects that will be covered will be the association between household FS, diet quality, GWG and depression. The prevalence of and risk factors for the development of antenatal depression and related factors will also be discussed from a South Africa perspective. Lastly the relationship between infant birth outcomes and maternal nutritional status, dietary intake, household FS and depression will be discussed.

2.1.1 Background on the maternal and infant/child health in South Africa

There are numerous problems regarding maternal and infant health in South Africa. The maternal mortality ratio is estimated to be 156.5 per 100 000 live births (Pattinson Fawcus & Moodley 2012). However, it is suggested that 60% of these deaths are preventable (Amnesty International 2014). The underlying but leading causes of maternal mortality in South Africa include: HIV/AIDS, hypertension and obstetric haemorrhage (Pattison *et al* 2012). Approximately 30% of South African pregnant women and girls' are HIV positive (Amnesty International 2014; DoH 2013a). KwaZulu-Natal (KZN) is the province with the highest maternal prevalence of HIV at 37.4% for pregnant women (DoH 2013b). Hypertension and obstetric haemorrhage can be avoided through appropriate nutrition and diet-related practices (Bradshaw, Chopra, Kerber, Lawn, Moodley, Pattinson, Patrick, Stephen & Velaphi 2008).

One in three South African women have a mental health problem during or shortly after gestation (Field & Honikman 2015; PMHP 2010). This statistic is three times higher than the prevalence for developed countries (PMHP 2010). One of the reasons why mental illness is common among South African women is that many develop psychological stress during and after pregnancy (Field & Honikman 2015). Women vulnerable to mental illness include: those living in poverty, experiencing violence or abuse, suffering from HIV/AIDS and those with unplanned pregnancies (Field & Honikman 2015).

The South African infant mortality rate is 27 per 1000 live births (Dorrington, Bradshaw & Laubscher 2014), with LBW infants comprising 12% of the 18% of neonatal deaths occurring in South Africa (DoH 2012). Prematurity is a leading cause of infant mortality and is associated with 45% of early neonatal deaths (DoH 2012). Intra-partum hypoxia which affects larger infants is the second leading cause of neonatal death, accounting for 28% of neonates (DoH 2012). The leading causes of neonatal and young child deaths are: AIDS-related diseases, neonatal illnesses, diarrhoea, pneumonia and severe malnutrition [United Nations Fund for Population Activities (UNFPA 2013].

A plausible explanation for the high prevalence of stunting among South African children aged one to three years, is that stunting is related to an inadequate maternal diet during pregnancy, resulting in the delivery of a LBW infant and subsequent early introduction of complementary foods (Mostert *et al* 2005). In 2011, approximately 60 000 children under the age of five died, with 75% of them being younger than one year (DoH 2011). Forty five percent of under-five childhood deaths are due to under-nutrition (DoH 2011). In 2011, 165 million children with stunting also had poor cognitive, physical and motor skills, resulting in a large reduction in human capital (DoH 2011). The prevalence of stunting, wasting and underweight for children under five is 21.6%; 2.5% and 5.5%, respectively. For one to three year olds, 26.5% are stunted, 6.1% underweight and 2.2% are wasted (Shisana, Labadarios, Rehle, Simbayi, Zuma, Dhansay, Reddy, Parker, Hoosain, Naidoo, Hongoro, Mchiza, Steyn, Dwane, Makoae, Maluleke, Ramlagan, Zungu, Evans, Jacobs, Faber & the SANHANES-1 Team 2013).

2.1.2 Malnutrition across the life span in relation to the UNICEF Conceptual Framework

Malnutrition across the lifespan

An inadequate nutritional status begins during foetal life and often continues into early childhood, adolescence and adulthood. Those affected by malnutrition are predominantly girls' and women (ACC/SCN 2000). The cycle of malnutrition can span across generations as mothers pass their nutritional inadequacies on to their offspring, resulting in stunting if appropriate nutrition intervention are not implemented. A stunted child has poor cognitive skills which leads to fewer years of schooling and fewer employment opportunities. The stunted girl in turn grows up to be a malnourished woman who will also give birth to a malnourished infant resulting in a continued cycle (ACC/SCN 2000). The consequences of malnutrition across the lifespan are depicted in Figure 2.1.

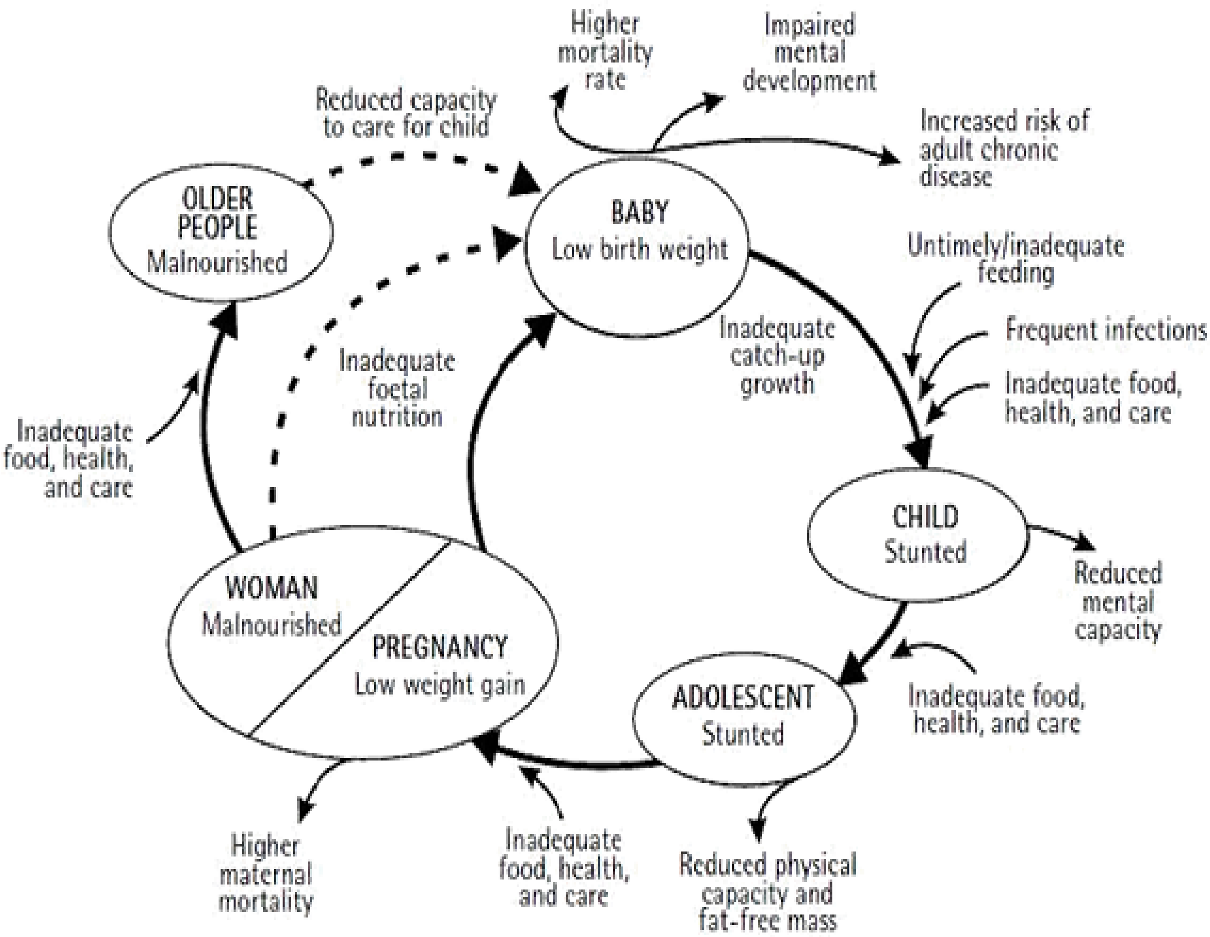

Figure 2.1: Malnutrition throughout the lifespan

Source: ACC/SCN (2000).

UNICEF conceptual framework

The UNICEF conceptual framework (see Figure 2.2) focuses on the causes of under-nutrition. Basic causes such as political, legal and cultural factors can restrict the attainment of good nutrition. Underlying causes such as household FS are dependent on whether individuals/families have access to food, whether it is available and if the food can be properly utilised. Vulnerable groups such as women and children need adequate care and support, access to good health services and to live in a healthy, sanitary environment. Immediate causes lead to malnutrition, maternal and infant morbidity and mortality which is the result of an insufficient nutrient intake or due to an increased demand for nutrients imposed by illness (Global Nutrition Cluster 2011). Some of the causes of malnutrition indicated in the framework will be discussed in further detail in this literature review.

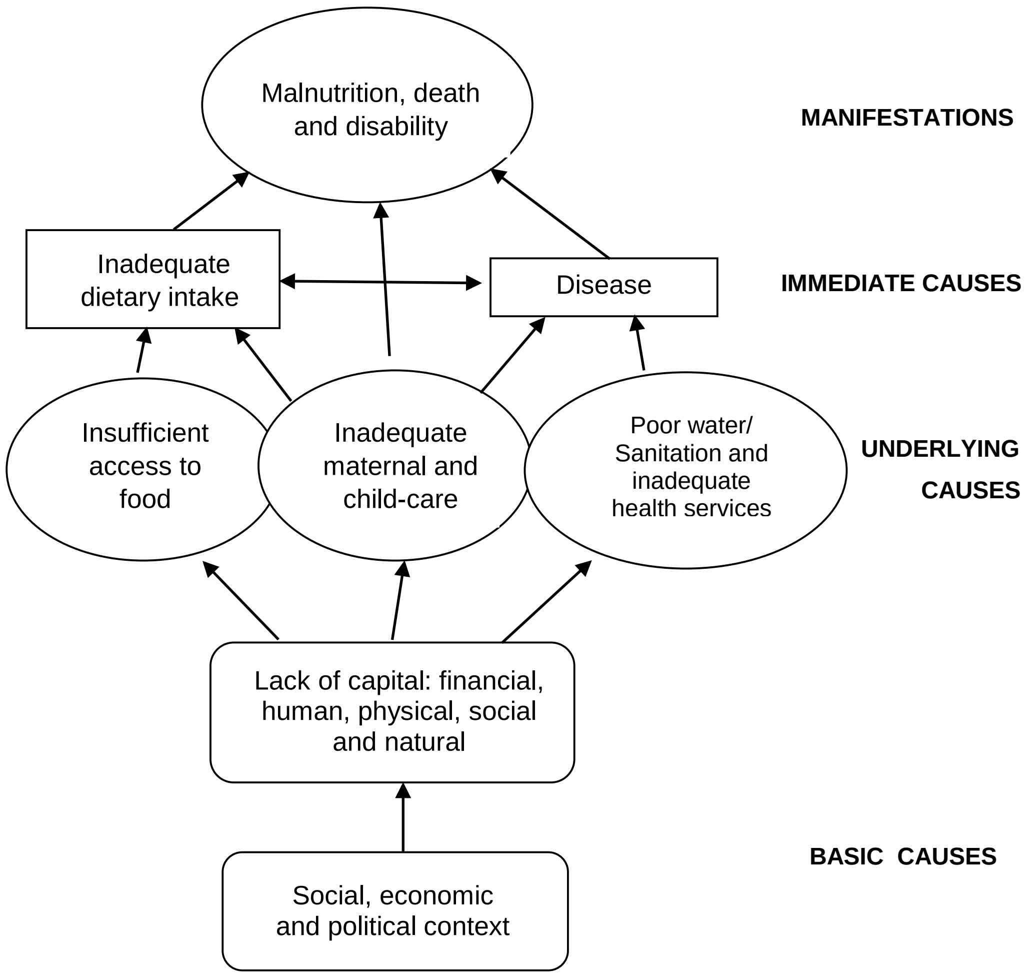

Figure 2.2: UNICEF conceptual framework

Adapted from: The State of the World's Children (1998); UNICEF(1997)

2.2 Nutrition during pregnancy

2.2.1 Nutrient Requirements and diet-related practices during pregnancy

Pregnancy is a critical stage of the lifespan where mothers' need to make the right choices regarding nutrition and lifestyle, as this can affect both maternal and infant health (Procter & Campbell 2014; Nash, Gilliland, Evers, Wilk & Campbell 2013). Hence, optimal dietary intake before, during and after pregnancy is a necessity (Labuschagne, Ackerberg & Lombard 2012). An inadequate nutritional status during pregnancy can have serious short and long term consequences (Moran 2007). Short term consequences include: pregnancy and birth complications, inadequate maternal nutritional status after birth, poor breast milk supply, and failure of the infant to thrive, greater risk of PTB, spontaneous abortion, abnormal development, and increased infant morbidity and mortality (Labuschagne *et al* 2012; IOM 1990). Long term effects of inadequate maternal nutritional status include compromised intrauterine development and growth (IOM 1990; Barker & Osmond 1986). This can "programme" the foetus to have heart disease, as well as metabolic and endocrine disorders later in life (Barker & Osmond 1986) (see Figure 2.3).

Dietary quality during pregnancy is influenced by: marital status, whether the pregnancy was planned or unplanned, occupation, income, presence of nausea, physical activity and mental well-being (Nash *et al* 2013). Pregnant women have increased energy requirements due to foetal growth and maternal body demands (Labuschagne *et al* 2012). Although it is often said that a pregnant woman is "eating for two", a pregnant woman only requires a few more kilojoules on a daily basis to meet these energy requirements (Brown 2011). During pregnancy, energy intake should not be restricted unless medically indicated. An additional 210 to 510 kJ per day is recommended. In the second and third trimester, pregnant women need an additional 340 kJ and 452 kJ per day, respectively (Whitney & Rolfes 2011). Consumption of six to eleven portions of unrefined carbohydrates (whole-wheat/whole grain breads and cereals), or 175g of carbohydrates but not less than 135g is advised for proper foetal brain development and to ensure that protein is not utilised for glucose synthesis (Whitney & Rolfes 2011). Pregnant women need an additional 25g per day of protein (Whitney & Rolfes 2011). Protein can be found in dairy products, meat or meat alternatives, legumes, nuts and seeds. At least three servings of dairy products (milk, maas, yoghurt and cheese) per day and six servings of meat or meat alternatives are recommended to meet protein need [Whitney & Rolfes 2011; Nutrition Information Centre University of Stellenbosch (NICUS) 2009). Fats, oils, sugar, sweets and salt should be consumed in small amounts (NICUS 2009).

Essential long chain polyunsaturated fatty acids omega 3 and 6 are crucial for foetal growth and development (Whitney & Rolfes 2011). Omega 3 fatty acids are needed for the development of the foetus's central nervous system and vision (McMillen, MacLaughlin, Muhlhausler, Gentili, Duffield & Morrison 2008). Studies show that an adequate consumption of omega 3 fatty acids can prevent PTB and increase IBW (McMillen *et al* 2008). Pregnant women should aim to consume two to three servings of omega three fatty acids a week (Opperman, Marais & Benade 2011; NICUS 2009). Sources of omega 3 fatty acids include mackerel, sardines, pilchards, herring and salmon (NICUS 2009).

Vitamins and minerals such as folate, vitamin B_{12}, iron and zinc are required for foetal DNA synthesis and production of new cells. Fortified foods, fruits, green vegetables and whole grains, milk and meat products contain these essential vitamins and minerals for healthy pregnancy (Whitney & Rolfes 2011). The IOM recommends that pregnant women drink 2.4 litres (approximately 10 glasses) of fluids per day (IOM 2005).

Alcohol consumption, cigarette smoking, herbal supplements, excessive caffeine and vitamin A intake, weight loss dieting and the use of artificial sugar Aspartame, especially for women with the condition Phenylketonuria are practices that can result in adverse birth outcomes (Whitney & Rolfes 2011). Caffeinated drinks such coffee and soft drinks should be limited to two cups and two cans per day, respectively (NICUS 2009; WHO 2001). Excessive caffeine consumption (> 300mg/day) should be avoided as it is linked to spontaneous miscarriage and LBW (Labuschagne *et al* 2012). Alcohol consumption is discouraged during pregnancy, especially during the first trimester as it can cause foetal alcohol syndrome (FAS) (Labuschagne *et al* 2012; NICUS 2009; WHO 2001). The consequences of FAS include: growth retardation, slow cognitive development, abnormal facial features and LBW (NICUS 2009).

Smoking cigarettes and the use of illegal recreational drugs is another harmful behaviour that is not recommended (Labuschagne *et al* 2012; NICUS 2009). It can lead to an infant born with a LBW, spontaneous abortion, PTB, sudden infant death syndrome (SID) and still birth (SB) (Labuschagne *et al* 2012; NICUS 2009).

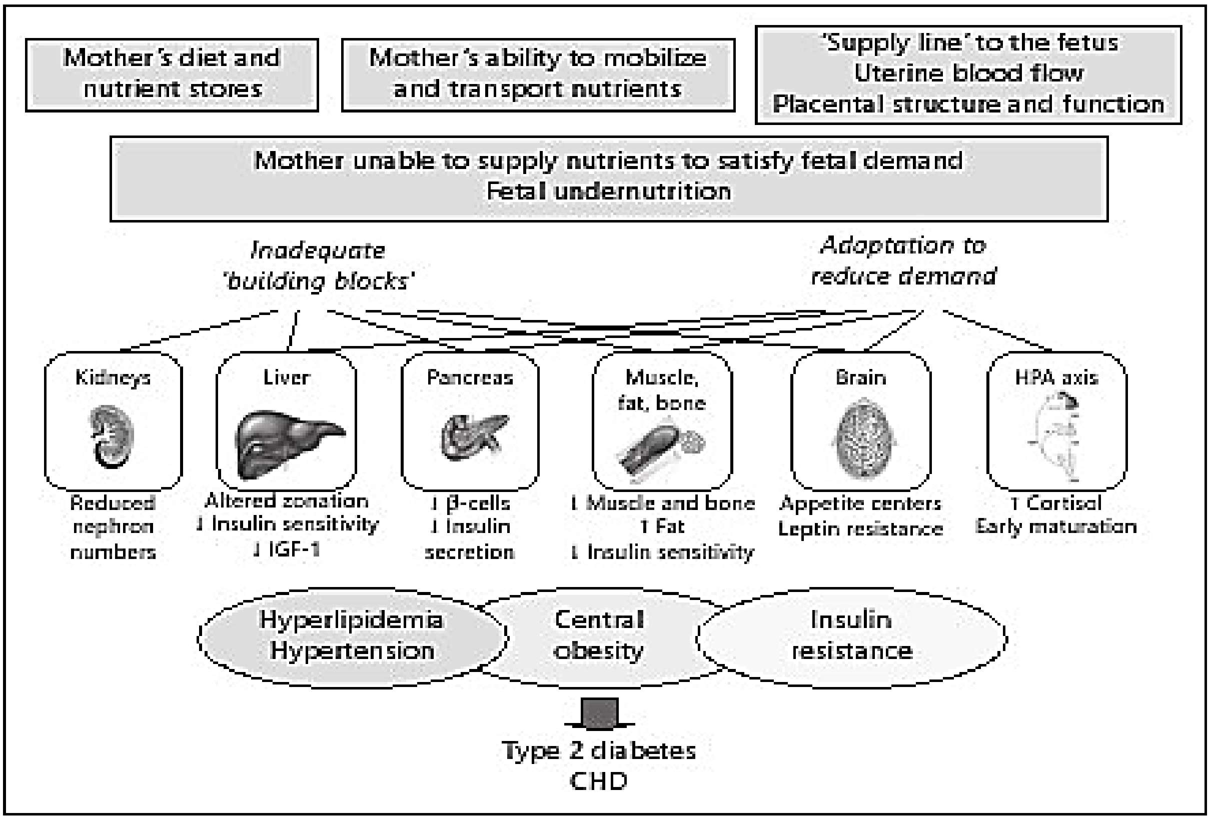

Figure 2.3: The Foetal programming hypothesis (Fall 2013)

2.2.2 Nutrition related diseases during pregnancy

The IOM reported that more women are falling pregnant at a more mature age (IOM 2009). Some of these women have already been diagnosed with nutrition-related diseases such as hypertension and diabetes before pregnancy (IOM 2009). According to a South African study by Hall, du Toit, Mason & Conradie (2015), 60% of the pregnant women in their study sample had GDM, while 33% had type 2 diabetes mellitus. Twenty-three percent of those with GDM also had chronic hypertension, while 42% of those with type 2 diabetes also had chronic heart disease (Hall *et al* 2015). Pre-eclampsia or gestational hypertension, is a hypertensive disorder that occurs in two to five percent of pregnancies (Petit & Brown 2012; Kenneth, Hall, Gebhardt &

Grové 2010). Signs of pre-eclampsia include high blood pressure and presence of proteins in the urine (Whitney & Rolfes 2011). The condition generally occurs in first time pregnancies and presents itself after 20 weeks of pregnancy (Whitney & Rolfes 2011). Pre-eclampsia causes poor placental perfusion resulting in retarded foetal growth (Roberts & Escudero 2012) and negative birth outcomes such as PTB and still birth (Whitney & Rolfes 2011). The cause of the increased prevalence of very low birth weight (VLBW) babies in South Africa and subsequent perinatal death, is due to hypertensive disorders (Taliep, Theron, Steyn & Hall 2010; Odendaal, Steyn & Odendaal 2003).

Pregnancy involves physiological changes such as changes in maternal glucose metabolism and insulin sensitivity. Insulin production demands increase. However, if the demands are not met, this could result in GDM (Macaulay, Dunger & Norris 2014). One in 25 women will develop GDM during pregnancy (Whitney & Rolfes 2011). Normal glucose metabolism is necessary for the attainment of a satisfactory birth weight and length (Mamabolo, Alberts, Steyn & Levitt 2006). Hyperglycaemia in pregnant women can have negative consequences for the baby. These consequences include congenital abnormalities, macrosomia, a difficult labour and birth injuries (McAuliffe 2013; Walsh, Walsh, McGowan, Mahony, Foley & McAuliffe 2012). A South African study conducted in rural Limpopo among black pregnant women in 2006, reported the prevalence of GDM as 8.8% (Mamabolo *et al* 2006). Another study conducted in urban Johannesburg among pregnant women of all races groups in reported the prevalence of GDM as 1.8% (Basu, Jeketera & Basu 2010).

2.2.3 HIV, nutrition and pregnancy

HIV infection can complicate a pregnancy as a woman's nutritional status can be compromised by the infection (Montgomery 2003). The infection can cause nutrient losses and malabsorption which lead to a poor nutritional status [Food and Nutrition Technical Assistance (FANTA) 2008; Papathakis & Rollins 2005; Montgomery 2003]. Medication used to treat HIV has side effects that include: nausea, vomiting, a dry mouth and alteration of taste and smell. These side effects can result in an inadequate dietary intake and hence a poor nutritional status (Montgomery 2003). Expectant mothers' with the HIV infection and poor nutritional status have a greater risk for IUGR, LBW and PTB (Brocklehurst & French 1998). Additional energy and protein in the diet is needed for HIV infected pregnant women. Energy needs vary according to the stage of disease progression. For protein, an additional 6g/day added to the total protein requirement beyond the recommendation for HIV negative pregnant women throughout pregnancy is recommended (FANTA 2008).

HIV positive women are more vulnerable to iron deficiency anaemia (IDA) and folate deficiency when compared to HIV negative women (FANTA 2008; Friis, Gomo, Koestel, Ndhlovu, Nyazema, Krarup & Michaelsen 2001; Allen 2000; Rush 2000). Iron deficiency anaemia in HIV positive pregnant women is a predictor for accelerated disease progression, poor weight gain, toxaemia and labour and delivery complications which increase the risk for mortality and mother-to-child-transmission (MTCT) of HIV (FANTA 2008; Allen 2000; Rush 2000). Studies on multivitamin, iron and folate supplementation for HIV infected pregnant women show that women gain more weight during pregnancy and have reduced risk for LBW and preterm delivery (FANTA 2008).

2.2.4 Dietary diversity

Dietary diversity and pregnancy

A diverse diet is an indication that nutrient requirements will be met. Dietary diversity increases the sources of various nutrients. Hence, diversity in one's diet is associated with a good nutritional status (Schaetzel 2012). Dietary diversity is also associated with an adequate micronutrient intake in adults (Foote, Murphy, Wilkens, Basiotis & Carlson 2004; Ogle, Hung & Tuyet 2001). Monotonous diets with a restricted number of food groups could lead to micronutrient deficiencies (Gambling & McArdle 2010; WHO 2002) and are associated with FI (Labadarios, Steyn & Nel 2011). Eating a variety of food could prevent health problems like anaemia, pre-eclampsia, LBW and congenital abnormalities in mothers and infants. An inadequate dietary intake may result in a complicated delivery, especially if the mother had unsatisfactory GWG (Whitney & Rolfes 2011).

Dietary diversity in South Africa

The general trend is that the average South African consumes four or less of the nine food groups. The minimum number of food groups to be consumed is six (Altman

2010). South African diets mainly lack eggs, legumes and vitamin A rich fruit and vegetables. Those living in rural areas and informal settlements have the most profound lack of dietary diversity. South African studies investigating dietary diversity have reported the mean dietary diversity score (DDS) for the whole population as 4.02 (Labadarios *et al* 2011) and 3.41 (Oldewage-Theron & Kruger 2008) respectively. Another study investigating the dietary diversity of non-pregnant black women living in informal settlements reported a considerably high average DDS of 6.7. The same study also reported that black women consumed mainly cereals and tubers, followed by meat/poultry/fish, fats and oils and dairy. Eggs, vegetables, fruits and vitamin A-rich vegetables were moderately consumed (Acham, Oldewage-Theron & Egal 2012). The dietary diversity of pregnant South African women has not been documented and will therefore be explored in more detail.

2.2.5 Dietary intake and nutritional status of pregnant women

Literature from North American, European and Asian studies show that pregnant women do not achieve the recommended food and nutrient recommendations (Nash *et al* 2013). These studies also report that pregnant women's diets often lack fruits, vegetables, grains, and folate and iron (Nash *et al* 2013). A study conducted in rural Limpopo, South Africa, revealed that pregnant women had a diet which was sufficient in protein but lacked energy and dietary fibre. The study also found that the intake of many micronutrients were lacking, especially for calcium, iron, zinc, niacin, folate, vitamin A, C, E and vitamin B_6 (Mostert *et al* 2005). As the nutritional status and dietary intake of South African women is not well documented, it requires further investigation.

2.3 Maternal nutrition interventions

Interventions to improve maternal nutritional status include: micronutrient supplementation, food fortification, food supplementation, nutrition education, counselling and the provision of cash vouchers. These methods have proved to be very effective in improving birth outcomes in LMICs (Victoria, Barros, Assuncao, Restrepo-Mendez, Matijasevich & Martorell 2012). South African food products such as maize and wheat flour have been fortified with important micronutrients such as vitamin A, iron, zinc, folic acid, thiamin, niacin, vitamin B_6 and riboflavin to prevent nutrient deficiencies among the whole South African population (DoH & UNICEF 2007).

Vitamin and mineral requirements increase during pregnancy. Especially for iron, calcium, folic acid and vitamins A, C and K (Gambling & McArdle 2010; NICUS 2009), as well as zinc, selenium, chromium, iodine, riboflavin, niacin, vitamin B_6, B_{12} and pantothenic acid (Labuschagne *et al* 2012). According to Scholl (2008), multiple micronutrients should be consumed before conception and during pregnancy as it is associated with decreased risk for PTB, LBW, pre-eclampsia, congenital defects and hypertension. Micronutrient supplementation in combination with protein/energy supplements decreases the risk of SGA by 34% (Haschke 2014). Acham *et al* (2011) reported that South African women have an inadequate micronutrient status. Many women rarely have adequate iron stores before conception. Therefore, supplementation is necessary to prevent IDA (American Dietetic Association 2008). According to McLean, Cogswell and Egli (2009), globally 42% of pregnant women suffer from IDA. One in three non-pregnant South African women is anaemic (Acham *et al* 2011). Iron deficiency anaemia is associated with perinatal, maternal, infant mortality and premature delivery (Save the Children 2012; American Dietetic Association 2008).

Folic acid supplementation should ideally be given before conception as it prevents neural tube defects in the foetus (American Dietetic Association 2008). An inadequate folate status is also linked to a smaller birth weight and preterm delivery (Mamabolo *et al* 2006). Mandatory folate and iron supplementation for all pregnant South African women was introduced by the national department of health (NDoH) (Labuschagne *et al* 2012). The WHO recommends a supplement of 30-60mg elemental iron and 0.4mg folic acid for pregnant women throughout pregnancy (WHO 2012).

