AN INTERVENTION STUDY FOR LOW AND HIGH RISK PREGNANT WOMEN
WITH GESTATIONAL DIABETES MELLITUS IN BUFFALO CITY
METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

NONCEBA MERCY VELLEM

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AN INTERVENTION STUDY FOR LOW RISK PREGNANT WOMEN AND HIGH RISK PREGNANT WOMEN WITH GDM IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

BY

NONCEBA MERCY VELLEM

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THE UNIVERSITY OF FORT HARE
FACULTY OF HEALTH SCIENCES

SUPERVISOR: PROF E SEEKOE

December 2017
DECLARATION

I, the undersigned, declare that this thesis entitled “An intervention study of low risk pregnant women and high risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa” submitted to the University of Fort Hare for the degree of PhD in the Faculty of Health Sciences, and the work contained herein is my original work with exemption to the citations and that this work has not been submitted to any other University in partial or entirely for the award of any degree.

Name: Nonceba Mercy Vellem

Signature: ..........................

Date: ............................
DECLARATION ON PLAGIARISM

I, Nonceba Mercy Vellem student number 9044168 hereby declare that I am fully aware of the University of Fort Hare's policy on plagiarism and I have taken every precaution to comply with the regulations.

Signature..................................: Date..............................
CERTIFICATION

This thesis entitled “An intervention study of low risk pregnant women and high risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa” meets the regulation governing the award of the degree of PhD of the University of Fort Hare and is approved for its contribution to scientific knowledge and literary presentation.

Prof E Seekoe 12-2017
Supervisor

Date
DEDICATION

This thesis is dedicated to the Grace of the Lord Jesus Christ that gave me strength and courage to finish this shaky and lonely journey. I am also grateful to my supervisor for the guidance, midwives, family, friends and my colleagues for support.
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# LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>ACOG</td>
<td>American College of Obstetrician and Gynaecologist</td>
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<tr>
<td>ADA</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>AIHW</td>
<td>Australian Institute of Health and Welfare</td>
</tr>
<tr>
<td>ANC</td>
<td>Antenatal care</td>
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<tr>
<td>BCMM</td>
<td>Buffalo City Metropolitan Municipality</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<tr>
<td>BP</td>
<td>Blood pressure</td>
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<tr>
<td>CDC</td>
<td>Centre for Disease Prevention and Control</td>
</tr>
<tr>
<td>CDE</td>
<td>Centre for Diabetes and Endocrinology</td>
</tr>
<tr>
<td>CHC</td>
<td>Community Health Care</td>
</tr>
<tr>
<td>CMH</td>
<td>Cecilia Makiwane Hospital</td>
</tr>
<tr>
<td>CS</td>
<td>Caesarean section</td>
</tr>
<tr>
<td>DH</td>
<td>Department of Health</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes Mellitus</td>
</tr>
<tr>
<td>DVDH</td>
<td>Duncan Village Day Hospital</td>
</tr>
<tr>
<td>ECSECC</td>
<td>Eastern Cape Socio – Economic Consultation Council</td>
</tr>
<tr>
<td>EDD</td>
<td>Estimated date of delivery</td>
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<tr>
<td>FAS</td>
<td>Foetal alcoholic syndrome</td>
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<tr>
<td>FBDG</td>
<td>Food Based Diet Guidelines</td>
</tr>
<tr>
<td>FCG</td>
<td>Fasting capillary glucose</td>
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<tr>
<td>FPG</td>
<td>Fasting plasma glucose</td>
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<tr>
<td>GDM</td>
<td>Gestational diabetes mellitus</td>
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<tr>
<td>HbA1c</td>
<td>Haemoglobin A1c</td>
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<tr>
<td>HPM</td>
<td>Health promotion model</td>
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<tr>
<td>HPT</td>
<td>Hypertension</td>
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<td>HRPW</td>
<td>High risk pregnant women</td>
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ABSTRACT

Low risk and high risk pregnant women (HRPW) with gestational diabetes mellitus (GDM) who practise sedentary life style are at risk of overweight and obesity that predispose to gestational diabetes mellitus (GDM). The purpose of the study is to describe the effectiveness of an intervention strategy of modified diet and planned physical activity implemented amongst low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality in the Eastern Cape, South Africa. Quantitative experimental intervention design and stratified random sampling was used for drawing a sample of low-risk and high risk pregnant women with GDM. A sample size 291 of LRPW and n=34 HRPW were eligible for the study. The sample frame of the study was taken from the registers of the CHCs, Frere Hospital and Cecilia Makiwane Hospital (CMH). Questionnaires were used to collect data from the low and high risk pregnant with GDM. Descriptive statistics (frequency, percentages, mean and standard deviation) were used for categorical variables. A p-value of < 0.05 was considered statistically significant. The total analysed of LRPW were n=135 and HRPW n=34 all in control group due to miscarriages, phone loss and relocation. LRPW had some risk factors of overweight (6.2%), obesity (15.5%), family history of diabetes (16.5%). HRPW also had overweight and obesity of (14.7%) and family history of (26.4%) as the Pvalue was statistically significant of weight was 001, MUAC Pvalue of 000 and Pvalue of BMI 000. There were alarming abnormalities of urinalysis of protein, glucose, leucocytes and blood in urine. The LRPW and HRPW had consumption of high content of carbohydrates, vegetables, fats and low in fruit, vegetables and fibre diet. Both LRPW and HRPW were also interested on the education about modified diet benefits (95.1%) and modified diet programs networks (87.5%). The barriers showed that LRPW and HRPW were low motivation (90%) minimal knowledge and benefits of modified diet (93%) and socio-cultural issues (86%). The majority of participants both LRPW and HRPW showed the interest in the planned physical activity benefits especially frequent education (96.9%) and encouragement of social support networks (90.2%) and convenient location (89.4%). But the HRPW had lower engagement than the LRPW in planned physical activity and is associated with risk of GDM. Although pregnant women were faced with fatigue and low energy (98.6%), as pregnancy progresses, minimum information regarding benefits of planned physical activity (87.6%) and the socio-cultural influence (77.8%). The recommendations are
education on frequent use of modified diet and planned physical activity that is available, less economical and within their context. Frequent screening of all pregnant women during pregnancy of BMI, MUAC and weight and educate accordingly. The availability of dietician and physical activity speciality is needed.

**Key words:**
Gestational diabetes
High risk pregnant woman
Low risk pregnant woman
Modified diet
Planned physical activity
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CHAPTER I
INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

Pregnancy is a state anticipated with pleasure by many women. When conditions are favourable it can be a time of great intimacy and enjoyment. However, pregnancy makes great demands on the body and may be associated with increased physical burden and stress (Yim et al., 2015:3). During pregnancy, the growing foetus may even be viewed as a parasite, depending on the woman for everything, and in some cases depleting her reserves of nutrition and energy. Despite the very special role it plays in the life of a woman, pregnancy can be a time of life-threatening complications and stress.

Pregnancy, according to Sellers (2014: 45), is the phase from conception until birth. It may be divided into the first, second and third trimesters, each lasting 13 weeks. During pregnancy, many women become cautious of physical exertion, sometimes to their own detriment. Poor lifestyle choices during pregnancy may endanger not only the pregnant woman but the fetus too, resulting in gestational diabetes mellitus (GDM) and Type-2 diabetes mellitus in the future. Monitoring the diet and engaging in physical activity during pregnancy may benefit the pregnant woman and the fetus, and may prevent conditions such as hypertension and GDM from developing (Skurzak, Kicia, Wiktor & Iwanowicz-Palus, 2015:169).

According to Turok, Ratcliffe & Baxley (2003:1767), GDM is a condition that occurs during pregnancy and sometimes disappears afterwards, a view which is supported by Kjos and Schaefer-Graf (2007:203). Turok et al., (2003:1767) state that GDM is a carbohydrate or glucose intolerance that usually appears during the second trimester at around 24 weeks’ gestation (Scollan-Koliopoulos, Guadagno & Walker, 2006:15; Turok et al., 2003:1767). If not properly managed, GDM can have adverse effects on the baby and the mother in both the short and long term (Tieu, Crowther & Middleton, 2008:7).
Complications of GDM may include unusually large body size for the gestational age of the fetus, which may necessitate Caesarian section during childbirth (The American College of Obstetricians and Gynecologists (ACOG) Guidelines 2017:3). Other complications of GDM are stillbirth, neonatal death, pre-term delivery and pre-eclampsia (Coghill, Hansen & Littman, 2011: 553). If untreated, GDM will later develop into Type-2 diabetes mellitus (Ferrara et al. 2004:529; Scollan-Koliopoulos, Guadagno & Walker, 2006:17).

Type-2 diabetes is a lifestyle condition which can be controlled through diet, physical activity and treatment (oral or insulin injections), all of which reduce complications. There is clearly a need to develop an intervention strategy that might assist pregnant women to prevent GDM, and where it exists, to manage it, so that the onset Type-2 diabetes may be prevented. The strategy would require adherence to a modified diet and planned physical activity among low-risk pregnant women and women with GDM (SEMDSA, 2017: 51).

1.2 Background

Obesity may be defined as a Body Mass Index (BMI) equal or over 30 kg/m2. It is an abnormal accumulation of body fat, usually 20% or more of an individual’s ideal body weight, and is associated with an increased risk of illness and disability. Much concern has been generated about the increasing incidence of obesity among Americans (Yang & Nichols, 2011:380). Also some studies have noted an increase in the incidence of obesity from 1991 and 1998 among Americans, from 12% to 18% of total population. Other studies have actually estimated that a full 50% of all Americans are overweight. The Global Burden of Disease Study of 2010 has estimated that approximately 3.8% disability-adjusted life years may be attributed to overweight and obesity (Lim, Vos & Flaxman, 2012:2224). In a recent commentary, Yang and Nichols (2011:380) highlighted the devastating and growing impact of obesity on the US healthcare system and economy due to modernization and unhealthy lifestyle. Modernisation is a contributing factor to all the diseases related to overweight and obesity.
Modernisation and unhealthy lifestyles of low physical activity and the consumption of fast foods contributes to obesity, high cholesterol levels, myocardial infarct, hypertension and diabetes mellitus (Ricanti et al., 2011:15). Furthermore, poor lifestyle choices are key contributors to inadequate relief from chronic diseases and the development and progression of preventable chronic diseases, including obesity and Type-2 diabetes mellitus. The World Health Organisation (WHO) (2013) described obesity as a major health problem and a public health challenge in the United States. Both (WHO, 2012) and Earl, Ford and Ali (2008:1) view obesity as a worldwide epidemic, with its related diseases becoming increasingly prevalent.

The condition is escalating because of poor lifestyle choices in all age groups, including amongst children of school-going age and women of child-bearing age. Both the incidence of obesity and GDM is rising worldwide and both are known as relative risk factors for adverse maternal and neonatal outcomes (Bajaj et al., 2013: 11). In the US, the overall prevalence of diagnosed GDM was less than 6% in 1994. By 2000, only half of the states in the US had a prevalence of 6%, and by 2009, only two states maintained that prevalence. In fifteen states, it exceeded 9% (DeSisto, Kim & Sharma, 2014:4).

The figures are rising elsewhere. In South Africa the occurrence obesity and GDM during pregnancy has been estimated to increase in South Africa (Society for Endocrinology Metabolism & Diabetes in South Africa (SEMDSA) 2017:19). The Demographic and Health Survey (2012:28) revealed that 30% of South Africans are overweight or obese. The effects of urbanization and unhealthy lifestyle are important contributors to the rising prevalence of obesity and diabetes mellitus. An epidemic of obesity poses risks to young women, especially those who are diagnosed with GDM (Amod et al., 2012; SEMDSA, 2017:17).

Globally, the quoted prevalence of GDM ranges from 1 to 16% (Agarwal & Panda 2005: 823). The Australian Carbohydrate Intolerance Study undertaken in 14 centres in Australia and four centres in the United Kingdom, reported that GDM affected 2 – 9% of all pregnancies (Crowther et al., 2005:2481). In Tanzania, the overall prevalence of GDM averaged 5.9%, with 8.4% in urban areas and 1.0% in rural areas.
The figure for urban areas was higher than expected, indicating an increasing population who are at risk of complications during delivery and Type-2 diabetes in sub-Saharan Africa (Macaulay, Dunger & Norris, 2014:1).

In Buffalo City Metropolitan Municipality in the Eastern Cape, South Africa, the prevalence of GDM was higher for women who had experienced a previous stillbirth, had family history of Type-2 diabetes, and a mid-upper arm circumference (MUAC) of 28 cm or above. DeSisto, Kim, and Sharma, (2014:4) reported that statistics revealed a GDM prevalence rate of 2% to 10% amongst pregnant women with GDM in the United States, which increased to 18% in a study done in 2012.

In a study conducted in South Africa, Limpopo by Mamabolo et al., (2007:237), the prevalence of GDM and insulin resistance in pregnant women was 8.8% (7.3% Gestational Impaired Glucose Intolerance (GIGT); 1.5% GDM). About six million people in South Africa and 347 million internationally have diabetes. It is estimated that these numbers will double to 153 million in 10 to 20 years due to lack of physical activity and proper diet (Booth, Roberts & Laye, 2014:1141).

Generally, the literature focuses on physical activity during delivery and the labour process, as well as post-natally; there has been little studied on planned physical activity for women during pregnancy. Attention has been given to physical activity in the first trimester, whereas GDM develops during the second trimester. This is when planned physical activity may be most required.

GDM, obesity and lack of planned physical activity together constitute the greatest health challenges of the 21st century. Key risk factors for GDM include maternal age over 30 years, obesity, poor diet and minimal physical activity (Ferrara et al., 2004:529; AIHW, 2010:21). The incidence of GDM is likely to increase in the future, as obesity and older maternal age become more widespread (AIHW, 2010:16). Notably, the literature emphasises diet education to address these threats, but generally fails to contextualise diet, failing to show how principles may be adapted to suit the country and budgets of various populations. The researcher has sought to fill this gap in the literature and to supplement clinical knowledge on diet and physical activity amongst women with GDM.
1.3 Problem Statement

Women with GDM experience increased glucose levels that have adverse effects on pregnancy and the foetus, irrespective of interventions conducted by the government. In addition, pregnant women who are obese or overweight, whether low or high risk, are predisposed to all the complications associated with overweight and obesity that can threaten pregnancy, delivery and the foetus. Many women of child-bearing age in Buffalo City Metropolitan Municipality tend to have high BMI, indicating that they are at risk of pregnancy-related conditions (Leddy, Power & Schulkin, 2008: 172).

Several studies have suggested a link between physical activity and a reduced risk of GDM, but so far the evidence on the feasibility of life-style counseling to increase physical activity in low- and high-risk pregnant women at primary care facilities is scarce (Korpi-Hyövältia, Heinonenb, Schwabc, Laaksonenc & Niskanenf, 2014:3). The researcher was interested in investigating planned physical activity and modified diet for low-risk pregnant women and high-risk pregnant women who have GDM, taking their context into consideration. In this study, low-risk pregnant women refer to women in normal health, with no chronic conditions, and high-risk pregnant women refers to those who already have GDM.

The following factors are notable with regard to high-risk pregnancies:

(1). There is poor adherence to modified diet and planned physical activity among both low-risk and high-risk pregnant women.

(2). There is increased risk during delivery for both the mother and the baby.

1.3.1 Poor adherence to physical activity and diet among low-risk pregnant women and high-risk pregnant women with gestational diabetes mellitus (GDM).

Women with both low- and high-risk pregnancies are at risk of developing problems related to sedentary lifestyles. Many women of child-bearing age are overweight or obese because of poor lifestyle choices. Difficulties with adhering to modified diets and planned physical activity during pregnancy increase the risk of developing GDM and Type-2 diabetes in the future (Belamy, Casas, Hingorani & Williams, 2009: 174).

The International Diabetes Federation (2015) estimated that in 20.9 million or 16.2% of live births to women, some form of hyperglycaemia is experienced. Mwanri, Kinabo,
Ramaiya and Feskens (2015: 1) showed that in sub-Saharan Africa the increase of hyperglycaemia in high-risk women was about 14%. In South Africa, GDM increases the future risk of developing diabetes and the rate of maternal mortalities, which currently stands at 333 deaths per 100,000 live births. In Buffalo City Metropolitan Municipality (East London) in South Africa, the prevalence of diabetes has increased hugely in the black communities, and the high prevalence of undiagnosed diabetes portends that cardiovascular diseases might grow to epidemic proportions in the near future in South Africa (Norris, 2014:1). In BCM women of the child bearing ages from 25 – 35 years’ ranges from 2.8% - 4% (District Health Barometer 2016).

The high prevalence of GDM is evidence that suggests poor adherence to modified diet and planned physical activity, with consequent minimal control of glucose levels. Sedentary lifestyles during pregnancy are associated with poor control of GDM, (Biswa, Oh & Faulkner, 2015:123). Information related to control of high glucose levels is crucial.

Education focusing on motivating low- and high-risk pregnant women to engage in planned physical activity and to modify diets would reduce the incidence of GDM, Type-2 diabetes and complications during pregnancy, labour and the post-natal period. Moreover, overweight and obesity during pregnancy leads to overweight babies and promotes many overweight-related conditions, such as GDM.

Despite many women’s compliance with treatment for increased glucose levels during pregnancy, GDM prevalence continues to rise. It is hypothesized that controlled, planned physical activity and appropriate, context-specific dietary modifications for GDM could be the solution. An intervention strategy of modified diet and planned physical activity is seen as obligatory to prevent and delay the development of diabetes mellitus in low- and high-risk women, to minimise complications to pregnancy, delivery and the foetus.

All GDM patients require nutritional counseling with a registered dietician or diabetic educator. Nutritional interventions in low- and high-risk women with GDM should be designed to achieve normal glucose levels while maintaining appropriate nutrition and weight gain (ACOG, 2017:3). The diet should consist of 40–50% complex
carbohydrates, 20–30% fat and 20–30% protein, according to guidelines. Intervention strategies based on modified diets and planned physical activities should also feature the foods available to the pregnant woman in her context.

1.3.2 Gestational diabetes mellitus and increased risk to pregnancy, labour/delivery and the foetus or baby.

1.3.2.1 Pregnancy

Low-risk pregnant women and high-risk pregnant women with GDM who manage diet and physical activity well reduce adverse outcomes associated with GDM such as pre-eclampsia, Cesarean delivery and Type-2 diabetes (ACOG, 2017:3). An earlier development of GDM exposes the mother and foetus to risk for longer; this change in the length of GDM reflects in the outcome of pregnancy, and may well worsen outcomes (Velusamy Sivakumar, Rajasekeran, Sen & Vijayakumar, 2015:1194). In addition, studies from Nigeria, South Africa, Cameroon and Tanzania have reported potential GDM-related foetal complications such as macrosomia, unexplained still birth and polyhydramnios (Mwanri et al., 2015: 1).

1.3.2.2 Labour and delivery

Adverse outcomes associated with GDM include pre-eclampsia, Cesarean delivery, and an increased risk of developing Type-2 diabetes later in life (ACOG, 2017:3). Other complications may include pre-term delivery, macrosomia, hypoglycaemia and hyperbilirubinemia and large baby for gestational age (LGA), with 20% of babies becoming big (LGA) during the 1st trimester. High-risk women with GDM frequently deliver at or before 38 weeks’ gestation due to a macrosomia birth weight of 4000 grams or greater (Sivakumar et al., 2015:1194).

A baby is defined as having ‘large gestational age’ (LGA) when its weight lies above the 90th percentile of weight for the gestational age. More LGA babies are found during the 1st trimester when the mother has been diagnosed with GDM than when no GDM is present (Velusamy Sivakumar, Rajasekeran, Sen & Vijayakumar, 2015:1194).

1.3.2.3 Foetus

Risks for the foetus and newborn include macrosomia, birth trauma, hyperbilirubinemia, hypoglycemia, respiratory distress syndrome and childhood obesity (ACOG, 2017:1).
Hypoglycaemia baby capillary heel blood glucose levels of 40 mg/dl or less, and hyperbilirubinemia (baby’s total bilirubin level in the blood more than 12 mg/dl) are also considered GDM-associated pregnancy complications (www.wjpps.com Vol 4, Issue 10, 2015).

Appropriate diagnosis and treatment of women with GDM reduces foetal macrosomia, pre-eclampsia, gestational hypertension, Caesarean sections, and composite neonatal morbidity (shoulder dystocia, nerve palsy and bone fracture) (Crowther et al., 2005: 2483).

Despite efforts exerted by government, including its many guidelines and protocols, GDM is still on the rise, demonstrating a need for intervention strategies based on modified diets and planned physical activities among low- and high-risk pregnant with GDM.

Globally, the incidence of GDM has increased in line with the escalating rate of Type-2 diabetes in the general population (Dabelea et al. 2005:580). GDM is associated with an increase in perinatal morbidity and is one of the commonest complications of pregnancy, predicted to increase in the future (Crowther et al., 2005:2481). Intervention strategies of diet and physical activity present an answer to the problems of low- and high-risk pregnancies. Neonatal complications such as LGA, macrosomia and neonatal hypoglycemia can be prevented with early diagnosis of GDM (Bartha, Del-Fresno & Delgado, 2000:346; Moses & Griffiths, 1995:523; Leipold et al., 2005:521).

The treatment of GDM using modified diet and planned physical activity may have far-reaching benefits for low- and high-risk pregnant women and their children.
Diet and physical activity provide a cost-effective approach to the prevention of obesity and Type-2 diabetes mellitus later in life. In addition, an intervention strategy of planned physical activity and modified diet will minimize and reduce the chances or complications of obesity and GDM during pregnancy.

1.4 Purpose of the Study

The purpose of the study is to describe the effectiveness of an intervention strategy of modified diet and planned physical activity implemented amongst low-risk pregnant women and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality in the Eastern Cape, South Africa.

The purpose of the study is also to develop the intervention guidelines for modified diet and planned physical activity

1.5 Research Questions

What is the effectiveness of the intervention strategy of modified diet and planned physical activity implemented amongst low-risk pregnant women and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality in the Eastern Cape, South Africa? There were several sub-question based on the main research question:

- What are the anthropometric measurements that will ascertain the effects of the modified diet and planned physical activity for low-risk pregnant women and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape?
- What is the effect of the modified diet and planned physical activity intervention in low- and high-risk women in Buffalo City Metropolitan Municipality, Eastern Cape?
- What preparations needed for the randomisation of low-risk pregnant women to participate in the intervention/experimental or control groups? There was no randomisation of high-risk women with GDM; all the high-risk women with GDM were in the intervention group.
• What is the relationship between the use of the modified diet and planned physical activity in the low-risk pregnant women and in the high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape?

• What are the guidelines for a healthy lifestyle for women with GDM with low- and high-risk pregnancies in Buffalo City Metropolitan Municipality, Eastern Cape?

1.6 Research Objectives

Phase 1: To identify and describe the anthropometric measurements and research instruments to be used for participants in the modified diet and planned physical activity in Buffalo City Metropolitan Municipality, Eastern Cape.

Phase 2: To identify and describe the effects of the modified diet and planned physical activity intervention in low- and high-risk pregnant women in Buffalo City Metropolitan Municipality, Eastern Cape.

Phase 3: To prepare the randomisation of low-risk pregnant women to participate in the intervention/experimental or control groups. There was no randomisation of high-risk women with GDM; all the high-risk women with GDM were in the intervention group.

Phase 4: To identify and describe the relationship between the use of the modified diet and planned physical activity in the low-risk group with the high-risk group in Buffalo City Metropolitan Municipality, Eastern Cape.

Phase 5: To describe the guidelines that promote a healthy lifestyle among women with both low- and high-risk pregnancies, in Buffalo City Metropolitan Municipality, Eastern Cape.

1.7 Significance of the Research

The interventions will add value to the low risk and high risk pregnant women of child bearing age (18 to 35 years) will learn on how to practise and improve health and prevent or delay the conditions related to obesity and overweight, such as GDM using their context. Pregnant women with low and high-risk pregnancies could also experience less problem (overweight babies and caesarean section) during delivery if engaged planned physical activity.
There will be minimal admission of pregnant women and risks of having gestational diabetes and complications of diabetes to women with gestational diabetes mellitus.

1.8 Scope and Delimitation

The study is delimited (restricted) to low- and high-risk pregnant women who attended four health community health clinics (CHCs) and two hospitals in Buffalo City Metropolitan Municipality, Eastern Cape; Frere Hospital and Cecilia Makiwane Hospital.

1.9 Literature Review

1.9.1 Obesity and overweight in low-risk pregnant and women with GDM

Obesity and GDM are currently silent killers globally. In particular, obesity and overweight is the cause of many progressive conditions associated with cardiovascular diseases and diabetes. A study conducted by Wahabi et al., (2014:2) found that maternal obesity and GDM were closely related to complications during all trimesters of pregnancy. Obesity and GDM also increase the risk of adverse pregnancy outcomes at term.

The researcher was interested in introducing a healthy lifestyle in terms of modified diet and planned physical activity relevant to the context of women in the Eastern Cape, in view of the fact that the prevalence of GDM is escalating. To this end, a thorough review of related and available literature was undertaken.

1.9.2 Prevalence of GDM

The global prevalence of GDM is 16.9%; the highest prevalence is in the South-East Asia region, at 25.0%, compared with 10.4% in the North American and Caribbean region (Guariguata et al., 2014:177). The above prevalence confirms the gradual increase of GDM worldwide, in particular in developing countries. In 16 states of the United States, the GDM prevalence in 2010 was 4.6%, as reported on birth certificates, and 8.7% and 9.2% as reported on either the birth certificate or questionnaires.

In sub-Saharan Africa the prevalence of GDM ranges from 0% to 13.9% in Tanzania and Nigeria, respectively. This was found in a review of GDM by Mwanri, Kinabo, Ramaiya and Feskens (2015:1).
In a study conducted in South Africa in 2016, the prevalence of GDM was found to be 3% (Chola et al. 2016: 19). Diabetes is a serious and growing public health concern in South Africa, but its prevalence and distribution in pregnant women has not been widely researched. South Africa does not have any data on maternal mortality due to diabetes; notwithstanding this, the legislation, guidelines and clinical protocols provided by the Department of Health will, if applied, help reduce maternal mortality (Strategic Plan for Maternal, Newborn, Child and Women’s Health (MNCWH) and Nutrition in South Africa 2012–2016; Department of Health, 2015: 15.

Moreover, there is an increase in the prevalence of diabetes mellitus. The 6th International Diabetes Federation atlas (2013) revealed that the Indian National prevalence was 9.27% (Dyavarishetty & Kowli, 2016). South Africa also ranks highly for diabetes mellitus, having the fifth highest prevalence for Africa. Diabetes mellitus therefore significantly contributes to the burden of non-communicable diseases in South Africa, with non-reversible complications that have impacted the country’s economy (Mayosi, Flisher & Lalloo, 2009: 374).

1.9.3 Guidelines for physical activity

Despite the alarming statistics, recommendations for simple preventative measures such as physical activity and diet prescribed as guidelines for low- and high-risk pregnant women are seldom promoted by midwifery institutions. Government guidelines on physical activity during pregnancy provide health professionals with what they need to know to prescribe physical activity appropriately. Various organisations have addressed the matter of physical activity during pregnancy, including the World Health Organisation. It’s guidelines for 2012 for all adults recommend that adults aged 18 to 64 years engage in at least 150 minutes of moderate-intensity aerobic activity throughout the week (in bouts of at least ten minutes each), or at least 75 minutes of vigorous aerobic activity, or an equivalent combination of the two. Muscle strengthening should be done two or more days per week.

The guidelines state that pregnant women may need to take some precautions and should seek medical advice before commencing the planned physical activity relevant to their risk category (WHO, 2012).
Some countries offer detailed guidelines for physical activity during pregnancy. A summary of guidelines across countries may stimulate national bodies to develop guidelines, share best practices, and update existing guidelines. It could also facilitate the development of a global recommendation for physical activity during pregnancy (World, Evenson, Barakat, Dargent-Molina, Haruna, Mikkelsen, Mottola, Owe, 2014: 102).

Women involved in physical activity during pregnancy strengthen their muscles and minimise the likelihood of complications during labour and the post-natal period. Furthermore, pregnant women, especially gravida-1 and para-0 women with anxiety, stress and depression, may find their symptoms alleviated through physical activity (ACOG, 2017:1). Pregnant women who engage in physical activity will reap benefits not felt by those with a sedentary lifestyle.

1.9.4 Barriers to physical activity in pregnant women with GDM

Regular physical activity is essential for the majority of people of all ages, including pregnant women. However, precautions should be practised by low- and high-risk pregnant women. Active low- and high-risk pregnant women tend to be most active during their first trimester, decreasing exercise as pregnancy advances to the second and third trimesters. The literature supports this decrease in physical activity (Borodulin, Evenson & Herring, 2009:9). Fatigue and lack of energy is the most common cause of minimal engagement in physical activity. However, lack of motivation and knowledge about the benefits of physical activity also contribute to its low uptake during pregnancy. Marquez et al. (2009:505) conducted a study on Latina and non-Latina white women, and identified physical limitations and restrictions, lack of resources, lack of energy, and lack of time as powerful barriers to exercise. Evenson et al. (2009:364) found that lack of social support was the primary inter-personal barrier to exercise.

Low- and high-risk pregnant women need motivation and constant education regarding the importance of physical activity for optimal health. Pregnant women have a tendency to have a low level of self-motivation for exercise during pregnancy because of their concern for their unborn babies. However, education could support this. Continuous motivation, education and information sharing about the necessity of physical education are needed.
Healthcare givers and midwives should be responsible for educating pregnant women on the physical activity guidelines for each stage of pregnancy.

Culture has a bearing on the beliefs and practices surrounding pregnancy. Kieffer et al. (2002:542) found that cultures expressed diverging opinions in relation to exercise during pregnancy. According to these authors, Mexican women respond to the cultural norm of increased rest during pregnancy, to protect the baby. As a result, their physical activity is very low during pregnancy (Thornton et al., 2006:95).

African cultures, similarly, do not encourage pregnant women to be physically active because of myths regarding losing the baby. The interesting aspect to this cultural prohibition on exercise is that traditionally, African women were as active during pregnancy as at other times, having to walk long distances for water or engaging in many household chores that involved exercise.

1.9.5 The benefits of physical activity

The benefits of physical activity include improved blood glucose, control of GDM, lower rates of Type-2 diabetes, reduced cardiovascular risk factors, weight loss, improved well-being, muscle strength and insulin sensitivity. The challenges related to blood glucose management vary with diabetes type, activity type, and the presence of diabetes-related complications (American Diabetes Association, 2016). Physical activity and exercise recommendations, therefore, should be tailored to meet the specific needs of each individual. Social support and access to resources have been identified as powerful facilitators of exercise. Additionally, Marquez et al. (2009:505) identified information sharing on physical activity as an important aspect of motivation.

1.9.6 Diet

Diet for pregnancy is the same as that specified by WHO (2015) for the general population, in that it ought to be balanced and varied. It should include carbohydrates, healthy fats, proteins, vitamins and minerals, and have reduced intake of refined carbohydrates and saturated fats. Fibre should be included, through the consumption of two servings of fruit and five servings of vegetables each day (WHO 2015; National Institute for health and Care Excellency (NICE) 2008).

The modified diet recommended for pregnancy remains the balanced diet recommend for all. The current diet standards are stipulated by diet and nutrition experts, as below.
1.9.6.1 Diet guidelines

Diet guidelines are the procedures and strategies that low- and high-risk pregnant women should follow. Diet and nutritional guidelines for low- and high-risk pregnant women have been specified by WHO (2015) and NICE (2008) for the benefit of the foetus and the pregnant woman. The pregnant woman is supposed to gain weight gradually, and to have gained on average 10kg to 12.5kg during pregnancy (Department of Health, 2015).