The South African NDoH also provides calcium supplements for pregnant women (Labuschagne *et al* 2012), as it is beneficial in preventing hypertensive disorders such as pre-eclampsia (WHO 2013). Pre-eclampsia is a major cause of maternal mortality and PTB which subsequently may lead to early neonatal and infant mortality (WHO 2013; Hofmeyr, Neilson, Alfiervic, Crowther, Duley, Gulmezoglu, Gyte, Hodnett 2008).

The WHO recommends 1.5 to 2.0 g of calcium per day from 20 week gestation until term for pregnant women with low calcium intake (WHO 2013).

The South African government introduced the Integrated Nutrition Programme (INP) in 1998. The Nutrition Therapeutic Programme (NTP) falls under the INP. It provides food supplements to correct malnutrition in groups that are at risk (DoH 2011). Pregnant and lactating women are targeted by the NTP. The criteria to be eligible for enrolment in the programme is a BMI of < 18.5 kg/m^2, unintentional weight loss of more than 10% over a six month period and unintentional weight loss of greater than 5% in one month as well as a mid-upper arm circumference (MUAC) of less than 21cm or between 21 and 23cm (DoH 2011). Meta-analyses show that food supplementation (energy and protein) during pregnancy can reduce the risk of SGA by 34% (Imdad & Bhutta 2012). Prenatal food supplementation has also been shown to decrease childhood stunting (Khan, Kabir, Ekström, Ǻsling-Monemi, Alam, Frongillo, Yunus, Arifeen & Persson 2011). The provision of food supplements is generally accompanied by nutrition education and counselling (Victoria *et al* 2012). Nutrition education during pregnancy has been proven to have a positive impact on maternal GWG and birth outcomes (Fowles 2004).

2.4 Anthropometric status of pregnant women

2.4.1 Maternal height and pre-gravid body mass index

Maternal height and weight is an important indicator of infant birth outcomes (Ay *et al* 2009). Short maternal height (<150 cm) is a risk factor for SGA, childhood stunting and low human capital. Short women might have low protein and energy stores. The latter in turn can impact on foetal growth and breast milk production postpartum (Ozaltin, Hill & Subramanian 2010, Subramanian, Ackerson, Davey & John 2009, Victoria, Adair, Fall, Hallal, Martorell, Richter, Sachdey, Maternal and Child Undernutrition Study Group 2008; Ramakrishnan Martorell, Schroeder & Flores 1999). Evidence from studies conducted in the United Kingdom (UK) and the United States of America (USA) suggest that both pre-pregnancy weight and GWG can influence foetal growth (Ay *et al* 2009). An optimal pre-conception weight is a BMI of 18.5 to 24.9kg/m^2

(PMNCH 2011). However, an ideal pre-conception BMI is often not attainable for most women (Tanaka *et al* 2014).

The global prevalence of obesity is increasing. Those most at risk are women of child bearing age (Heude, Thie´baugeorges, Goua, Forhan, Kaminski, Foliguet, Schweitzer, Magnin, Charles & The EDEN Mother–Child Cohort Study Group 2012). According to Haschke (2014), more than 50% of young women are overweight or obese. An average BMI for black South African women is 29.0 kg/m^2 with the prevalence of overweight being 24.9% and that of obesity being 39.9%. The prevalence of underweight BMI is 3.6% and normal weight BMI is 31.6% among black women (Shisana *et al* 2013). These statistics regarding the anthropometric status of black female South Africans is a cause of concern as this might imply that many black pregnant women have an overweight/obese BMI pre-conception. A study conducted in Khayelitsha, South Africa, reported that 44.2% of pregnant women had a normal weight, 5.7% were underweight, 17% overweight and 33.1% were obese (Davies, Visser, Tomlinson, Rotheram-Borus, Gissane, Harwood & LeRoux 2013).

According to Drehmer, Duncan, Kac & Schmidt (2013), a high pre-pregnancy BMI and pre-pregnancy overweight/obesity is a risk factor for excessive weight gain. An underweight BMI status pre-pregnancy is however, not a predictor for inadequate GWG (Drehmer *et al* 2013). Overweight and obese pregnant women have a higher incidence of haemorrhage, venous thromboembolism and postpartum weight retention (NNI 2013). A pre-pregnancy BMI of > 25 kgm^2 is associated with pre-eclampsia and GDM (Queenan *et al* 2007; Kugyelka, Rasmussen & Frongillo 2004).

Pre-pregnancy obesity is linked to numerous adverse pregnancy outcomes (Heude *et al* 2012; Tenenbaum-Gavish & Hod 2012; Cnattingius, Bergström, Lipworth & Kramer 1998), these include: GDM, pre-eclampsia, emergency caesarean section, PTB, LGA and SB (Heude *et al* 2012; Choi, Park & Shin 2011). On the contrary, one systematic review showed that a pre-pregnancy overweight and an obese class I pre-pregnancy BMI can prevent PTB (Torloni, Betrán, Daher, Widmer, Dolan, Menon, Bergel, Allen & Merialdi 2009). Women with a pre-pregnancy BMI obese class II and class III, have a greater risk for preterm delivery (Masho, Bishop & Munn 2013). Pre-pregnancy obesity and excessive GWG is associated with LGA or macrosomia, hypoglycaemia and hyperbilirubinemia (jaundice) in infants (Radhakrishnan *et al* 2014; Tanaka *et al* 2014). A study conducted in India reported that women who were underweight had greater risk for IDA and giving birth to LBW infants (Sahu *et al* 2007). According to Koh, Ee, Malhotra, Allen, Tan and Østbye (2013), maternal age under 20 years and an underweight pre-gravid BMI, is a risk factor for insufficient weight gain during pregnancy.

2.4.2 Maternal mid upper-arm circumference

The MUAC is used to measure body fat and can reflect changes in both muscle mass and subcutaneous fat (Gibson 2005). It is also a useful indicator for protein-energy-malnutrition or starvation. The MUAC is used to assess nutritional status and determine whether individual requires nutrition assistance. It is used for among others, pregnant women (Verves, Antierens, Sackl, Staderini & Captier 2013). Many studies have shown that the MUAC is related to BMI in adult populations (Mazicioghu, Yalchin, Ozturk, Ustunbas & Kurtoglu 2010; Martin, Pascoe EM, Forbes 2009; Chakraborty, Bose & Bisai 2009). According to Ververs *et al* (2013), MUAC is the preferred indicator for identifying malnourished pregnant women because of its strong association with LBW.

A MUAC of less than a range of 22cm to 23cm is associated with adverse birth outcomes (Verves *et al* 2013). Both longitudinal and cross-sectional studies reported that a low MUAC is associated with LBW, PTB (Assefa, Berhane & Worku 2012; Sebayang, Dibley, Kelly, Shankar, Shankar & SUMMIT Study Group 2012), irregular intrauterine growth (Kalanda, Verhoeff, Chimsuku, Harper & Brabin 2006), birth asphyxia (Lee, Darmstadt, Khatry, LeClerq & Shrestha 2009) and SGA (Sebayang *et al* 2012). In table 2.1, the MUAC references for adults of different race groups are reported.

Table 2.1: MUAC reference values for adults in developing countries

Mid-Upper Arm Circumference (cm)			
African adults (men and women)	**Asian/Caucasian adults**		**Nutritional status**
	Men	Women	
>24.0	>22.0	>22.0	Normal malnutrition
23.1-24.0	22.1-23.0	20.1-22.0	Mild malnutrition
22.1-23.0	21.1-22.0	19.1-20.0	Moderate malnutrition
<22.1	<21.1	<19.1	Severe

Source: Ismail & Manandhar (1999)

2.4.3 Gestational weight gain

Sufficient GWG is needed to ensure ideal growth of the foetus, placenta and other maternal tissues such as the breasts and uterus (WHO 2002). Satisfactory weight gain will meet the metabolic stress induced by pregnancy. Therefore, all pregnant women should ideally gain weight gradually during pregnancy (WHO 2002). However, GWG depends on pre-pregnancy BMI, age, height, parity, education, socio-economic status, smoking and the presence of chronic illness during pregnancy (Koh *et al* 2013).

Weight gain during pregnancy can be regulated through nutrition counselling and lifestyle changes (Cnattingius *et al* 1998). According to Shin, Bianchi, Chung, Weatherspoon & Song (2013), an insufficient intake of vegetables and fats (oils), is associated with a high GWG, while excessive weight gain can increase the risk of delivery via a caesarean section, GDM, pregnancy-induced hypertension (PIH) and pre-eclampsia (Kapadia, Gaston, Van Blyderveen, Schmidt, Beyene, McDonald & McDonald 2015; De Onis 2011). A study conducted in Japan, revealed that pregnant women with an underweight pre-gravid BMI and/or normal pre-gravid BMI but gained less than nine kilograms during pregnancy, had twice the risk of giving birth to a SGA infant (Watanabe, Inoue, Doi, Matsumoto, Ogasawara, Fukuoka & Nagai 2010). A study conducted by Esimai & Ojofeitimi (2014) in Nigeria regarding factors affecting

GWG, found that 97% of women gained weight below recommendations. The same study reported that 28% of women had infants with a normal birth weight and that the majority of women had LBW infants. The WHO classification and IOM guidelines for GWG according to pre-gravid BMI is summarised in table 2.2.

Table 2.2: WHO classification and IOM guidelines for gestational weight gain in pregnant women.

GWG category	**Recommended range of total weight gain (kg)**			
Pre-pregnancy BMI category	**Inadequate**	**Adequate**	**Excessive**	**Recommended weight gain (kg/week)**
BMI <18.5 (kg/m^2), underweight	<12.5	12.5–18	>18	0.45
BMI 18.5–24.9 (kg/m^2), normal weight	<11.5	11.5–16	>16	0.45
BMI 25–29.9 (kg/m^2), overweight	<7	7–11.5	>11.5	0.27
BMI ≥ 30 (kg/m^2), obese	<5	5–9.1	>9.1	0.20

Source: Tanaka *et al* (2014); IOM (2009)

2.5 Household food security

2.5.1 Household food security in South Africa

South Africa is a food secure country but many households are food insecure (Altman & Jacobs 2009; Hart 2009). Only an estimated 11 million South Africans are food insecure, despite the fact that South Africa is an agriculturally productive country. Access to food is still a major challenge for many South Africans (South African Human Rights Commission 2013). The National Food Consumption Survey (NFCS) 2005 reported that 20% of the population was food secure and 52% were hungry (Altman & Jacobs 2010). The Hunger Index developed from the NFCS (2005) showed that more than 50% of households experienced hunger, 28.2% of households were at risk for hunger and 20.2% were food secure. It was also reported that 58% households in rural areas experienced hunger, while 46% of urban households experienced hunger (DoH 2014).

The SANHANES-1, found that 45.6% of the South African population were food secure, 28.3% were at risk of hunger and 26.0% experienced hunger. The highest level of FI was found in urban informal dwellings (32.4%) and rural formal settlements (37.0%). High levels of being at risk for hunger was found in urban informal settlements (36.1%) and rural informal settlements (32.8%) (Shisana *et al* 2013). The leading causes of South African household FI include recurrent poverty and unemployment [Human Sciences Research Council (HSRC) 2007]. The provision of social grants has however, dramatically reduced household FI and hunger among South Africans (Altman & Jacobs 2010).

According to the United Nations Human Settlements Programme (UN-HABITAT), 61.7% of South Africans live in urban areas (The Centre for Development and Enterprise (CDE) 2005). Food access as a dimension of FS is dependent on the availability of income (Kennedy 2003). Food security in urban areas relies on residents having enough money to purchase food. Generally, those with a low income have to purchase smaller amounts of food (Kennedy 2003). This makes them vulnerable to FI (Van der Merwe 2011). Another component of FI in urban areas is food utilisation. In South Africa, eating patterns are generally influenced by ethnicity, culture and living in an urban or rural areas. In the past, urban black South Africans typically ate a low fat and high carbohydrate diet. However, many have undergone a nutrition transition resulting in a Westernised diet that is high in fat, protein, free sugars and low in fibre and carbohydrates. This shift in dietary habits is also linked to a lack of physical activity and the increased use of tobacco and alcohol (Van der Merwe 2011).

2.5.2 Household food security, dietary intake and gestational weight gain

According to the National Development Agency (2013) a quarter of South African women have malnutrition and vitamin deficiencies because of FI. Pregnant women are vulnerable to FI as they have greater nutrient requirements. They may also be less mobile or cannot access adequate amounts of food. Vulnerability increases especially during the third trimester and early postpartum stage (Natamba, Kilama, Arbach, Achan, Griffiths & Young 2014). In the USA, FI in women is associated with a higher BMI and hence a higher prevalence of overweight/obesity (Castell, Rodrigo, de la Cruz & Bartrina 2015). Studies conducted in the UK, USA, Canada and Australia show that

FI in adults is associated with a low consumption of fruits and vegetables (Ihab, Rohana, Wan Manan, Wan Suriati, Zalilah & Mohamed Rusli 2013; Nelson *et al* 2007). Food insecure pregnant women whose diets lack energy and micronutrients, have a greater likelihood of LBW infants. Mothers' pass on their nutritional deficiencies to their infants. This can result in dire consequences for infants such as impaired growth and development (Ihab *et al* 2013).

Underweight and overweight can co-exist within an impoverished home (Ihab *et al* 2013). An American study reported that women from food insecure households had a pre-pregnancy BMI classified as morbidly obese. A possible explanation for this finding is that household FI can fuel the consumption of unhealthy appetising foods as a way to cope with stress (Laraia, Siega-Riz & Gundersen 2010). Household FI can result from dependence on reasonably priced energy-dense, mainly starchy foods. During late pregnancy it may be difficult for a woman to buy food and prepare it herself. Hence, pregnant women may turn to eating inexpensive non-nutritious foods. As a result, women who are food insecure would seemingly have high GWG due to unhealthy eating habits (Laraia, Epel & Siega-Riz 2013).

2.5.3 Household food insecurity and depression in pregnant women

Food security and stress (depression) are important environmental predictors of maternal health and the prevalence of LBW (Mozayeni, Motlagh, Eshraghian & Davaei 2014). The major factors that influence FI and depression during pregnancy are unwanted pregnancies, low earnings, unemployment and low education level (Mozayeni *et al* 2014). One study reported that 66.9% of food insecure mothers' suffered from depression (Mozayeni *et al* 2014). Another study reported that 32.9% of mothers' suffered from depression, of those who were depressed, 67.1% were food insecure (Casey, Goolsby, Berkowitz, Frank, Cook, Cutts, Black, Zaldivar, Levenson, Heeren & Meyers 2004). Food insecure households in rural Malaysia have a greater probability of adults within households that suffer from nutrient deficiencies, morbidity, mental health problems, chronic diseases of lifestyle and elevated levels of depression (Ihab *et al* 2013; Laraia *et al* 2010). In South Africa, there seems to be a lack of published research that have investigated both household FI and depression in pregnant women.

2.6 Socio-economic status, food insecurity, dietary diversity and pregnancy

Although some studies show evidence that the maternal diet influences infant birth outcomes; SES actually lays the foundation for pregnancy outcomes (Saaka 2012), as factors related to SES, have a direct impact on maternal dietary habits and food intake during pregnancy (Abu-Saad & Fraser 2010). A low SES indirectly affects foetal growth but directly affects access to food, diet quality and access to health care. Factors such as low level of education, lack of employment, access to housing and other resources are associated with adverse birth outcomes (Jansen, Tiemeier, Looman, Jaddoe, Hofman, Moll, Steegers, Verhulst, Mackenbach & Raat 2009; Morgen, Bjørk, Andersen, Mortensen & Andersen 2008; Fairley & Leyland 2006; Torres-Arreola, Constantino-Casas, Flores-Hernández, Villa-Barragàn & Rendón-Macìas 2005). According to de Swardt, Puoane, Mickey Chopra & du Toit (2005), there are five sources of income in South Africa. These are wages, social grants, temporary employment, self-employment and other sources of income. Wages and social grants are the largest and second largest sources of income in South Africa respectively.

South Africa has a high unemployment rate of 25% (National Treasury 2011). Approximately 36% of youth under 24 years and 73% of people under 34 years of age are unemployed (National Treasury 2011). A number of studies have showed that dietary diversity is associated with household SES and reported that high SES and access to resources is associated with higher dietary diversity (Brinkman, de Pee, Sanogo, Subran, & Bloem 2009; Murakami, Miyake, Sasaki, Tanaka, Ohya & Hirota 2009; Ponce, Ramirez & Delisle 2006; Arimond & Ruel 2004). Poor households generally use large portions of their income for food (Altman *et al* 2009). This means that diets lack energy, quality and diversity as they try to cope by purchasing primarily starchy foods (Altman *et al* 2009). Pregnant women with a low income have difficulty getting a good quality diet. One cross sectional study reported that pregnant women in their first trimester with low income, depressed mood and lack of social support had low intakes of vegetables, fruit, folate and iron (Fowles, Bryant, Kim, Walker, Ruiz, Timmerman & Brown 2011). According to Abu-Saad & Fraser (2010), the major socioeconomic predictor for good health is educational level. Low educational levels restrict one from obtaining a job and having access to other social resources, therefore increasing the risk of poverty. Hence, maternal diet is negatively affected. There are however, studies that have found no relationships between maternal nutrition and adverse birth outcomes in developed countries where the prevalence of a low SES was low (Cohen, Curet, Levine, Ewell, Morris, Catalano, Clokey & Klebanoff 2001; Mathews, Yudkin & Neil 1999).

2.7 Antenatal Depression

2.7.1 Global prevalence, signs and risk factors for antenatal depression

The WHO defines health as ‘a state of complete, physical, mental and social well-being’ (WHO 2001). Mental health is therefore an important component of health and is essential for the overall well-being of individuals and society (DoH 2014). Globally, the prevalence of antenatal and postnatal depression is estimated to be 20% and between 12% and 18% respectively (Leung & Kaplan 2009). These estimates are however not a true reflection of maternal depression, as antenatal depression is rarely diagnosed or reported (Leung & Kaplan 2009). A systematic review found the prevalence of antenatal depression to be 7.4%, 12.8% and 12.0% during the first, second and third trimesters, respectively (Bennet *et al* 2004).

There are no discrepancies regarding the signs and symptoms of perinatal depression and general depression (Leung & Kaplan 2009). Common signs and symptoms of depression include: a depressed mood (sadness, tearfulness), loss of interest or pleasure, feelings of guilt or worthlessness, abnormal sleeping patterns (insomnia or hypersomnia), lethargy, change in appetite (resulting in weight loss or gain), decreased energy, difficulty in concentrating, body aches and pains and suicide ideation or attempts of self-harm (Field & Honikman 2015; Leung & Kaplan 2009).

Risk factors for developing antenatal depression can be hereditary, environmental, social, psychological and biological (Leung & Kaplan 2009). Environmental factors linked to depression include: stress (physical, mental and emotional), viral infections, abnormal hormone levels, chronic diseases and use of sedatives (Räisänen *et al* 2014; Leung & Kaplan 2009). Social factors include: a lack of social support, unhappy marriage, single marital status, poor SES (lack of income), low level of education, poverty, life altering events (death, divorce), domestic violence, life stresses and substance abuse (smoking, alcohol, drugs) (Räisänen *et al* 2014; Alder *et al* 2011; Leung & Kaplan 2009).

Poor nutrition is one of the major biological risk factors for developing depression (Leung & Kaplan 2009). A deficiency of folate, vitamin C, D, E and vitamin B_{12}, calcium, iron, selenium, chromium, magnesium, zinc and omega 3 fatty acid is associated with depressive mood disorders (Leung & Kaplan 2009). Many of the nutrients listed above regulate the synthesis of serotonin, dopamine and norepinephrine. Low levels of serotonin and dopamine are associated with depression (Leung & Kaplan 2009).

Pregnant women who regularly use pain medication have four times the risk of antenatal depression (Alder *et al* 2011). Other risk factors include: young maternal age, history of depression, history of miscarriage and abortion, history of childhood sexual abuse, low self-esteem, high anxiety and pessimism during pregnancy (Leigh & Milgrom 2008). The risk of common depressive disorders in pregnant women is reduced if women have a higher level education, stable employment and a partner who is employed (Fisher *et al* 2012).

According to Claesson, Josefsson & Sydsjö (2010), several studies found evidence that obese pregnant women are vulnerable to developing anxiety and depression during and after pregnancy. A systematic review by Kapadia *et al* (2015) reviewing 35 studies conducted in the USA and Asia, found that excessive GWG is not associated with depression/anxiety or stress. Women who suffered from GDM, diabetes mellitus, pre-eclampsia, anaemia, previously had a caesarean section and placental abnormalities had a higher prevalence of suffering from perinatal depression (Räisänen *et al* 2014). An unwanted pregnancy poses twice the risk of developing depression (Yanikkerem Ay & Piro 2013), whereas an unplanned pregnancy is associated with delayed prenatal care, LBW, delayed initiation of folic acid supplementation, pregnancy complications, depression and postpartum depression (Yanikkerem *et al* 2013; Karaçam & Ançel 2009). Pregnant women who experienced household FI and violence from their partner during pregnancy are at a greater risk for developing depressive symptomatology (Dibaba, Fantahun & Hindin 2014).

2.7.2 Antenatal depression in South Africa

The South African Stress and Health (SASH) survey found that 16.5% of adults have had a mood, anxiety or substance abuse problem in the previous year of the survey. The survey also reported that women are at a greater risk for developing depression and anxiety disorders (Williams, Herman, Stein, Heeringa, Jackson, Moomal & Kessler 2007). Mental illness is more common in urban- rather than rural areas of South Africa (Copper *et al* 1999; Rumble, Swartz, Parry & Zwarenstein 1996). In addition, mental illness is more prevalent among people with diabetes, hypertension and HIV/AIDS (Kugee 2008; Myer *et al* 2008). HIV is a risk factor for developing antenatal depression in pregnant women (Rochat, Tomlinson, Newell & Stein 2013; PMHP 2010). According to a study conducted in rural KZN, 47% of HIV negative pregnant women were depressed and 45% of HIV positive pregnant women were depressed. An HIV positive status, unplanned pregnancy and low income were SES risk factors for antenatal depression (Rochat *et al* 2013). A study conducted in an urban community in KZN, reported the prevalence of antenatal depression to be 39% (Manikkam & Burns 2012).

A study conducted in urban KZN found that the major risk factors for developing depression included a positive HIV status, history of depression, suicide ideation, single marital status and unplanned pregnancy (Manikkam & Burns 2012). The PMHP report states that poverty, violence against women and lack of social support are leading risk factors for antenatal depression among South African women (PMHP 2010). The major risk factors for depression among pregnant women in Cape Town's peri-urban informal settlements were inadequate partner support, intimate partner violence, a household income of less than R2000 per month and younger maternal age (Hartley *et al* 2011). A number of studies suggest FI an indicator for poverty is also a risk factor for poor mental health (Lund, Breen, Flisher, Kakuma, Corrigall, Joska, Swartz & Patel 2010; Maes, Hadley, Tesfaye & Shifferaw 2010; Huddleston-Casas, Charnigo & Simmons 2009). Two South African studies found that FI is also associated with greater risk for having anxiety, substance abuse and suicide ideation (Dewing, Tomlinson, le Roux, Chopra & Tsai 2013; Sorsdahl, Slopen, Siefert, Seedat, Stein & Williams 2011).

Identifying pregnant women with mental illness is difficult in South Africa, as there is a shortage of staff, large patient numbers and insufficient staff trained on diagnosing and dealing with mental health problems (Honikman, Fawcus & Meintjes 2015). South Africa also has a major problem of health care staff in maternity facilities being abusive, unkind and disrespectful to pregnant women (Honikman *et al* 2015). The presence of antenatal depression can worsen the situation if pregnant women do not receive the necessary support and compassion from health care staff (Breier, Wildschut & Mgqolozana 2009). Abuse of pregnant women can result in inadequate care and negative pregnancy outcomes as women avoid utilising the ANC services (Honikman *et al* 2015).

2.7.3 Impact of antenatal depression on pregnant women and their offspring.

Depression during pregnancy can affect a mother's brain functioning which can lead to irrational thoughts (Manikkam & Burns 2012). Depressive symptoms are associated with pregnant women not seeking medical assistance, substance abuse and unhealthy eating habits (Barker, Kirkham, Ng & Jensen 2013; Manikkam & Burns 2012; PMHP 2010; Leung & Kaplan 2009). A study conducted in Pakistan that investigated the relationship between antenatal depression and dietary intake, found a positive association between depression and a poor maternal dietary intake of mainly macronutrients (Saeed, Raana, Saeed & Humayun 2016). The study reported that women suffering from depression ate small amounts of carbohydrates, protein and average amounts of fat when compared to non-depressed women. Depressed women were also found to consume low amounts of milk, fruit, meat and poultry. In the same study, 71% of depressed women had a poor dietary intake (Saeed *et al* 2016).

Adverse pregnancy outcomes that are also associated with depression include: hypertension, pre-eclampsia and GDM (Grote, Vik, von Kries, Lugue, Socha, Verduci, Carlier, Koletzko & European Childhood Obesity Trial Study Group 2010). Infants are also affected by maternal depression (Fisher *et al* 2012), as maternal mental instability can increase the risk of infant and maternal mortality (PMHP 2010). Pregnant women who are depressed and experience severe weight loss or excessive weight gain expose the foetus to an unhealthy nutritional environment, which can predominantly affect foetal brain development (Barker *et al* 2012; PMHP 2010). Infants born to women who experienced antenatal depression have decreased cognitive behaviour and poor maternal-infant bonding (Field & Honikman 2015; Talge *et al* 2007). Perinatal depression in mothers' living in LMICs is associated with an increased risk of malnutrition, stunting, diarrheal diseases, infectious diseases and decreased completion of immunisation among infants (Field & Honikman 2015; Fisher *et al* 2012). The negative consequences of perinatal depression are depicted in Figure 2.4.

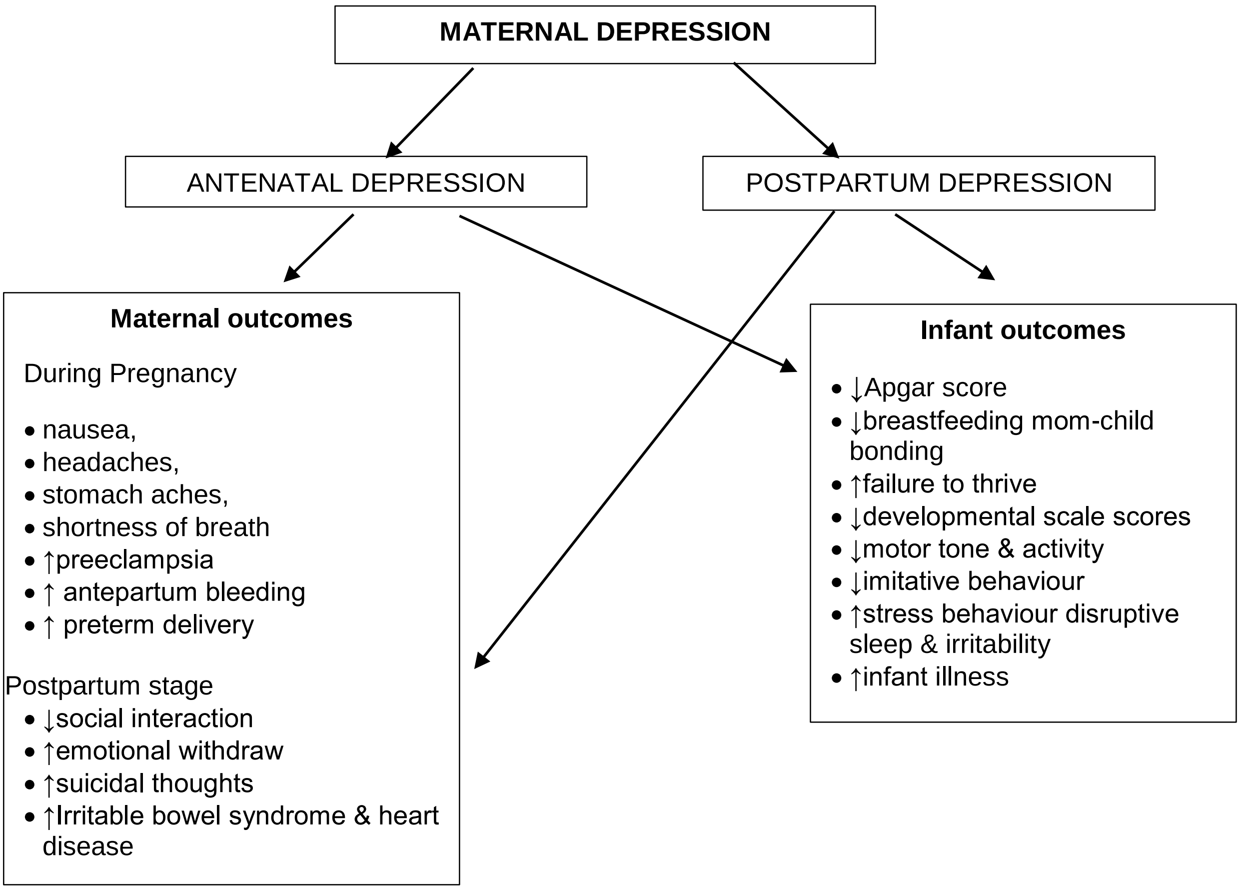

Figure 2.4: Diagram showing the effects of maternal depression on the infant
Source: Leung & Kaplan (2009)

2.8 Infant birth outcomes

Birth weight is an important anthropometric measurement as it relates to infant mortality, morbidity, childhood development and adult health (Godfrey & Barker 2000). A WHO Collaborative Study stated that IBW between 3.1 and 3.6kg (average 3.3kg) is linked to positive foetal and maternal outcomes (PMNCH 2011). With regards to gestational age, it is well known that girls weigh less than boys and that firstborn infants are lighter in weight when compared to subsequent infants (ACC/SCN 2000). The average weight-for-age for boys is 3.3kg and for girls is 3.2kg [World Food Programme (WFP) 2005]. Infants with a weight of 2kg to 2.499kg have four times the risk of neonatal mortality when compared to infants with a weight of 2.5kg to 3.499kg. A high infant birth weight is associated with delivery complications such as shoulder dystocia and caesarean section (Ay *et al* 2009). Further complications for LGA infants include childhood and adult obesity (Ay *et al* 2009) and cancer and diabetes in adulthood (Fall 2013). Table 2.3 shows classification of birth weight according to gestational age.