Diet guidelines for low- and high-risk pregnant women include supplements such as folic acid for the first 12 weeks, and vitamin D throughout the pregnancy. Calcium is also important during pregnant, with twice as much needed each day than for non-pregnant women. The WHO (2015) and NICE (2008) guidelines on nutrition for pregnant women also suggest supplementation for pregnant women to prevent conditions related to shortage of calcium, iron and vitamin A and D. In simple terms, all pregnant women are supposed to have daily meals with a variety of foods from the four main food groups such as:

- Fruits and vegetables: fresh, frozen, tinned, dried or juiced, five portions a day.
- Starchy food: bread, pasta, rice and potatoes, and one wholegrain.
- Foods rich in protein: lean meat and chicken, fish, eggs, beans and lentils, two portions of fish a week, including oily fish.
- Dairy foods: milk, cheese and yoghurt, which contain calcium, (National Health Standards 2011).

1.9.6.2 Benefits and enhancers of a healthy diet

A healthy lifestyle means having a balanced diet from all key food categories, namely carbohydrates, protein, fruit and vegetables, and fats. All people, including pregnant women, need to be regularly reminded, educated and informed about the functions of each type of food, the needs of the body and the dangers of fatty, junk and fast foods.

The Nutritional Society of South Africa (2012) states that encouraging a healthy lifestyle decreases the risk of non-communicable diseases (NCDs).
1.9.6.3 Barriers to a healthy diet

The majority of Africans (men and women) eat diets weighted in favour of carbohydrates (starch) and fatty meat, with few or no vegetables. Culturally, African men and women believe in a full plate daily, full of carbohydrates. The role of carbohydrates in the body is to provide energy, as they are the body's main source of fuel, needed for physical activity, brain function and the operation of the organs. However, WHO (2016) warns against the intake of excessive carbohydrates, sugars, and fats, especially in combination with low activity.

Poor pregnant women, especially those in rural areas, have diets high in carbohydrates which may lead to obesity if not combined with high physical activity. In a study done in a poor rural area in Limpopo, pregnant women ate diets high in carbohydrates, with little or no vegetables or chicken. The diet provided energy but inadequate nutrients for the woman and the unborn baby. Unfortunately the women became overweight and obese, with BMIs of 25 to 30 (Mostert et al., 2013).

The South African food-based dietary guidelines of 2012 highlights barriers such as food insecurities, especially in developing countries, and the prevalence of junk food, which is affordable to low-income groups. Poor lifestyle choices and lack of information about correct diet has deleterious effects on health.

1.10 Definition of terms

Intervention study

An intervention study is one that provides care to improve a situation, especially medical procedures or applications that are intended to relieve illness or injury. Whereas an intervention strategy is a deliberate process seeking to influence people’s thoughts and beliefs for the betterment of a community, (Collins, 2002). In this study, the intervention strategy was the act of sharing information with women who had GDM, to promote a healthy diet and planned physical activity.
Modified diet
Diet refers to food particles that provide one or more nutrients from the six classes of nutrients, namely carbohydrates, fats, proteins, water, vitamins and minerals, in specific proportions (Vlok, 2006:254). The sources of these nutrients may be influenced by culture and region. In this study modified diet is the carbohydrates, vegetables, fresh fruit and dairy products that were available to low- and high-risk pregnant women in their specific environment.

Planned physical activity
Physical activity is body movements that leads to energy expenditure, whether moderate or vigorous (Moss & Lubbe, 2011: 14). In this study planned physical activity refers to a more conscious plan of some everyday activities such as household chores, gardening or doing things that require mild to moderate physical effort.

Low-risk pregnancy
Low-risk pregnant women are women who are healthy, with few minor ailments and no complications, which allows birth preferences to be followed by the midwifery team. Low risk also means the weight, overall health and age are within the safe range, and the pregnancy is a singleton one (Department of Health, 2015). In this study, low-risk pregnancies are those that are managed by midwives in midwifery obstetrics units (MOUs) and community health care centres, with one baby and no complications.

High-risk pregnancy (GDM)
A high-risk pregnancy is one that threatens the health or life of the mother or her foetus. It is usually caused by conditions such as diabetes and GDM. (http://www.acog.org/~/media/For%20Patients/faq113.pdf?dmc=1&ts=20120730T164032605).

GDM is the onset of abnormal carbohydrate metabolism diagnosed during pregnancy (Littleton-Gibbs & Engebretson, 2013: 366). In this study, GDM refers to all pregnant women (24 – 28 weeks’ gestation) diagnosed with gestational diabetes mellitus and attending one of two tertiary hospitals or one of four clinics for antenatal care.
1.11 Worldwide Theoretical Lenses and Paradigms

Researchers are attached to a certain set of beliefs that are associated with different approaches to research. The researcher will see the world through his or her beliefs which will always guide the study. In this study, the researcher is guided by the knowledge specific to improving lifestyles and health in African women.

In research, there is also an epistemological focus when knowledge is acquired from participants through questionnaires (Polit & Beck, 2014:342). This forms part of the process by which the researcher brings a sense of order to reality.

1.11.1 Paradigm perspective

Paradigms are world views, and encompass systems and general perspectives on the complexities of the world (Polit & Becker, 2014:11, Terre Blanche, Durrheim & Painter, 2006:6). Paradigms are distinguished by the way an individual respond to basic philosophical questions using the following dimensions: ontology, epistemology and methodology (Terre et al., 2006:6). The positivism paradigm is a systematic way of doing research that emphasises the importance of observable facts (Brink et al., 2014:24). The positivist paradigm is used by quantitative researchers using the scientific approach, applying randomisation, statistical generalization and testing of hypotheses. Reliability, validity and the use of a large sample is the core to true experimental design.

1.11.2 Meta-Theoretical Matters

Each woman is unique and belongs to a specific physical and cultural environment. Pregnant women are affected by many factors in their immediate and national environment, and will manifest their responses through their psycho-social, emotional and physical beings.

Midwives are always responsible for the wellbeing of low-risk pregnant women, and obstetricians are responsible for high-risk pregnant women, including those with GDM. Gestational diabetes self-management education (GDSME) on diet and planned physical activity is always crucial for managing GDM and for women with low- and high-risk pregnancies. A good management strategy needs to take into account the total environment in which the woman lives and by which she is shaped and influenced.
1.1.2.1 Meta-theoretical assumptions

The meta-theoretical assumptions of this research study naturally arise from the researcher’s own beliefs, perceptions and opinions about health, environment, persons and illness. Her recommendations will, to some extent, be shaped accordingly.

1.1.2.2 Health

Nurses and midwives are always responsible for the well-being of pregnant women. The key responsibility of the midwife is to share information related to pregnancy in order to ensure a healthy pregnancy and foetus. High-risk women with GDM are also educated about self-management with a modified diet and planned physical activity, both of which are always crucial for managing GDM. According to George (2002:127) Orems and Becker (1984:1) and Pender (2005), all theories of nursing focus on the wholeness and capacity of a human being to live within a physical, social and biological environment. Healthcare, therefore, focuses on the actualization of that integral part of a human being and on developing the potential to be healthy through healthy behaviour and competent self-care.

1.1.2.3 Internal and external environment

The internal environment of an individual encompasses the mind, body, intellect and spiritual aspects of the person. The external environment comprises the situations and conditions outside of individual control which may be both physical and social. Pregnant women belong to both environments, and women’s experiences of these environments differ because environments, cultures and individuals differ. Pregnant women are affected by the external environment, which may contribute to GDM. They are also affected by their own internal environments, from where they may derive the motivation to overcome and manage the condition.

These considerations were borne in mind by the researcher throughout this study so that each woman could be empowered to manage behaviour, and all could be encouraged to strive for physical and emotional wellbeing for optimum health during pregnancy.
1.11.2.4 Person
A person is a human being and has a sense of self. All persons have values and unique understandings, and are shaped by different experiences (Watson, 1998: 51). The mind and emotions are sometimes referred to as ‘the windows to the soul’. In this study, pregnant women with GDM were exposed to different conditions that necessitated the care and assistance of nurses. The environment and the person can never really be separated; because of this, human beings must be understood in their totality, and when ill, must be restored to health in the understanding that wholeness and health are natural and essential conditions for human beings. In this study the woman with GDM is a viewed as a human being, affected by a condition induced by pregnancy which can be managed with proper education.

1.11.2.5 Illness
Illness, according to Watson (1998:48) is a state of disharmony within a person, rather than the presence of disease. When a human is ill, he or she experiences disharmony and instability within the body. Health itself exists on a continuum from health to illness, and varies in all human beings. In this study, the researcher is interested in the restoration of optimum health irrespective of the condition – in this case, GDM – using modified diet and planned physical activity within a specific context.

1.12 Theoretical Assumptions
Orem’s general theory of nursing, Becker’s health belief model and Pender’s health promotion theory are the underlying assumptions of this research.

1.12.1 Orem’s theory
Orem’s theory is based on the concepts of self-care, self-care agency, basic conditioning factors and therapeutic self-care demand. The researcher has made use of two of Orem’s concepts – self-care and self-deficit – which are demonstrated when an individual chooses to engage in dietary modification and planned physical activity or to reject such aspects of self-management.

1.12.1.1 Self-care
Orem refers to any activities performed by individuals to maintain life, health and wellbeing as self-care (George, 2002:127).
In this study, the activities of using a healthy modified diet and engaging in planned physical activity are examples of self-care, towards the ultimate goal of having a healthy pregnancy and baby.

1.12.1.2 Self-deficit

Self-deficit refers to the limits of an adult’s abilities to provide continuous care for the self, requiring a nurse or any other person to assist. In this study, guidance, assistance, support and education were the means used to address the self-deficit needs of pregnant women to ensure personal development and health. It included all activities aimed at empowering low- and high-risk pregnant woman about modified diet and planned physical activity so that health of mother and child could be as they were meant to be – optimum. Figure 1.1 shows Orem’s theory.

A state of self-deficit exists when a high-risk woman is newly diagnosed with GDM and has no knowledge of the condition. The nurse, midwife, obstetrician and dietician are required to empower the woman with information related to the condition, to administer treatment (oral and injectable) and to educate regarding diet and physical activity to ensure adequate self-management. When the pregnant women with GDM is able to manage and control her GDM with treatment as a result of this help, self-care is the result – which is the ultimate goal of the team employed to assist (George, 2002:127).
1.12.2 Becker’s health belief model

Becker's health belief model is a psychological model that attempts to explain and predict health behaviors. The model focuses on the attitudes and beliefs of individuals, and the stress levels which contribute to the development of diabetes. The model in this study makes use of all the concepts of the health belief model (Glanz, Rimer & Viswanath, 2015), as follows:

1.12.2.1 Perceived threat of the disease

The model postulates that health-seeking behavior is influenced by a person’s perception of a threat posed by a health problem. In this study, it refers to the woman’s values and associated actions which are brought to bear to reduce the threat of overweight during pregnancy, GDM and diabetes (Glanz et al., 2015).
1.12.2.2 Perceived susceptibility
Perceived susceptibility is a person’s perception of her health problem, and whether she feels it is personally relevant or accurate. In this study, it refers to the awareness of low-risk pregnant women and women with GDM regarding the predisposing factors to diabetes, and their level of recognition of their own susceptibility to it (Glanz et al., 2015).

1.12.2.3 Perceived benefits
Perceived benefits are a patient’s beliefs that will cause them to adopt or not adopt the treatment; in this case, the diet modification and planned physical activity. In this study the perceived threats of the disease (GDM) and the perceived benefits of treatment may promote adherence to the treatment; they stand opposed to various barriers to behavioural change which may affect a woman’s thinking (Glanz et al., 2015). Figure 1.2 shows how the health belief model functions:
Figure 1.2: Becker's health belief model
(Glanz et al., 2015).

1.12.3 Pender's health promotion model

The Health Promotion Model was designed by Pender (2005) to be ‘a complementary
counterpart to models of health protection’.

The model defines health as a positive dynamic state, rather than simply the absence
of disease. Health promotion is directed at increasing a patient's level of well-being. In
this study, the health promotion model is the foundation of recommending measures
that manage and prevent complications caused by GDM. Pender's model focuses on
three areas or concepts, all three of which are adopted in this study; individual
characteristics (poor diet and lack of planned physical activity), experiences (i.e., that of having GDM) and behavioural outcomes (managed GDM, without complications to pregnancy or the baby).

The theory posits that each person has unique personal characteristics and experiences that affect subsequent actions. The set of variables for behaviour-specific knowledge have motivational significance and can be modified through nursing actions. Health-promoting behaviour is the desired behavioral outcome. In this study, the desired outcome was a change of lifestyle through the adoption of a modified diet and planned physical activity. These behaviours should result in improved health and decreased chances of developing the complications of GDM. Figure 1.3 shows Pender’s health promotion model.

![Figure 1.3: Pender's health promotion model (adapted) (Pender 2005)](image)

All three theories are intertwined and relevant for this study. The rationale for using these theories was the improvement of health by enabling people to develop and internalise the skills of managing themselves from self-deficit and to self-care, after health education. The health belief model is interested in making individuals aware of perceived threats and perceived benefits and encouraging correct action through health education. The health promotion model, on the other hand, is interested in lifelong behavioural modification and behaviour for correct outcomes (Pender: 2005).
1.13 Research Methodology

1.13.1 Quantitative, descriptive, experimental intervention

A quantitative, descriptive, experimental intervention design was used for low- and high-risk pregnant women in this study. The rationale for this design was to enable an accurate description of the effectiveness of intervention strategies based on modified diet and planned physical activity in Buffalo City Metropolitan Municipality, Eastern Cape.

1.13.2 Research method

The research for this study was sub-divided into four phases which guided the process. These phases were as follows:

Phase 1: identifying and describing anthropometric measurements and research instruments to be used for the modified diet and planned physical activity.

Phase 2: identifying and describing the effect of the modified diet and planned physical activity intervention in low- and high-risk pregnant women.

Phase 3: preparing the randomisation of low-risk pregnant women to participate in the intervention/experimental or control groups.

Phase 4: identifying and describing the relationship between the use of the modified diet and planned physical activity in the low-risk women and the high-risk pregnant women. Implementation of modified diet and planned physical activity intervention.

Phase 5: describing the guidelines to promote a healthy lifestyle to women with low- and high-risk pregnancies.
Table 1.1: Research design and methodology

<table>
<thead>
<tr>
<th>Process</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
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<tbody>
<tr>
<td>Objective</td>
<td>To identify and describe the anthropometric measurement(s) needed for modified diet and planned physical activity for low- and high-risk pregnant women in BCM, Eastern Cape.</td>
<td>To identify and describe the effect of modified diet and planned physical activity interventions in low- and high-risk pregnant women in BCM, Eastern Cape.</td>
<td>To identify and describe the randomisation of the participants in BCM, Eastern Cape.</td>
<td>To identify and describe the relationship between the use of modified diet and planned physical activity interventions to low-risk and high-risk pregnant women in BCM, Eastern Cape.</td>
<td>To identify and describe the guidelines that promote a healthy lifestyle to low- and high-risk pregnant women in BCM, Eastern Cape.</td>
</tr>
<tr>
<td>Research questions</td>
<td>What are the anthropometric measurement(s) for modified diet and planned physical activity for low- and high-risk pregnant women with GDM?</td>
<td>What is the effect of modified diet and planned physical activity intervention in low-risk and the high-risk pregnant women with GDM?</td>
<td>What type of randomisation is needed for the participants?</td>
<td>What is the relationship between the use of modified diet and planned physical activity interventions in low-risk and in high-risk pregnant women with GDM?</td>
<td>What are the guidelines for intervention strategies to be used to promote healthy lifestyles to women with low-risk and in high-risk pregnant women with GDM?</td>
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<tr>
<td>Research design</td>
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<tr>
<td>Population</td>
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<td>Low- and high-risk pregnant women (GDM)</td>
<td>Low-risk pregnant women</td>
<td>Low- and high-risk pregnant women (GDM)</td>
<td>Committees and stakeholders</td>
</tr>
<tr>
<td>Target population</td>
<td>Low- and high-risk pregnant women (GDM)</td>
<td>Low- and high-risk pregnant women (GDM)</td>
<td>Low-risk pregnant women</td>
<td>Low- and high-risk pregnant women (GDM)</td>
<td>Midwife, dietician, obstetrician and physical activity trainer</td>
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<td>Stratified random sampling</td>
<td>Random sampling</td>
<td>Stratified random sampling</td>
<td>Literature</td>
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<td>Registers from CHCs</td>
<td>Employed stakeholders in the CMH and Frere Hospital and CHCs</td>
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<tr>
<td>Data collection method</td>
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<td>Questionnaire</td>
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<td>Frequency, percentages, statistical comparison</td>
<td>Frequency, percentages</td>
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<td>Internal validity and reliability</td>
<td>Content validity</td>
<td>Content validity</td>
<td>Internal validity and reliability</td>
<td>Content validity</td>
</tr>
</tbody>
</table>

1.13.2.1 Phase 1: Descriptive, quantitative

Quantitative research focuses on strategies that can improve and make a difference in people’s lives, and is often experimental in nature (Melnyk & Morrison-Beedy, 2012:1). Furthermore, it focuses on the cause and effect relationship, the implementation of an intervention or treatment, and the outcome. The researcher in this study was interested in reducing complications to women with GDM, and preventing and promoting health in pregnant women, using a modified diet and planned physical activities suited to their context. Studies on diet and physical activities are usually based on adaptations to the western diet. Physical activities also emphasize exercises that are western in nature; for example, aerobics and the use of machines and gyms. However, the modified diet and planned physical activity which is suited to this context would be more economical and culturally relevant.