Table 2.3: Classification of LBW/PTB

Gestational Age	Low Birth Weight	Normal Birth Weight
> 37 Weeks	IUGR	Normal
< 37 Weeks	PTB and/or IUGR	Preterm

Source: Global Nutrition Cluster (2011).

In developing countries, LBW results from IUGR and infants are born small at term (> 37 weeks). However, 6.7% of these infants are born prematurely (Muthayya 2009). Low birth weight and SGA is an indicator of impaired foetal growth and IUGR (Bergmann & Bergmann 2008). Small-for-gestational-age infants have a greater risk of mortality and impaired cognitive and psychological development (Watanabe *et al* 2010). This has negative outcomes in adulthood when compared to infants with AGA (Watanabe *et al* 2010). Preterm birth and SGA is related with under-nutrition at two years of age (Katz *et al* 2013) and short adult height and fewer years of schooling in LMICs (Stein, Barros, Bhargava, Lee, Horta, Kuzawa, Martorell, Ramji, Stein & Richter on behalf of the COHORTS Group 2013). The consequences of a LBW in infants is summarized in the figure 2.5. A study conducted in Khayelitsha, Cape Town, reported that only 3.4% of infants had a LBW. The same study also reported that 8.5% of babies were LGA. These findings are significantly higher than other South African studies which reported that 2.3 to 3.43% of babies were LGA (Davies *et al* 2013).

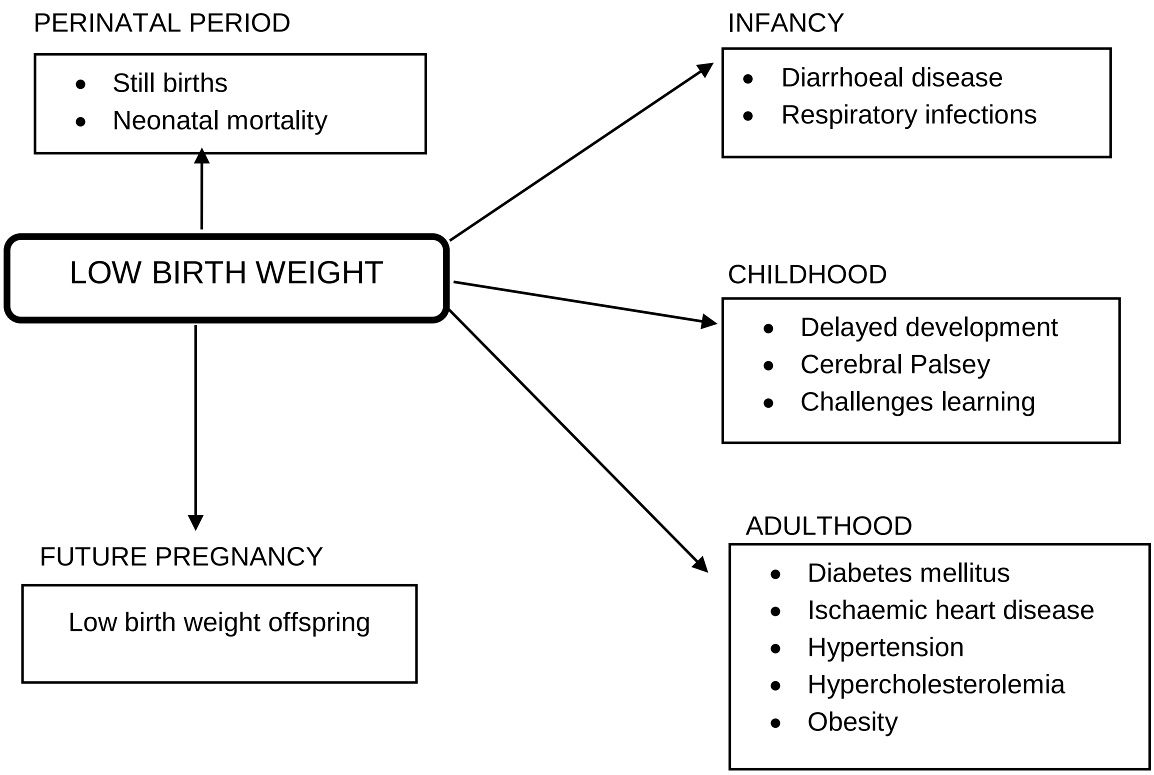

Figure 2.5: Consequences of low birth weight at different life cycles
Source: DoH (2007)

2.8.1 Maternal diet and infant birth outcomes

Birth weight is largely influenced by the maternal foetal growth, maternal diet from birth to pregnancy and body composition at the time of conception (ACC/SCN 2000). Past observational studies show that a maternal nutrient-dense diet or a well-balanced diet is associated with a higher birth weight and lower risk for SGA infants (Okubo, Miyake, Sasaki, Tanaka, Murakami, Hirota, Osaka Maternal and Child Health Study Group, Kanzaki, Kitada, Horikoshi, Ishiko, Nakai, Nishio, Yamamasu, Yasuda, Kawai, Yanagihara, Wakuda, Kawashima, Narimoto, Iwasa, Orin, Tsunetoh, Yoshida, Iito, Kaneko, Kamiya, Kuribayashi, Taniguchi, Takemura, Morimoto, Matsunaga, Oda & Ohya 2012; Rodriguez-Bernal, Rebagliato, Iniguez, Vioque, Navarrete-Munoz, Murcia, Bolumar, Marco & Ballester 2010; Thompson, Wall, Becroft, Robinson, Wild & Mitchell 2010).

A Norwegian study found that pregnant women who follow a traditional and/or healthy diet consisting of vegetables, fruit, lamb, poultry, fish, and root vegetables, had a significantly lower risk for SGA when compared to those who consumed a "Western diet" which included mainly red meat, processed meat and high fat dairy products (Murphy, Stettler, Smith & Reiss 2014). Therefore, dietary diversity is important as poor dietary diversity is linked to an increased risk for delivering a LBW infant (Saaka 2012). The ROLO study found that a low glycaemic index (GI) diet decreases the incidence of infant macrosomia. A low GI diet also resulted in a significant decrease in maternal glucose intolerance and GWG (Walsh *et al* 2012).

Increased energy and protein intake in underweight women is associated with a decreased prevalence of LBW and PTB (Newton 2007). It has been found that an increase in dietary energy and protein intake (40 to 60g) in underweight women, increased infant birth weight by 100 to 400g. Maternal weight gain also increased by 0.8 to 0.9kg per month (Queenan *et al* 2007). Diets with inadequate amounts of protein and carbohydrates are associated with LBW (American Dietetic Association 2008). A systematic review conducted by Murphy *et al* (2014) on eleven studies, found one study where a low consumption of fruit was linked to a LBW. Two studies conducted in developing countries reported that an increase in vegetable or fruit intake is linked to an increase in IBW. However, more evidence is required to support these findings. A number of studies have reported that the consumption of milk and fish during pregnancy is associated with optimal IBW (Olsen *et al* 2007; Mannion, Gray-Donald & Koski 2006; Olsen & Secher 2002). A study conducted by Fawzi, Msamanga, Urassa, Hertzmark, Petraro, Willet & Spiegelman (2007) concluded that prenatal multivitamin supplementation (excluding vitamin A) decreases the risk of LBW and SGA infants.

2.8.2 Pre-gravid body mass index and infant birth weight

Frederick, Williams, Sales, Martin & Killien (2008) stated that pre-pregnancy BMI and GWG is independently and positively correlated with IBW. Pre-pregnancy underweight and inadequate GWG is a predictor for a shorter gestation period, and increased risk for SGA, having a LBW infant, foetal growth retardation and/or preterm delivery (Tanaka *et al* 2014; Gao *et al* 2013; De Onis 2011; Scholl 2008). On the contrary, results from the study by Heude *et al* (2012), showed that underweight women had the lowest risk for preterm delivery and SGA while obese women had more preterm deliveries. A study conducted in India reported that pre-pregnancy overweight and obesity is associated with infant complications such as low Apgar scores, birth defects and underweight (Sahu *et al* 2007). Obese pregnant women with a high GWG but no signs of GDM and hypertension, are at greater risk for delivering a LGA infant (Heude *et al* 2012). Obese women are also believed to give birth to newborns weighing 300g more than other newborns (Haschke 2014). Higher BMI and excessive GWG is also associated with infants with more adipose tissue and childhood overweight (Oken, Taveras, Kleinman, Rich-Edwards & Gillman 2007). Although some studies associate an obese pre-pregnancy BMI with LGA infants, a study conducted by Davies *et al* (2013), found that gestational BMI was not associated with macrosomia.

2.8.3 Gestational weight gain and infant birth weight

Several studies show that maternal weight gain during the first trimester has no significant influence on IBW. However, weight gain during the second and third trimester had the most significant influence on infant birth (Strauss & Dietz 1999; Li, Haas & Habicht 1998; Hickey, Cliver, McNeal, Hoffman & Goldenberg 1996). Drehmer and colleagues (2013) reported that inadequate weight gain during the second trimester is associated with SGA, whilst excessive GWG was linked to LGA. Excessive weight gain during the third trimester is associated with PTB (Drehmer *et al* 2013). Several studies suggest that GWG below IOM guidelines in overweight/obese women does not have a negative influences on foetal growth and resultant adverse birth outcomes (Beyerlein, Schiessl, Lack & von Kries 2009; Oken, Kleinman, Belfort, Hammitt & Gillman 2009). Overweight and obese women with low GWG is preferable than high GWG, as this can result in LGA (Nohr, Vaeth, Baker, Sørensen, Olsen & Rasmussen 2008). High GWG in underweight women is associated with macrosomia (Nohr, Bech, Vaeth, Rasmussen, Henriksen & Olsen 2007), caesarean delivery (Young & Woodmansee 2002) and postpartum weight retention (Olson, Strawderman, Hinton & Pearson 2003).

In a study conducted by Masho *et al* (2013), a lower level of weight gain for women who are overweight/obese before conception, could prevent PTB. However, the same study also stated that excessive GWG in obese women is linked with PTB (Masho *et al* 2013). Women with medium to high weight gain (12 to 16kg total GWG for a full term pregnancy), have the lowest risk for preterm delivery (Heude *et al* 2011). Gestational weight gain below IOM guidelines is doubles the risk of LBW (Frederick *et al* 2008). A study conducted in Norway found that weight gain below the IOM guidelines increased the risk for LBW for nulliparous women with a normal pre-pregnancy BMI. Pregnant women with a normal pre-gravid BMI but excessive GWG, are at a greater risk for a high IBW (Haugen, Brantsæter, Winkvist, Lissner, Alexander, Oftedal, Magnus & Meltzer 2014).

2.8.4 Household food insecurity and infant birth weight

Mozayeni *et al* (2014) reported that, 82.1% of mothers' who gave birth to LBW infants were food insecure, while approximately 30.5% of mothers' with infants born with a normal weight were food insecure. It was also observed that 35.8% and 23.2% of mothers with LBW infants experienced moderate to severe stress, respectively.

2.8.5 Antenatal depression and infant birth outcomes

Antenatal depression is associated with negative pregnancy outcomes such as: SB, IUGR, SGA, LBW, preterm delivery, an Apgar score of less than 7 at 5 minutes, admittance to a neonatal intensive care unit (NICU), congenital defects and infant behavioural problems (Dibaba *et al* 2013; Evans & Bullock 2012; Manikkam & Burns 2012; Alder *et al* 2011; Leung & Kaplan 2009; Diego, Field, Hernandez-Reif, Schanberg, Kuhn & Gonzalez-Quintero 2009; Andersson, Sundstrom-Poromaa, Wulff, Astrom & Bixo 2004). Although IUGR can be caused by nutritional and weight gain inadequacies, weight loss during pregnancy as a result of depression, can adversely affect foetal growth (Manikkam & Burns 2012). A study conducted on 720 pregnant women in their third trimester in rural Bangladesh, found that symptoms of depression and anxiety, were associated with LBW (Nasreen, Kabir, Forsell & Edhborg 2010). Expectant mothers with depressive symptoms had double the risk of giving birth to LBW. The study also found the characteristics of pregnant women with symptoms of depression and anxiety to be older, less educated and having a low body weight when compared to non-depressed women. It was also reported in the study that poor nutritional status may result from poverty, but also underlying mental illness (Nasreen *et al* 2010).

2.9 Conclusion

This chapter reviewed the literature regarding nutrition during pregnancy, maternal anthropometric status, household FS, socio-economic factors and antenatal depression in relation to infant birth outcomes. South African statistics on infant and maternal mortality are still relatively high. It was portrayed that malnutrition during the life span has consequences in terms of foetal under-nutrition and how it extends into childhood, adolescence and adulthood. The UNICEF conceptual framework illustrates the path that leads to malnutrition and contributes to morbidity and mortality. Women and children are the most vulnerable to becoming malnourished. Therefore, investigating the components of this framework that impact on maternal, infant and child health is important.

Optimal maternal nutrition is crucial for foetal growth, prevention of micronutrient deficiencies and nutrition-related diseases that could cause pregnancy complications and adverse birth outcomes. The optimal IBW is between 3.1 to 3.6kg. Deviation from this standard, whether it be a birth weight that is lower or higher than the recommendations, can have serious health consequences for the new born. Low birth weight, SGA and PTB infants have the highest risk of mortality, compromised cognitive and physical development, childhood malnutrition, stunting and development of chronic diseases of lifestyle in adulthood. Macrosomic or LGA infants have a greater risk for childhood obesity and obesity during adulthood as well as the development of non-communicable diseases of lifestyle

A balanced diet containing a variety of food sources ensures adequate GWG and prevents LBW and SGA birth outcomes. A low GI diet reduces the risk of women giving birth to macrosomic infants and can reduce maternal glucose intolerance. Protein/energy and/or micronutrient supplementation is beneficial to underweight pregnant women as it allows them to gain adequate weight during pregnancy and prevents PTB, LBW and SGA infants. The presence of HIV infection, hypertension and diabetes before conception, places mothers at risk for a pregnancy marked by complications. Women diagnosed with HIV, IDA, pre-eclampsia and GDM during pregnancy need extra care and dietary intervention to ensure that optimal birth outcomes are achieved. The general DDS of the South African population is low. International studies regarding the dietary patterns of pregnant women show that in general, the diets of pregnant women lack variety. This places pregnant women at risk for developing malnutrition. It is therefore important to explore the dietary diversity of pregnant women.

Pre-pregnancy BMI and GWG both contribute to foetal growth, birth weight and length. Most women do not have an ideal pre-pregnancy BMI according to the guidelines in the literature. The number of women with an overweight/obesity pre-conception BMI is increasing globally. This is a cause for concern, as pre-pregnancy overweight/obesity is associated with many pregnancy complications and adverse birth outcomes. Some studies show that an overweight/obese pre-conception BMI is associated with preterm deliveries and both LBW and LGA infants. Pre-pregnancy underweight and a MUAC below 21cm to 23cm is a risk factor for PTB, LBW, SGA and IUGR. Gestational weight gain below IOM guidelines doubles the risk for a LBW infant. Excessive GWG is a risk factor for a high IBW. Weight gain in excess of the IOM guidelines is also associated with GDM, hypertension and pre-eclampsia.

Many South African households are food insecure. Pregnant women are vulnerable to FI due to increased nutrient requirements and a lack of mobility, especially during the third trimester. Food insecurity can result in excessive weight gain and an unbalanced diet. The majority of food insecure women supposedly gave birth to LBW infants. Studies show that many pregnant women who are food insecure also suffer from depression. A low SES indirectly affects foetal growth but directly affects access to food, diet quality and access to health care.

Antenatal depression is a problematic condition that has an adverse effect on pregnant women and their offspring. South African studies show that the risk factors for antenatal depression include: a positive HIV status, unplanned pregnancy, low income, single marital status, lack of social support and partner violence. The presence of antenatal depression can result in weight loss or excessive weight gain, development of unhealthy eating habits and substance abuse during pregnancy. This behaviour is harmful to the growing foetus. In addition, antenatal depression is worsened by health professionals who are ill-equipped in diagnosing and managing the problem. Health professionals are also reported to ill-treat pregnant patients. This impedes the delivery of care and support that pregnant women require.

It is also evident that government investment in preconception care is necessary. Preconception care is important so that a suboptimal nutritional status and chronic diseases can be identified addressed to ensure that pregnancy-related, complications are minimised. In South Africa, maternal care needs to be addressed in a holistic manner in order to address all the potential complications pregnant women and their foetuses face.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will elaborate on the study design, study population and sample selection, study methods and materials, fieldworker recruitment and training, pilot study, data collection and statistical analysis, as well as data quality control and ethical considerations. The study design employed and methods used were to ensure that the objectives specified in chapter one are met and that valid and reliable results are generated.

3.2 Background on location of the study

The study was conducted at Imbalenhle CHC which is located in the urban township of Imbali, Pietermaritzburg (Figure 3.1). Imbalenhle CHC provides numerous basic health services including: 24-hour causality, emergency and maternity services (KZN DoH 2001). The antenatal clinic provides health care to an average of 760 pregnant women and adolescents per month. Approximately 62.5% of women and adolescents attend ANC before 20-week gestation (Imbalenhle CHC 2015). Imbalenhle ANC also runs a programme called Mothers 2 Mothers (m2m) (Baek, Mathambo, Mkhize, Friedman, Apicella & Rutenberg 2007). The m2m programme educates HIV positive pregnant women and mothers’ with new borns on the prevention-of-mother-to-child transmission (PMTCT) of HIV services and also provides psychosocial support during pregnancy and postpartum to all women regardless of HIV status (Baek *et al* 2007).

Figure 3.1: Imbalenhle Community Health Centre

Source: KZN DoH (2001).

The map below (Figure 3.2) shows the Msunduzi Municipality of the UMgungundlovu District in KZN South Africa were Imbalenhle CHC is located.

Figure 3.2: uMgungundlovu district map

Source: Integrated Development Plan (IDP) (2015)

3.3 Study design

Research design can be defined as procedures followed to test a hypothesis under specific conditions (Bless, Higson-Smith & Kagee 2006). For the purposes of this study, a cross-sectional descriptive study design was used to determine and compare the influence of nutritional status, FS status and presence of depression in pregnant women on their antenatal pattern of weight gain and IBW.

Advantages of cross-sectional studies

This type of study design can be used to approximate the prevalence of a condition or behaviour in population (Sedgwick 2014; Silman & Macfarlane 2002). In a cross sectional study, measurements are obtained once off but recruitment of participants can occur during different time periods. The study design allows for testing of multiple variables and more than one outcome. The researcher is able to measure any factor that can be reported by participants or measured through a non-invasive manner (Sedgwick 2014). The cross-sectional study is easy and inexpensive to conduct and can be done within a short period of time (Sedgwick 2014; Silman & Macfarlane 2002). Due to the advantages of a cross-sectional study reported by numerous authors, this study used a cross-sectional design, especially as a result of time and cost constraints.

Disadvantage of cross-sectional studies

The cross-sectional study design is liable to non-response bias where misinterpretation of the population can result if there is a difference between participants that consented to be part of the study and those that refused to participate. The study design is can also be influenced by self-report biases (Sedgwick 2014; Silman & Macfarlane 2002). Cross-sectional studies can only give an account for associations between variables but not ascertain causes of outcomes. Results from cross-sectional studies call for more detailed study such as a longitudinal or cohort study to gain more knowledge on the hypotheses (Sedgwick 2014). As all research instruments were administered by trained fieldworkers, some of the disadvantages associated with a cross-sectional study were addressed.

3.4 Study population and sample selection

3.4.1 Study population

The study population included all black women between the ages of 18 to 45 years in their second (≥ 25 weeks) and third trimester of pregnancy attending Imbalenhle CHC.

3.4.2 Sample selection

Imbalenhle CHC is one of the two CHC's that fall under the uMgungundlovu District and is situated in the township of Imbali. Many pregnant residents of Imbali township utilise Imbalenhle CHC antenatal services. Several clinics in and outside Imbali township also refer their patients to Imbalenhle CHC. Imbalenhle CHC is also within walking distance for some residents of Imbali. Therefore, Imbalenhle CHC was a suitable choice for the researcher to recruit black pregnant women. Hence, all pregnant women in their third trimester of pregnancy who met the study inclusion criteria were invited to participate. Once written informed consent was obtained from potential participants, the pregnant woman was interviewed by a trained fieldworker in isiZulu to facilitate the completion of four research instruments. The researcher planned on interviewing a sample size of (N = 255) women based on a calculation using the Imbalenhle CHC ANC statistics of 2014/2015.

3.5 Study methods and materials

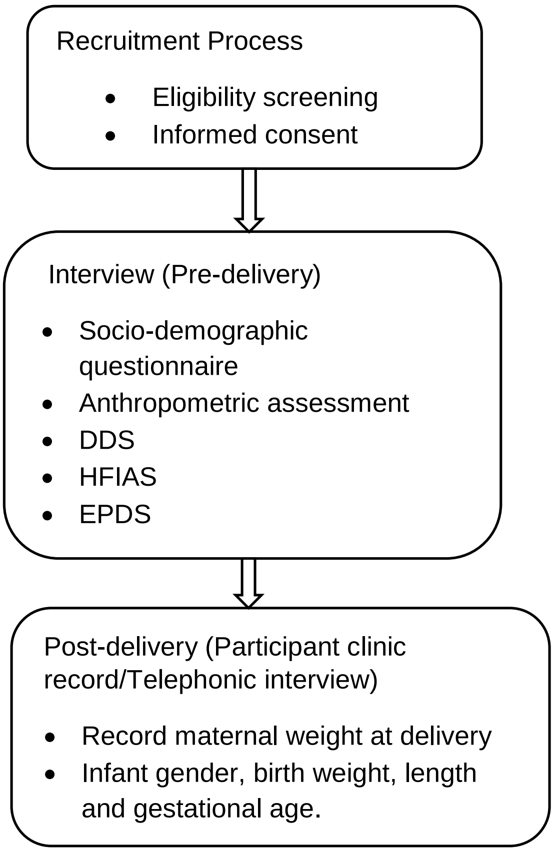

Figure 3.3: The research process and related measuring instruments

3.5.1 Research instruments

Research objectives were measured using four research instruments to collect quantitative data with. They included: (i) Socio-demographic questionnaire; (ii) DDS; (iii) Household food insecurity access scale (HFIAS); and the (iv) Edinburgh postnatal depression scale (EPDS). The weight and height of the participants was also measured at the time of the interview. Weight and MUAC measurements from previous ANC visits was also recorded as they were documented on the participant's clinic card.

All questionnaires were interviewer administered in isiZulu with the exception of the EPDS which was self-administered unless participant could not read. The researcher chose to utilise the interview approach as this ensures higher response rates and that questionnaires will be completed (Silman & Macfarlane 2002). Three participants completed the EPDS as an interview because they could not read. Due to study constraints, a 24-hour recall (24-H-RQ) was only administered once during the data collection process. Although a single 24-H-RQ cannot be used to describe an individual's usual diet, it can be used to describe the average dietary intake of a specific population group (Steyn & Labadarios 2001). In this case the population being black pregnant women attending Imbalenhle CHC. An interview schedule was used to guide fieldworkers through questions (see Appendix C & D). The questionnaires were compiled in English and then translated into isiZulu via the back translation method, as it was the mother tongue of the study participants. The anthropometric measurements weight and standing height were also determined on the day of the interview.

1. *Socio-demographic questionnaire*

The socio-demographic questionnaire (see Appendix E & F) was used to obtain information regarding participants' age, pregnancy history, whether pregnancy was planned or not, living arrangements, level of education, marital status, access to basic resources such as water, electricity, land to grow vegetables on and sources of income.

2. *Dietary Diversity score*

Dietary assessment of participants' was conducted using a DDS (see Appendix G). The DDS is a tool used to measure household food security and nutrient sufficiency of individuals' diets (FAO 2010). It also measures the utilisation dimension of food security at household and individual level (FAO 2010). Participants were interviewed by a trained fieldworker regarding the foods they consumed the previous day by means of an unquantified 24-H-QR (portion sizes not included). A trained interviewer recorded the foods and beverages that were consumed in the course of the previous 24 hours. The time and place where food was consumed was also recorded. Participants were further probed for any snack items that they may have consumed. Miscellaneous food items such as tea, sugar and sweets were recorded during the 24-H-RQ but not included in the DDS.

Food items recorded from the 24-H-RQ questionnaire were classified according to nine food groups to generate a DDS (Labadarios *et al* 2011; FAO 2010). According to the FAO, these are the nine food groups that are essential for a healthy active life. They include (i) cereals, roots and tubers, (ii) dairy, (iii) eggs, (iv) fats and oil, (v) legumes and nuts, (vi) other vegetables, (vii) other fruits, (viii) vitamin A rich fruits and vegetables and (ix) meat products (meat, poultry, fish & offal). The dietary diversity questionnaire food list was adapted to include foods commonly eaten by South Africans such as mielie meal, samp, amadumbe, amasi, amahewu, holsum, amaranth and pumpkin leaves. Foods that were consumed from a specific food group were counted once. According to Steyn *et al* (2006), a diet consisting of four or more food groups (DDS ≥ 4) is adequate whilst diet with less than four food groups (DDS < 4) is inadequate. A score of nine indicates total dietary diversity (Labadarios *et al* 2011). Table 3.1 shows the DDS classification (FAO 2007; Savy, Martin-Prével, Sawadogo, Kameli, Delpeuch 2005).

The advantages of using the DDS is that it requires a short recall period, is considered to therefore be more reliable, easy to collect information, easy to train fieldworkers, is relatively quick to complete and is inexpensive (Kennedy, Brouwer, Dop & Kok 2009). The advantages associated with using a DDS in the current study was that prospective mothers were interviewed while they were waiting to receive medical assistance. Hence the interview period had to be kept to a realistic time frame. Fieldworkers were also trained on how to conduct a 24-H-RQ therefore information was easy to collect.

Table 3.1: DDS Classification

DDS	Classification
≤ 3	Low dietary diversity
4-5	Medium dietary diversity
≥ 6	High dietary diversity

3. *Household Food Insecurity Access Scale*

The HFIAS (refer to Appendix H & I) was used to assess the FS status of study participants (Coates, Swindale & Bilinsky 2007). The HFIAS measures the accessibility dimension of FS at household level. The tool was developed by FANTA (Coates *et al* 2007) and consists of nine questions that cover all aspects and/or factors for insecure access to food. Each question asks for a recall period of four weeks (thirty days). Assessment of the severity of FI at household level and in a specified population is possible. Participants are required to answer an occurrence question followed by a frequency-of-occurrence question to determine if the condition happened and how often it occurred (Coates *et al* 2007). The HFIAS consists of one question regarding anxiety, three questions regarding food quality and five questions regarding dietary intake and consequences. The last three questions are used to determine household hunger levels. High FI is an indication of inconsistent eating patterns and poor dietary intake due to lack of resources (Casey *et al* 2006). The HFIAS score ranges from 0 to 27, with a high score reflecting severe FI (Coates *et al* 2007). Table 3.2 depicts the classification of FI.

Table 3.2: HFIAS score classification

Food secure	Mildly food insecure	Moderately food insecure	Severely food insecure
0 - 6.75	6.75 - 13.5	13.5 - 20.5	20.5 - 27

4. *Edinburgh Postnatal Depression Scale*

The EPDS (refer to Appendix J & K) is a popular self-report tool used to screen for risk for depression during pregnancy and postpartum (Cox *et al* 1987). The EPDS which was designed for use in the postnatal period has been validated for use during the antenatal period (Murray & Cox 1990). It consists of a 10-item self-report questionnaire. There are four possible responses to each question and women are required to select one response that best describes how they felt over the past seven days. The tool asks questions related to feelings of depression, anxiety, low self-esteem, guilt and suicidal thoughts (Rochat, Tomlinson, Bärnighausen, Newell & Stein 2011).

Items on the EPDS are scored on a 4-point scale (0-3), items 3, 5 to 10 are reverse scored. Scoring ranges from 0 to 30 points. A score of 0-9 indicates low likelihood of depression, while a score of 10 to 12 indicates moderate likelihood of depression and a score of 13 or more indicates that the likelihood of depression is considered high and should be discussed with a health professional (Cox *et al* 1987). According to the literature, women with an EPDS score of 13 or more have a 60 to 100% chance of suffering from clinical depression (Leverton & Elliot 2000; Zelkowitz, Milet & Can 1995; Boyce, Stubbs & Todd 1993; Cox *et al* 1987). As the EPDS does not give a clinical diagnosis of depression, further psychiatric assessment is required to determine if the person in question suffers from depression.

5. *Anthropometric assessment*

Weight was measured using a digital electronic scale (Scales 2000) with a 250 kg capacity and a platform size of 305 mm x 305 mm. Participants were requested to stand still on the centre of the scale platform, have feet together, hands hanging on the side and looking straight ahead. Weight was measured in kilograms to the nearest 100g with participants wearing no shoes and wearing light indoor clothing. The scale was placed on a hard surface and calibrated with a 2 kg weight before each weighing session. Weight measurements were repeated three times and the average of the three measurements was recorded.

Standing height was measured using a standard stadiometer (Leicester height measure) to the nearest 0.1cm. Participants were requested to remove shoes and hair accessories and stand on the base of the stadiometer board with feet together and arms and shoulders relaxed. The back of the head, shoulder blades, buttocks and heels of subjects touched the vertical surface of the stadiometer where possible. The participant looked straight ahead with their head in the Frankfort horizontal plane and then took in a deep breath. The fieldworker then lowered the head board to touch the top of the head in order to measure height. This measurement was repeated three times and the average of the measurement was recorded.

Data regarding pre-pregnancy weight, BMI, MUAC and previous weights recorded at ANC visits were obtained from participant maternal case records. Enrolled nursing staff take anthropometric measurements at the first ANC visit and measure weight during subsequent visits using a column scale (Seca 224). The researcher observed that there was a difference between the weight and height measurements taken by the clinic and measurements taken by the fieldworkers who collected data for this study. The ANC staff had different ways of measuring height. The registered nurse would ask patients to remove shoes whilst the enrolled nurse would ask them to keep shoes on while taking height. Both the registered nurses and enrolled nurses did not ensure that patients stood straight when height was measured. In terms of weight, patients were generally weighed wearing shoes and heavy clothing. Hence, the accuracy of these measurements are questionable.

6. Delivery information

Delivery information was obtained from maternal case records at Imbalenhle CHC or via a short telephonic interview with participants to determine maternal weight at delivery, IBW, length, gender, and gestational age. A telephonic interview was chosen as the second method of follow-up because it is cheap and saves time. However, the disadvantage with telephone interviews is that multiple attempts have to be made to gather all the participants' information and sometimes contact needs to be made outside normal working hours so that the participant is retained.

3.6 Fieldworker Recruitment

Eleven isiZulu speaking fieldworkers were recruited from UKZN Dietetics and Human Nutrition (Pietermaritzburg campus). The fieldworkers were extensively trained on how to conduct an interview using an interview schedule, how to record questionnaire related information, how to conduct a 24-H-RQ and how to take anthropometric measurements such weight using an electronic scale and standing height using a stadiometer prior to the start of data collection.

3.7 Pilot Study

A pilot study can be defined as a small study done before a larger study to test whether the procedure to be followed, recruitment of the study sample and research instruments are suitable and serve their intended purpose (Bless *et al* 2006). The pilot study was conducted at Imbalenhle CHC one week prior to the actual study. Five percent of the calculated sample size (N = 255) of pregnant women were interviewed during the pilot study (n = 15). The participants were first screened to determine whether they met the study's inclusion criteria. Prior to participation, an informed consent form was signed by all participants.

The pilot study was conducted over a period of two days with the purpose of identifying errors in the questionnaires, to determine whether participants understood the questions, to find out if any questions were in a logical order and if they required rephrasing as a result of ambiguity, obtain feedback on the flow of interviews and determine the average time taken to complete the interview with the participant. The pilot study was also done to determine whether the level of participation at Imbalenhle CHC will reach the required target sample size. During the pilot study, the researcher found that a large number of women were still in their first and second trimester with fewer being in their third trimester. In order to ensure that the intended sample size could be reached, the researcher decided to include pregnant women who were in their latter half of the second trimester (≥ 25 weeks) as they would be in the third trimester by the end of the data collection period. From piloting it became evident that all the survey questionnaires were understood by participants.

The researcher decided to include participant's last menstrual period (LNMP) and first examination date to facilitate calculation of how many weeks' gestation participants were, and how far they were in their gestation period when they came for their first clinic visit. The researcher also decided to record the participant's MUAC as it is an important anthropometric measurement that is used to identify patients that are eligible for nutrition supplementation due to malnutrition.

During the pilot study, the researcher spoke to the medical manager of Imbalenhle CHC in order to arrange some form of a referral system for participants that required assistance from the social worker and/or dietician as well as those who need referral to a psychologist. The medical manager spoke to the various members of staff who would be involved in the referral system. Participants who screened positive for symptoms of depression, were referred to the ANC registered nurse who then conducted a further assessment using the Imbalenhle CHC mental health questionnaire screening tool. Based on the outcome of this tool, the participant would then be given an appointment date to see the clinical psychologist.

3.8 Data collection

The study was conducted between middle June until end of July 2016. Participants were recruited in the waiting room and hallway where patients are weighed, have their blood pressure, glucose and iron levels monitored. The researcher would then introduce herself and the fieldworkers and then briefly explain that a study was being conducted and what would be required from an eligible participant. All pregnant women were then asked by a show of hands, who was in their second or third trimester of pregnancy. Women who raised their hands would then be approached by a fieldworker who would briefly explain the purpose of the study and present them with an information sheet and informed consent form.

Only participants who agreed to participate and subsequently signed the informed consent form, were then interviewed. Participants were asked to provide two contact numbers to facilitate follow-up. This was followed by the interview process. The majority of interviews were conducted while participants were waiting in the queue to see the ANC registered nurse. The fieldworker would have to sit next to the participant and ask the survey questions because clinic space was very limited and a vacant interview room or cubicle was not available. However, the majority of study participants were comfortable with being interviewed while waiting in the queue. Those participants who preferred more privacy, were interviewed once the waiting room was vacant.

The height and weight of participants was also measured by the fieldworker. The pre-pregnancy weight, height, MUAC and weight measured at other ANC visits was taken from the participant maternal case record. At the end of the interview, the fieldworker would calculate questionnaire scores to determine if a participant needed referral. If participants needed a referral they were given a letter stating the problem and subsequently referred the dietician or ANC registered nurse. During the three months after participants were recruited, the researcher followed up those participants who had then given birth. This was done in order to obtain maternal weight, infant gender, birth weight, birth length, and gestational age at delivery. This information was obtained from participant clinic records or through a short telephonic interview with participant in the case where clinic records could not be found. Figure 3.4 is a comprehensive diagrammatic summary of the data collection process.

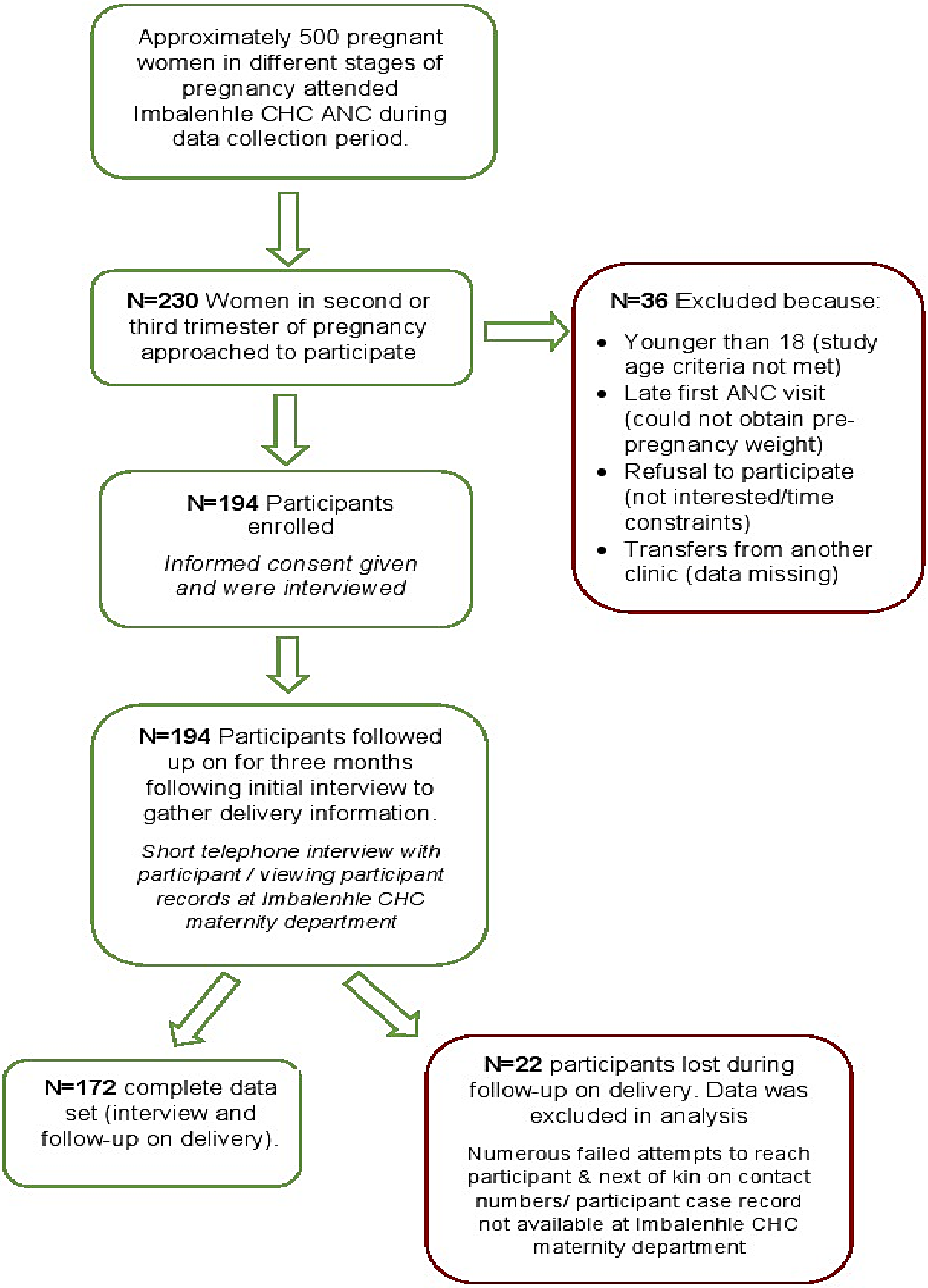

Figure 3.4: Summary diagram of the participants approached, excluded, enrolled, lost to follow-up and retained.

3.9 Variables included in the study, data capturing and statistical analysis

Table 3.3: Variables included in the study

Objectives	Independent variable	Dependent Variable	Statistical Analysis
To determine the nutritional status of pregnant women in the third trimester of pregnancy.	Dietary intake, pre-pregnancy BMI, GWG, socio-demographic characteristics	Maternal nutritional status	Chi-square tests. Univariate and multivariate linear regressions.
To determine the dietary diversity of pregnant women in the third trimester of pregnancy	Maternal dietary quality, socio-demographic status, level of education, source of income, employment status	DDS	Chi-square tests. Univariate and multivariate linear regressions. Independent samples t-test.
To determine the household food security status of pregnant women in the third trimester of pregnancy	Socio-demographic variables, presence of depression, pre-pregnancy BMI, GWG, diet quality.	Household food secure or household food insecure.	Chi-square tests. Univariate and multivariate linear regressions. Independent samples t-test.
To determine the presence/prevalence of depression in pregnant women in the third trimester of pregnancy.	Socio-demographic variables, household food security status, pre-pregnancy BMI, GWG, diet quality. Pregnancy was planned or unplanned.	Presence of maternal depression	Bivariate comparisons of groups were performed using Chi-square analysis for categorical variables. Cronbach's alpha to assess internal consistency.
To determine the pattern of weight gain of pregnant women starting at the first antenatal visit until delivery.	Dietary intake, household food security status, presence of depression, pre-pregnancy BMI.	Pattern of weight gain	Linear regression. Pearson's correlation coefficient
To determine infant birth weight (IBW) at delivery.	Gestational age, maternal socio-demographic characteristics (age, marital status, employment status, parity), height, pre-pregnancy BMI, maternal anaemia, diabetes or pre-eclampsia	PTB, LBW, LGA, AGA	Chi-square tests. Univariate and multivariate linear regressions. Pearson's correlation coefficient
To investigate the relationship between IBW and maternal nutritional status, dietary diversity, household food security and presence of depression	Maternal DDS, socio-economic status, HFIAS score, EPDS score, GWG, presence of anaemia, GDM or pre-eclampsia.	Infant birth weight	Multivariable logistic regression. Pearson's correlation coefficient

3.10 Statistical Analysis

Socio-demographic questionnaire

The socio demographic questionnaires data was captured on excel spreadsheets and analysed using Statistical Package for Social Sciences (SPSS) version 24. Statistical analysis of socio-demographic and obstetric data was examined using Student t-test and Fisher's exact test.

Dietary diversity Score

Chi-square tests were used to determine participant characteristics in relation to the dietary diversity. Independent samples t-tests were used to determine associations with socio-demographic characteristics, anthropometric measurements and HFIAS.

Household food insecurity access scale

The HFIAS data was analysed with other study variables to determine if there was an association using Independent samples t-test and the Chi-square test. The HFIAS was analysed against the DDS and variables such as: socio-demographic factors (income, access to a government grant, employment and education level), weight gain, EPDS and IBW.

Edinburgh postnatal depression score

To determine the total EPDS score, Pearson correlation coefficient and multiple linear regression was used. Demographic variables compared to the EPDS using Chi-square test include: age, BMI, parity, education, and occupation, presence of chronic disease and whether pregnancy was planned or not planned.

Anthropometric assessment

The weight and height of all the respondents was captured on an excel spreadsheet and used to classify and determine the pre-pregnancy BMI and total weight gained.

Pattern of weight gain and infant birth weight

Study participants were divided into four groups according to their pre-pregnancy BMI. The Chi-square test or Fisher's exact test were used to compare categorical variables.

Univariate and bivariate analyses was used to evaluate the relationship between dietary diversity, household FS, pre-pregnancy BMI, depression and GWG and IBW. Multivariate logistic regression analyses were used to assess the relationship between dietary diversity, household FI, presence of depression and GWG and IBW.

3.11 Data quality control

Reliability

Reliability refers to the degree to which research data is void of measurement error. It also refers to the consistency of a measure but does not ensure validity (Babbie & Mouton 2008; Katzenellebogen & Joubert 2007). The internal reliability of the EPDS was tested using the Cronbach's alpha that indicated that all research instrument status, obstetric history and expert consultation on aspects to be investigated in had acceptable internal reliability. A comprehensive theoretical background discussion on concepts that were included in the socio-demographic questionnaire ensured the reliability of the questionnaire. The dietary diversity questionnaire was subject to input from six Zulu speaking dieticians prior to its use in a PhD study involving urban female Zulu participants. The EPDS was evaluated for validity and reliability among isiXhosa speaking impoverished South African women in the study by de Bruin, Swartz, Tomlinson, Cooper & Molteno (2004). Another South African study validated the tool against the 'gold standard' which is the DSM-V diagnosis and reported that the EPDS had 80% sensitivity and 77% specificity (Lawrie, Hofmeyr, de Jager & Berk 1998). The HFIAS is a globally recognized scale used to determine household FI and to date has been used by staff and post graduate students in Dietetics and Human Nutrition, UKZN to determine household FS.

Reliability of the study was also increased by: conducting a pilot study to test clarity of the research questionnaire, fieldworkers received extensive training on how to conduct an interview using an interview schedule as well as how to accurately measure weight and height in accordance with the International Society for the Advancement of Kinanthropometry (ISAK) standards. Weight and height was measured three times on the same day and the mean of the two closest values was recorded. The electronic scale used for measuring weight on the day of the interview was calibrated with a known weight. The interview schedule was administered in the same sequence for all study participants and a consistent scoring system was used for the DDS, HFIAS and EPDS.

Validity

Validity refers to the extent which research instruments measure what was intended to be measured as well as if these instruments accurately reflect the theory being explored (Babbie & Mouton 2008; Katzenellebogen & Joubert 2007). Construct, concept and face validity was guaranteed by ensuring that the sociodemographic, DDS, HFIAS and EPDS questionnaires measured the mentioned hypotheses and objectives and that the questionnaires showed the association between the described concepts and specified objectives. As previously mentioned the research instruments used in this study have been validated for various groups. It should be stated however that the validation of an instrument for a particular group does not indicate that the instrument is valid for another group. The results generated by these instruments should therefore be interpreted with caution. Construct, content, and face validity of the socio-demographic, obstetric history, information on current pregnancy and non-quantified 24-H-RQ sections of the questionnaire were ensured by providing an extensive theoretical framework, consultation with experts and pilot testing.

3.12 Reduction of bias

Bias is defined as a "systematic deviation from the truth" (Silman & Macfarlane 2002). It is a form of systematic error that can occur in sampling or testing by selecting or favouring a particular result or response over others (Merriam-Webster Dictionary 2016). Potential biases in this particular study included: Selection bias that arise from the selection of participants. Observer bias which is another form of information bias (Silman & Macfarlane 2002). Recall bias which occurs when information is misclassified or falsely reported, for example when participants over and/or under estimate food intake (Rothman 2002; Silman & Macfarlane 2002). Measurement bias can occur when there are significant differences in measurements when using a new instrument or procedure compared to measurements acquired using standard instruments or procedures with the same participants under the same setting and can occur with both subjective and objective research instruments. “Measurement bias can be uniform or non-uniform’’ (Goldin & Sayre 1996). Unvalidated research tools and uncalibirated electronic tools can introduce measurement bias (Sica 2006). Participation bias results from factors that affect determining the final sample size. This bias occurs when not all potential participants agree to participate or when medical records are missing. There may be a difference between the intended sample and the sample of participants that agreed to participate (Sica 2006). Loss-to-follow-up bias occurs when participants lost to follow-up are different from those who remain in the study until its termination (Szklo & Nieto 2000).

Bias was reduced by ensuring that: only pregnant women who were eligible for the study were individually approached by a fieldworker to determine their willingness to participate in the study. In addition, fieldworkers were trained on how to conduct a 24-H-RQ by probing participants on food consumed and validated questionnaires were used. Questionnaires were back translated into isiZulu using simple layman’s terms to facilitate clarity regarding the content for both fieldworker and the study participant. Structured interviews (interview schedule) and standardised anthropometric measuring techniques were used, participants were weighed using a calibrated electronic scale and stadiometer on the day of the interview. Participants were requested to state whether they would deliver their infant at Imbalenhle CHC or at another health facility and to provide two contact numbers so that they can be reached after they have delivered their baby so that the researcher could obtain data regarding the birth outcomes. This was done to minimise loss-to-follow up bias.

3.13 Ethical considerations

Ethical approval was obtained from the University of KwaZulu-Natal, Humanities and Social Science Ethics Committee (HSS/1604/015) (Appendix L). A letter of support for the study was obtained from the uMgungundlovu District DoH (Appendix M). Approval to conduct research was obtained from the KZN DoH (Appendix N).

Study participants were requested to sign an informed consent form that indicated their voluntary agreement for participating in the study. Each participant was assigned a code. Hence, all data sets were only identifiable by means of a code. Participant names and contact details were not recorded on the research instruments. Fieldworkers were required to sign a confidentiality agreement stipulating that they may not share any of the personal information and participant responses with anybody other than the researcher and study supervisors. In order to ensure beneficence, one of the bioethics principles, participants with severe household food insecurity and low dietary diversity were referred to the Imbalenhle CHC dietician for assistance. Participants who screened positive for possible signs of depression where referred to the registered nurse who then booked an appointment for the participant to see a clinical psychologist after they were assessed using Imbalenhle CHC criteria.

3.14 Conclusion

This chapter provided a brief background on the study setting. The methods and procedures followed to obtain the data for this cross-sectional descriptive study design were discussed. The research instruments used to measure the research objectives were also discussed. Details on fieldworker recruitment and training, pilot study and data collection process during actual study was also provided. Measures taken to ensure reliability and validity as well as reduce bias in study results were outlined. An overview of how statistical analysis of data was conducted was also given. The results of the data analysis will be presented in chapter four.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter will present the results of the study as per the following objectives specified in chapter one: socio-demographic characteristics, nutritional status, dietary diversity and household food security status, prevalence of antenatal depression and pattern of weight gain of the study population. The IBW at delivery as well as the results of the association between IBW and the objectives mentioned above will be presented and described. A total of 172 pregnant women between the ages of 18 – 45 years with ages ranging from 18 to 41 years participated in the study. The mean age of participants was 26.19 ± 5.63 years. The pregnant women's weeks of gestation on initial interview ranged from 25 to 40 weeks.

4.2 Socio-demographic Results

Table 4.1: Relationship status and living arrangements

Characteristics of participant	Frequency (N=172)	Percentage (%)
Relationship Status		
Single	88	51
Married	24	14
Have a partner	59	34
Separated	1	0.6
Divorced	0	0
Widow	0	0
Living Arrangements		
Live Alone	10	6
Live with friends	4	2
Live with husband/partner	19	11
Live with husband/partner and children	12	7
Live with parents	80	47
Live with husband/partner and parents	2	1
Other(Grandparents/Relatives/Siblings)	45	26

Table 4.1 shows that the majority of the study participants were single (51%), whereas 34% had a partner. Only 14% of the participants were married and 0.6% were separated from their spouse. A large number of participants live with their parents (47%) followed by those living with other people such as relatives, grandparents and/or siblings (26%).

Table 4.2: Education, employment and household income

Characteristics of participant	Frequency (N=172)	Percentage (%)
Education		
Yes	159	92
No	13	8
Level of Education		
Primary school	17	10
Secondary school	101	59
Tertiary	54	32
Employed	61	36
Full time employment	34	56
Part time employment	11	18
On maternity leave	16	26
Unemployed	111	65
Left job because of pregnancy	7	6
Stable household income		
Yes	126	73
No	46	27
Main household Breadwinner		
Participant	41	33
Husband	15	12
Partner	6	5
Mother	30	24
Father	11	9
Grandparent/s	3	2
In laws	2	1
Siblings	10	8
Other (Relative)	8	6
Grant Recipient		
Yes	85	49
No	87	51
Type of Grant		
Social Relief	3	2
Disability	4	2
Pension	17	10
Child Support	58	34
Foster Care	2	1
Care Dependency	0	0
Number of grant beneficiaries		
No one	89	52
One person	51	30
Two people	19	11
Three people	8	5
Four people	4	2
Five people	1	1

As shown in table 4.2, the majority of participants (92%), had received some form of schooling. Approximately 8% participants have never attended school. The percentage of participants with a primary school level of education was 10%. The majority of those who went to primary school (8.1%) attained grade 6 whilst 1.8% attained grade 7. A large number of participants went to secondary school (58%). Of those who have been to secondary school, 1.2 % have completed grade 8, 5.2% have completed grade 10, 15.1% have grade 11 and 37.2% completed grade 12. The percentage of participants that have studied at tertiary institutions was 32%. This percentage comprises of 19.2% of participants that went to college, 4.7% that went to a technikon and 7.6% that have a university education.

A total of 65% of participants were unemployed and only 36% participants had some form of employment. The majority of participants (73%) had a regular household income that is not related to a government grant. A large number of the participants were the main breadwinners in their households (24%) followed by the mothers of participants, husbands, participants father, siblings, other, partners, in laws and lastly grandparents. Approximately 51% of participants did not have access to a grant, while the remainder reported that they had access to a grant. The two main grants that participants benefited from was child support (34%) and pension (10%). The majority of participants with access to a grant had at least one grant beneficiary.

The majority of participants had access to running water (92%) and electricity (97%) (see Table 4.3). The percentage of participants that did not have access to running water (8%) reported that they utilise water from rivers and streams. The main source of fuel is utilised by the participants is electricity. Approximately 56% of participants do not have a vegetable home garden.

Table 4.3: Access to resources

Characteristics of participant	Frequency (N = 172)	Percentage (%)
Access to running water		
Yes	158	92
Yes (inside house)	79	46
Yes (outside house)	79	46
No	14	8
Access to electricity		
Yes	166	97
No	6	3
Main source of fuel		
Electricity	161	94
Gas	7	4
Paraffin	4	2
Vegetable home garden		
Yes	75	44
No	97	56

Table 4.4 shows that 77% of the pregnancies in this study were unplanned and that 53% of them were not first pregnancy. Approximately 8% of participants had previously given birth to a full term LBW infant while 5% had given birth to a preterm infant that also had a LBW. The majority of participants did not have any pre-existing health condition before pregnancy. Approximately 8% of the participants developed a health condition during pregnancy.

Table 4.4: Details on current pregnancy, obstetric and medical history

Characteristics of participant	Frequency (N =172)	Percentage (%)
Planning status of pregnancy		
Planned Pregnancy	39	23
Unplanned Pregnancy	133	77
Parity		
First pregnancy	81	47
Not first pregnancy	91	53
Pregnancy history		
Previously gave birth to LBW	13	8
Previously gave birth to PTB	9	5
Pre-existing Health condition before pregnancy		
No condition	169	98
Diabetes mellitus	0	0
High Blood Pressure	1	0.6
Anaemia	2	1
Health condition during pregnancy		
No condition	158	92
GDM	4	2
High Blood Pressure	6	4
Anaemia	4	2

4.3 Anthropometric results

Participant pre-pregnancy weight ranged from 42 kg to 110 kg and the mean pre-pregnancy weight for the entire study sample was 66.69 ± 14.32 kg. The height ranged from 1.43 m to 1.74 m with the mean height being 1.59 ± 0.05 m. The BMI using clinic measurements ranged from 16.5 kg/m^2 to 44.4 kg/m^2 and the mean BMI was 26.29 ± 5.35 kg/m^2 which is classified as overweight under the WHO classification and IOM guidelines. The MUAC ranged from 20 to 38 cm and the mean was 28.78 ± 3.87 cm. Total weight gained during pregnancy ranged from -9 kg to 28 kg and the mean total weight gained for the entire study population was 11.03 ± 5.08 kg. Table 4.5 describes the mean pre-pregnancy weight, height, BMI, MUAC and total weight gained during pregnancy using clinic measurements according to different age categories of the mothers.

Table 4.5: Mean anthropometric measurements from clinic

	Mean pre-pregnancy weight ± SD (kg)	**Mean height ± SD (m)**	**Mean BMI ± SD (kg/m²)**	**Mean MUAC ± SD (cm)**	**Mean total weight gain ± SD (kg)**
Whole group (N = 172)	66.69 ± 14.32	1.59 ± 0.05 (n = 168)	26.29 ± 5.35	28.78 ± 3.87 (n = 113)	11.03 ± 5.08
18 – 24 years (n = 81)	64.03 ± 12.09	1.58m ± 0.05	25.64 ± 4.89	27.27 ± 3.17	11.59 ± 4.65
25 – 34 years (n = 74)	69.19 ± 15.55	1.60m ± 0.05	26.92 ± 5.50	29.95 ± 4.08	10.98 ± 5.58
35 – 41 years (n = 17)	69.33 ± 17.86	1.58m ± 0.05	26.46 ± 6.47	27.93 ± 4.44	9.13 ± 4.29

Table 4.6 reports the participants' mean BMI calculated using the clinic pre-pregnancy weight measurement and height measured by trained fieldworkers as part of the current study using a stadiometer. The height measured by fieldworkers ranged from 1.40m to 1.74m. The mean height for the study sample was 1.58 ± 0.05 m. The BMI ranged from 16.6 to 45.5 kg/m^2 and the mean BMI was 26.32 ± 5.46 kg/m^2 which is classified as overweight according to the WHO classification and IOM guidelines. When comparing table 4.5 and 4.6 there was no significant difference in the height and BMI of the study sample using measurements taken by enrolled nursing staff and measurements taken by the fieldworkers in the current study.