1.13.2.2 Phase 2: Experimental

The emphasis in experimental design is on the manipulation of one or more variables and the random allocation of participants to experimental and control groups. The experimental design has three components; randomisation, control and experimental
groups (Grove, Burns & Gray, 2013:245). Manipulation comes into effect with the implementation of the intervention (Burns & Grove, 2013:198). The two groups are randomised, one receiving the experimental treatment and the other, no treatment, or only a placebo treatment or routine standard care (Grove, Burns & Gray, 2013:245).

1.13.2.3 Phase 3: Randomisation

In this study there were two groups of participants, namely low- and high-risk pregnant women. The low-risk pregnant women were randomly allocated into either the experimental or the control group. The rationale for the design was to test and compare the groups for differences in the outcomes of the intervention. All the high-risk pregnant women, who had GDM, were in the intervention group. All manipulation related to low- and high-risk pregnant women and their environment was for the improvement of their health.

1.13.2.4 Phase 4: Intervention

Intervention design has to do with development, implementation and testing of an intervention (Polit & Beck, 2014:294).

The intervention is an alternative treatment or condition administered to participants, differing according to occasion or need. The aim of intervention is to improve people’s lives and promote behavioural changes in real life settings, using evidence-based practice. In this study, the researcher was interested in promoting healthy lifestyles among child-bearing aged women and protecting them from conditions associated with poor lifestyle, such as obesity, overweight and minimal physical activity. GDM is one of the conditions associated with poor lifestyle choices and is dangerous to pregnant women and their unborn babies.

The rationale for this design was to test innovative strategies related to modified diet and planned physical activities against the existing modifications of diet and physical activity used to promote maternal and foetal health.

1.13.2.5 Phase 5: Development of guidelines

The researcher developed and described guidelines for health care workers to use among pregnant women to promote healthy lifestyles to women with low- and high-risk pregnancies. This phase can be evaluated and implemented post-doctoral.
1.13.3 Setting

The study was planned to be conducted in all four community health care centres (CHCs) in Buffalo City Metropolitan Municipality. Three CHC’s from urban areas of which two from East London (Gompo and DVDH), one from Mdantsane (Nontyantyambo) and one from the King William’s Town rural area (Dimbaza).

![Community Health Care Centres in BCM](image)

**Figure 1.4: Community health care centres in BCM**

Four hospitals (Frere, Cecilia Makiwane, Grey and Bisho) were also selected for high-risk pregnant women with GDM but only two hospitals (Frere and Cecilia Makiwane) were relevant.
The two hospitals finally selected in Buffalo City Metropolitan Municipality were Frere and Cecilia Makiwane Hospitals, selected because of their referral status. Two other hospitals, Grey and Bisho Hospitals, were not used because they refer clients to Frere Hospital and Cecilia Makiwane Hospitals (CMH).

### 1.14 Population
Population is the entire element, whether individuals or objects, that meet inclusion criteria in a given universe (Polit & Beck, 2014:273). The population of Phase 1 were all low- and high-risk pregnant women attending Buffalo City Metropolitan Community Health Care Centres, Frere Hospital and CMH. Low-risk pregnant women were those who had experienced no complications, were healthy and had no chronic conditions. High-risk pregnant women with GDM were those diagnosed with GDM during their second trimester at 24 to 26 weeks’ gestation. The target population was low-risk pregnant women and high-risk pregnant women with GDM receiving diabetic ANC in the hospitals and CHCs in Buffalo City Metropolitan Municipality, Eastern Cape.
1.15 Sampling
Stratified random sampling was used for drawing a sample of low-risk pregnant women. The sample size was \( n = 142 \) for the control group, and \( n = 149 \) for the experimental group of low-risk pregnant women. For the high-risk pregnant women, the sample size was \( n = 291 \) and for women with GDM, sample size was \( n = 34 \), all in the experimental group. The sample frame of the study was taken from the registers of the CHCs, Frere Hospital and CMH.

1.16 Data collection
Data was collected using structured questionnaires with closed and open-ended questions for low- and high-risk pregnant women. Data was collected at four community health care centres and hospitals in East London and Mdantsane. There are various sections of the questionnaire namely demographic information, anthropometric measurements, medical history, past and present history, lifestyle history, diabetes mellitus and gestational diabetes mellitus (GDM), stakeholders, theoretic framework, planned physical activity and modified diet that will be discussed in Chapter 3.

1.17 Validity and reliability

1.17.1 Validity
Validity is the measure of how useable, consistent and effective the instrument used for research is (Grove, Burns & Gray, 2013:392). The instrument or tools were tested for consistency to see if they yielded the same results in each case. To confirm the thoroughness of the intervention, the research assistance (midwives) underwent thorough training. Validity was ensured through making use of content, face, predictive, concurrent and criterion validity.

1.17.2 Reliability
The pilot test is a tool used to ensure that the devices, tools and techniques used by the researcher yield what they are expected to yield. The researcher conducted a pilot study to test for possible pitfalls and errors that may have yielded problems in the actual study, and was able to identify and correct them (Brink et al., 2014:160).
1.18 Ethical considerations

Research ethics refer to standards and behaviour in practical procedures that the researcher is expected to follow (Burns & Grove, 2013:189). Dhai and McQuoid-Mason (2011:175) state that researchers and reviewers of research both have an ethical human rights protection responsibility towards the research participants. The ethics of science are concerned with what is wrong and what is right in the carrying out of research. Because scientific research takes the form of human conduct, such conduct has to conform to generally accepted norms and values (Mouton, 2001:238).

In this study all the ethical principles were considered. Permission was obtained to conduct research, informed consent was signed for, and the principles of anonymity, confidentiality, right to self-determination, right to privacy, beneficence and protection from harm were adhered to.

1.19 Data Analysis

Data were summarised as frequencies and percentages and presented in tables and graphs. Inferential statistics were used for statistical comparison of nominal, ordinal and continuous variables using SPSS, latest version 7, to draw conclusions (Polit & Beck, 2014: 337). The chi-square was used for categorical data. The relationship between the adoption of a modified diet and planned physical activity was measured using correlation coefficients.

1.20 Dissemination of Results

Research results will be published and disseminated through workshops with the management of the institutions responsible for antenatal care, labour wards and obstetric units in hospitals, and conferences. A copy of the report will be forwarded to the University of Fort Hare to be kept in the library for public use. A number of articles will be submitted to accredited journals for publication.

1.21 Chapter outline

Chapter 1: Introduction and background

Chapter 1 introduced the topic of the study, focusing on the following aspects:

- Definition of GDM
- Prevalence of GDM
- Risk factors for GDM
- Complications of GDM to mother and unborn baby
- Poor lifestyle due to poor diet and minimal physical activity

The chapter also gave the problem statement, the aims, objectives and research questions that guided the study, the significance of the study and the three theories (Orem’s self-care theory, Becker’s health belief theory and Pender’s health promotion theory) that guided the study.

**Chapter 2: Literature review**

Chapter 2 provides an overview of the literature on GDM, the prevalence of GDM, its definition, screening, diagnosis, the at-risk population, pre-conception counselling, pre-gestational diabetes, management, monitoring, complications, challenges, NHI (2011) issues, guidelines and the role players and team leaders in the management of GDM.

**Chapter 3: Methodology of the study.**

Chapter 3 describes the methodology used in the study which followed five phases:

Phase 1 was the identification and description of anthropometric measurements conducted during data collection.

Phase 2 was the identification and description of the effects of the modified diet and planned physical activity.

Phase 3 was the randomisation of low-risk pregnant women only. High-risk pregnant women with GDM were not randomised; instead all women with GDM were in the intervention group.

Phase 4 was the implementation of the modified diet and planned physical activity.

Phase 5 was the development and description of the guidelines for an effective intervention strategy.

Other parameters of methodology are also discussed, such as setting, sample, data collection, validity, ethical considerations, data analysis and dissemination of results.
Chapter 4: Results and discussion of the descriptive data
Chapter 4 presents the results and a discussion of the descriptive data of ow-risk pregnant women and high risk pregnant women with GDM. The results and discussion of the demographic data (age, education, setting, occupation, marital status, race and home languages), anthropometric measures (weight, MUAC, BMI, blood pressure, blood glucose levels, pulse and urine), modified diet and planned physical activity of all the pregnant women.

Chapter 5: Randomisation
Chapter 5 presents the randomisation of the low risk pregnant women only for the control and intervention group. The high risk pregnant women with GDM were not randomised instead all of the high risk pregnant women were in the intervention group only. The research randomizer programme from Excel was used to avoid bias during the selection of pregnant women to the control and intervention group.

Chapter 6: Modified diet and planned physical activity
Chapter 6 presents a proposed intervention strategy and in-depth information on how to support low-risk pregnant women and high-risk pregnant women with GDM. The intervention strategy constitutes the modified diet and planned physical activity. The implementation of the modified diet and planned physical activity for low risk pregnant women and high-risk pregnant women with GDM expected to be performed by health-care professionals (midwives, dietician and speciality of physical movement). Healthcare professionals would need to be trained on how to communicate, motivate and support low-risk and high-risk pregnant women with GDM by this researcher in the post-doctoral period.

Chapter 7: Results and discussion for the modified diet and planned physical activity
Chapter 7 presents the results and a discussion of the modified diet and planned physical activity of ow-risk pregnant women and high risk pregnant women with GDM. The control and intervention group were compared to understand the outcomes of the modified diet and planned physical activity to the low risk pregnant women and high risk pregnant women with GDM.
Chapter 8: Development and description of guidelines
Chapter 8.5 presents a proposed guidelines developed from the results of the modified diet and planned physical activity intervention for the low risk pregnant women and high risk pregnant women with GDM. The guidelines were identified and described with clear language and procedure of the roles of the stakeholders.

Chapter 9: Summary, conclusion, limitations and recommendations
The chapter 9 presents a summary of the key findings of the research study and highlights the limitations, implications and recommendations for further research. The chapter will also summarize the study and explains the limitations of the study and the solutions in terms of recommendations.

1.22 Conclusion
Chapter 1 has introduced the alarming problem of obesity in low- and high-risk pregnant women, a problem that requires urgent intervention to minimise complications to mothers and unborn babies. Changes to lifestyle, especially regarding diet and planned physical activities during pregnancy, remain the surest way to manage and prevent complications associated with GDM and later diabetes mellitus. This will be evidenced in the findings which follow.
CHAPTER 2
LITERATURE REVIEW: GESTATIONAL DIABETES MELLITUS

2.1 Introduction

The first chapter of this study introduced the topic and established the scientific foundation of the study. This chapter will focus on a discussion of the literature on gestational diabetes mellitus (GDM). The literature review made use of a variety of sources, including online sources such as Ebsco, Google Scholar, Scopus and PubMed.

The key words used in the search for articles were ‘gestational diabetes mellitus’ ‘pregnant women’, ‘low-risk pregnant women’, ‘high-risk pregnant women’, ‘poor lifestyle in pregnancy’, ‘diet for low-risk pregnant women’, ‘high-risk pregnant women with GDM’, ‘physical activity for pregnant women’, ‘guidelines about diet and physical activity for pregnant women’ and ‘women with GDM’. Most of studies consulted used a quantitative approach.

The topics discussed in this literature review are the definition of diabetes and GDM, its historical background and contextual dimensions, screening, characteristics of the client with GDM and the role players for managing GDM. The chapter also reviews the diagnosis of diabetes mellitus and GDM, the types of diabetes in pregnancy, pre-conception counselling, GDM’s prevalence and causes, its barriers according to health care providers, and to women who have the condition, the issue of low-risk and high-risk pregnancies, who is at risk for GDM, management and lifestyle treatment – that is, oral treatment, insulin therapy, diet and exercise – the complications and effects of diabetes in pregnancy, labour and post-natal care, NHI issues related to diabetes, how diabetes is handled in the national and provincial Departments of Health, diabetes and GDM guidelines, and challenges imposed by diabetes mellitus and GDM. The chapter concludes with overall observations and some recommendations.

Unpublished literature and grey literature, e.g., policy documents, reports and dissertations, were included for review in this chapter. The search was limited to literature produced between 2007 and 2016 and to papers published in English.
2.2 Prevalence

Reported rates for GDM in the United States in 2011 ranged from 2% to 10% of all pregnancies. After pregnancy, 5% to 10% of women with GDM are found to have diabetes, usually Type-2. Therefore, women who have had GDM have a 35% to 60% chance of developing diabetes in the next 10–20 years (Noctor & Dunne, 2015:3).

An international, multicentre study of GDM in 2012 found that as many as 18% of the pregnancies in the United States were affected by GDM. About six million people in South Africa and 347 million internationally have diabetes. Experts in the medical field estimate that the numbers will double to 153 million in 10 to 20 years due to lack of planned physical activity and proper diet (www.health-e.org.za/2012/11/19).

In Australia GDM affects 6.5% of pregnant women and is increasing (Sathyapalan, Mellor & Atkin, 2010:89). Globally, the population with diabetes is projected to rise to a high of 592 million in 2035, from 285 million in 2010 (Shaw, Sicree & Zimmet, 2010).

In South Africa, adult diabetes prevalence was estimated to be approximately 9% in 2009 (Bertram et al., 2013). With these trends, there has also been an increase in the prevalence of diabetes during pregnancy, which is a source of major concern for countries worldwide (Hunt & Schuller, 2007). The range of 2% to 8% has been reported for GDM in South African populations (Labadarios et al., 2014).

Other literature reviewed stated that there was not much known about the prevalence and distribution of diabetes amongst pregnant South African women. The South African government arranged an audit of pregnancy outcomes at Chris Hani Baragwanath Hospital in Soweto between 1992 and 2002, which suggested that approximately 2% of screened pregnant women had diabetes (Huddler, 2005:789). A programme implemented at the hospital to manage diabetes in pregnancy was estimated to reduce perinatal mortality by 25%. Studies conducted in sub-populations in Johannesburg and Limpopo found a diabetes prevalence of 1.8% and 8.8% in pregnant women, respectively (Basu, Jeketera & Basu, 2010).
The prevalence of GDM has been increasing globally, including in China. In Tianjin, a cosmopolitan city near Beijing in North China, GDM increased from 2.3% in 1999 to 6.8% in 2008 (Zhang et al., 2018). A contributing factor here was the rapid lifestyle and socioeconomic changes brought about in China under the influence of westernisation, which brought with it changes in dietary intake and physical inactivity (Hu, 2011). In a national survey conducted 2010, GDM was reported to be as high as 11.6% (Xu et al., 2013).

2.3 Definition of GDM

GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (https://doi.org/10.2337/diacare.26.2007.S103) and resulting in hyperglycaemia of variable severity with onset during pregnancy. The body cannot produce enough insulin to handle the effects of a growing baby and changing hormone levels. The diagnosed woman is treated with diet and exercise, or oral treatment or insulin therapy (https://doi.org/10.2337/diacare.26.2007.s103). The worldwide problem of diabetes mellitus, as a long-lasting metabolic condition triggered by deficiencies in insulin production, has Danaei et al. (2011) persistently escalated, with rapid growth detected in low- and middle-income countries.

The high-risk pregnant woman with GDM who experiences uncontrolled high glucose levels during pregnancy would typically have Type-2 diabetes mellitus later in life. Babies born to pregnant women with undiagnosed and untreated GDM will usually be categorised as big babies, weighing 3.6kg – 4kg, which will result in instrumental delivery or Caesarean delivery (Canadian Diabetes Association Clinical Practice Guidelines (2013). www.diabetes.ca/clinical-practice-education/clinical-practice-guidelines.

According to WHO (2013) GDM globally is defined as ‘hyperglycaemia of diabetic levels occurring during pregnancy’. It is a common condition during pregnancy which is associated with negative short-term and long-term outcomes for both mothers and their offspring.

2.4 Screening of GDM

Early screening and diagnosis is crucial amongst low-risk pregnant women because diabetes mellitus and GDM frequently appear unexpectedly.
GDM plays a major role in maternal and infant morbidity. Some studies indicated that many trials have established a relationship between multiple maternal and foetal complications like preeclampsia, Caesarean sections and birth injuries and GDM (Hartling et al., 2012).

Pregnant women with Type-2 diabetes have sometimes been previously diagnosed with GDM minimal screening, so it is critical to screen and detect women at high risk of developing GDM. Planning and implementing user-friendly ways of promoting healthy lifestyles is crucial in order to prevent GDM and Type-2 diabetes mellitus in future (Cheung & Byth, 2009).

Ethnicity is a particularly important factor in determining the incidence of GDM. At high risk are women of Australian indigenous, Polynesian and South Asian ethnic groups. Indian, Middle Eastern and other Asian groups are at moderate-high risk (Diabetes Care, 2013).

There has been much debate about whether universal or selective screening of pregnant women for GDM is appropriate. Moses and Colagiuri (1990) recently estimated that, between 1991 and 1994, 50% of pregnant women in New South Wales were not screened for GDM. In some areas of known low-GDM incidence, selective screening is recommended.

The Australasian Diabetes in Pregnancy Society (ADIPS: 2013) recommends that screening for GDM should be considered in all pregnant women. ADIPS developed easy and clear screening and diagnostic procedures which were recommended by the American Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (Diabetes Care 2013). Complex criteria for selective screening may cause difficulties in a busy clinical practice (Hoffman et al., 2003).

However, if resources are limited, screening may be reserved for those at highest risk. High risk would include the presence of glycosuria, age over 30 years, obesity, family history of diabetes, past history of GDM or glucose intolerance, previous adverse pregnancy outcomes, and belonging to an ethnic group with a high risk for GDM. Screening for GDM is practised differently in different countries, each of which has different guidelines (ADIPS, 2013).
Different screening criteria are used for detecting GDM in various countries. WHO (2016) recommends the oral glucose tolerance test (OGTT) for diagnosis of Type-2 diabetes mellitus in non-pregnant adults using two values: fasting plasma glucose and the 2-hour plasma glucose levels after 75g of oral glucose. These common thresholds are applied to both pregnant women and non-pregnant adults; the diagnosis of GDM is applied if a woman is pregnant. For a diagnosis of diabetes, the (American Diabetes Association ADA 2013) lowered the fasting plasma glucose (FPG) cut-off to 7.0 mmol/L. WHO (2016) then followed suit, applying the same FPG criteria as recommended by the ADA (2013) to the OGTT. WHO (2016) has always applied the same criteria to pregnant and non-pregnant women, even though common thresholds for pregnant and non-pregnant women have been shown to be erroneous. However, the simple criteria adopted by WHO (2016) have remained popular in most countries of the world.

The role of the International Association of Diabetes and Pregnancy Study Groups (IADPSG) was to find consensus between many national and international groups in addressing diabetes in pregnancy. In 2010, IADPSG recommended universal screening of all pregnant women with the 75g OGTT, (Metzger et al. 2010). Thus, the IADPSG criteria had the possibility of being accepted by all preeminent medical, endocrine and health organisations worldwide.

The American College of Obstetricians and Gynecologists (ACOG) on the other hand, has endorsed the two-step approach to GDM. In 1986, ACOG recommended the 50g 1-hour screening test for ‘women at risk,’ and later applied it to all women, excluding those at very low-risk. In 2013, ACOG indicated that it favoured the two-step procedure using the threshold of 100g for the OGTT, recommended by the National Diabetes Data Group (NDDG) (Carpenter & Coustan, 1982).

The ADA criteria are used by Canada, Mexico and the United States, due to their proximity to one another. The ADA criteria used the four sample, 3-hour 100-g OGTT for diagnosis of GDM. In 2000 the ADA then recommended a two-step approach which was becoming popular in North America; the 50g GCT screen, followed by the 100g OGTT, if the GCT screen was positive.
In 2003, the ADA also accepted the one-step approach of using the 75g OGTT for the screening and diagnosis of GDM, especially in high-risk populations, since it was deemed more cost-effective (Carpenter & Coustan, 1982).

In 2011, the ADA accepted the recommendations of the International Association of Diabetes and Pregnancy Study Groups (IADPSG) that is, using the 75g OGTT on all women as a one-step screening and diagnostic method, eliminating the need for the 50g GCT (Metzger et al., 2010).

McIntyre et al. 2015 acknowledged the work done by the International Diabetes Federation (IDF) strategies in 2016. The IDF concurs that women at high risk of developing GDM will have negative outcomes such as perinatal morbidity and mortality in index pregnancies, Type-2 diabetes later in life for the mother, and intra-uterine epigenetic programming in the developing foetus. As a result, the IDF established consensus with the two-step or one-step methods of the ADA and WHO, respectively. However, the IDF had a preference for the 75g OGTT, because it used less glucose and was of shorter duration. Currently, IDF, WHO, IADPS and ADA have accepted these criteria which are used as guidelines.

In Africa the criteria were different. Many African countries have adopted the WHO criteria (Odar, Wandabwa & Kiondo, 2004). Some discrepancies in methods have been presented between countries; Morocco used 100g OGTT criteria, Mozambique used their own diagnostic criteria and Nigeria used 75g or 100g OGTT for diagnosis, with varying criteria in others.

The screening of GDM in African states clearly has many discrepancies compared to other countries. Some African states use 50g; others use 75g or 100g OGTT for screening pregnant women. The Society for Endocrinology, Metabolism and Diabetes of South Africa (2017:29) has adopted the WHO criteria of fasting plasma glucose below or equal to 7mmol/l or 75g for the OGTT.

There is also a paucity of information about GDM screening in Africa. National guidelines for diabetes were published in Nigeria in 2013 which included screening for high-risk women who were deemed to need risk assessment at booking, using the one-step 75g OGTT or the two-step method (50g GCT with 100-g OGTT) (Clinical Practice Guidelines for Diabetes Management in Nigeria 2011).
Pregnant women at high risk for GDM may be screened earlier than 24–28 weeks’ gestation. In such cases the 2-hour oral glucose tolerance test (OGTT) is used with 75g glucose loaded. Pregnant women who are not at high risk for GDM may also be screened at 24–28 weeks’ gestation. However, it is reasonable to exclude screening for previously undiagnosed diabetes if the woman is at low-risk for diabetes and GDM. This would include women who are Caucasian, young (age <25), thin, and who have no personal or family history of diabetes. Women at increased risk of diabetes or GDM would include those with a history of GDM, BMI >30, previous macrosomic baby (weighing 4.5 kg or more), first-degree relative with diabetes, ethnicity with high prevalence of diabetes (Hispanic, American Indian, African American, South Asian), or polycystic ovarian syndrome (PCOS) (Garrison, 2015;6).

2.5 Diagnosis

In Australia, the guidelines for diagnosing GDM have remained essentially unchanged from those recommended for use in Australasia in 1991. Although there are no uniform international criteria for the diagnosis of GDM, the commonly used criteria are those of the American Diabetes Association (ADA: 2013) and the World Health Organisation (WHO: 2013). Society for Endocrinology, Metabolism and Diabetes in South Africa (SEMDSA, 2017:29) guidelines are also used for diagnosing GDM, using a two-hour 75g OGTT at booking and at 24 – 28 weeks’ gestation.

Pregnant women with the risk factors listed below should undergo a two-hour 75g OGTT at booking and at 24 – 28 weeks’ gestation to screen for GDM: Repeated glycosuria, previous GDM, family history of diabetes (first-degree relative), history of stillbirths of unknown origin, previous congenital anomalies and suspicion of polyhydramnios in present pregnancy, history of high-birthweight infant ≥ 4kg and obesity (body mass index (BMI) > 30 kg/m2) (America Diabetes Association (ADA) 2013).

Women of South Asian descent who were previously diagnosed with GDM should have an OGTT at 16 –18 weeks and a further OGTT at 28 weeks if the results are normal. Current criteria for diagnosis given by the World Health Organisation (WHO:2013) has these criteria, to be revised in the near future.
Fasting plasma glucose (FPG) $\geq 7.0$ mmol/l; or two hours’ post-glucose load (75 g) plasma glucose $\geq 7.8$ mmol/L. The proposed criteria for diagnosis of GDM is that one or more of these criteria must be satisfied: FPG $\geq 5.1$ mmol/l one-hour post-glucose load, (75 g) plasma glucose $\geq 10.0$ mmol/l.

In New Zealand, the 2-hour OGTT cut-off value for a positive diagnosis is a venous plasma glucose level of 9.0 mmol/L. This figure was chosen by a majority decision of specialists of the New Zealand Society for the Study of Diabetes. In 2014, the New Zealand Ministry of Health published a clinical practice guideline for screening, diagnosis and management of GDM in New Zealand. Twenty international and national guidelines and position statements were identified and critically appraised. Their recommendation was that a HBA1c should be ordered at booking and at 24 – 28 weeks. Depending on the result of the HBA1c, a 50-g GCT or an OGTT may be done (cut-offs $F \geq 5.5$ mmol/L or 2-hour $\geq 9.0$ mmol/L) (http://www.health.govt.nz/publication/screening-diagnosis-and-management-gestational-diabetes-new-zealand-clinical-practice-guideline).

ADIPS recognises the importance of working towards an Australasian consensus on the issue. If the clinical suspicion of GDM is high, a diagnostic OGTT is indicated, irrespective of the stage of pregnancy. In such circumstances, if an OGTT gives normal results early in pregnancy, the test should be repeated between 26 and 30 weeks’ gestation. A 75g OGTT should use 75g of anhydrous glucose or the equivalent, and preferably should also be performed after a high carbohydrate diet of at least 150g of carbohydrates for three days (Linda et al., 2003).

2.6 Risk Factors for GDM

Even low-risk pregnant women aged 35 years or older are at risk of having GDM. Women of particular ethnic groups, i.e., Aboriginal, Hispanic, South Asian, Asian and African, are at high risk of having GDM (Hawkins et al., 2015). Obese women with BMI of 30 kg/m2 or higher, women who have given birth to a baby weighing more than 4kg and those frequently using corticosteroid medication are also at risk.
Similarly, pregnant women having prediabetes or who had GDM in a previous pregnancy, or who have a parent, brother or sister with Type-2 diabetes, who have polycystic ovary syndrome (PCOS) or acanthosis nigricans (darkened patches of skin) should all be screened for GDM within 24 to 28 weeks of pregnancy because of being at high risk (Hawkins et al., 2015).

Other risk factors for diabetes include obesity and no or minimal physical activity. Diabetes in pregnancy presents major challenges in childbirth and has the potential to cause perinatal morbidity and mortality (Persson, Norman & Hanson, 2005:207). A high systolic blood pressure, parity≥1, multiple pregnancies and habitual smoking before or during pregnancy have been positively associated with the risk of developing GDM (Kessous et al., 2013:119). Although some pregnant women are at risk of preeclampsia, women with GDM have higher risks for Type-2 diabetes and cardiovascular diseases later in their life in Chinese and other populations (Metzger et al., 2008).

Babies born to mothers with uncontrolled GDM will be big babies and tend, later in life, to become obese and suffer diseases related to cardiovascular conditions and impaired glucose intolerance (Hillier et al., 2007:287).

In South Africa, evidence suggests that scaling up the management of diabetes in pregnancy can prevent stillbirths and deaths of mothers, yet the condition does not receive much attention. Little is known about the extent and distribution of GDM in South Africa, hampering efforts to manage the disease (Huddle, 2005:789).

Type-2 diabetes mellitus is a future risk for women with GDM. In this study women with GDM were monitored for six weeks after delivery, with treatment stopping immediately after delivery. The obstetrician and midwives monitored the women frequently after delivery, emphasising the modified diet and planned physical activity according to guidelines. The main aim of this emphasis was to reduce and delay the risk of Type-2 diabetes mellitus development later in their lives, (http://www.socialstyrelsen.se/Lists/Artikelkatalog/Attachments/8356/2009-126-135_2009126135.pdf.)
The prevalence of GDM, as a precursor to Type-2 diabetes mellitus, has increased at an alarming rate in pregnant women at 24 – 28 weeks’ gestation. In a recent review and meta-synthesis study, the relative risk of developing Type-2 diabetes mellitus after a pregnancy with GDM was more than 10% higher than in women with a normoglycemic pregnancy (Bellamy et al., 2009:174).

In Denmark, 40% of women with prior GDM developed Type-2 diabetes mellitus within ten years from the index pregnancy, an incidence that is increasing over time, probably due to a parallel increase of obesity among women (Lauenborg et al., 2004:1). In Sweden 35% of women with prior GDM are diagnosed with Type-2 diabetes mellitus 15 years after the index pregnancy (Gilinsky, Kirk, Hughes & Lindsay, 2015:8).

The ADA recommends measurements of fasting glucose in the immediate post-partum period in order to identify women with persisting hyperglycaemia after childbirth. Low-risk pregnant women with previous GDM appear to be more likely to develop autoimmune or monogenic forms of Type-2 diabetes mellitus, usually presenting with Type-2 diabetes mellitus symptoms very quickly after delivery compared to overweight or obese women, due to chronic insulin resistance. When normal blood glucose levels in the immediate post-partum period are observed, an OGTT is recommended some time during the first two weeks to six months postpartum. If the second measurement post-partum is normal, the ADA recommends annual testing for DM (Metzger et al, 2007).

However, an American study found that only a third of the women underwent the ADA recommended screening (Almario et al., 2008:198). In Sweden, there is no unified recommendation for the performance of the GDM follow-up post-partum; however, in the majority of clinical guidelines, a follow-up including an OGTT is recommended within the first year post-partum (Persson, Winkvist & Mogren, 2005:207)

In a Swedish study, women developing Type-2 diabetes mellitus after childbirth gained significantly more weight after their pregnancy than women who did not develop Type-2 diabetes mellitus (Gilinsky, Kirk, Hughes & Lindsay, 2015: 8). Swedish women tend to regard GDM as an alarm bell, signalling improvements in lifestyle in order to prevent future Type-2 diabetes mellitus.
2.7 Pre-conception counselling

The child-bearing aged woman who does not have pre-gestational diabetes mellitus still has to prepare for pregnancy. Unfortunately, the majority of black Africans do not have a culture of planning pregnancy and, since our healthcare institutions do not provide pre-conception counselling, lack all pre-conception care. Most pregnant women first visit the obstetrician or clinic for antenatal care at 12 weeks’ gestation or later, and yet the first trimester is a crucial time for foetal development.

Women with pre-gestational diabetes should have effective contraception until the blood glucose levels are controlled and brought close to normal. The avoidance of hypoglycaemia and hyperglycaemia can be achieved by using self-monitoring blood glucose (SMBG). Women with pre-gestational diabetes mellitus should be educated regarding signs of hypoglycaemia and hyperglycaemia and how to avoid and manage the condition. Counselling by a dietician and engagement in physical activity can prevent hypoglycaemia and hyperglycaemia. However, even though a healthy diet is the priority advice given to pregnant women during pre-counselling teachings, it is insufficient for full control of blood glucose levels. Therefore, planned physical activity is encouraged before the commencement of oral and insulin therapy (Castorino & Jovanovic, 2011:1).

Planned physical activity is always relevant for women of child-bearing age and women with pre-gestational diabetes mellitus when doing SMBG. Furthermore, all women of child-bearing age and women with pre-gestational diabetes mellitus should be encouraged to do regular exercise, especially those with BMI > 27 kg/m². Moreover, advice should be given on smoking cessation, responsible alcohol use and the use of supplied medications from the clinic or hospital.