Table 4.6: Mean height and BMI obtained by fieldworkers using a stadiometer

	Mean pre-pregnancy weight ± SD	**Mean height ± SD**	**Mean BMI ± SD (kg/m²)**
Whole group (N = 172)	66.69 ± 14.32	1.58 ± 0.05	26.32 ± 5.46
18 – 24 years (n = 81)	64.03 ± 12.09	1.58 ± 0.05	25.66 ± 4.88
25 – 34 years (n = 74)	69.19 ± 15.55	1.59 ± 0.05	26.98 ± 5.72
35 – 41 years (n = 17)	69.33 ± 17.86	1.57 ± 0.04	26.63 ± 6.75

Figure 4.1 and figure 4.2 show that approximately 2-3% of the participants were classified as having an underweight pre-pregnancy BMI, 41 - 42% had a normal pre-pregnancy BMI, an estimated 34 - 36% had an overweight pre-pregnancy BMI and almost a quarter of participants had an obese pre-pregnancy BMI (21 - 22%).

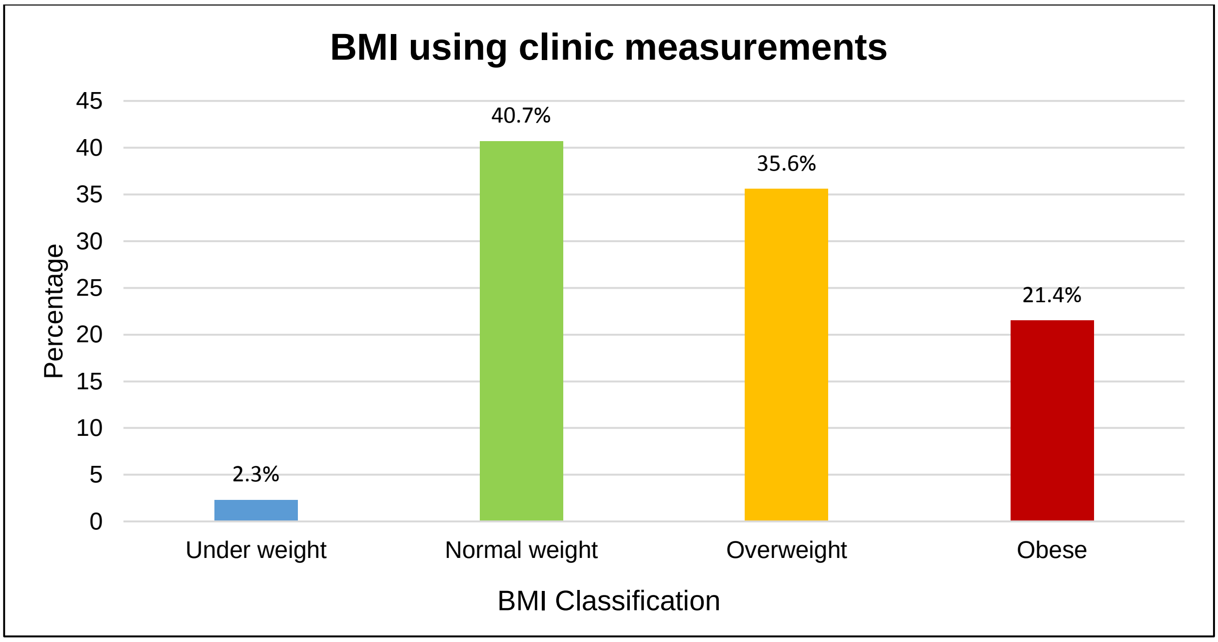

Figure 4.1: Percentage BMI classification using height measured by enrolled nursing staff

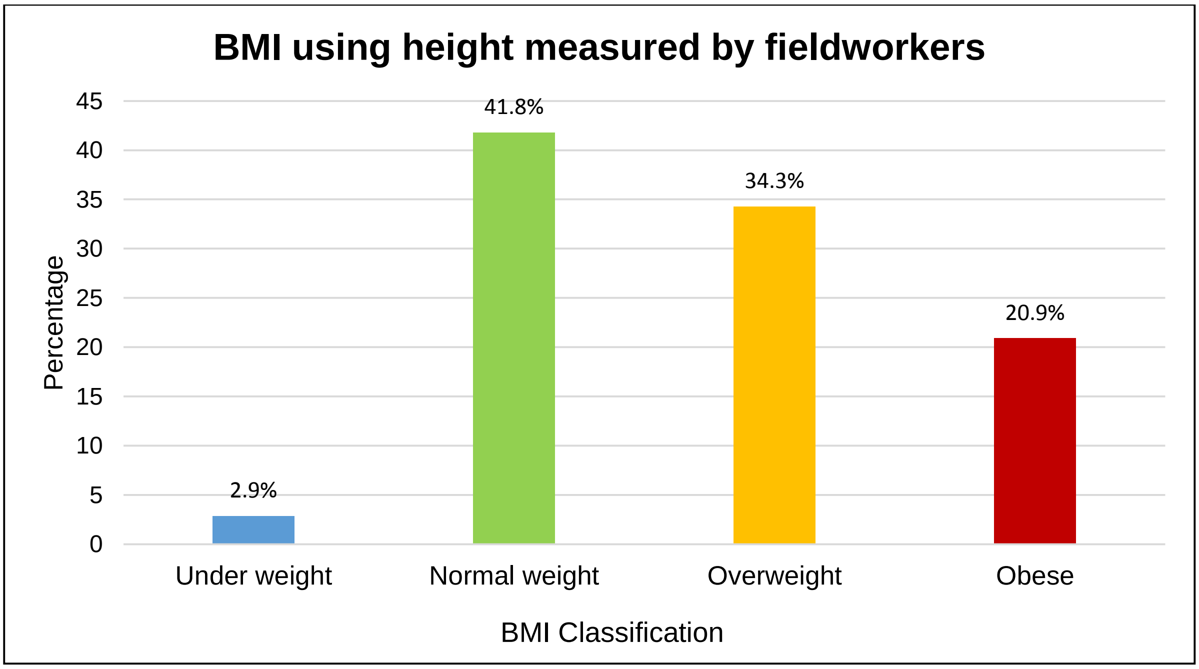

Figure 4.2: Percentage BMI classification using measurements taken by fieldworkers

Approximately 26% of the women had inadequate weight gain, 40% had adequate weight gain and 34% had excessive weight gain during pregnancy. The frequency of participants with inadequate, adequate and excessive GWG in relation to BMI classification is shown in table 4.7. More than half the participants with a normal pre-pregnancy weight had inadequate GWG. Women with overweight pre-pregnancy BMI had the most excessive weight gain. A large number of participants with an obese pre-pregnancy BMI also had excessive weight gain.

Table 4.7: Participant BMI classification in relation to gestational weight gain category

BMI Classification	**Inadequate GWG (n = 45)**	**Adequate GWG (n = 68)**	**Excessive GWG (n = 59)**
Underweight (<18.5 kg/m^2)	5% (n = 2)	3% (n = 2)	2% (n = 1)
Normal weight (18.5 – 24.9 kg/m^2)	53% (n = 24)	41% (n = 28)	34% (n = 20)
Overweight (25.0 – 29.9 kg/m^2)	20% (n = 9)	41% (n = 28)	37% (n = 22)
Obese (≥ 30 (kg/m^2)	22% (n = 10)	15% (n = 10)	27% (n = 16)

4.3.1 Total weight gain correlations

A Pearson correlation coefficient (r) was calculated and analysed for the relationship between maternal total weight gained during pregnancy and other factors related to GWG. Results show that there was a statistically significant negative correlation between total weight gained and parity ($r = -0.20$; $p = 0.02$), a statistically significant positive correlation between total weight gained and access to a grant ($r = 0.21$; $p = 0.02$) and specifically access to child support grant ($r = 0.19$; $p = 0.02$). The correlation was significant at a p-value ≤ 0.05. There was also a significant positive correlation between pre-existing health conditions before pregnancy and total weight gained ($r = 0.29$; $p = 0.00$). The correlation was significant at a p-value > 0.001. No significant correlations were observed between total weight gained and maternal age, household income, employment status, health condition during pregnancy, pre-pregnancy BMI, DDS, HFIAS and EPDS.

4.4 Dietary diversity score

Table 4.8 indicates that the majority of the participants had a DDS of five (29.1%) and six (27.3%). Approximately 80% (79.7%) of participants recalled a weekday, whilst 20.3% recalled a Sunday. The mean DDS for the participants was 5.39 ± 1.36.

Table 4.8: Participant DDS

DDS Score	N = 172	Percentage (%)
1	1	0.6
2	3	2
3	10	6
4	26	15
5	50	29
6	47	27
7	27	16
8	7	4
9	1	0.6

Figure 4.3 shows the classification of the participant DDS. Low dietary diversity equates to ≤ 3 food groups consumed, while medium dietary diversity represents 4 - 5 food groups and high dietary diversity equates to ≥ 6 food groups consumed.

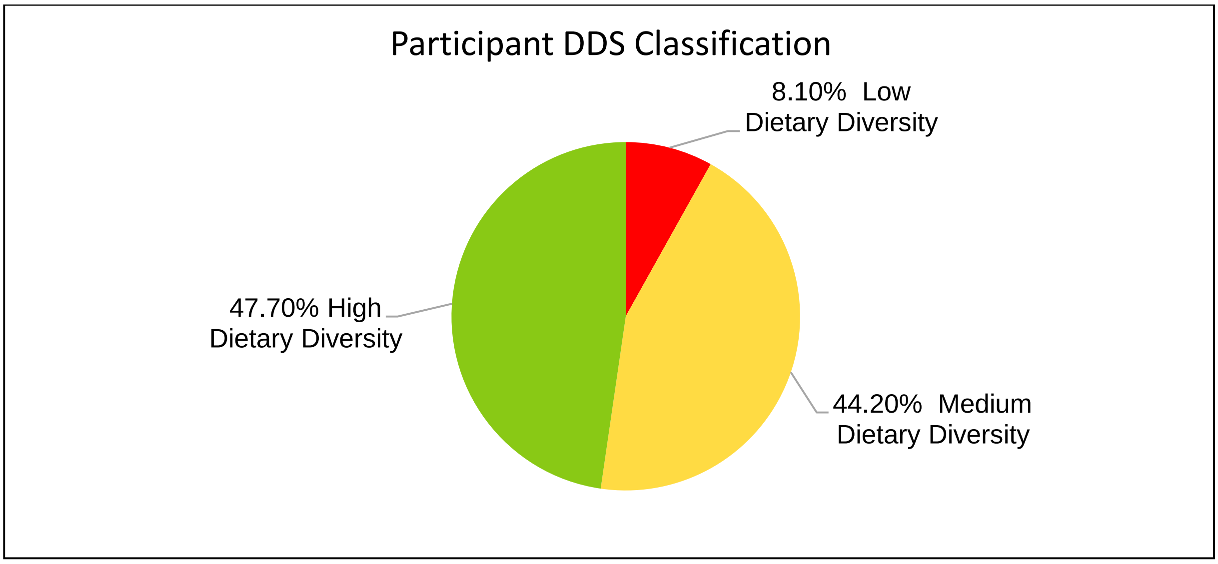

Figure 4.3: DDS classification (N = 172)

Figure 4.4 describes the percentage of participants that consumed each of the nine food groups. The most frequently consumed food groups were cereals/roots/ tubers, fats and oils and meat/poultry/fish. The least consumed food groups were vitamin A rich fruit and vegetables, eggs and legumes and nuts.

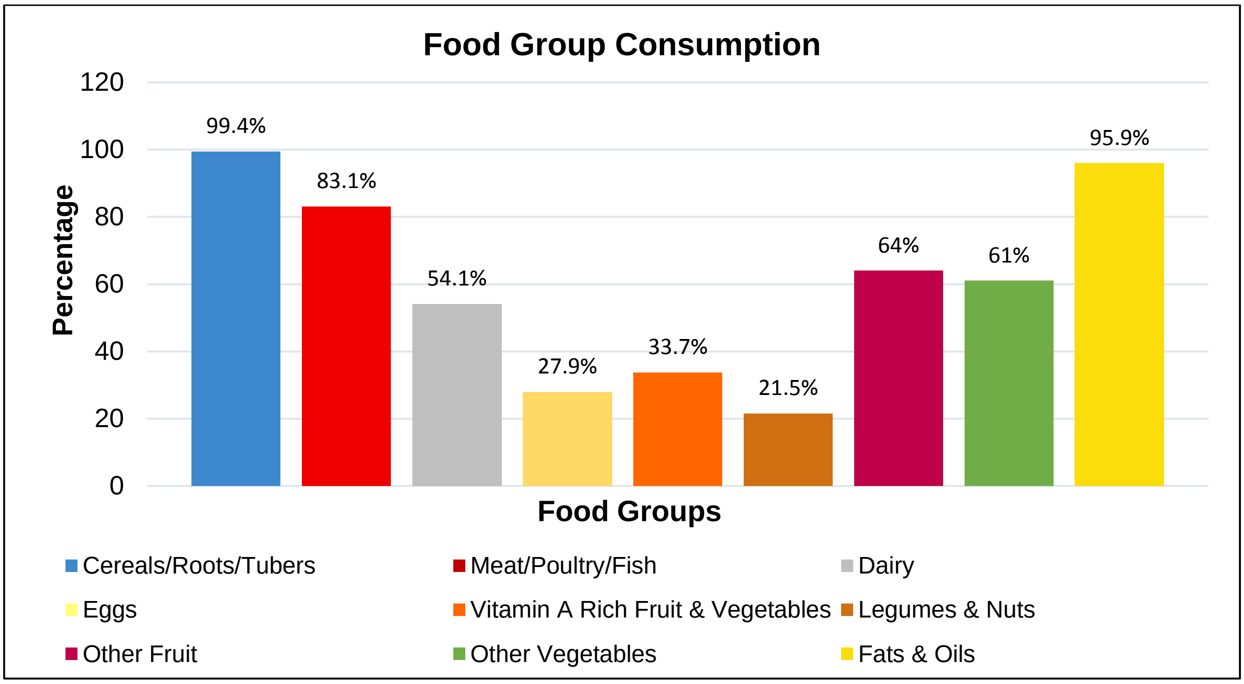

Figure 4.4: Percentage of food groups consumed

Table 4.9 depicts the food groups consumed by participants according to the DDS classification.

Table 4.9: Food group consumption in relation to DDS classification

Food Group	**DDS Classification**			**P- value #**
	Low DDS (n= 14)	Medium DDS (n = 76)	High DDS (n = 82)	
Cereals/Roots/Tubers	93% (n = 13)	100% (n = 76)	100% (n = 82)	0.00
Meat/Poultry/Fish	29% (n = 4)	80% (n = 61)	95% (n = 78)	0.00
Dairy	29% (n = 4)	36% (n = 27)	76% (n = 62)	0.00
Eggs	0% (n = 0)	20% (n =15)	40% (n = 33)	0.00
Vitamin A rich fruit & vegetables	0% (n = 0)	17% (n = 13)	55% (n = 45)	0.00
Legumes & Nuts	14% (n = 2)	14% (n = 11)	29% (n = 24)	0.06
Other Fruit	14% (n = 2)	53% (n = 40)	83% (n = 68)	0.00
Other Vegetables	3% (n = 3)	53% (n = 40)	76% (n = 62)	0.00
Fats & Oils	71% (n = 10)	96% (n = 73)	100% (n = 82)	0.00

Pearson Chi-square; p-value of < 0.05 considered significant

4.4.1 Dietary diversity and socio-demographic characteristics

The DDS classification of food groups and their consumption in relation to various socio-demographic characteristics and health indicators is presented in table 4.10. A Chi-square test was performed to determine if there is a statistically significant difference between participant DDS and socio-demographic characteristics. No statistically significant association was found for most of the socio-demographic characteristics with the exception of level of education (p-value = 0.00) and household income (p-value = 0.04). The statistical significance indicates that a higher level of education and a stable household income meant greater dietary diversity for study participants.

Table 4.10: DDS classification in relation to socio-demographic characteristics and health indicators

Socio-demographic characteristics	DDS			P-value #
	Low (n = 14)	Medium (n = 76)	High (n = 82)	
Living Arrangements				
Live Alone	7% (n = 1)	8% (n = 6)	4% (n = 3)	
Live with friends	0% (n = 0)	1% (n = 1)	4% (n = 3)	
Live with husband/partner	14% (n = 2)	14% (n = 11)	7% (n = 6)	
Live with husband/partner and children	0% (n = 0)	5% (n = 4)	10% (n = 8)	0.60
Live with parents	43% (n = 6)	49% (n = 37)	45% (n = 37)	
Live with husband/partner and parents	0% (n = 0)	0% (n = 0)	2% (n = 2)	
Other(Grandparents/Relatives/Siblings)	36% (n = 5)	22% (n = 17)	28% (n = 23)	
Education				
Yes	93% (n = 13)	91% (n = 69)	94% (n = 77)	0.75
No	7% (n = 1)	9% (n = 7)	6% (n = 5)	
Employment status				
Employed	29% (n = 4)	28% (n = 21)	44% (n = 36)	
Unemployed	71% (n = 10)	72% (n = 55)	56% (n = 46)	
Stable household income				
Yes	50% (n = 7)	70% (n = 53)	80% (n = 66)	0.04*
No	50% (n = 7)	30% (n = 23)	20% (n =16)	
Grant				
Yes	50% (n = 7)	53% (n = 40)	46% (n = 38)	0.73
No	50% (n = 7)	47% (n = 36)	54% (n = 44)	
Vegetable home garden				
Yes	29% (n =4)	41% (n =31)	49% (n = 40)	0.29
No	71% (n = 10)	59% (n = 45)	51% (n = 42)	
Pre-existing health condition before pregnancy				
No condition	100% (n = 14)	99% (n = 75)	98% (n = 80)	
High Blood Pressure	0% (n = 0)	0% (n = 0)	1% (n = 1)	0.86
Anaemia	0% (n = 0)	1% (n = 1)	1% (n = 1)	
Health condition during pregnancy				
GDM	0% (n = 0)	1% (n = 1)	4% (n = 3)	
High Blood Pressure	0% (n = 0)	4% (n = 3)	4% (n = 3)	0.83
Anaemia	0% (n = 0)	3% (n = 2)	2% (n = 2)	

#Pearson Chi-square, *p-value of < 0.05 considered significant

4.4.2 Dietary diversity and household food security

In table 4.11, the dietary diversity classification in relation to the mean HFIAS score is presented. The average number of participants regardless of level of dietary diversity, had low HFIAS scores indicating that they were food secure. A Chi-square test was also performed to compare the DDS scores and HFIAS scores. The test yielded a p-value = 0.34. This indicates that there is no statistically significant association between the DDS and HFIAS scores for this study sample. An independent samples t-test and Levene's test for equality of variances was conducted to determine variability of the DDS and HFIAS. The Levene's test for produced a p-value of 0.88. Therefore, variances in DDS in relation to mean HFIAS score are equal. However, the independent samples t-test indicate that there was no statistically significant difference between the two variables t (88) = 0.29, p = 0.77.

Table 4.11: Dietary diversity classification in relation to mean HFIAS score.

DDS	**N = 172**	**Mean HFIAS ± SD**
Low dietary diversity	14	4.93 ± 4.96
Medium dietary diversity	76	4.45 ± 5.70
High dietary diversity	82	4.33 ± 5.63

4.5 Household food security status

The mean HFIAS for the study participants was 4.26 ± 5.26. Table 4.12 shows that 80% of the study sample was food secure, 13% were at risk for FI, 6% were food insecure and 2% were severely food insecure.

Table 4.12: Household food security status of pregnant women

	HFIAS Score	**Percentage (%)**	**Mean ± SD**
Food Secure	0 - 6.75	80% (n = 137)	2.00 ± 1.33
At risk of food insecurity	6.75 – 13.5	13% (n = 22)	9.45 ± 1.76
Food Insecure	13.5 – 20.5	6% (n = 10)	17.5 ± 2.32
Severely food insecure	20.5 – 27.0	2% (n = 3)	25.3 ± 2.51

The following tables will depict comparisons between the HFIAS and other variables according to the two categories: frequency of participants with low HFIAS score (≤ 6.75) lower 50%) and high HFIAS score (≥ 6.3) (higher 50%). The mean HFIAS score for the lower 50% category is 1.27 ± 0.44 and for the higher 50% category is 8.42 ± 6.48.

4.5.1 Household food security status and socio-demographic characteristics

Table 4.13 describes the frequency of responses for the HFIAS and socio-demographic characteristics. A Chi-square test was also performed to determine the association between the HFIAS and the socio-demographic characteristics. Results of the test show that there was no statistically significant association between the HFIAS and the socio-demographic characteristics.

Table 4.13: Household food security status and socio-demographic characteristics

Socio-demographic characteristics	**HFIAS**		**P-value #**
	Lower 50% (n = 96)	Higher 50% (n = 76)	
Age			
18 - 24 years	50	31	0.89
25 - 34 years	36	38	
35 - 41 years	10	7	
Relationship Status			
Single	47	41	0.53
Married	16	8	
Have a partner	32	27	
Separated	1	0	
Living Arrangements			
Live Alone	4	6	
Live with friends	3	1	
Live with husband/partner	11	8	
Live with husband/partner and children	6	6	0.49
Live with parents	41	39	
Live with husband/partner and parents	2	0	
Other(Grandparents/Relatives/Siblings)	29	16	
Education			
Yes	88	71	0.66
No	8	5	
Employment status			
Employed	32	29	0.51
Unemployed	64	47	
Stable household income			
Yes	67	59	0.24
No	29	17	
Grant			
Yes	47	38	0.89
No	49	38	
Vegetable home garden			
Yes	45	30	0.33
No	51	46	

#Pearson Chi-square; p-value of < 0.05 considered significant

4.5.2 Household food security status and anthropometric status

The participants' household food security status in relation to anthropometric measurements is reported in table 4.14. A statistically significant difference could not be found in the mean participant anthropometric measurements under the HFIAS categories. Levene's test for equality of variances and an independent samples t-test was conducted to compare the HFIAS to the anthropometric measurements. The

Levene's test produced a p-value > 0.05 for all the anthropometric measurements in the table. It can therefore be concluded that the variances in HFIAS between the anthropometric measurements are equal. The independent samples t-test results however, indicate that there is no significant difference between the HFIAS scores and the individual anthropometric measurements (p- value > 0.05).

Table 4.14: Household food security status in relation to maternal anthropometric measurements

Anthropometric measurements	HFIAS		Independent samples test P-value
	Lower 50% (Mean ±SD)	Higher 50% (Mean ±SD)	
Pre-pregnancy weight	66.16 ± 13.71	67.31 ± 15.07	0.63
Height from clinic	1.59 ± 0.05	1.58 ± 0.05	0.44
Height taken by fieldworkers	1.59 ± 0.05	1.58 ± 0.05	0.44
BMI using clinic height	26.02 ± 5.05	26.64 ± 5.68	0.46
BMI using height taken by fieldworkers	26.13 ± 5.30	26.56 ± 5.68	0.61
Delivery weight	77.03 ± 13.90	78.75 ± 12.75	0.40
Total weight gained	11.72 ± 5.40	10.11 ± 4.48	0.07

*Independent samples t-test; p, 0.05 considered significant between two groups

4.6 Presence of antenatal depression

The mean EPDS score for the study sample was 10.94 ± 6.35. Table 4.15 shows that a little over half (52%) the study participants had a low likelihood of depression while 32% had a severe likelihood of depression.

Table 4.15: EPDS score and classification

EPDS Classification	EPDS Score	Percentage
Low likelihood for depression	0 - 9	52% (n = 89)
Moderate likelihood for depression	10 – 12	16% (n = 28)
Severe likelihood for depression	13 – 30	32% (n =55)

The mean EPDS score according to different age groups is presented in table 4.16. The table also shows the frequency of participants in the lower 50% and higher 50% EPDS score category within the different age groups. The mean EPDS score for the lower 50% category was 7.34 ± 3.53. The mean EPDS score for the participants in the higher 50% category was 18.43 ± 3.88.

Table 4.16: EPDS score in relation to age groups

Age Groups	**EPDS Score**		
	Mean ± SD	**Lower 50%**	**Higher 50%**
Whole group (N = 172)	11.03 ± 7.16	116	56
18 – 24 years (n = 81)	10.58 ± 6.47	54	27
25 – 34 years (n = 74)	11.08 ± 6.62	51	23
35 – 41 years (n = 17)	12.12 ± 4.51	11	6

Table 4.17 shows the participants who possibly experienced anxiety as they scored maximum points on question three and four on the EPDS questionnaire. The table also shows the number of participants with suicide ideation (scored one to three points on question 10 of the EPDS questionnaire). Possible anxiety and suicide ideation are also divided into lower 50% and higher 50%. Approximately 77% of participants possibly experienced anxiety and 29% of the study participants had suicide ideation.

Table 4.17: Possible anxiety and suicide ideation based on EPDS

	EPDS	
	Lower 50%	**Higher 50%**
Possible Anxiety		
Yes (n = 133)	68% (n = 90)	32% (n = 43)
No (n = 39)	67% (n = 26)	33% (n = 13)
Suicide ideation		
Yes (n = 50)	68% (n = 34)	32% (n = 16)
No (n= 122)	67% (n = 82)	33% (n = 40)

4.6.1 Presence of antenatal depression and socio-demographic characteristics

Table 4.18 on the next page shows the participant socio-demographic characteristics under the two EPDS score categories and depicts that a large number of participants were in the lower 50% EPDS score category regardless of relationship status, living arrangements, level of education, employment status, household income, access to a social grant, planning of pregnancy and health conditions that occurred before and during pregnancy. A Chi-square test was conducted to determine associations between the EPDS and the socio-demographic variables. Results of the test indicate there was no statistically significant association between the EPDS and the socio-demographic variables.

Table 4.18: Presence of possible antenatal depression in relation to maternal socio-demographic characteristics

Socio-demographic characteristics	EPDS		P-value #
	Lower 50% (n = 116)	Higher 50% (n = 56)	
Relationship Status			
Single	56	32	0.60
Married	16	8	
Have a partner	43	16	
Separated	1	0	
Living Arrangements			
Live Alone	8	2	0.41
Live with friends	4	0	
Live with husband/partner	14	5	
Live with husband/partner and children	7	5	
Live with parents	49	31	
Live with husband/partner and parents	2	0	
Other(Grandparents/Relatives/Siblings)	32	13	
Education			
Yes	107	52	0.88
No	9	4	
Level of Education			
Primary school	1	1	0.52
Secondary school	65	36	
Tertiary	41	13	
Employment status			
Employed	41	20	0.96
Unemployed	75	36	
Stable household income			
Yes	80	46	0.06
No	36	10	
Grant			
Yes	56	29	0.66
No	60	27	
Planning status			
Planned pregnancy	24	15	0.37
Unplanned pregnancy	92	41	
Parity			
First pregnancy	54	27	0.83
Not first pregnancy	62	29	
Pre-existing health condition before pregnancy			
No condition	114	55	0.68
Diabetes mellitus	0	0	
High Blood Pressure	1	0	
Anaemia	1	1	
Health condition during pregnancy			
No condition	105	53	
GDM	4	0	0.16
High Blood Pressure	4	2	0.96
Anaemia	3	1	0.74

#Pearson Chi-Square; $p < 0.05$ considered significant

4.6.2 Presence of antenatal depression and maternal anthropometric measurements

The EPDS scores in relation to anthropometric measurements of participants is depicted in table 4.19. An independent samples t-test was conducted to compare the EPDS scores to maternal anthropometric measurements. There was no statistically significant difference between the EPDS and anthropometric measurements with the exception of delivery weight. There was a statistically significant difference between EPDS scores and delivery weight in that those participants with higher EPDS scores had a lower weight at delivery than those with low EPDS scores.