All the risks associated with pregnancy should be monitored in all pregnant women and women with pre-gestational diabetes mellitus. The risks for obesity and overweight are as follows:

- Risks to the foetus are:
  - miscarriage,
  - malformation
  - stillbirth
- neonatal death and macrosomia

- Risks to the pregnancy are:
  - pre-eclampsia
  - pre-term delivery, and
  - Caesarean section

- For obese pregnant women, there are risks of progression to diabetes, (Castorino & Jovanovic, 2011:3).

Medication that play a major role before conception is folate (5 mg/day), which should be taken just prior to conception and in the first 12 weeks of gestation to prevent neural tube defects (SEMDSA guidelines, 2017:17).

### 2.8 Types of Diabetes Mellitus in Pregnancy

WHO (2016) states that diabetes mellitus is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels. In 2014, 8.5% of adults aged 18 years and older had diabetes. In 2015, diabetes was the direct cause of 1.6 million deaths and in 2012 high blood glucose was the cause of another 2.2 million deaths (WHO, 2016).

#### 2.8.1 Pre-gestational diabetes mellitus

Pre-gestational diabetes mellitus is indicated when a women of child bearing age has had diabetes in the past, whether Type-1 or Type-2. Both Type-1 and Type-2 diabetes have negative outcomes for both the mother and foetus during pregnancy, including birth defects and spontaneous abortions, if the condition is poorly controlled (Castorino & Jovanovic, 2011:1).
Pre-gestational diabetes mellitus is divided into two groups; Type-1 and Type-2 diabetes mellitus, discussed below.

2.8.1.1 Type-1 diabetes
Type-1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterised by deficient insulin production and requires a daily administration of insulin (WHO, 2015). According to SEMDSA (2017:17) Type-1 diabetes is also increasing and has a prevalence of 5 to 10% globally. Type-1 diabetes is the result of pancreatic beta-cell destruction, leading to absolute insulin deficiency. Type-1 diabetes mellitus clients are prone to ketoacidosis, coma and death and may be immune-mediated or idiopathic (no known aetiology). Latent autoimmune diabetes in adults (LADA) is also classified as Type-1 diabetes.

The symptoms for Type-1 and Type-2 diabetes mellitus are similar. These symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes and fatigue. The symptoms may occur suddenly. But new research shows that the above symptoms usually appear very late; new emerging signs are an increased waist circumference from 90cm to 100cm in non-pregnant women. Pregnant women with Type-1 diabetes are always treated with insulin.

2.8.1.2 Type-2 diabetes
Type-2 diabetes (formerly called non-insulin-dependent, or adult-onset) results from the body’s ineffective use of insulin. Type-2 diabetes is the most common aetiological type, occurring in 90 to 95% of diabetes cases. It is due to a progressive loss of insulin secretion coupled with insulin resistance (a disorder of insulin action); it ranges from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance (SEMDSA, 2017:31).

Type-2 diabetes occurs in the majority of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity. Symptoms may be similar to those of Type-1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have
already arisen. Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children. Poor lifestyle choices leading to obesity plays a major role in increasing the prevalence and incidence of Type-2 diabetes. One of the new symptoms of diabetes mellitus is the development of abdominal fat, which is becoming more common in teenagers. Table 2.1 compares the two types of diabetes mellitus:

Table 2.1: Differences between Type-1 and Type-2 diabetes mellitus

<table>
<thead>
<tr>
<th>Type-1 diabetes mellitus</th>
<th>Type-2 diabetes mellitus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostly in children and younger people</td>
<td>Occurs to people of 21 years and over</td>
</tr>
<tr>
<td>Normal weight</td>
<td>Overweight and obese</td>
</tr>
<tr>
<td>Acute onset</td>
<td>Gradual progressive disease</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>Treatment is insulin</td>
<td>Start with oral treatment; if not controlled, progress to insulin</td>
</tr>
</tbody>
</table>

Source: SEMDSA (2017)

### 2.8.1.3 Pre-diabetes

Pre-diabetes is another type of diabetes or condition in which blood glucose levels are higher than normal but not high enough to be diagnostic of Type-2 diabetes; that is, when checking using finger pricking. Pre-diabetes is usually diagnosed when doing a fasting blood sugar test, sometimes during pregnancy and sometimes after pregnancy. The diagnosis can also be made on the basis of an impaired fasting glucose test (IFG) and/or impaired glucose tolerance test (IGT) (Queensland Clinical Guidelines: Gestational Diabetes Mellitus, 2015).

Campaigns emphasising education and support are crucial to empower women with pre-gestational diabetes mellitus because the majority of women do not have knowledge of the dangers of uncontrolled pre-gestational diabetes mellitus. Pre-gestational counselling, planning and pre-conception care can play a crucial role in reducing negative outcomes during pregnancy. Midwives and health care professionals should frequently emphasise self-monitoring blood glucose during pregnancy and before conception, respectively (SMBG).
Studies have revealed that controlled blood glucose during the pre-gestational period and first trimester minimises the risks of congenital abnormalities and spontaneous abortions (Castorino & Jovanovic, 2011:3). Health education and screening in primary health care facilities at each and every visit can minimise the risks of uncontrolled pre-gestational diabetes, especially in cases here there is undiagnosed Type-2 diabetes mellitus. Overweight and obese women of child-bearing age have increased risks of gestational diabetes and Type-2 diabetes mellitus. Counselling that emphasises promoting health is an essential aspect of empowerment. In this study the researcher was interested in promoting health through modified diet and planned physical activity using what was available in the contexts of the participants.

2.8.1.4 Gestational diabetes mellitus (GDM)

Gestational diabetes mellitus is hyperglycaemia with blood glucose values above normal but below those diagnostic of diabetes, and usually appears during the second trimester (24 to 28 weeks) of pregnancy. Gestational diabetes is diagnosed through prenatal screening, rather than through reported symptoms (WHO 2015). Women at risk of having GDM are those aged 35 years and over, those with one or both parents diagnosed with diabetes mellitus and those with a poor diet and minimal physical activity. The modified diet and planned physical activity tested in this study were expected to reduce complications during pregnancy and labour, and to have the added benefit of reducing the incidence Type-2 diabetes in the future lives of the babies born (WHO, 2015).

According to SEMDSA (2017:31), GDM is first diagnosed during pregnancy. Pre-gestational diabetes, Type-1 and Type-2 diabetes are diagnosed before pregnancy, with or without the complications of diabetes. A newly diagnosed pregnant woman with GDM generally knows nothing about GDM and fears complications and effects on the unborn baby. Through education and counselling, such women can be brought to an understanding of GDM, and can manage their conditions in cooperation with the health care team. The emphasis would be on managing blood glucose levels and keeping them within the target range. In this study, complications of GDM during pregnancy, labour and post-natal were reduced and pregnancy had normal outcomes when the women with GDM complied with treatment – the modified and planned physical activity.
A risk remains of developing GDM in the following pregnancy but the risk of developing Type-2 diabetes in the future will be minimised and delayed through adherence to the diet and exercise guidelines. Late-diagnosed or undiagnosed GDM is often untreated, exposing the pregnant woman and unborn baby to increased blood glucose levels. This increases the risk of a big baby, instrumental or Caesarean delivery and Type-2 diabetes in the mother (Canadian Diabetes Association, 2013).

2.9 Management

All women of child-bearing age, and especially those with pre-gestational diabetes, are supposed to be made aware of pre-conception care. Pre-conception care emphasises stabilising the blood glucose levels to HbA1c < 7% for at least three months before the woman becomes pregnant. Women who are overweight and obese should be given dietary and physical activity advice (Canadian Diabetes Association, 2013).

Medication that plays a major role before conception is folate (5 mg/day) which should be taken just prior to conception and in the first 12 weeks of gestation to prevent neural tube defects (SEMDSA Guidelines, 2017:17). Woman on hypertensive drugs should be changed to pregnancy hypertensive drugs. Pre-gestational and gestational diabetic women are monitored frequently (every two weeks) and blood glucose levels are also tested frequently, with routine referrals to the obstetrician, dietician and physical movement specialist (SEMDSA Guidelines, 2017:22).

2.9.1 Lifestyle promotion

Pre-gestational diabetes, Type-1 and Type-2 diabetes mellitus and GDM can be controlled through lifestyle measures. These measures could promote the prevention of diabetes mellitus and GDM complications and prevent or delay the onset of Type-2 diabetes in women with GDM. Type-2 diabetes and GDM complications could be prevented through physical activity. The physical activity guidelines stipulate that every pregnant woman should engage in at least 30 minutes of regular or moderate-intensity activity on most days, up to 150 minutes per week.

Physical activity during pregnancy is beneficial because it enables both low-risk and high-risk pregnant women to maintain healthy body weight (ACOG, 2017:3).
Diet is also another effective strategy for positive pregnancy outcomes. In this study the researcher promoted a healthy lifestyle through a modified diet that was affordable, available and relevant to the context of the women. Guidelines were given regarding healthy diet; that is, fewer carbohydrates and fats, and more vegetables and protein. WHO (2016) supports this idea of a healthy diet and also recommends the avoidance of sugars and saturated fats. Carbohydrates, sugars and saturated fats are sources of energy with low disease-fighting value. This study therefore promoted a healthy lifestyle through recommending small portions of carbohydrates and more proteins, vegetables and fruits, a diet that would boost the immune systems of both pregnant women and their unborn babies.

All low- and high-risk pregnant women with diabetes mellitus are always asked during antenatal visits to stop smoking. Smoking is dangerous for any pregnant woman and especially to those with diabetes mellitus. Non-smokers are also educated on preventing and delaying the onset of Type-2 diabetes and decreasing the risk of cardiovascular diseases through modified diet and planned physical activity (WHO, 2015).

2.9.2 Oral treatment

The oral hypoglycaemic agents, metformin and glibenclamide, may be used in selected patients with Type-2 diabetes and GDM, provided the target blood glucose levels are met (Garrison, 2015:9)

2.9.2.1 Metformin

For pregnant women who have GDM, the drug of choice is insulin rather than metformin because metformin has been found to cross the placenta (Charles, 2006). However, in a study by Rowan, (2008) 46.3% of women in the metformin group needed supplemental insulin to control their GDM (Rowan et al., 2008). Another randomised controlled trial compared metformin to glyburide for controlling blood glucose; no significant difference was found in the blood glucose levels of the two groups tested. However, significantly more pregnant women in the metformin group than in the glyburide group required insulin therapy to control blood glucose levels (Rowan et al, 2008).
2.9.2.2 Glyburide

Glyburide is not considered safer than insulin; birth weight and the rate of macrosomia were significantly higher for neonates whose mothers were treated with glyburide than of those whose mothers were treated with insulin (Lain, 2009:1). Oral drugs are not considered appropriate for pregnant women, even if some do use them, because insulin is also required. The choice to use oral drugs for women with GDM can be made only if the pregnant woman has challenges in using insulin, like lack of access to storage for the insulin (a fridge) and minimal competency with injecting.

2.9.3 Insulin therapy

Insulin therapy is indicated in all patients with Type-1 diabetes. Insulin therapy should be initiated in those with GDM or Type-2 diabetes if the target blood glucose levels are not met. Target blood glucose levels during pregnancy are fasting blood glucose levels of 3.5-5.9 mmol/l, one hour postprandial < 7.8 mmol/l. Insulin requirements rise progressively as the pregnancy advances. Frequent adjustments to insulin dosages must be made to achieve the target levels of blood glucose. Insulin therefore is safe to use during pregnancy and is the obstetrician’s preference (WHO, 2015; ADA, 2013; SEMDSA, 2017).

Side effects of insulin have been recorded; hypoglycaemia, local allergic reactions and skin eruptions. Insulin therapy in some cases is combined with metformin. As pregnancy progresses, insulin may need to be titrated due to the needs of the individual pregnant woman (Queensland Clinical Guidelines: Gestational Diabetes Mellitus, 2015). The midwife and diabetes educator should frequently emphasise prevention and management of hypoglycaemia and hyperglycaemia. They should also educate regarding the safe storage of insulin, how to administer and sites of injection.

2.9.4 Diet

All low-risk pregnant women and high-risk pregnant women with GDM are responsible for proper lifestyle modifications. Healthcare providers should encourage low- and high-risk pregnant women to modify the carbohydrate content in their meals using what is available in their context. Midwives and obstetricians ought to educate and support pregnant women on self-monitoring of the blood glucose, and the dietician
ought to focus on dietary modifications that are appropriate and available to the pregnant women they counsel.

High-risk pregnant women with GDM can successfully control their blood glucose with modified diet and planned physical activities. The role players in hospital for women with GDM have an important role to play; they are responsible for educating pregnant women about diet, physical activities and self-glucose monitoring. In this study pregnant women with GDM were monitored in hospital in the antenatal diabetes clinics fortnightly during the first trimester and weekly during the third trimester.

The diet should comprise approximately 60% carbohydrates (complex, low-glycaemic index, high fibre); 25% fat (at least 50% unsaturated) and 15% protein. The daily meal plan should include three meals plus three or four snacks. Dietary consistency (in amount and timing of food intake) must be maintained to facilitate tight glycaemic control without inducing hypoglycaemia (Garrison, 2015:11).

The dietician and midwives should empower pregnant women with simple messages about nutrition along these lines:

- Decrease simple sugars and carbohydrates.
- Increase lean protein and vegetable consumption.
- Eat more protein and less fat.
- Eat more fruit.
- Include moderate amounts of dairy products.
  (Garrison, 2015:11).

In addition, the dietician and midwives in the team should frequently educate and motivate both low-risk pregnant women and women with GDM about calorie distribution.

Most programmes suggest three meals and three snacks a day; however, in overweight and obese women the snacks are often eliminated and the focus is on three main meals, listed below for caloric distribution:

- Breakfast: This form 10% of total caloric allotment. Carbohydrate intake at breakfast is limited since insulin resistance is greatest in the morning.
- Lunch: This should form 30% of daily calorie intake.
- Dinner: This should form 30% of daily calorie intake.
• Snacks: These may form 30% of calories, were snacks are recommended.

The recommended overall total caloric distribution is carbohydrates: 33–40%, protein: 20% and fat: 40% (Garrison, 2015: 13).

2.9.4.1 Diet benefits during pregnancy

Low- and high-risk pregnant women practising a healthy lifestyle will gain the correct amount of weight during pregnancy. A healthy lifestyle means consuming all four categories of food groups in correct quantities, namely carbohydrates, proteins, vegetables and fruit diary and fats. Correct weight gain in pregnancy is between 10 and 12 kg, varying somewhat according to individual make-up. Healthy eating habits will promote the following:

• normal gestational weight
• normal labour
• normal weight of the baby
• normal weight post-natal

A decrease in the likelihood of conditions related to obesity and malnutrition

The diet recommended by the Department of Health, Directorate: Nutrition shows food groupings necessary for healthy eating. Figure 2.1 shows the Department’s recommendations, comprising carbohydrates, protein (composed of both dairy products and meat), fats, vegetables and fruit, all which it recommends using daily (WHO, 2012).
2.9.4.2 Diet barriers during pregnancy

All pregnant women are faced with the challenge of avoiding junk food and sticking to an optimally healthy diet during pregnancy. In this study, low- and high-risk pregnant women consumed a lot of starchy foods rather than vegetables, proteins and fruit. Midwives and dieticians have always educated pregnant women on healthy diets but pregnant women face many challenges in sticking to recommendations, as follows:

- Poverty means some women lack basic food security.
- Healthy foods may be unavailable, difficult to access or unaffordable.

2.9.5 Physical activity

Physical activity in pregnancy is restricted in many cultures, although physical activity promotes the health of the pregnant women and the unborn baby. Some pregnant women have very limited knowledge about the benefits of physical activity during pregnancy. Moderate physical activity is recommended for low-risk pregnant women and women with GDM by the American Diabetes Association (ADA, 2016). ADA (2016) suggests that all women, including those who are pregnant, should exercise 30 minutes daily. The physical activity intensity and type of physical activity should be
modified for obvious safety issues; activities involving balance and direct contact sports should be avoided (Garrison, 2015: 13).

2.9.5.1 Physical activity benefits during pregnancy

Physical activity has been found to be an essential component for promoting the life of every human being at any stage of life, pregnancy included. In a study conducted in Nigeria, most low-risk pregnant women acknowledged the importance of engaging in physical activity during pregnancy, finding that it decreased back pain, enhanced labour and delivery and prevented excessive weight gain (Pennick & Young, 2007:8).

Recent studies have reported a positive paradigm shift in attitudes toward physical activity during pregnancy over the past two decades, with increasing numbers of pregnant women participating in sporting activities. Improved knowledge of the safety of exercise for both the mother and foetus during pregnancy was linked to the willingness to initiate or continue antenatal exercises (Barakat et al., 2011:402).

The health education and motivation of low-risk pregnant women and women with GDM would increase satisfactory outcomes for pregnancies. Exercise in pregnancy plays a significant role in maternal health and the creating of awareness in this regard would have positive outcomes for national statistics on pregnancy outcomes. Efforts in to initiate and maintain exercise awareness campaigns for pregnant women would eventually decrease the burden of pregnancy-related preventable conditions in the health care system.

2.9.5.2 Barriers according to health care providers

Three studies, two from the US and one from Australia, reported on health care providers’ perceptions of barriers to physical activity during pregnancy and postpartum for diabetic women. These barriers were diverse, and included the fact that some women became lost to follow-up visits and could therefore not be monitored and questioned. Lack of the communication and collaboration between health care providers was the most widely mentioned issue. Other barriers were inconsistent guidelines or lack of familiarity with guidelines, lack of awareness of the patient’s history with GDM, patients not considering the test necessary, declining testing or being unable to complete the test, testing not affordable, patients being uninformed
about the need for testing, and health care professionals being too busy (Nielsen et al. 2014:41).

### 2.9.5.3 Barriers according to low-risk pregnant women

It was found in other studies that the attitude towards physical activity in low-risk pregnant women was influenced mostly by tiredness, lack of will to exercise and insufficient information on exercise (Evenson et al., 2009:9; Cioffi et al., 2010:456). Furthermore, a study by Duncombe et al. (2009) reported that reasons for not exercising during pregnancy included tiredness, discomfort, sickness and being too busy.

Ribeiro and Milanez (2011:31) suggested that the fact that the principal barriers to exercise described by pregnant women were lack of time, tiredness and discomfort suggests that pregnant women were not motivated, despite being aware of the benefits that physical exercise offered. It was found that the younger the age, the higher the level of engagement in physical activity. Physical activity engagement was also found to be related to the woman’s type of occupation.

Abedzadeh et al., (2011:0:6) found that knowledge about the benefits of physical activity and the cases where it was contraindicated significantly influenced the attitudes of women towards physical activity during pregnancy. Their findings were consistent with other reports that revealed a significant association between adequate knowledge of antenatal physical activity and attitudes towards physical activity during pregnancy (Abedzadeh et al., 2011:6).

### 2.10 Monitoring of Blood Glucose

Glycaemic control in pregnancy can be done through measuring HbA1c, which provides a picture of glycaemic control over a prolonged period. Blood glucose can also be used for diabetes mellitus control in preconception care and continuous monitoring of diabetic women. Self-monitoring blood glucose (SMBG) is crucial when monitoring blood glucose in order to achieve the target HbA1c levels (ADA, 2011; ADIPS, 2013; Health Council of the Netherlands, 2007; Meltzer, 2003; NICE, 2008:1).

Self-monitoring of blood glucose levels is the most effective method for diabetes monitoring and is used for primary health care in diabetes hospital and clinics. At least
one fasting blood glucose and 1- or 2-hour postprandial glucose levels should be obtained daily. The frequency of self-monitoring of blood glucose may be decreased if diabetes mellitus is controlled, and increased if it is found not to be controlled. Women with GDM may use self-monitoring of blood glucose and appropriate insulin therapy for the prevention of macrosomia and its associated perinatal complications.

The goal of introducing insulin therapy is to bring blood glucose levels to <5.5 mmol/L one hour after consumption of a meal; thereafter it should be <8.0 mmol/L. After two hours, blood glucose level should be <7.0 mmol/L (The Australasian Diabetes in Pregnancy Society (ADIPS) 2013). These minimum goals have been set on the basis of informed consensus in Australasia. They vary little from those of the American Diabetes Association (ADA) clinical practice recommendations (2011). For gestational diabetes, the fasting glucose level should be 5.8 mmol/L and after 2-hour postprandial plasma glucose it should be 6.7 mmol/L.

The recommended fasting glycaemia goal of <5.5 mmol/L is supported by Langer et al. (2000), who have shown that rates of large-for-gestational-age (LGA) infants increase in diet-treated GDM pregnancies if the fasting glucose level is between 5.3 and 5.8 mmol/L. In such cases, 28.6% of babies are LGA. With 5.3 mmol/L, only 5.35% of babies are LGA. Insulin treatment was shown to reduce the rates of LGA infants to 10.3% in GDM pregnancies with fasting glucose levels of between 5.3 and 5.8 mmol/L. These figures support of the 1-hour and 2-hour postprandial glycaemic goals of <8.0 and <7.0 mmol/L, respectively.

It has been shown that glycohaemoglobin (HbA1c) levels, birth weight and rates of macrosomia, neonatal hypoglycaemia and Caesarean section (for cephalopelvic disproportion) can all be significantly reduced in insulin-treated GDM subjects. If insulin therapy is adjusted according to 1-hour postprandial, rather than pre-prandial, glucose measurements aimed for <7.8 mmol/L. HbA1c levels may be used as an ancillary test, as assurance that the self-monitored blood glucose results are appropriate.

Fructosamine levels are reduced during pregnancy because of the dilution effect of pregnancy on plasma proteins. HbA1c and fructosamine are not reliable substitutes for self-monitoring of blood glucose levels (Langer et al., 2000).
2.11 Complications and Effects of Diabetes in Pregnancy, Labour and Post-natal

According to the SEMDSA guidelines (2017:21), risks associated with uncontrolled diabetes in pregnancy pose numerous risk, for both mother and foetus. In such cases, mothers are more prone to hypertension, the development of hydramnios and urinary tract infections. There was also an increased risk of miscarriage, stillbirths and macrosomia, and higher rates of perinatal morbidity and mortality.

However, outcomes have improved considerably in many countries in recent years as a result of improved management, so that most women with diabetes in pregnancy can now expect a positive outcome. Thus, women of child-bearing age with Type-1 diabetes mellitus, Type-2 diabetes mellitus and undiagnosed Type-2 diabetes mellitus must stabilise their glucose levels before becoming pregnant to avoid unexplained stillbirths and the formation of congenital anomalies, (SEMDSA Guidelines, 2017:45). Over time, diabetes can damage the heart, blood vessels, eyes, kidneys and nerves.

All patients with diabetes mellitus have a two- to three-fold increased risk of heart attacks and strokes (Sarwar et al., 2010). Moreover, reduced blood flow and neuropathy (nerve damage) in the feet increase the chance of foot ulcers, infection and the eventual need for limb amputation. Complications like diabetic retinopathy are an important cause of blindness and occur as a result of long-term accumulated damage to the small blood vessels in the retina. As much as 2.6% of global blindness can be attributed to diabetes (Bourne et al., 2010).

2.12 Challenges of GDM

GDM is one of the greatest health challenges of the 21st century, with key risk factors including maternal age over 30 years, obesity and lack of planned physical activity (Ferrara et al., 2004:529; AIHW, 2010:210).

Moreover, GDM is likely to increase in the future as obesity and older maternal age become more widespread (AIHW 2010:16). It is imperative, therefore, to develop modified diets and planned physical activity strategies that will address the needs of both low-risk pregnant women and women with GDM.
When untreated, GDM gives rise to Type-2 diabetes mellitus. This condition is accelerating in prevalence and is increasingly common because of the unhealthy effects of urbanisation, which lead overweight and obesity. In developing countries, increases in both GDM and Type-2 diabetes are over-burdening health systems that are already over-burdened.

It is therefore essential to place the consumption of a healthy diet and planned physical activity at the centre of efforts to control the condition. The guidelines and protocols for pregnant women with diabetes stipulate the diet plan, planned physical activity and treatment (SEMDSA, 2017:57). It is imperative, therefore, to develop strategies that will talk to women with GDM and address their specific contexts and needs.

2.13 NHI Issues Related to Diabetes

The National Health Insurance is a plan to extend health care cover to all citizens of South Africa. It was approved in June 2017. The Constitution of South African states that health care is a right for everyone; the NHI proposal seeks to fulfil that idea and has the support of government, unions, business, doctors and hospitals. According to the plan, the NHI is likely to be financed from increased taxes on individuals and companies, with private Medical Aid cover maintained for those who can afford it (Crouser & Forbes, 2009). The NHI is, by definition, a ‘health financing system that pools funds to provide access to quality health care services to all South Africans, based on their health needs and irrespective of their socio-economic status’.

The South African government’s goal is to reorganise the health system which currently gives tax rebates to medical scheme members annually, serving to make the rich richer. These tax monies are needed to assist the poor. Medical aid rebates will be used for the NHI financing (NHI, 2011). Hospitals would become more autonomous and report directly to the National Department of Health instead of to the current provincial system.

The problems experienced by the public sector, it is envisaged, will be minimised because the majority of South Africans who are poor and unemployed use public sector facilities (Hofman, Cook & Levitt, 2014:16). Most pregnant women currently attend public sector facilities where there are shortages of human resources, medication and equipment for proper management of conditions.
Government facilities are currently so hampered that those who have the means prefer to private sector services, which are generally more competent. However, there is an alarming escalation of GDM due to poor lifestyle among the poor; the NHI will accommodate them by sustaining the health care system.

The South African government has networked the NHI abroad and with the World Health Assembly Resolution (67.23) of 2014, to which South Africa is a signatory. NHI pilot districts have been identified and work has begun to ensure that everyone has access to a ‘defined comprehensive package of healthcare services’ (NHI, 2011).

NHI will require closer co-operation between private and public health care providers in order to provide more cost-effective and efficient health care services for all South African citizens. The essence of the NHI scheme is to channel funds from the private healthcare sector to the public healthcare sector, which is cash strapped and struggling (NHI, 2011).

NHI could be successfully address our severely unequal society, with life expectancies and health-related equalities of life. Policy-makers around the world face similar challenges regarding medicines lists, health benefit plans and health technology assessment (HTA) (Chalkidou et al, 2015:3). Medicine lists and health technologies have been implemented formally by several high-income countries and are increasingly being adopted in low- and middle-income settings. In addition, it is widely recognised that wide and transparent stakeholder engagement on issues of decision-making and prioritisation is the key to the success of these processes, with authorities setting out guidelines aimed at encouraging participation from the public, patient groups, healthcare providers and medicines councils (Health Information and Quality Authority, 2014).

Pregnant women with diabetes mellitus face life-threatening complications; NHI could greatly assist such women, especially those in rural areas where services have historically lagged.

With the support of NHI, the risk of complications due late diagnosis of GDM may be minimised and if managed well, Type-2 diabetes in the future may be prevented or delayed. The professional nurse will be in a position to provide the necessary assistance to pregnant women with GDM for self-management strategies.
The mission of the NHI collaboration is to guide decision makers to effective and efficient healthcare-resource allocation for improving people's health. Health technology was defined in the broadest sense as 'an intervention that may be used to promote health, to prevent, diagnose or treat acute or chronic disease, or for rehabilitation'.

In the private sector, a Preferred Provider Network of diabetes centres around South Africa has been formed, where facilities are available to deliver minimum services to members of certain medical aid schemes, but not all patients have access to this service (Hofman, Cook & Levitt, 2014:16). There are over 230 Centres for Diabetes and Endocrinology around South Africa, providing holistic management of diabetes mellitus (De Mendonca, 2009:91; Centre for Diabetes and Endocrinology (CDE), 2009). Unfortunately, these remain out of reach for most South Africans.

The current position of NHI in SA is that several research units at academic and self-funded institutions are already conducting research and providing training in economic evaluation and pharmaco-economic assessment. The recently published tertiary and quaternary essential medicines list suggests that specialised medicines have been scrutinised, but the rationale for positive or negative recommendations is not yet explicit (NDoH, 2015). Much of the economic evaluation research work in SA has focused on the curative aspects of HIV/Aids and tuberculosis epidemics and has not expanded to four other priority areas: maternal and child health, reproductive health, injury and non-communicable disease (diabetes mellitus included) (Chola et al., 2016:11).

Financial issues may affect the patient living with diabetes mellitus, whether treatment is managed in the private or in the public health sector.

If the patient receives treatment in the private sector, the affordability or otherwise of medical aid schemes or insurance and the limitations imposed by a particular scheme will affect the level of management experienced by the patient. Only 20% of the population of South Africa is treated in the private sector (Distiller & Cullinan, 2004:16).

With NHI, whether a person is treated in private or in the public sector, the delivery of services will be the same. The NHI will function like a medical scheme for the poor, enabling the same standard of care as the private medical aid schemes currently enable. In conclusion, NHI offers hope for South Africans, the majority of whom have
not had access to a decent standard of health care due to financial constraints. NHI would make health care services affordable, accessible and available to all.

Financial aspects of low- and high-risk pregnant women differ, with rural populations usually far worse off than their urban counterparts. The NHI strategy seeks to accommodate all citizens and maximise accessibility for proper management of all conditions, including GDM. It is seen as the answer for those low-risk pregnant women who have severe financial hardships and for those, both low- and high-risk, who have no access to medical aid schemes.

2.14 Diabetes Guidelines
All diabetes guidelines have similar methods of diagnosis and screening, with a few variations when it comes to risk factors and management. The pharmacological aspects of management are consistent; some add dietary guidelines and few or none specify exercise as part of treatment. The researcher studied the following guidelines: ADA, WHO, IADPSG, SEMDSA, ACOG, ADIPS, with a heavier leaning towards the SEMDSA guidelines because they accommodated all the others, and were relevant for South Africa.

2.14.1 Diagnosis
Pregnant women presenting with elevated blood glucose (hyperglycaemia) for the first time at any stage of pregnancy are diagnosed as having GDM. Fasting plasma glucose (FPG) should be between \( \geq 5.1 - 6.9 \text{ mmol/l} \geq 7.0 \text{ mmol/l} \); or one-hour post-glucose load (75 g) plasma glucose should be \( \geq 10.0 \text{ mmol/l} \).

Lastly two hours’ post-glucose load (75 g) plasma glucose should be \( \geq 8.5-11 \text{ mmol/l} \geq 11.1 \text{ mmol/l} \) (SEMDSA, 2017:30).

2.14.2 Screening
Pregnant women considered at high-risk for diabetes should be offered a 75g 2-hour OGTT at their first visit, and labelled as Grade B; a further test at 24 – 28 weeks should be administered if the first test is normal, and the label Grade A applied (SEMDSA, 2017:45). The use of electronic medical-records reminders or automated telephone reminder systems have been shown to improve patient compliance with screening, especially during the post-natal period. The postpartum visit is an opportunity not only
to screen for glucose tolerance but also to educate women with recent GDM pregnancies on their increased risk of Type-2 diabetes, and to provide counselling on the importance of physical activity and continued referrals to appropriate nutrition resources. Hence the ADA recommends that all women with a history of GDM be educated about lifestyle modification (Jean et al., 2014).

Guidelines from ACOG recommend that women with recent GDM pregnancies who have additional risk factors for Type-2 diabetes such as obesity receive diet, exercise and weight management counselling. Both ACOG and the ADA endorse the OGTT as acceptable postpartum glucose tolerance tests (Jean et al., 2014).

2.14.3 Women at risk

Pregnant women with the following conditions are at risk of GDM:

- repeated glycosuria
- previous GDM
- family history of diabetes (first-degree relative)
- history of stillbirths of unknown origin
- previous congenital anomalies
- suspicion of polyhydramnios in current pregnancy
- history of high-birth weight infant ≥ 4.5 kg
- obesity (BMI > 30 kg/m2)
- history of polycystic ovarian syndrome
- history of unexpected perinatal death and

2.14.4 Pharmacological management

The preferred pharmacological management of diabetes during pregnancy involves the use of insulin. Non-insulin oral agents, both metformin and glibenclamide, may be prescribed or continued during pregnancy under specialist supervision. Women with GDM and post-natal hyperglycaemia should be reassessed with a 2-hour OGTT at 6 weeks’ post-partum and then screened annually for diabetes (SEMDSA, 2017:30).
2.14.5 Dietary therapy
All diagnosed pregnant women with GDM should be referred to a dietician for detailed dietary advice. The diet should comprise approximately 40% carbohydrates (complex, low-glycaemic index, high fibre), 40% fat (at least 50% unsaturated) and 20% protein. The daily meal plan should include three meals, plus three or four snacks. Dietary consistency (in amount and timing of food intake) must be maintained to facilitate tight glycaemic control without inducing hypoglycaemia (SEMDSA, 2017:20).