Table 4.19: EPDS and anthropometric measurements

Anthropometric measurements	**EPDS**		**Independent samples test P-value**
	Lower 50% (Mean ± SD)	Higher 50% (Mean ± SD)	
Pre-pregnancy weight	66.16 ± 13.71	67.31 ± 15.07	0.57
Height from clinic	1.59 ± 0.05	1.58 ± 0.05	0.39
Height taken by fieldworkers	1.59 ± 0.05	1.58 ± 0.05	0.67
BMI using clinic height	26.02 ± 5.05	26.64 ± 5.68	0.24
BMI using height taken by fieldworkers	26.13 ± 5.30	26.56 ± 5.68	0.17
Delivery weight	77.03 ± 13.90	78.75 ± 12.75	0.02*
Total weight gained	11.72 ± 5.40	10.11 ± 4.48	0.30

*p-value < 0.05

4.6.3 Presence of antenatal depression and participant dietary diversity

The following table shows a comparison between the mean EPDS score and participant DDS category. Study participants with low dietary diversity had the highest mean EPDS score.

Table 4.20: EPDS score versus DDS

DDS	**N = 172**	**Mean EPDS ± SD**
Low dietary diversity	8% (n = 14)	13.07 ± 7.70
Medium dietary diversity	42% (n = 76)	10.79 ± 6.37
High dietary diversity	48% (n = 82)	10.73 ± 6.11

4.6.4 Presence of antenatal depression and participant household food security status

The frequency of participants that belong to the lower 50% EPDS category and those who belong to the higher 50% EPDS according to their HFIAS score classification is shown in table 4.21. The majority of participants with a low EPDS score were food secure whilst those at risk for food insecurity or were food insecure had higher EPDS scores. Levene's test for equality of variances and an independent samples t-test was conducted to compare the EPDS scores to the HFIAS scores. The Levene's test produced a p-value > 0.05 for HFIAS. It can therefore be concluded that the variances in EPDS scores between the HFIAS scores are equal. The independent samples t-test results however, indicate that there is no significant difference between the EPDS scores and the HFIAS scores (p- value > 0.05).

Table 4.21: EPDS score versus HFIAS

HFIAS	EPDS	
	Lower 50% (n= 116)	Higher 50% (n = 56)
Food Secure	91% (n =105)	63% (n = 35)
At risk of food insecurity	8% (n = 9)	23% (n = 13)
Food Insecure	9% (n = 1)	11% (n = 6)
Severely food insecure	0.9% (n = 1)	4% (n = 2)

4.7 Infant birth outcomes

The gender, birth weight and birth length of infants born to the 172 pregnant women in the study sample are shown in table 4.22. The gestational age ranged from 31 weeks to 44 weeks with the mean being 38.98 ± 1.80 weeks. The Pearson correlation coefficient showed that there was a statistically significant positive correlation between gestational age and IBW (r = 0.41; p < 0.00) with the correlation being significant at p-value < 0.00. The mean infant birth length was 49.6 ± 20.73 cm. Infant birth length ranged from 41cm to 61cm. The mean birth weight was 3.11 ± 0.55 kg. The mean birth weight for male and female infants was 3.17 ± 0.49 kg and 3.07 ± 0.61 kg, respectively. Birth weight for all infants ranged from 1.50 kg to 6 kg.

Table 4.22: Infant gender and related birth outcomes

Characteristics of Infants	Frequency	Percentage (%)
Infant Gender		
Male	81	47
Female	91	53
Birth weight classification		
Normal weight (≥ 2.5 kg ≤ 4.0 kg)	148	86
LBW (< 2.5 kg)	8	5
PTB (<37 weeks < 2.5 kg)	7	4
PTB (normal weight) (< 37 weeks >2.5 kg)	4	2
LGA (> 4.0 kg)	5	3

4.7.1 Infant birth weight in relation to socio-demographic characteristics.

Results generated by the Pearson correlation coefficient results showed that there was no correlation between IBW and maternal age ($r = -0.06$; $p = 0.42$), relationship status ($r = 0.03$; $p = 0.74$), living arrangements ($r = -0.026$; $p = 0.73$), first time or not first time pregnancy ($r = -0.12$; $p = 0.09$), education ($r = -0.106$; $p = 0.17$), education level ($r = 0.06$; $p = 0.46$), employment status ($r = -0.34$; $p = 0.08$), household income ($r = 0.08$; $p = 0.29$), access to a social grant ($r = 0.10$; $p = 0.19$), pre-existing health condition ($r = -0.02$; $p = 0.76$), GDM ($r = 0.08$; $p = 0.29$), high blood pressure ($r = 0.11$; $p < 0.16$) and anaemia during pregnancy ($r = - 0.05$; $p = 0.51$).

The mean weight gain and mean IBW according to the maternal pre-pregnancy BMI classification is presented in table 4.23. The mean weight gain for the participants with an underweight, normal weight, overweight and obese pre-pregnancy BMI shows that overall, the majority of these participants had adequate weight gain throughout pregnancy according to the WHO classification and IOM guidelines for weight gain during pregnancy. The mean IBW for each maternal pre-pregnancy BMI group indicated that the majority of infants had an ideal IBW.

Table 4.23: Mean weight gained and infant birth weight according to maternal pre-pregnancy BMI

BMI Classification	Weight gain range	Mean weight gained (±SD)	Mean IBW (± SD)
Underweight (<18.5 kg/m^2)	9 kg – 28 kg	16.2 ± 8.06	3.01 ± 0.35
Normal weight (18.5 – 24.9 kg/m^2)	4 kg – 27.5 kg	12.75 ± 4.45	3.13 ± 0.44
Overweight (25.0 – 29.9 kg/m^2)	5 kg – 28 kg	10.83 ± 4.55	3.11 ± 0.71
Obese (≥ 30 (kg/m^2)	-9 kg – 20.8 kg	8.37 ± 6.03	3.14 ± 0.44

In table 4.24, the frequency and percentage of normal weight, LBW, PTB and LGA infants born to women who had an underweight, normal weight, overweight and obese pre-pregnancy BMI is reported. The table shows that all infants born to women with an underweight pre-pregnancy BMI had infants with a normal birth weight. Equal numbers of LBW infants were born to women with normal and overweight pre-pregnancy BMI. Most LGA infants were seemingly born to women with an overweight pre-pregnancy weight.

Table 4.24: Frequency Birth weight classification vs. maternal pre-pregnancy BMI

Birthweight Classification	Underweight pre-pregnancy BMI	Normal weight pre-pregnancy BMI	Overweight pre-pregnancy BMI	Obese pre-pregnancy BMI
Normal weight (n = 148)	3% (n = 5)	43% (n = 64)	31% (n = 46)	22% (n = 33)
LBW (n = 8)	0% (n= 0)	38% (n = 3)	38% (n = 3)	25% (n = 2)
PTB (n = 7)	0% (n = 0)	43% (n = 3)	57% (n = 4)	0% (n= 0)
PTB (normal weight) (n = 4)	0% (n = 0)	0% (n = 0)	50% (n = 2)	50% (n= 2)
LGA (n = 5)	0% (n = 0)	0% (n = 0)	80 % (n = 4)	20% (n = 1)

Approximately 80% of women with LGA had excessive weight gain during pregnancy. Seventy-five percent of women with PTB (normal weight) infants had excessive weight gain and 20% of them had inadequate weight gain during pregnancy. Approximately 71% of women with PTB infants had inadequate weight gain, 14% had adequate weight gain whilst another 14% had excessive weight gain. An estimated 25% of women with LBW infants had adequate weight gain, 50% had inadequate weight gain and 25% had excessive weight gain during pregnancy according to the WHO classification and IOM guidelines.

There was no statistically significant association between IBW and maternal pre-pregnancy weight, height, BMI and MUAC (see Table 4.25). There was however a positive correlation between maternal delivery weight and IBW (r =0.17; p = 0.02) as well as a statistically significant positive correlation between the total weight gained during pregnancy and IBW (r = 0.32; p = 0.00).

Table 4.25: Birth weight correlation with maternal anthropometric measurements

		Pre-pregnancy weight (kg) (N = 172)	**Height from clinic (m) (n = 168)**	**Height measured by fieldworkers (m) (N = 172)**	**BMI using clinic height kg/m^2 (n = 168)**	**BMI using height measured by fieldworkers kg/m^2 (N = 172)**	**MUAC (n = 113)**	**Delivery Weight (kg) (N = 172)**	**Total weight gained (N = 172)**
Birth Weight (kg)	Pearson Correlation	0.013	-0.053	-0.036	0.042	0.039	0.016	.174	.317
	p-value	0.878	0.491	0.644	0.593	0.608	0.869	0.023*	0.000**

* P-value < 0.05; **. P-value < 0.01; Pearson Correlation

4.7.2 Infant birth weight and dietary diversity

Table 4.26: Birth weight classification in relation to DDS classification

Birth weight	**DDS Classification**			**P- value #**
	Low DDS (n= 14)	Medium DDS (n = 76)	High DDS (n = 82)	
Normal weight (≥ 2.5 kg ≤ 4.0 kg)	71% (n = 10)	88% (n = 67)	87% (n = 71)	NS
LBW (≥ 37 weeks, < 2.5 kg)	7% (n = 1)	3% (n = 2)	6% (n = 5)	NS
PTB (<37 weeks, < 2.5 kg)	0% (n = 0)	20% (n =4)	4% (n = 3)	NS
PTB (normal weight) (< 37 weeks, >2.5kg)	7% (n = 1)	5% (n = 1)	2% (n = 2)	NS
LGA (> 4.0 kg)	14% (n = 2)	3% (n = 2)	2% (n = 2)	NS

#Chi-square; p < 0.05 considered significant; NS = non-significant

Table 4.26 presents the relationship between birth weight classification and DDS classification. Participants with high DDS had the largest number of LBW infants and those with a medium DDS had the most PTB infants. Participants with medium and high DDS had an equal number of LGA infants. The Chi-square test showed that there was no significant association between the IBW and DDS scores. A Pearson correlation coefficient between the two variables was computed to analyse the relationship between dietary diversity and IBW. This rendered a weak negative correlation (r = -0.16; p = 0.04) with the correlation being significant at the p-value < 0.05 level.

4.7.3 Infant birth weight and household food security

The relationship between birth weight and HFIAS scores is represented in table 4.27. The table indicates that the same percentage of participants with both low and high HFIAS scores had normal birth weight infants. Low birth weight infants were born to mostly women with higher HFIAS scores.

Table 4.27: Birth weight classification in relation to HFIAS classification

Birth weight	**HFIAS**		**P- value #**
	Lower 50% (n = 96)	Higher 50% (n = 76)	
Normal weight (≥ 2.5 kg ≤ 4.0 kg)	86% (n = 83)	86%(n = 65)	NS
LBW (≥ 37 weeks, < 2.5 kg)	2% (n = 2)	8% (n = 6)	NS
PTB (<37 weeks, < 2.5 kg)	4% (n = 4)	4% (n = 3)	NS
PTB (normal weight) (< 37 weeks, >2.5 kg)	3% (n = 3)	1% (n = 1)	NS
LGA (> 4.0 kg)	4% (n = 4)	1% (n = 1)	NS

Chi-square test; p < 0.05 considered significant; NS = non-significant

The association between IBW and HFIAS was tested by performing a Pearson correlation coefficient. There was no correlation between the two variables (r = -0.07; p = 0.39). A scatter plot summarises the results (Figure 4.5).

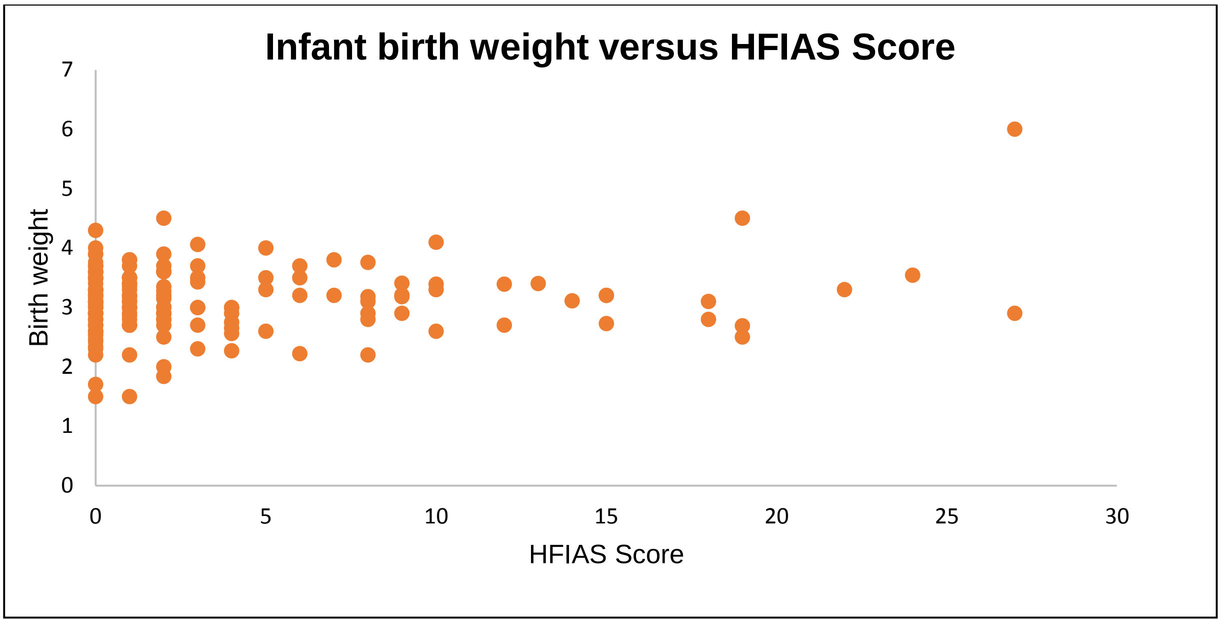

Figure 4.5 Correlation between infant birth weight and HFIAS

4.7.4 Infant birth weight and presence of possible antenatal depression

Table 4.28 shows the birth weight classification in relation to EPDS scores. The table indicates that the majority of participants with normal birth weight infants, LBW, PTB, PTB (normal weight) and LGA had lower EPDS scores. The majority of those with higher EPDS scores had normal birth weight infants, equal number of LBW and fewer PTB, normal weight PTB and LGA when compared to participants with lower EPDS scores.

Table 4.28: Birth weight classification in relation to EPDS score category

Birth weight	**EPDS**		**P- value #**
	Lower 50% (n = 116)	Higher 50% (n = 56)	
Normal weight (≥ 2.5 kg ≤ 4.0 kg)	85% (n = 99)	86% (n = 49)	NS
LBW (≥ 37 weeks, < 2.5 kg)	3% (n = 4)	7% (n = 4)	NS
PTB (<37 weeks, < 2.5 kg)	5% (n = 6)	2% (n = 1)	NS
PTB (normal weight) (< 37 weeks, >2.5 kg)	3% (n = 3)	2% (n = 1)	NS
LGA (> 4.0 kg)	3% (n = 4)	2% (n = 1)	NS

Chi-square test; $p < 0.05$ considered significant; NS = Non significant

A Pearson correlation coefficient was performed to analyse the relationship between IBW and EPDS. The results showed that there was no correlation between IBW and EPDS scores (r = 0.01; p= 0.95). Figure 4.6 summarises the results of the association between the variables.

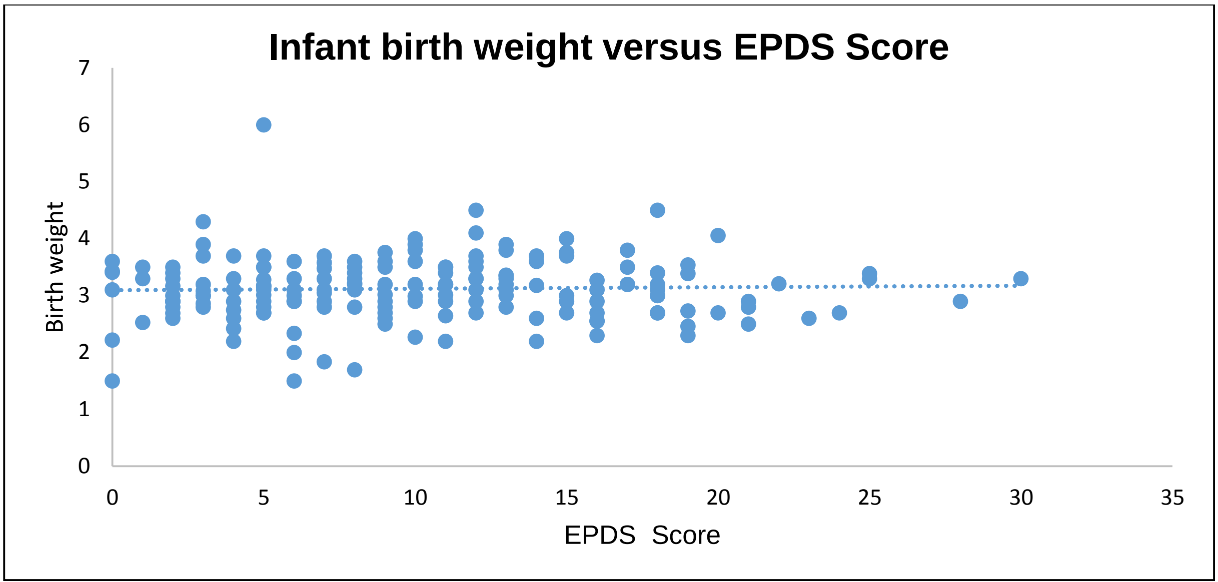

Figure 4.6: Correlation between infant birth weight and EPDS.

4.8 Conclusion

In conclusion, this chapter presented the results of the study. The average participant DDS was five indicating a medium dietary diversity for the study sample. No statistically significant association was found between the participant DDS and most of the socio-demographic characteristics with the exception of level of education and household income; indicating that a higher level of education and a stable household income meant greater dietary diversity for study participants. The average number of participants regardless of level of dietary diversity, had low HFIAS scores with the mean score being 4.26 ± 5.26 indicating that the majority of participants were food secure. Results show that 80% of the study sample was food secure, 13% were at risk for FI, 6% were food insecure and 2% were severely food insecure.

A little over half (52 %) the study participants had a low likelihood of depression, 16% had a medium likelihood of depression and 32% had a severe likelihood of depression. Participants with higher EPDS scores had a lower weight at delivery than those with low EPDS scores. Study participants with low dietary diversity also had the highest mean EPDS score. The majority of participants with low EPDS score were food secure whilst those at risk for FI or were food insecure had higher EPDS scores. With that said, statistical analysis showed that household food security status was not related to likelihood of antenatal depression.

The majority of participants had adequate weight gain throughout pregnancy according to the WHO classification and IOM guidelines. Participants with an overweight pre-pregnancy BMI who had overall slightly excessive weight gain during pregnancy had the most number of LGA infants. The majority of LBW infants were born to women with normal and overweight pre-pregnancy BMI. Infant LBW and PTB was mainly associated with inadequate GWG. Total weight gained during pregnancy was not associated with other variables measured.

The mean IBW reported indicates that the majority of infants had an ideal birth weight. Eighty-eight percent of infants born full term and preterm had normal weight, whilst 9% were born with a LBW and 3% were LGA infants. A statistically positive association between maternal delivery weight, total weight gained during pregnancy and IBW was however found. No significant association between the IBW participant dietary diversity, household food security status and presence of antenatal depression in the present study. The results of this study will be discussed in the next chapter.

CHAPTER 5: DISCUSSION

This chapter will discuss the results of the study in relation to the literature review presented in chapter two.

5.1 Socio-demographic characteristics and nutritional status of pregnant women

The literature states that socio-demographic factors such as: level of education, employment status, earnings and access to basic resources are the underlying determinants of nutrition and dietary habits (Saaka 2012; Abu-Saad & Fraser 2010). The findings of the current study indicated that the participants had a medium level of education with more than one quarter of the participants having completed secondary school and/or received education at a tertiary institutions. The level of education an important socio-economic indicator as it is associated with job attainment, access to resources and lower risk of poverty (Abu-Saad & Fraser 2010). A small percentage of the study sample were employed. However, three quarters of the participants had a stable household income. These findings are consistent with the National Treasury report that stated that the South African unemployment rate is high (National Treasury 2011). Almost half the participants had direct or indirect access to a social grant while the majority had access to running water and electricity. More than 50% of participants did not have a vegetable garden to grow crops.

<u>Maternal anthropometric measurements</u>

Studies show that maternal anthropometric measurements such as pre-conception weight, height and GWG have an influence on foetal growth and birth weight outcomes (Ay *et al* 2009). The average height of participants was 1.59 ± 0.05 m. Therefore, the majority of study participants did not have a short stature which is associated with adverse birth outcomes. The average pre-pregnancy BMI of the study sample was 26.29 ± 5.35 kg/m^2. This pre-pregnancy BMI is higher than the recommended BMI of 18.5 to 24.9 kg/m^2 (PMNCH 2011). According to Tanaka *et al* (2014) the recommended pre-pregnancy BMI is in most cases not attained by women. The pre-pregnancy BMI findings are however lower than the average BMI of 29.0 kg/m^2 previously reported for black South African women (Shisana *et al* 2013).

In the current study, approximately 3% of the participants were underweight, 41% had a normal weight, 35% were overweight and 21% had an overweight pre-pregnancy BMI. These findings are different to those found in a study conducted in Khayelitsha that reported that 5.7% of pregnant women were underweight, 44.2% had a normal weight, 17% were overweight and 33.1% were obese prior to conception (Davies *et al* 2013).

The mean MUAC of the study sample was 28.78 ± 3.87 cm indicating that the majority of the women were not malnourished. The MUAC is a good indicator for identifying malnutrition in pregnant women (Verves *et al* 2013). A MUAC of less than 21 cm or between 21 and 23cm is used as the cut-off for a pregnant women's eligibility to enrol in a nutrition supplementation programme. However, in the current study none of the participants had been enrolled in the nutrition supplementation programme.

5.2 Dietary diversity of pregnant women

In the current study, pregnant women had a medium DDS and consumed an average of four to five food groups on a daily basis. The average number of study participants consumed slightly below the minimum recommended number of food groups. The average DDS for the study sample was 5.39 ± 1.36. According to Altman (2010) the minimum number of food groups to be consumed is six. The study sample DDS is higher than the DDS reported in other South African studies. Labadarios *et al* (2011) reported a score of 4.02 for entire South African adult population while Oldewage-Theron & Kruger (2008) reported an average DDS of 3.41. Whilst the DDS in the current study is high, it is not as high as that reported in another South African study conducted on black non-pregnant women where a DDS of 6.7 was found (Acham *et al* 2012). Food groups that were most often consumed by the study sample include: cereals/roots/tubers, meat/poultry/fish and fats and oils. The least consumed food groups include vitamin A rich fruit and vegetables, eggs, legumes and nuts. These findings are similar to that reported by Acham *et al* (2012) and Altman & Jacobs (2010) that found that South African diets mainly lack eggs, legumes and vitamin A rich fruit and vegetables.

Dietary diversity, socio-demographic characteristics and household food security

Dietary quality is influenced by socio-demographic factors such as: level of education, income, employment status, marital status and whether or not the pregnancy was planned (Nash *et al* 2013). Results of the study documented no significant association between socio-demographic characteristics and dietary diversity, with the exception of level of education and household income. A higher level of education and stable household income was associated with higher dietary diversity. Therefore factors related to SES have an impact on dietary habits and food intake during pregnancy (Abu-Saad & Fraser 2010). For the purposes of this study, the DDS was used to determine the study population's nutrient intake. However, the DDS can also be used to measure level of food security. A comparison was made between the DDS and HFIAS scores. The results of this comparison showed that there was no significant relationship between the DDS and HFIAS scores.

5.3 Household food security status of pregnant women

Results of the study indicated that 80% of participants were food secure, 13% were at risk of FI and 8% were food insecure. These results indicate lower FI in this study sample when compared to other South African studies. The SANHANES-1 found that only 45.6% of South Africans are food secure, 28.3% were at risk of hunger and 26.0% experienced hunger (Shisana *et al* 2013). The Hunger Index found that only 20.2% South Africans were food secure, 28.2% were at risk for hunger and more than 50% of households were food insecure (DoH 2014). No association was found between socio-demographic characteristics and HFIAS scores.

Numerous studies have found that FI is associated with an overweight and obese pre-pregnancy BMI (Castell *et al* 2015; Laraia *et al* 2010). Although results from the current study show that women in the higher 50% HFIAS score category had a slightly higher BMI when compared to women in the lower 50% HFIAS category (26.02 vs. 26.64 kg/m^2), no association was found between pre-pregnancy BMI and HFIAS scores.

5.4 The presence of antenatal depression among pregnant women

Findings from the current study revealed that more than 50% of the pregnant women had a low likelihood of antenatal depression, whilst 48% had a moderate to severe of suffering from likelihood of antenatal depression. The results also showed that 80% of the participants possibly had symptoms of anxiety and 29% had suicidal thoughts. The findings are higher than that of the study by Manikkam and Burns (2012) who reported a prevalence of 39%. Results of the present study are consistent with another study conducted in KZN that reported a depression prevalence of 47% for HIV negative pregnant women and 45% for HIV positive pregnant women (Rochat *et al* 2013).

<u>Antenatal depression, health conditions and unplanned pregnancies</u>

According to Räisänen *et al* (2014), women with GDM, diabetes mellitus, pre-eclampsia and anaemia have a greater risk of suffering from perinatal depression. Findings for the current study showed that there was no significant association between the EPDS scores of pregnant women with GDM, high blood pressure and anaemia.

Unplanned pregnancies are also associated with antenatal depression (Yannikkerem *et al* 2013; Karaçam & Ançel 2009). Results in the present study indicated that the majority of pregnancies were not planned. However, no association was found between having an unplanned pregnancy and the prevalence of antenatal depression. A large number of participants with unplanned pregnancies had a low EPDS score. A low SES is associated with poor mental health. Results from the current study showed that there was no association between the socio-demographic characteristics of the study sample and screening positive for antenatal depression using the EPDS. Young maternal age is another risk factor for antenatal depression (Hartley *et al* 2011; Leigh & Milgrom 2008). Findings from the current study show that 18-24 year olds had a slightly lower mean EPDS score when compared to 25 to 41 year olds. These findings indicate that young maternal age was not a risk factor for antenatal depression in the current study sample.

Antenatal depression, diet and nutrition

A study conducted in Pakistan found that depression is associated with an inadequate dietary intake (Saeed *et al* 2016) and unhealthy eating habits (Barker *et al* 2013). The findings of this study are consistent with the literature, as pregnant women with low dietary diversity had the highest EPDS score. The study conducted by Saeed *et al* (2016) also reported that women with depression consumed smaller amounts of meat and poultry, milk and fruit when compared to non-depressed women. The same study reported that depressed women consumed more macronutrients and fewer micronutrients (Saeed *et al* 2016). In the current study, participants with low dietary diversity consumed small amounts from the other fruits and other vegetables food group and did not consume vitamin A rich fruit and vegetables and eggs. However, low DDS participants consumed large amounts of cereals/roots/tubers and fats and oils.

Antenatal depression and household food insecurity

Food security and depression directly impact on maternal health and can influence birth outcomes (Mozayeni *et al* 2014). According to Dibaba *et al* (2014), pregnant women who experienced household food insecurity during pregnancy have a higher risk of developing depression. Results of the current study show that participants with a low EPDS score were food secure whilst participants with a high EPDS score were food insecure. Approximately 23% of those at risk for FI and 15% of those who were food insecure were in the higher 50% EPDS category. These findings differ from two other studies. The first study reported that 66.9% of food insecure pregnant women suffered from depression (Mozayeni *et al* 2014). The second study found that 67.1% of the 32.9% depressed women were also food insecure (Casey *et al* 2004).

5.5 Pattern of weight gain

Gestational weight gain depends on pre-pregnancy BMI, age, height, level of education, SES and the presence of chronic illness during pregnancy (Koh *et al* 2013). According to Drehmer *et al* (2013), a high pre-pregnancy BMI and pre-pregnancy overweight/obesity is a risk factor for excessive GWG. An underweight pre-pregnancy BMI status is however, not a predictor for inadequate GWG (Drehmer *et al* 2013). Findings of the current study show that a large number of participants with an overweight and obese pre-pregnancy BMI had excessive weight gain and an equal number of participants with underweight pre-pregnancy BMI had inadequate and adequate GWG. Therefore, findings support the report by Drehmer *et al* (2013).

Approximately 26% of the women irrespective of pre-pregnancy BMI in this study had an inadequate weight gain, 40% had an adequate weight gain and 34% gained an excessive amount of weight according to the WHO/IOM guidelines. Results show that some participants lost weight instead of gained weight as participant GWG ranged from -9Kg to 28Kg. Weight loss during pregnancy was however not covered in the literature review therefore this finding cannot be discussed further in the present study. One Nigerian study found that 97% of pregnant women gained less than the recommendations (Esimai & Ojofeitimi 2014). The findings of the latter study seem to differ significantly from that of the present study. A study by Laraia *et al* (2013) reported an association between FI and high GWG. The findings study are inconsistent to this statement as participants in the lower 50% category had more weight gain than those in the higher 50% HFIAS score category (11.72 ± 5.40 vs. 10.11 ± 4.48). Nevertheless, in the current study sample, no associations were found between total weight gained and HFIAS, maternal age, income, employment status, pre-pregnancy BMI and DDS. Depression, stress and anxiety is associated with both inadequate and excessive GWG. One systematic review concluded that excessive GWG is not linked to depression (Kapadia *et al* 2015). The findings of this present study are consistent with that of the systematic review as no correlations were found between EPDS and total weight gained during pregnancy.

5.6 Infant birth weight

The ideal IBW ranges from 3.1 kg to 3.6 kg (PMNCH 2011). The mean weight for infants born to this study sample was 3.11 ± 0.55 kg. Over 80% of the infants had a normal birth weight, while 9% of the infants had a LBW (includes PTB and full term LBW). It has been said that in developing countries, LBW results from IUGR and PTB (Muthayya 2009). In the case of the current study, almost half of the LBW infants were also PTB infants. A study in conducted in Khayelitsha South Africa, reported that 3.4% of infants had a LBW, whilst 8.5% were LGA. Other studies in South Africa reported a lower percentage of 2.3% and 3.43% of LBW (Davies *et al* 2013). Results generated by the current study showed that prevalence of LBW was higher than results generated by the Khayelitsha study. The percentage of LGA infants in the current study is however consistent with the other South African studies reported in Davies *et al* (2013).

<u>The relationship between IBW and maternal nutritional status</u>

No association was found between IBW and pre-conception weight, height, BMI or MUAC. Positive associations were however found for weight at delivery. Frederick *et al* (2008) states that pre-pregnancy BMI and GWG is independently and positively correlated with IBW. Positive correlations were also found for GWG but not for pre-pregnancy BMI. The mean weight for infant boys was 3.2 kg and for infant girls 3.1 kg. These findings are similar to the weight-for-age classification in literature that states that the average weight-for-age for infant boys is 3.3 kg and infant girls is 3.2 kg (WFP 2005).

Pre-pregnancy underweight and inadequate GWG increases risk for giving birth to a LBW infant, foetal growth retardation and/or preterm delivery (Tanaka *et al* 2014; Gao *et al* 2013; De Onis 2011; Scholl 2008). Findings from the current study indicate that the underweight participants had adequate weight gain and all delivered infants of a normal birth weight. A study by Heude *et al* (2012), found that underweight women had the lowest risk for preterm delivery and SGA while obese women had more preterm deliveries. Findings from this study are consistent with the above study as underweight women had no PTB infants while overweight and obese women delivered the PTB infants. Several studies suggest that GWG below IOM guidelines in overweight/obese women does not have a negative influence on foetal growth and resultant adverse birth outcomes (Masho *et al* 2013; Beyerlein *et al* 2009; Oken *et al* 2009). The results of the above studies are consistent with the findings of the current study as all obese women with inadequate weight gain delivered normal birth weight infants. Inadequate weight gain for overweight women, however in the present study resulted in LBW infants. This contradicts literature. Nohr *et al* (2008) state that overweight and obese women with low GWG is preferable than high GWG, as the latter can result in LGA (Nohr *et al* 2008). Findings from the current study show that this statement to be true, as both overweight and obese women with excessive weight gain during pregnancy gave birth to LGA infants.

<u>Infant birth weight and dietary diversity</u>

Observational studies have shown that a maternal balanced diet is associated with higher birth weight and lower risk for SGA infants (Okubo *et al* 2010). Findings from the current study show that women with medium DDS had the most PTB. Participants with a low DDS delivered the most number of LBW infants. This supports the findings of the study by Saaka (2012) who concluded that poor dietary diversity is linked to the risk of giving birth to a LBW infant. Furthermore, the current study showed a weak negative correlation between IBW and DDS, this means that increase in dietary diversity does not necessarily result in a higher IBW.

<u>The relationship between infant birth weight and household food security</u>

The current study found no association between IBW and HFIAS. Food insecure pregnant women gave birth to both normal weight and LGA infants, while food secure women gave birth to LBW, normal weight and LGA infants. These findings are inconsistent with a study that reporting that 82.1% of food insecure women gave birth to LBW infants and 30.5% of women with normal weight infants were food insecure (Mozayeni *et al* 2014).

Infant birth weight and antenatal depression

A study conducted in Bangladesh found that depressive symptoms in pregnant women in their third trimester was associated with LBW (Nasreen *et al* 2010). In the current study, the relationship between IBW and antenatal depression showed that there was no significant association between IBW and possible antenatal depression.

5.7 Testing of Hypotheses

The first null hypothesis reported in chapter one stated that, "all pregnant women (regardless of age) with inadequate dietary intake will not gain adequate weight during pregnancy when compared to the IOM guidelines (IOM 2009)". This hypothesis is rejected as pregnant women with inadequate dietary intake gained adequate and even excessive amounts of weight during pregnancy.

The second null hypothesis reported in chapter one stated that, "inadequate weight gain in pregnant women will not result in LBW infants delivered at term." This hypothesis is rejected as LBW infants were born to 50% of women with inadequate weight gain and 25% had adequate and the other 25% had excessive weight gain during pregnancy.

The third null hypothesis in chapter one stated that, "food insecurity of pregnant women will not result in an unsatisfactory pattern of weight gain in pregnant women and LBW of infants." This hypothesis is accepted as findings of the study show that food insecure women had similar weight gains and possibly excessive weight gain during pregnancy when compared to food secure women. Food insecurity was not associated with LBW infants but rather normal birth weight and LGA infants in the current study.

The fourth and final null hypothesis in chapter one stated that, “the presence of antenatal depression will not result in inadequate/excessive weight gain in pregnant women when compared to the IOM guidelines”. This hypothesis is rejected as pregnant women in the higher 50% EPDS category had lower mean delivery weight when compared to women in the lower 50% EPDS score category.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The aim of the study was to determine the dietary diversity, household food security status, prevalence of antenatal depression and maternal pattern of weight gain in relation to IBW. Findings of the study show that pregnant women had a medium dietary diversity, low levels of FI and moderate likelihood of suffering from antenatal depression. Maternal nutrition is a modifiable and important factor for ensuring optimal foetal growth and preventing adverse birth outcomes. It is imperative that maternal malnutrition be addressed to prevent maternal and infant mortality, stunting and impaired physical and mental development in children. Pregnant women in literature are generally reported to have an inadequate nutrient intake and consume diets lacking in variety. The mean DDS of pregnant women who participated in the current study was higher than that reported in other South African studies. The pregnant women in the current study consumed small amounts of vitamin A rich fruit and vegetables, eggs, legumes and nuts, this indicates that these pregnant women may be missing valuable micronutrients and protein in their diets.

It is postulated that low dietary diversity amongst participants was possibly related to household FI. Socio-economic factors affect access to food, diet quality and access to health care. Low FI levels could possibly be attributed to the SES of participants. Food insecurity in the current study was associated with excessive weight gain this shows that FI can lead to unhealthy eating habits. Excessive weight gain is associated with weight retention postpartum and development of non-communicable diseases later on in life for women.

The mean pre-pregnancy BMI for participants was in the overweight category. This is a cause for concern as maternal overweight/obesity is a risk factor for pregnancy complications such as pre-eclampsia, GDM and possible PTB or LGA. The mean MUAC of the study participants was also high indicating that the majority of women were not malnourished but rather over nourished. The number of LBW infants was still relatively high when compared to literature and is a cause of concern as LBW have greater risk for stunting during childhood and developing chronic diseases in adulthood. Participants' overweight pre-pregnancy BMI coupled with excessive weight gain and large number of LGA infants is a cause of great concern and calls for preventative and management interventions. Infants born LGA have greater risk for childhood and adulthood obesity as well as development of chronic diseases of lifestyle later on in life.

Possible antenatal depression prevalence in the current study was much like in other South African studies very high. Although no associations were found between IBW and prevalence of antenatal depression; participants with low dietary diversity had the highest EPDS score. Antenatal depression should therefore not be ignored as it can potentially affect food intake, weight gain during pregnancy and birth outcomes. Further studies are however still needed to understand the factors that contribute to maternal nutrition and negative infant birth outcomes.

6.2 Critique of the study

6.2.1 Study limitations

A large number of participants were interviewed while waiting in the queue due to lack of space or private room in the research site. The lack of privacy may have caused some participants to feel uncomfortable and therefore not share vital information with the interviewer. The 24-H-RQ was only administered once it therefore was not an accurate reflection of the patterns of food groups. A record of all foods consumed during a seven day period would be more reflective of food group consumption patterns and therefore dietary diversity. The study results do however shed some light on the dietary diversity and nutritional status of this sample of urban black pregnant women. The study only included one race group. Due to time and financial constraints only one large clinic was used to conveniently sample the study participants. The responses given by participants for the 24-H-RQ were influenced by the participants ability to accurately recall precisely what they had ate and drank in the previous 24 hours. The study relied on secondary data regarding participants' anthropometric measurements recorded primarily by the enrolled nurse in the course of their pregnancy.

Medical records were used to retrieve information regarding maternal weight in order to calculate pattern of weight gain. As these values were not documented by the researcher it is possible that measurement or recording error could have influenced these values. These errors however, were expected to be minimal. Missing data in the statistical analysis may have been source of bias. The majority of women were recruited during the third trimester of pregnancy therefore those who gave birth prematurely could have been unintentionally excluded because they would have given birth and therefore could no longer form part of the study sample. The EPDS was not followed by a clinical assessment for depression. It is therefore possible that results generated by this screening tool were not a true reflection of depression status.

6.2.2 Recommendations for improvement of the study

A future study of similar nature should be conducted as a longitudinal study where participants are followed from their first trimester until delivery. This is so that weight gain, dietary diversity, household FI and presence of depression can be monitored during all the trimesters of pregnancy. It is advisable that all anthropometric measurements (weight, height and MUAC) must be taken by the researcher and well trained fieldworkers. The 24-H-RQ should be taken for one weekend and one week day. The 24-H-RQ must also be quantified to obtain the exact energy, macronutrient and micronutrient intake of pregnant women. Gaining access to hospitals were study participants deliver is advisable so that the researcher can personally view medical records, hence preventing participants having to recall information such as infant delivery weight. Utilising several clinics and hospitals to obtain a larger study sample and hence have more reliable results which would be beneficial.

6.2.3 Recommendation for nutrition practice

Pregnancy is an opportunity to support women in maintaining or changing lifestyle habits for the good of their health and that of their infant. Pregnant women must receive individual or group nutrition counselling to encourage healthy eating and lifestyle practices during pregnancy to prevent inadequate or excessive weight gain and possibly negative birth outcomes. Topics such as how to deal with nausea and vomiting should be discussed as in the current study many women lost weight during the first trimester as a result of nausea and vomiting. Emphasis on teaching expectant mothers' to eat diversified diets will ensure that maternal nutrient requirements are met and that the foetus grows adequately. Pregnant women can also be informed on food safety during pregnancy as well as how to eat healthy on a limited budget, especially for those who experience FI or are of a low SES. Dietary interventions need to be tailored to meet needs of pregnant women with high and low SES so that healthy eating habits can be attained and maintained. Nutrition intervention for pregnant women should not only focus on under nutrition in pregnant women but also interventions are also needed to address over nutrition among pregnant women.

6.2.4 Recommendation for policy

To facilitate healthy pregnancies, pre-conception nutrition counselling for underweight, overweight and obese patients should be mandatory in cases where the pregnancy is planned. Interventions such as these should be offered in clinics and hospitals. There is a great need for integration between the DoH, Department of Agriculture and Department of Social Services to educate or assist people on how to access available programmes that address household food insecurity, especially for those women who live in poverty. Department of Agriculture should encourage and teach urban dwellers with land and access to water to plant vegetable gardens so that household food security can be improved.

Government may want to consider offering the food vouchers or food hampers along with micronutrient supplementation to pregnant women living in poverty so that birth outcomes may be improved. It is advisable that screening for depression should form part of routine ANC so that pregnant women with social or psychological problems are identified and supported. There is a need to Increase awareness of family planning services and encourage family planning in order to prevent unplanned pregnancies. This can be done through community education programmes. All women of child bearing age should be encouraged to attend the ANC as early as possible in their pregnancy as many women attend ANC for the first time when they are in the second or third trimester of pregnancy. This means that health interventions such as folate and iron supplementation are not administered timeously in order to prevent delivery complications and adverse birth outcomes. Through timeous ANC attendance maternal malnutrition can also be corrected early in pregnancy to improve IBW. Women can be encouraged to attend the ANC early and be informed of the benefits of early ANC in their pregnancy by creating awareness in the community through social marketing strategies.

6.2.5 Implications for further research

- A similar study can be conducted amongst different race groups, a rural as well as an urban setting and including using pregnant teenagers as part of the study sample.
- A comparative study regarding the dietary diversity, household food security, prevalence of antenatal depression, pattern of weight gain and Infant birth weight of HIV negative versus HIV positive pregnant women.
- The association between nutrient deficiencies/ chronic disease/ pre-eclampsia/ gestational diabetes and the development of antenatal depression can be explored.
- The link between chronic maternal depression and early childhood nutritional status in South Africa can also be studied.
- The relationship between household food insecurity, pre-pregnancy overweight and obesity and dietary intake during pregnancy can be explored.

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APPENDIX A: Information sheet and informed consent form

Participant Information and Informed Consent Form

Study Title:

The dietary diversity, household food security, and depression status of pregnant women in relation to pattern of weight gain during pregnancy and infant birth outcomes, Pietermaritzburg.

Dear Participant,

My name is Samukelisiwe Madlala, I am a registered nutritionist who is currently busy with her Masters of Science in Human Nutrition, University of KwaZulu-Natal.

You are hereby invited to participate in a study investigating dietary intake, food security and the presence of depression in pregnant women to determine whether these factors have an effect on the mother's pattern of weight gain during pregnancy and the birth weight of her baby.

The purpose of the study

Pregnancy is a very critical stage in a woman's life. Adequate nutrition is essential for the growth and health of the baby and mother. Malnutrition (incorrect nutrition) can exist due to lack of nutrients or an excessive intake of nutrients. This can result in poor pregnancy outcomes such as an infant born with a low birth weight or weighing too much at birth which in turn complicates delivery. In addition, this can have a negative effect on an infant during childhood and much later on in life.

The main aim of the study will be to determine the nutritional status, dietary intake and food security status of pregnant women in their third trimester of pregnancy. The study will also investigate the pattern of weight gain during pregnancy and the presence of depression in pregnant women so that the effect of these factors on an infant's birth weight can be investigated.

Study procedure:

You will be requested to participate in an interview conducted by a trained fieldworker that will last approximately 30 minutes. After the interview, you will have to complete a short questionnaire by yourself. In addition, your weight and height will be measured as part of your routine antenatal visit.

It is important to know that:

- Participation is voluntary
- There are no physical or emotional risks involved in participating in the study.
- You have the right to withdraw from the study at any time without any negative consequences or discrimination.
- During the interview, the fieldworker will need to read your maternity file in order to get important information needed for the study.
- All data collected will be treated as anonymous as subjects will be assigned a code. So instead of your name appearing on the questionnaire a code known only by the researcher and fieldworker will be on the questionnaire papers. Hence, it would not be possible to trace any data set back to individual participant.
- The researcher will require your name and contact details so that after you have delivered they can find out information on your delivery. The researcher will call you after approximately 1 to 2 months after the interview and ask for: your weight at delivery, infant birth weight, sex of the infant and how many weeks into pregnancy you were at delivery.

  *It is very important that when the researcher calls that you have your maternity file and baby's Road to Health booklet.

  * Remember that your name and contact details will only be available to the researcher and will not be revealed in any results of the study.
- No payment will be given for your participation.

Benefits to participating in the study:

- If you are found to potentially have a moderate risk for depression, with your consent you will be referred to the antenatal nurse for further assessment. If you are found to potentially suffer from severe depression or suicide ideation you will be referred to the clinical psychologist at Imbalenhle CHC.

- If you have a poor dietary diversity you will receive dietary counselling on how to eat a variety of food. With your consent you will be referred to the clinic dietician for counselling and further assessment.
- If you have food insecurity with your consent you will be referred to the clinic dietician and/or clinic social worker so that they can assist you.
- Your participation in this study may assist health professionals' in providing better care for pregnant women in order to prevent pregnancy-related complications and undesirable infant birth outcomes.

ETHICS:

This research project was approved by the Human & Social Science Research Ethics Committee (HSSREC) of UKZN to ensure that the research meets ethical standards. However, should you have any concerns, please feel free to contact the researcher, study supervisors or ethics committee as per the following contact details:

<table>
<tr><td>Researcher:
Samukelisiwe Madlala
Cell: 0795886525
Email:ssmadlala@gmail.com/
210515442@stu.ukzn.ac.za</td><td rowspan="2">Human and Social Science Research Ethics Committee (HSSREC)

Mrs Mariette Snyman
Tel: 031 260-8350
Fax: 031 260-3093
Email: snymanm@ukzn.ac.za</td></tr>
<tr><td>Study supervisors:
Dr Suna Kassier
Tel: (033) 260-5431
Email:kassiers@ukzn.ac.za
Prof Frederick Veldman
Tel: (033) 260-5453
Email: veldmanf@ukzn.ac.za</td></tr>
</table>

Thank you for your time and cooperation.

Sincerely,

Samukelisiwe Madlala

Should you be willing to participate, please consent by signing the informed consent form below

Informed Consent Form

I, ______________________________ hereby declare that I have read and understood the above information. I had the opportunity to ask questions and was satisfied by the way my questions were answered. In addition, I understand the purpose of the study as well as the benefits. I understand my participation is voluntary and I may exit from the study at any point should I wish to do so. I am aware that I can contact the researcher at any time should I require clarification regarding the study or its purpose, as well as my rights as a participant.

I hereby consent to voluntary participate in the above mentioned study.

____

Name & Surname

________________________ ________________________

Signature of Subject Date

APPENDIX B: Information sheet and informed consent form in isiZulu

Participant Information and Informed Consent Form in isiZulu

Isihloko socwaningo:

The dietary diversity, household food security, and depression status of pregnant women in relation to pattern of weight gain during pregnancy and infant birth outcomes, Pietermaritzburg.

Igama lami ngingu Samukelisiwe Madlala, ngiyi-registered nutritionist (umaluleki ngezokudla) okwamanje ngenza izifundo kwi-Masters of Science in Human Nutrition eNyuvesi yaKwaZulu-Natal.

Ngicela ukuba ubeyingxenye yocwaningo olumayelana ngokudla okudlayo, ngabe uyathola ukudla okwanele kanye nokwazi ukuthi abesifazane abakhulelwe banayo yini incindezi. Ucwaningo futhi luzobheka ukuthi loku osekubaliwe kunomuthelela muni esisindweni somzimba kamama ngesikhathi esakhulelwe nokuthi kunomuthelela muni kwisisindo sengane yakhe azoyibeletha.

Inhloso yalolucwaningo

Ukukhulelwa isikhathi esibucayi empilweni yomuntu wesifazane. Ukuqikelela ukuthi uthola zonke izakha'mzimba kubalulekile ukuze umntwana akhule kahle, futhi nawe okhulelwe ube nempilo. Ukungatholi zonke izakha'mzimba noma ukondleka ngokweqile kungaba nem'phumela emibi; njengokuthi ukukhulelwa kungabanzima noma ingane izalwe inesisindo esiphansi noma esiphezulu kakhulu. Lokhu kuzalwa kwengane inesisindo esingagculisi kungenza umonakalo enganeni isakhula noma futhi isindala.

Inhloso enkulu yalolucwaningo ukuqhathinisa isimo sokondleka, emzimbeni, kanye nesimo sokudla emakhaya sabantu besifazane abakhulelwe. Lolucwaningo luzobheka abesifazane abakhulelwe ukuthi isisindo sabo emzimbeni sikhula kanjani futhi baphatheke kahle yini engqondweni nasemoyeni. Konke lokhu okubaliwe ngenhla kuzoqhathaniswa nesisindo sezingane ezizelwe. Imiphumela yalolucwaningo ingasiza abasebenza emkhakheni wezempilo ukuthi bakwazi ukunakekela kangcono omama abakhulelwe ukuze kunqandeke ama-complications aphathelene nokukhulelwa futhi kuvimbe ukuzalwa kwe-zingane ezingenayo impilo.

Inqubo yocwaningo:

Kulolucwaningo uzocelwa ukuba uphendule amaphepha embuzo amathathu azobuzwa njenge-interview elesine iphepha lombuzo uzoliphendula ngokubhala phansi. Amaphephambuzo azothatha imizuzu engu30 ukuphendulwa. Uzokalwa isisindo kanye nobude bakho njengaloku uhlale ukalwa uma uvakasha e-clinic.Iminigwane yakho efana negama lakho nesibongo sakho kanya ne-cellphone/ telephone number ibalulekile ukuze umcwaningi akwazi ukuthola imininingwane yokuthi ubelethe kanjani.

Kubalulekile wazi okulandelayo ngaphambi kokubayingxenye yocwaningo:

- Uyazikhethela ukuba yingxenye yocwaningo.
- Abukho ubungozi emzimbeni wakho nasemizweni yakho ngokuba yingxenye yalolucwaningo.
- Unelungelo lokuhoxa ukuba yingxenye yocwaningo nganoma yisiphi isikhathi ngaphandle kokujeziswa.
- Ngesikhathi se-interview abasizi bocwaningo (i-fieldwoker) izodinga ukufunda ifayela lakho ukuze athole imininingwane ebalulekile edingakalayo kulolucwaningo.
- Izimpendulo zakho kumaphephambuzo zizogcinwa ziyimfihlo ngoba kuzobhalwa ikhodi esikhundleni segama lakho. Igama nekhodi iyokwaziwa kuphela umcwaningi nabasizi bocwaningo. Ngakho-ke ngeke kube nokwenzeka kube nomkhondo ozoveza ukuthi wena ungubani.
- Umcwaningi uzodinga igama neminingwane yokuxhumana (contact details) ukuze akwazi ukukubuza imininingwane ngokubeletha kwakho. Umcwaningi uzoxhumana nawe emva kwanyanga eyodwa noma ezimbili kulandela i-interview. Uzobuzwa ngokulandelayo: isisindo sakho ngaphambi kokubeletha, isisindo sengane, ubulili bengane kanti futhi nokuthi ubusunama viki amangaki ukhulelwe ngesikhathi usubeletha.

*Kubalulekile kakhulu ukuthi lakho umcwaningi exhumana nawe ngocingo ukuthi ifayela yakho kanye ne- Road to Health booklet (incwadi yengane) kube kuwena.

* Khumbula ukuthi igama nemininigwane yokuxhumana yakho izokwaziwa kuphela umcwaningi. Igama nemininingwane yakho angeke ivele kwim' phumela yocwaningo.

- Angeke ukhokhelwe ngokuba yingxenye yalolucwaningo.

Inzuzo ngokubamba iqhaza kulolucwaningo:

- Uma utholakala usengozini esesilinganisweni sokuba nencindezi, ngemvume yakho uzosizwa ngokuthi uyiswe kunesi akuhlole kabanzi. Uma utholakala unengozi enkulu yokuba nencindezi noma unokucabanga ukuzibulala, ngemvume yakho sizokuyisa kwi- clinical psychologist ezokuhlola.
- Uma kutholakala uthi kudla okudlayo kuncane futhi akukho nhlobo nhlobo wena uzolulekwa ngokuthi ukudla kanjani kudla okunhlobonhlobo. Ngemvume yakho uzoyiswa kuchwepheshe wezokudla (dietition) ukuze ululekwe ngesimo sakho sihlolwe kangcono.
- Uma kutholakhala ukuthi uswele ukudla ekhaya isimo sibi kakhulu, ngevume yakho uyodluliselwa kuchwepheshe wezokudla noma i-social worker ukuze uthola usizo oludingayo.
- Ukubamba kwakho iqhaza kulolucwaningo kungasiza abezempilo ukuthi banakekele kangcono abesifazane abakhulelwe ukuze kunqandwe izinkinga ezihlobene nokukhulelwa kanye nezingane ezizalwa zingenayo impilo enhle.

ETHICS:

Lolucwaningo lugunyaziwe iHuman & Social Science Research Ethics Committee (HSSREC) of UKZN ukuqinisekisa ukuthi ucwaningo luyahlangabezana nezindinganiso zokuziphatha. Uma uneminye imibuzo sicela ukhululeke uthinte umcwaningi, abaqondisa ucwaningo noma ikomidi le-ethics. Iminingwane yokuxhumana nabo ithi:

Umcwaningi: Samukelisiwe Madlala Cell: 0795886525 Email:ssmadlala@gmail.com/ 210515442@stu.ukzn.ac.za	**Human and Social Science Research Ethics Committee (HSSREC)** Mrs Mariette Snyman

Abaqondisa ucwaningo: Dr Suna Kassier Tel: (033) 260-5431 Email:kassiers@ukzn.ac.za Prof Frederick Veldman Tel: (033) 260-5453 Email: veldmanf@ukzn.ac.za	Tel: 031 260-8350 Fax: 031 260-3093 Email: snymanm@ukzn.ac.za

Siyabonga ngesikhathi sakho nangokubambisana.

Ozithobayo,

Samukelisiwe Madlala

Uma uvuma ukuba ingxenye yocwaningo sicela ugcwalise ifomu ngenzansi.

Informed Consent Form

Mina ______________________________ ngiyavuma ukuthi ngifundile futhi ngiyizwe kahle yonke imininingwane echazwe ngenhla. Nginikeziwe ithuba lokubuza imibuzo futhi nganeliseka ngendlela imibuzo yami ephendulwe ngayo. Ngaphezu kwalokho, ngiyaqonda inhloso yocwaningo nokuthi ngizozuzani ngokuba yingxenye yocwaningo. Ngiyaqonda ukuthi ngizobamba iqhaza ngokuzithandela futhi ngikhululekile ukuthi ngihoxe nganoma isiphi isikhathi uma ngifisa ukwenza kanjalo. Ngiyaqaphela ukuthi ngingakwazi ukuthintana nomcwaningi nganoma yisiphi isikhathi uma ngifuna ukucaciselwa mayelana nalesifundo noma inhloso yaso, kanye namalungelo ami njengomuntu oyingxenye yocwaningo.

____

Igama nesibongo

______________________________ ______________________________

Signature

APPENDIX C: Interview Schedule in English

Interview Schedule

Topic	**Discussion**
Introduction	Interviewers name.
Topic of interview	I would like to ask you a few questions on your background, education, the food you eat, your food situation at home and how you are feeling since you are pregnant.
Aim of interview *and responses*	I just want to get information about you so that we can help other pregnant women have a safe and normal pregnancy. There are no right or wrong answers to any of the questions.
Explaining note taking	I (fieldworker) will be writing down all the answers to your questions so that we have a record of what you have said.
Confidentiality	This interview is strictly confidential. These means that your name will not appear in the research report nor in any other publication containing research results
Check understanding	Do you understand?
Clarification needed	Do you have any questions?
Questionnaire one (Socio-demographic)	I would like to begin by asking you about your pregnancy, background, if you work, where you live and who you live with and so forth.
Anthropometric assessment	1. May I please see your maternity file so that I can record previous weight and height measurements…?
Questionnaire Two (Dietary diversity)	1. I would like you to please tell everything you ate and drank yesterday starting from the first thing you ate or drank in the morning up until the last thing you ate or drank at night. 2. Please can you be as detailed as possible when mentioning what foods you ate.

	Allow participant to recall without interrupting them when they say they are done ask the following: 3. Did you have any snacks during the day? 4. Did you eat any special food since you are pregnant? 5. Please can you give me the ingredients of … (mixed meal/food you do not know or have not heard of)?
Questionnaire Three (Household food insecurity access scale)	I would now like to ask you about whether you and your family have enough food to eat.
Questionnaire four (Edinburgh postnatal depression scale)	1. I would like you to please fill out the following questionnaire by yourself. 2. It is just some questions asking about how you feel emotionally since you are pregnant. 3. If you don't understand something please feel free to ask...
Clarification needed	Do you have any questions?
Closing	We have reached the end of this interview. Thank you very much for taking the time to answer my questions. We may call you to ask you details about your baby once you have given birth. *(Double check their phone number)*. Please take this …this is just to say thank you for participating in the study.

APPENDIX D: Interview schedule in isiZulu

Interview Schedule in isiZulu

Topic	**Discussion**
Isingeniso	Bingelela uzisho ukuthi uwubani.
Izinto okuzokhulunywa ngazo	Ngiyacela ukukubuza imibuzo embalwa ngemvelaphi yakho, imfundo yakho, ukudla okudlayo, simo sokudla ekhaya nokuthi uphatheke kanjani emoyeni njengoba ukhulelwe
Inhloso ye-interview	Ukuphendula kwakho lemibuzo kungasisiza sithole ulwazi olungasiza abanye abantu besifazane abakhulelwe. Imibuzo engizokubuza yona azinayo impendulo e-right noma e-wrong.
Ukuchaza ukuthi ubhalani phansi	Izimpendulo zemibuzo engizokubuza yona kufanele ngiyibhale phansi kuze si-recorder ukuthi ubuthini.
Ukuchaza ukuthi yonke into izogcinwa iyimfihlo	Konke esizokukhuluma kuzogcinwa kuyimfihlo. Lokhu kusho kuthi igama lakho angeke livela kwi-report locwaningo noma enye i-report ezobhala ngemiphumela yalolucwaningo.
Hlola ukuqonda	Ingaba kuyezwakala engikushoyo?
Ukucacisa uma kudingeka	Unawo umbuzo?
Uhlu lwemibuzo lokuqala *(Socio-demographic)*	Ngizoqala ngokubuza imibuzo emayelana nokukhulelwa kwakho, imvelaphi yakho, usebenzaphi, uhlalaphi, uhlala nobani, kanjalo kanjalo.
Anthropometric assessment	1. Ngisacela ukubona i-file yakho ukuze ngizobhala Isisindo mhla uvakasha emtholampilo ngokudlule.
Uhlu lwemibuzo *lwesibili (Dietary diversity)*	1. Ngicela ungitshele ngakho konke ukudla okodlile nokuphuzile izolo. Qala ngokudla okudlile noma okuphuzile uvuka ekuseni ugcine ngokudla okudlile noma okuphuzile usulala ebusuku. . 2. Ngicela uchaze kabanzi ngokudla okudlile.

	Vumela umama okhulelwe akhulume aze aqede ungamphazamisi. Uma eseqedile mbuze le mibuzo elandelayo: 3. Akhona ama-snacks okewawadla osukwini? 4. Kukhona ukudla okungajwayelekile okudlile njengoba ukhulelwe. 5. Ngicela ungiphe izithako ze … (Ukudla okuxubile/ukudla ongakwazi)?
Uhlu lwemibuzo lwesithathu *(Household food insecurity access scale)*	Ngingathanda ukwazi ukuthi wena nomndeni wakho ninakho yini kudla okwanele.
Uhlu lwemibuzo *lwesine (Edinburgh postnatal depression scale)*	1. Ngicela uziphendulele imibuzo ebhaliwe kuleliphepha. 2. Lemibuzo imayelana nokuthi uzizwa unjani njengoba ukhulelwe. 3. Uma kukhona ongakuqondi, khululeka ungibuze.
Ukucacisa uma kudingeka	Ikhona imibuzo?
Ukuvala	Sesifike emaphethelweni. Siyabonga kakhulu ngokusinika isikhathi sakho nokuphendula imibuzo obubuzwa yona. Kungenzeka sikuthinte uma usubelethile sikubuze imininigwane ngengane yakho. *(Double check their phone number)*. Ngicela uthathe la… lokhu indlela yethu yokubonga ukuthi ube yingxenye yalolucwaningo.

APPENDIX E: Socio-demographic questionnaire

SURVEY QUESTIONNAIRE

Subject code: ☐

Socio-demographic questionnaire

Subject date of birth: ______________________________

Subject age: ______________________________

1. Details of the current pregnancy (Interview Schedule)

1. Number of antenatal clinics visits thus far:

   First☐ Second☐ Third ☐ Fourth and above☐
2. Expected due date (EDD): ________________________
3. Expected delivery place: ___________________________
4. Pregnancy was: Planned ☐ Unplanned ☐
5. First pregnancy ☐ or Not first time pregnancy ☐
6. If this is not your first pregnancy, have you previously had a baby who was not born early (i.e before 38 weeks) but weighed less than 2.5kg at birth? Yes ☐ No ☐
7. If this is not your first pregnancy, have you previously had a baby who was born early (i.e. before 38 weeks) and weighed less than 2.5kg at birth? Yes ☐ No ☐
8. If yes, how many times have you given birth to a baby weighing less than 2.5kg at birth? ______________________________

2. Details regarding relationship status and living arrangements

9. What is your current relationship status?

Single ☐ Have a partner ☐

Married ☐ Separated ☐

Divorced ☐ Widow ☐

10. Do you live?

1. Alone ☐
2. With friends ☐
3. With your husband/partner ☐
4. With your husband/partner and children ☐
5. With your parents ☐
6. Living with husband/partner and parents ☐
7. Other. Please specify ____

3. Level of Education and Occupation

11. Do you have any education?

Yes ☐ No ☐

12. If yes, please indicate your level of education

Schooling ☐ Indicate highest grade attained: _____

Tertiary education ☐

13. If you have received tertiary education, please specify:

College ☐ Technikon ☐ University ☐ Other: Please specify: ______________________

14. Are you currently employed: Yes ☐ No ☐

15. If yes, please specify whether: Full time ☐ Part time ☐ On maternity leave ☐

16. If no, please specify : Left job because pregnancy ☐ Have been unemployed ☐

4. Income

16. Is there any formal (permanent or regular) income coming into your home which is not related to a government grant: Yes ☐ No ☐

17. If answered yes to the above question, who is the main breadwinner?

Myself ☐

Husband ☐

Partner ☐

Mother ☐

Father ☐

Grandparent/s ☐

In Laws ☐

Sibling ☐

Other ☐

17. Do you receive any direct or indirect support from a grant? Yes ☐ No ☐

If yes, specify the type, number of grants received as well as the member of the household who received the grant.

Social Relief ☐ ______________________________

Disability ☐ ______________________________

Pension ☐ ______________________________

Child support ☐ _________________________

Foster Care ☐ ______________________________

Care Dependency ☐ ________________________

5. Access to water, electricity and cultivation of home garden

18. Do you have access to running water?

Yes □ No □

19. If yes, please indicate the source:

In the house □ Outside the house □

20. Do you have access to electricity:

Yes □ No□

21. What is your main source of fuel:

Wood □ Paraffin □ Coal □ Electricity □ Gas □ Other □

22. Do you have a vegetable home garden?

Yes □ No □

6. Health conditions

21. Do or did you suffer from the any of the following conditions before pregnancy?

Diabetes mellitus □

High blood pressure □

Anaemia □

None of the above □

22. Did you develop any of these conditions during this pregnant?

Diabetes mellitus □

High blood pressure □

Anaemia □

None of the above □

7. Anthropometric assessment

23. Pre-pregnancy weight (in kilograms): ________________
24. Height (in meters): ________________________________
25. Pre-pregnancy BMI: _____________________ MUAC: ________________
26. Examination Date (1st visit): ____________________________
27. LNMP Date: ____
28. Weight from previous ANC visits:

Date	Weight	Weeks of gestation

29. Current number of weeks into pregnancy: _______________
30. Current weight: _________________________
31. Weight at delivery: _______________________

8. Infant anthropometric status

32. Birth Weight: __________
33. Birth Length: __________
34. Infant gender: Male □ Female □
35. Gestational age: __________

APPENDIX F: Socio-demographic questionnaire in isiZulu

Socio-demographic questionnaire in isiZulu

Subject code:

Usuku lokuzalwa: ____

Iminyaka: ____

1. Imininigwane ngokukhulelwa kwakho manje

1. Njengoba ukhulelewe, usuvakashe kangaki emtholampilo:

   Kanye ☐ Kabili ☐ Kathathu ☐ Okwesine nangaphezulu ☐

2. Usuku olindele ukubeletha ngalo: ________________________________

3. Indawo ohlele ukubeletha kuyo: ___________________________

4. Ukukhulelwa kwakho: Kuhleliwe ☐ or Akuhleliwe ☐

5. Uyaqala ukukhulelwa ☐ or Awuqali ukukhulelwa ☐

6. Uma kungesikho okokuqala ukhulelwa, ngabe usake wabeletha ingane ngesikhathi, kepha yazalwa inesisindo esingaphansi kuka-2.5kg? Yebo☐ Cha ☐

7. Uma kungesikho okokuqala ukhulelwa, ngabe ukewabeletha ngaphambi kwesikhathi (before 38 weeks) isisindo sengane sasingaphansi kuka-2.5kg?

   Yebo ☐ Cha ☐

8. Uma yebo, kukangaki ubeletha ingane enesisindo esingaphansi kuka-2.5kg?

   ____

If the subject answer for questions 6, 7, & 8 is ‘I don’t know ask for their maternity file and read the obstetric history.

2. Imininigwane ngokuganwa nokuhlala

9. What is your current relationship status?

Angishadile □ Khona ohlalisene naye □

Ushadile □ Ngishadile, kodwa sehlukene □

Wehlukanisile □ Umfelokazi □

10. Ingabe uhlala?

- Wedwa □
- Nabangani □
- Nom'myeni wakho / umlingani □
- Nom'myeni wakho / umaqondana kanye nezingane □
- Nabazali bakho □
- Nom'myeni/umaqonda kanye nabazali bami □
- Nabanye □

11. Ingabe unayo imfundo?

3. Imfundo nomsebenzi

Yebo ngifundile esikoleni □ Angikaze ngifunde □

12. Uma uphendule wathi yebo, yiliphi ibanga owagcina kulona

Esikoleni □ Wagcina kuliphi ibanga: ______

Imfundo ephakeme □

13. Uma wafunda endaweni yemfundo ephakeme, ngicela uchaze uthi wafunda kuphi:

College □ Technikon □ University □ other: Ngicela ucacise: ____________________

14. Ngabe uyasebenza manje: Yebo □ Cha □

15. Uma uthe yebo, ngicela ucacise ukuthi usebenza :

Full time ☐ noma Part time (Itoho) ☐ Ngikwi-maternity leave ☐

16. Uma uthe cha, ngicela ucacise :
Ngiwushiyile umsebenzi ngoba ngikhulelwe ☐ Bengivele ngingasebenzi ☐

4. Imali

17. Ingabe ikhona imali esemthethweni engena ekhaya engaveli kuhulumeni:

Yebo ☐ Cha ☐

18. Uma uphendule ngoyebo umbuzo ngenhla, ubani oletha imali endlini?

Imina ☐

Umlingani (partner) ☐

Umama ☐

uBaba ☐

Ugogo/Umkhulu ☐

Abasemzini ☐

Udadewethu/Umfowethu ☐

Omunye ☐

19. Ingabe uyazuza yini ngokuqondile noma ngokungaqondile imali evela kuhulumeni: Yebo ☐ Cha☐

20. Uma yebo, cacise uhlobo, inani lemali kanye nabazuzi bemali evela kukhulumeni

Social Relief ☐ ______________________________

Disability ☐ ______________________________

Pension ☐ ______________________________

Child support ☐ __________________________

Foster Care ☐ ______________________________

Care Dependency ☐ ________________________

5. Ukufinyelela emanzini, ugesi kanye nokutshalwa engadini yasekhaya

20. Uyawathola amanzi agobhozayo?

Yebo ☐ Cha ☐

21. Uma uthe yebo, cacise uthi amanzi uwakhaphi :

Akhona amanzi phakathi endlini ☐ Amanzi siwathola emnyango ☐

22. Unawo ugesi?

Yebo ☐ Cha ☐

23. Yikuphi kulokhu opheka ngakho:

Izinkuni ☐ Upharafini ☐ Amalahle ☐ Ugesi ☐ i-Gas ☐ Okunye ☐

24. Ngabe ikhona ingadi yemifino?

Yebo ☐ Cha ☐

6. Izifo

23. Unazo noma ukewaba nalezizifo ungakakhulelwa?

Isifo sashukela ☐

High blood pressure (BP) ☐

Ukushoda kwe-Iron egazini ☐

Akukho kulokhu okungenhla ☐

24. Ingabe uhlushwa yiziphi izifo ezilandelayo njengoba ukhulelwe manje?

Isifo sashukela ☐

High blood pressure (BP) ☐

Ukushoda kwe-Iron egazini ☐

7. Isisindo samama okhulelwe

25. Isisindo ngaphambi kokukhulelwa (kilograms): ______________________

26. Ubude (meteres):____

27. Pre-pregnancy BMI: ____

Isisindo mhla uvakasha emtholampilo ngokudlule:

Usuku	Amaviki ukhulelwe	Isisindo

26. Isisindo sakho manje:_________________

27. Amaviki ukhulelwe: ___________________

28. Isisindo sakho usuyobeletha: __________

8. Isisindo sengane neminye imininigwane

29. Isindo ekuzalweni: _____________

30. Ubude ekuzalweni: _______________

31. Ubulili: Owesilisa ☐ Owesifazane ☐

32. Amaviki: __________

APPENDIX G: DIETARY DIVERSITY SCORE

Participant code: ____

Interviewer: ____

Date: _____/_____/ 2016

Mark X what day it was yesterday:

Sunday	Monday	Tuesday	Wednesday	Thursday

Was yesterday a normal day or were you celebrating something and may have ate special foods or ate more than usual?

____

I would like to know about all the food you ate and drank yesterday and the place you ate it. Please tell me everything you ate and drank from the time you woke up in the morning until you went to bed at night. Please start with the food or drink you can in the morning.

Note for Interviewer:

*Ask about snacks eaten between main meals.

*Ask if they ate any special foods during the day since they are pregnant.

*Ask if they add sugar in tea, fried foods.

* If a mixed food was eaten ask for ingredients of the dish and write down.

Time	Food/Drinks	Description	Location

Food Group	**Examples**	**YES = 1 NO = 0**
Cereals/roots/ tubers	White or brown and/or buns/rolls/bread, breakfast cereal: All bran, High Bulk Bran, Muesli, Weetbix, Pronutro, Oats, Rice Crispies, Cornflakes, Coco pops, Fruit loops & Morevite. Rice, mealie rice, maize meal, samp, phutu, pap, ujeqe (steamed bread), pasta, potatoes, sweet potatoes and amadumbe. Amahewu, fat cakes and scones.	
Meat/poultry/fish	Red meat e.g. beef, mutton, pork. Chicken/turkey. Goat. Fresh/fried fish, tinned sardines, pilchards, salmon, tuna. Sausages: Vienna, Russians, frankfurter, wors. Cold meat: polony, salami, ham & bacon. Organ meat e.g. liver, kidney, tripe, heart, chicken head and feet. Dried meat (biltong).	
Dairy	Milk, yoghurt, sour milk (maas), powdered milk (e.g. Nespray, Klim), cheese, custard, yogisip	
Eggs	Eggs from chicken.	
Vitamin A rich fruit and vegetables	Pumpkin, carrot, red sweet pepper, dark leafy vegetables (amaranth, spinach, pumpkin leaves), mango, apricot, papaya, dried peach. 100% fruit juice made from vitamin A rich fruit.	
Legumes and nuts	Legumes e.g. baked beans, lentils, dahl, haricot beans, split peas, broad beans, kidney, sugar beans, dried bean salad/soup , soya mince, nuts, seeds and foods made from these e.g. peanut butter.	
Other fruit	Other fruits e.g. apple, plum, grapes, pear, orange, banana watermelon, pineapple, guava, avocado including wild fruits and 100% fruit juice made from these.	
Other vegetables	Other vegetables e.g. tomato, onions, brinjal, baby marrow, cucumber, mushrooms, peppers, onions, beetroot, cabbage, green beans, peas, cauliflower, lettuce, sweetcorn	
Fats and oils	Soft margarine, Butter/hard margarine, ghee, Cooking oil e.g. sunflower oil. Dripping, holsum, salad dressing, mayonnaise	
	Total Score	

APPENDIX H: Household food insecurity access scale in English

Household Food Insecurity Access Scale

HFIAS score classification

Food secure	Mildly food insecure	Moderately food insecure	Severely food insecure
0 - 6.75	6.75 - 13.5	13.5 - 20.5	20.5 - 27

NO	QUESTION	RESPONSE OPTIONS	CODE
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	
1 a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
2	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	
2a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	
3a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0 = No (skip to Q5) 1 = Yes	
4 a.	How often did this happen?	1 = Rarely (once or twice in the past four	

		weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	
5a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	
6 a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	
7a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	
8a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	

9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes	
9a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	

Total Score:

APPENDIX I: Household food insecurity access scale in isiZulu

Household Food Insecurity Access Scale in isiZulu

NO.	UMBUZO	IZINDLELA ZOKUPENDULA	CODE
1	Esikhathini esingamasonto amane adlule, ukewakhatha-zeka ngokuthi ekhaya ngeke ukudla okwanele?	0 = Cha (Dlula uyeku-Q2) 1 = Yebo	
1 a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
2	Esikhathini esingamasonto amane adlule, kuke kwenzeka yini ukuthi wena noma elinye ilunga lomndeni nangakwazi ukudla izinhlobo zokudla enizithandayo ngenxa yokuntula kwemali	0 = Cha (Dlula uyeku-Q3) 1 = Yebo	
2a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
3.	Esikhathini esingamasonto amane adlule, kuke kwenzeka yini ukuthi wena noma elinye ilunga lomndeni ningakwazi ukudla, ukudla okunhlobonhlobo ngenxa yokuntula kwemali?	0 = Cha (Dlula uyeku-Q4) 1 = Yebo	
3a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	

4	Esikhathini esingamasonto amane adlule kuke kwenzeka yini ukuthi wena noma elinye Ilungu lomndeni niphoqeleke ukuba nidle ukudla eningakuthandi noma eningakufuni ngempela ngenxa yokuswela imali yokuthenga ezinye izinhlobo zokudla.	0 = No (Dlula uyeku-Q5) 1 = Yebo	
4 a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
5.	Esikhathini esingamasonto amane adlule kuke kwenzeka yini ukuthi wena noma elinye Ilungu lomndeni kufanele nidle ukudla okuncane kunaloku enikudingayo ngenxa yokuthi ukudla akwenele?	0 = Cha (Dlula uyeku- Q6) 1 = Yebo	
5a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
6.	Esikhathini esingamasonto amane adlule kuke kwenzeka yini ukuthi wena noma elinye Ilungu lomndeni nidle kancane ngosuku ngoba kwakungekho ukudla okwanele?	0 = Cha (Dlula uyeku- Q7) 1 = Yebo	
6 a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
7.	Esikhathini esingamasonto amane adlule kuke kwenzeka kwangaba bibikho khona ukudla lwanoma uluphi uhlobo ukuthi niludle ngenxa yokuswela imali noma eminye imizamo yokuthola ukudla.	0 = Cha (Dlula uyeku- Q8) 1 = Yebo	

7a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
8.	Esikhathini esingamasonto amane adlule kuke kwenzeka yini ukuthi wena noma elinye Ilungu lomndeni nalala nilambile ngoba kwakungekho ukudla okwanele?	0 = Cha (Dlula uyeku- Q9) 1 = Yebo	
8a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	
9.	Esikhathini esingamasonto amane adlule kuke kwenzeka yini ukuthi wena noma elinye Ilungu lomndeni nihlale usuku lonke nobusuku ngaphandle kokudla ngoba kwakungekho ukudla okwanele?	0 = Cha (Imibuzo Isiphelile) 1 = Yebo	
9a.	Kukangaki lokhu kwenzeke?	1 = Akuvamile (kanye noma kabili kulamasonto amane adlule) 2 = Izikhathi (izikhathi ezintathu kuya kweziyishumi kulamasonto amane adlule 3 = Ngokuvamile (izikhathi ezingaphezu kweshumi kulamasonto amane adlule).	

I-Total:

APPENDIX J: Edinburgh postnatal depression scale in English

Edinburgh Postnatal Depression Scale

As you are pregnant, we would like to know how you are feeling. Please check the answer that comes closest to how you have felt IN THE PAST 7 DAYS, not just how you feel today.

In the past 7 days ……..

1. I have been able to laugh & see the funny side of things
☐ As much as I always could
☐ Not quite as much now
☐ Definitely not as much now
☐ Not at all

2. I have 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 have blamed myself unnecessarily when things went wrong
☐ Yes, most of the time
☐ Yes, some of the time
☐ Not very often
☐ No, never

4. I have been anxious and worried for not good reason
☐ No, not at all
☐ Hardly ever
☐ Yes, sometimes
☐ Yes, very often

5. I have felt scared or panicky for no good reason
☐ Yes, quite a lot
☐ Yes, sometimes
☐ No, not much
☐ No, not at all

6. * Things have been getting on top of me
☐ Yes, most of the time I haven’t been able to cope
☐ Yes, sometimes I haven’t been coping as well as usual
☐ No, most of the time I coped quite well
☐ No, I have been coping as well as ever

7. * I have been unhappy that I have had difficulty sleeping
☐ Yes, most of the time
☐ Yes, sometimes
☐ Not very often
☐ No, not at all

8. * I have felt sad or miserable
☐ Yes, most of the time
☐ Yes, quite often
☐ Not very often
☐ No, not at all

9. * I have been so unhappy that I have been crying
☐ Yes, most of the time
☐ Yes, quite often
☐ Only occasionally
☐ No, never

10. * The thought of harming myself has occurred to me
☐ Yes, quite often
☐ Sometimes
☐ Hardly ever
☐ Never

Total score:

APPENDIX K: Edinburgh postnatal depression scale in isiZulu

Edinburgh Postnatal Depression Scale

Njengoba ukhulelwe sifuna ukwazi ukuthi impilo yakho ebinjani kulezizinsuku eziyisikhombisa ezidlule. Sicela ufunde imibuzo engezansi. Umbuzo ngamunye unezimpendulo ezine ongakhetha kuzo. Phawula X kwimpendulo evumelana nawe ukuthi ubuzizwa kanjani ezinsukwini eziyisikhombisa ezedlule, hayi namhlanje kuphela.

Ezinsukwini eziyisikhombisa ezedlule ……..

1. **Ngiye ngakwazi ukuhleka futhi ngakwazi ukubona izinto ezihlekisayo empilweni**
   - ☐ Njengokujwayelekile
   - ☐ Ayikangakho kunokujwayelekile
   - ☐ Kancane kunalokhu okujwayelekile
   - ☐ Lutho

2. **Ngisanako ukulangazelele noku ukujabulele izinto.**
   - ☐ Njengokujwayelekile
   - ☐ Kancane kunokujwayelekile
   - ☐ Kancane kakhulu kunokujwayekile
   - ☐ Cha, impela akusavamile

3. **Ngiba nokuzisola ngokungadingekile lapho izinto zingahambi kahle**
   - ☐ Yebo, sonke isikhathi
   - ☐ Yebo, kwezinye izikhathi
   - ☐ Akuvamile
   - ☐ Cha, akwenzeki

4. **Benginokhu khathazeke kungenasizathu**
   - ☐ Cha, akwenzeki
   - ☐ Akuvamile
   - ☐ Yebo, kwezinye izikhathi
   - ☐ Yebo, bekuvame kakhulu

5. **Bengizizwa ngesaba kakhulu noma nginokutatazele singekho isizathu**
   - ☐ Yebo kuvamile kakhulu
   - ☐ Yebo kwezinye izikhathi
   - ☐ Cha, hhayi kakhulu
   - ☐ Cha, hhayi akwenzeki

6. *** Izinto eziningi bengihluleka ukubhekana nazo, ngizwa izinto zingaphezu kwami**
   - ☐ Yebo, kaningi angikwazanga ukubhekana nezinto.
   - ☐ Yebo, kwezinye isikhathi bengingakwazi ukubhekana nezinto.
   - ☐ Cha, isikhathi esiningi bengikwazi ukubhekana nezinto.
   - ☐ Cha, bengikwazi ukubhekana nezinto

7. *** Bengizizwa ngingajabule futhi kuye kwanzima nokulala ebusuku.**
   - ☐ Yebo, isikhathi esiningi
   - ☐ Yebo, ngezinye izikhathi
   - ☐ Bekungavamile
   - ☐ Cha, akwenzekanga

8. *** Bengizizwa ngidabukile noma nginosizi**
   - ☐ Yebo, isikhathi esiningi
   - ☐ Yebo, ngokuvamile
   - ☐ Akuvamile kakhulu
   - ☐ No, not at all

9. *** Bengilokhu ngingenayo injabulo futhi ngikhala**
   - ☐ Yebo, isikhathi esiningi
   - ☐ Yebo, ngokuvamile
   - ☐ Kuphela ngezikhathi ezithile
   - ☐ Cha, angikaze

10. *** Ngike ngafikilwa umcabango wokufuna ukuzilimaza**
    - ☐ Yebo, ngokuvamile
    - ☐ Ngezinye izikhathi
    - ☐ Cha, akuvamile
    - ☐ Awukaze

I-Total:

APPENDIX L: Ethics Approval from UKZN

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

11 March 2016

Ms Samukelisiwe Sthokozisiwe Madlala 210515442
School of Agricultural, Earth and Environmental Sciences
Pietermaritzburg Campus

Dear Ms Madlala

Protocol Reference Number: HSS/1604/015
Project Title: The dietary diversity, household food security status and depression status of pregnant women in relation to their pattern of weight gain during pregnancy and infant birth outcomes, Pietermaritzburg

Full Approval – Full Committee Reviewed Protocol

In response to your application received 7 September 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

....

Dr Shenuka Singh (Chair)
Humanitities & Social Scinces Research Ethics Committee

/pm

Cc Supervisor: Dr SM Kassier & Prof FJ Veldman
Cc Academic Leader Research: Professor Onisimo Mutanga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

APPENDIX M: Support letter from uMgungundlovu DoH District Office

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

Physical Address171 Hoosen Haffejee Street
Postal Address: Private Bag X9124, Pietermaritzburg, 3200
Tel: 033 897 1023 Fax: Fax: 033 897 1076 Email: ndumiso.zondi@kznhealth.gov.za
www.kznhealth.gov.za

HUMAN RESOURCE DEVELOPMENT

SUBMISSION

Date: 20/04/2016	File No:
To: Mrs N.M. Zuma-Mkhonza District Manager: uMgungundlovu Health District KZN Department of Health	From: Ms N.A. Zwane Assistant Manager: HRD uMgungundlovu Health District KZN Department of Health

SUBJECT: REQUEST FOR APPROVAL TO CONDUCT ACADEMIC STUDY AT IMBALENHLE CHC

1. PURPOSE

To request that the District Manager, by virtue of powers bestowed up on her, approve the request for conducting an academic study at Imbalenhle CHC.

2. BACKGROUND

21. A request was received from Ms Samukelisiwe Madlala Sthokozisiwe Madlala currently enrolled for her Master's Degree in Human Nutrition at the University of KwaZulu Natal, to conduct a study as part of her academic portfolio.

2.2 This study aims to determine and compare the dietary diversity, household food security status and presence of depression in pregnant women in relation to pregnancy weight gain and infant birth weight outcomes in a South African setting.

2.3 The student has identified Imbalenhle CHC as a conducive and appropriate facility to conduct this particular study, hence approval is hereby sought to conduct the study at Imbalenhle CHC.

2.4 Further attached herewith please find the supporting documentation from the Student and the University of KwaZulu Natal.

REQUEST FOR APPROVAL TO CONDUCT ACADEMIC STUDY AT IMBALENHLE CHC

MR N.V ZONDI
HRD PRACTITIONER
UMGUNGUNDLOVU HEALTH DISTRICT

20/04/2016
DATE

Supported / ~~Not Supported~~

MR T.G. NTSHINGILA
HUMAN RESOURCE MANAGER
UMGUNGUNDLOVU HEALTH DISTRICT

20/04/2016
DATE

Approved / ~~Not Approved~~

MRS N.M. ZUMA-MKHONZA
DISTRICT MANAGER
UMGUNGUNDLOVU HEALTH DISTRICT

25/04/2016
DATE

APPENDIX N: Ethics Approval from KZN DoH Ethics Committee

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

330 Langalibalele street,
Private Bag X9051 PMB, 3200
Tel: 033 395 2805/3189/3123 Fax: 033 394 3782
Email: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Health Research & Knowledge Management (HKRM)

Reference: **HRKM139/16**
KZ_2016RP41_462

19 May 2016

Dear Ms S S Madlala
(University of KwaZulu-Natal)

Subject: Approval of a Research Proposal

1. The research proposal titled **'The dietary diversity, household food security status and depression status of pregnant women in relation to their pattern of weight gain during pregnancy and infant birth outcomes, Pietermaritzburg'** was reviewed by the KwaZulu-Natal Department of Health (KZN-DoH).

   The proposal is hereby **approved** for research to be undertaken at Imbalenhle Clinic.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Ms G Khumalo on 033-395 3189.

Yours Sincerely

ELutge

Dr E Lutge
Chairperson, Health Research Committee
Date: 24/05/16.

Fighting Disease, Fighting Poverty, Giving Hope