2.14.6 Physical activity
None of the guidelines (ADA, WHO, IADPSG, SEMDSA, ACOG, ADIPS) mention physical activity during pregnancy as a component of management for diabetes mellitus in pregnancy.

2.15 Role Players
The role players in this study are the obstetrician, midwives, dietician and physical movement specialists responsible for the empowerment of high-risk pregnant women with GDM. Together they manage diet, physical activity, oral and insulin treatment. Also the role players should work as a team, with the main focus being self-management for the patient in order to reduce or delay complications to both low-risk pregnant women and women with GDM and Type-2 diabetes mellitus.

Self-management refers to the tasks that an individual must undertake to live well with one or more chronic conditions. Self-management involves managing cognitive processes and consequences by means of planning, organising, leading and control, (Jooste, 2010).

In this study, self-management refers to empowerment by means of a healthy diet which is relevant, available and appropriate in the context of low- and high-risk pregnant women in South Africa. It includes an understanding of the GDM condition. In this study women with GDM would use minimal carbohydrates and focus more on vegetables, fruits and proteins.

Self-management provides women with GDM with all the necessary skills and values essential during pregnancy, intrapartum and post-natal to promote a healthy lifestyle. The physical activities need to be practised frequently, at least three or five times a
week, according to SEMDSA guidelines (2017:174) in order to control GDM and prevent complications.

In this study the role players, also called the multi-disciplinary team, refers to all the health-care professionals who provide health education to patients on self-management of GDM to prevent or delay Type-2 diabetes in the future. Some of the multi-disciplinary team or role players are illustrated in Figure 2.2, which shows recommendations from the public sector. Low- and high-risk pregnant women are not generally referred to the ophthalmologist, dentist, podiatrist or audiologist, as recommended in this figure.

Figure 2.2: The ideal team for management of diabetes

2.15.1 Health care professionals

Health-care professionals are professionals based on their academic qualifications, employed to provide health-care to patients in a health facility. The health-care professionals in this study were the obstetrician, nurses, dieticians and human physical specialist workers, who were involved in caring for patients with GDM and Type-2 diabetes. In the public sector, patients are offered the services of the obstetrician, midwives and dietician only. In the private sector patients may receive help from the dentist, ophthalmologist, podiatrist and audiologist.
2.15.1.1 Nurse or midwife
A nurse or midwife is an individual who has passed the nursing qualifying examination in order to be licenced by the South African Nursing Council (WHO 2015) to enable the individual nurse or midwife to practise in South Africa. In this study, the term nurse/midwife refers to the central player of health education in the management of pregnant women with GDM in an antenatal diabetes clinic. Besides giving health education, the nurse/midwife also empowers pregnant women with information and personal counselling before, during and after pregnancy.

The nurse/midwife does screening during antenatal care and post-natal care for glucose tolerance, both to low-risk pregnant women and those with GDM. This is done any time from immediately after delivery until 6 weeks post-natal. Furthermore, nurses or midwives are supposed to educate on diet and physical activity at every antenatal care visit to prevent and delay Type-2 diabetes mellitus. They should focus more than is currently the case on low-risk pregnant women who are overweight or obese post-natal, and refer others who have recent GDM histories to a dietician for continued support and nutritional counselling (Jean et al., 2014).

2.15.1.2 Dietician
A lifestyle coach or dietician may be added to the team that supports and empowers patients with Type-2 diabetes (Delahanty, 2010). The dietician can help patients choose the correct diet to control blood sugar and maintain a healthy weight. In a study by Inzucchi, Bergenstal and Buse (2015) all pregnant women with GDM in the diabetes antenatal clinic were referred to the dietician for managing GDM and promoting normal blood glucose levels.

As most of the pregnant women had challenges of poor eating habits and cravings, the dietician had to plan individual diet plans according to the context of the individual pregnant women with GDM (Inzucchi, Bergenstal & Buse, 2015). The dietician who is knowledgeable and skilled in providing specific, individualised medical nutrition needs always to emphasise education and empowerment of women with GDM (Evert & Boucher, 2014).

It is important that each member of the health care team be knowledgeable about nutritional therapy principles for people with all types of diabetes, and be supportive of
their implementation, emphasising healthy eating patterns for all (ADA, 2017; Evert & Boucher, 2014). The rationale for nutrition therapy in pregnant women with diabetes is to improve overall health, maintain gestational bodyweight goals, control blood glucose levels and blood pressure, and prevent the complications of diabetes.

2.15.1.3 Human physical movement professional

Human physical movement is a specialist profession concerned with helping individuals, families, groups and communities to enhance their individual and collective well-being through physical activity (Colberg et al., 2016). In this study, a human physical activity specialist was consulted, as was literature related to physical activity for empowering pregnant women with or without GDM. The physical activity guidelines in the literature gave the benefits, duration and ‘how to’ of physical activity during pregnancy as a form of treatment for GDM and Type-2 diabetes mellitus.

The literature indicates that all individuals (pregnant and non-pregnant, with diabetes and without), should engage in physical activities that control blood glucose levels and break the pattern of sedentary living that leads to conditions related to obesity (Colberg et al., 2016).

2.15.1.4 Obstetrician

An obstetrician is both a gynecologist and a physician specialist who provides medical and surgical care to women and has particular expertise in pregnancy, childbirth and disorders of the reproductive system (www.healthcommunities.com/pregnancy/what-is-obgyn.shtml).
Obstetricians routinely perform antenatal care, delivery and postpartum evaluations of glucose tolerance in patients diagnosed with GDM. Women with disorders and conditions like diabetes in pregnancy, complications of pregnancy and labour are managed by the obstetrician in tertiary hospitals (https://www.angieslist.com/research/obstetrics-gynecology/).

The role of the obstetrician in this study was to manage high-risk women with GDM throughout pregnancy, labour and the post-natal period. The obstetrician monitored the pregnant women with GDM weekly and fortnightly if blood glucose levels were not controlled and, if controlled, monthly until 32 weeks’ gestation, then weekly until admission at 38 weeks’ gestation for delivery.

2.16 Institutions

Low-risk pregnant women are monitored in community health care centres and referred to hospitals when there is anything that needs the obstetrician. High-risk pregnant women are managed in the diabetic antenatal clinic and by the obstetrician when in hospital. High-risk pregnant women should attend all antenatal visits in the antenatal diabetes clinic in hospital, unlike low-risk pregnant women who will be referred to hospital only when the need arises. They will continue attending antenatal visits in the community health care centre.

2.17 Critical Summary of Literature Review

Literature on low and high risk pregnant women was critically reviewed, focusing on the quantitative experimental intervention research in order to inform the current study. Low risk pregnant women in this study were at risk if, they were overweight and obese as indicated by MUAC of 30 cm and above, BMI OF 30kg/2; had one or both parents with diabetes mellitus and had been diagnosed in the previous pregnancy with gestational diabetes mellitus (GDM) meaning that, they would develop GDM. Women with GDM are likely to develop complication of GDM such as big babies and Caesarean delivery becomes the likely mode of delivery. The solution therefore is the use of modified diet and planned physical activity within their context.

It also forms the basis for the development of the modified diet and planned physical activity guidelines for the pregnant women.
2.18 Conclusion

Education on all aspects of diabetes and its management before and during pregnancy should be provided by suitably trained educators. Pre-conception counselling is particularly important (SEMDSA Guidelines, 2017:57). Neonates should be assessed by a paediatrician. Patients with GDM should undergo a 75 g OGTT at six weeks to check for postpartum persistence of glucose intolerance. Contraception should be discussed and then implemented. Importantly, insulin requirements fall exponentially after delivery. Caution should be exercised during this period, in order to avoid hypoglycaemia. Furthermore, the management and treatment of GDM, diet and physical activity should be ongoing during pregnancy. Post-partum education and advice needs to be provided for both low- and high-risk pregnant women in order to control GDM complications.

In South Africa a greater provision of skills is needed for frequent and continuous education by obstetricians, midwives, dieticians and physical movement trainers. The GDM guidelines should always be emphasised by healthcare workers which, in this study, means the midwives. The guidelines should be implemented vigorously. The aim should always be to empower women of child-bearing age and their significant others to sustain a healthy lifestyle. The South Arian healthcare system can barely cope with its current load; rigorous interventions that looks far into the future are needed.

More emphasis needs to be placed on modified, contextualised healthy diets at the initial visit and subsequent visits. Pregnant women need to engage with planned physical activities based on the physical activity guidelines that stipulate 150 minutes of moderate exercise per week. Moderate physical activity includes walking and swimming, and can be for at least 30 minutes daily for five days a week. Moderate aerobics can also be undertaken (WHO 2015). All clinicians (the obstetrician, dietician, midwife, physical movement educator, midwives and diabetic nurse educator) should emphasise modified diet and planned physical activities that will delay or prevent Type-2 diabetes. The intervention programme should take into account the need to motivate women who fail to comply with guidelines. They need frequent motivation, positive reinforcement and support during all antenatal visits.
CHAPTER 3
METHODOLOGY

3.1 Introduction

The previous chapter focused on a literature review of all GDM-related issues. This chapter focuses on the research design and methods used in the study. The study followed the quantitative experimental intervention research design. The research design and methodology will be discussed according to the phases of their implementation in the study, as follows:

**Phase 1:** identifying and describing the anthropometric measurements and research instruments to be used for the modified diet and planned physical activity.

**Phase 2:** identifying and describing the effect of the modified diet and planned physical activity intervention in low- and high-risk pregnant women.

**Phase 3:** preparing for randomisation of low-risk pregnant women to participate in the intervention/experimental and control groups. There was no randomisation of high-risk women with GDM, as all of these women fell in the intervention group.

**Phase 4:** identifying and describing the relationship between the use of the modified diet and planned physical activity intervention in the low-risk pregnant women and in the high-risk pregnant women.

**Phase 5:** describing the guidelines to promote a healthy lifestyle to women with low- and high-risk pregnancies.

The guidelines will be used to develop an intervention strategy of modified diet and planned physical activity for implementation amongst low-risk pregnant women and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality in the Eastern Cape, South Africa.

Figure 3.1 below shows the research process used in this study; Table 3.1 presents the process in more detail:
Figure 3.1: The research process
3.2 Setting of the Study for all the Phases

The study was conducted in Buffalo City Metropolitan Municipality, situated relatively centrally in the Eastern Cape Province. The Eastern Cape Province is the second largest province in South Africa, and covers some 169,580 square kilometres, which is 13.9% of South Africa’s total land area. The province has the third largest population of South Africa’s provinces. Eastern Cape Community Survey (2016) stated that the population of the Eastern Cape increased from 6.6 million people in 2011 to 7 million in 2016, making it the third most populous province in the country, behind Gauteng at 13.4 million and KwaZulu-Natal at 11.1 million (Eastern Cape Census 2011). The number of households in the province has also increased to 1.8 million in 2016, from 1.7 million in 2011. The district municipality with the largest share of households in the province is Buffalo City Metropolitan Municipality (368 520), followed by OR Tambo (313 889), Nelson Mandela Bay (247 759), Amathole (222 415), Alfred Nzo (195 979), Chris Hani (191 356), Sarah Baartman (138 182) and Joe Gqabi (95 294). The province is generally seen as one of the two poorest in South Africa. There are two major urban conurbations within the Province, Nelson Mandela Bay Metropolitan and Buffalo City Metropolitan Municipality (Eastern Cape Census, 2011).

Buffalo City Metropolitan Municipality (East London) is the key urban centre of the eastern part of the Eastern Cape and consists of East London to the east, through to Mdantsane and reaching Dimbaza in the west, which is more rural. East London is the primary node, while the King Williams Town (KWT) area is the secondary node. It also contains a wide band of rural areas on either side of the urban corridor. Buffalo City MM’s land area is approximately 2,515 km², with 68km of coastline. A large swathe of Buffalo City Metropolitan Municipality comprises peri-urban and rural settlements, which are distinct in character and land use patterns, and include Newlands settlement and Ncera settlement, both located west of East London (Eastern Cape Census 2011). Buffalo City Metropolitan Municipality is regarded as 61.9% urban and 21.1% rural.

The population groups in Buffalo City Metropolitan Municipality comprise the following: 86% is black African, with whites and coloured constituting 7% and 6%, respectively. The Indian or Asian group represents 1% of the population.

The population is characterised by a high unemployment rate, formal and informal housing structures and increasing diseases due to over population.
Buffalo City Metropolitan Municipality has four community health care centres (CHCs):

- Nontyatyambo CHC
- Dimbaza CHC
- Duncan village CHC and
- Gompo CHC.

Buffalo City Metropolitan Municipality also has four hospitals namely:

- Frere Hospital
- Cecilia Makiwane Hospital (CMH)
- Grey Hospital and
- Bisho Hospital.

Only two hospitals were used in this study, namely Frere Hospital and CMH because of their referral status in relation to the other two hospitals, Grey and Bisho. The public hospitals are Frere Hospital, Bhisho Provincial Hospital, Cecilia Makiwane Hospital (Mdantsane), Duncan Village Day Hospital which acts as a Community Health Centre and is known as DVDH, Grey Provincial Hospital (King William's Town), Mount Coke Hospital (renamed Bhisho Hospital in December 1991).

Hospitals located in Buffalo City Metropolitan Municipality are divided into private and public hospitals, which include a specialised TB hospital. Private hospitals and TB hospitals that did not form part of the study were Life Beacon Bay Hospital, East London Private Hospital, Grey Monument Private Clinic, St Dominics Hospital, St James Hospital and St Marks Clinic. The public TB hospitals are the Fort Grey TB Hospital and Nkqubela Chest Hospital (Mdantsane).

The hospitals selected for this study were Frere Hospital in East London and Cecilia Makiwane Hospital (CMH) in Mdantsane. Frere Hospital is the referral centre for East London, a portion of King Williams Town and the rural areas surrounding East London, namely Mooiplaas, Chalumna, a portion of Butterworth and Idutwa.

CMH is a referral hospital for Mount Coke Hospital (now known as Bisho Hospital) with referrals from King William’s Town and Dimbaza CHC. Grey Provincial Hospital serves
rural areas and Mdantsane serves urban referrals from the clinics and Nontyantyambo CHC.

The population of East London is 267,007 and is served by three CHCs (DVDH, Empilweni and Gompo). The Mdantsane population is 156,835 (Census, 2011) and is served mainly by Nontyantyambo CHC. Table 3.2 shows the hospitals of Buffalo City Metropolitan Municipality. Table 3.3 shows the community health care centres (CHCs) in rural and urban areas of Buffalo City Metropolitan Municipality.

Table 3.1: Hospitals and CHCs of Buffalo City Metro

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Urban</th>
<th>Rural</th>
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<tr>
<td>Frere Hospital</td>
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<td>Cecilia Makiwane Hospital</td>
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<td>Bisho Hospital</td>
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<td>X</td>
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<tr>
<td>Grey Hospital</td>
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Table 3.2: Community Health Care Centres in Buffalo City Metro

<table>
<thead>
<tr>
<th>CHC's</th>
<th>Urban</th>
<th>Rural</th>
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<tbody>
<tr>
<td>Nontyantyambo</td>
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<tr>
<td>Gompo</td>
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<tr>
<td>Dimbaza</td>
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<td>Duncan Village</td>
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3.3 Phase 1: Quantitative

A quantitative design was used in the first phase. Phase 1 described setting, research questions, objectives, research methods, data collection, reliability, validity, data analysis and interpretation. Anthropometric measurements and questionnaires were also described.

3.3.1 Quantitative design

Quantitative research focuses on strategies which are experimental in nature and which can improve and make a difference in people’s lives (Melnyk & Morrison-Beedy,
The aim is to investigate phenomena, leading to precise measurements and quantification involving a rigorous and controlled design (Polit & Beck, 2014:763). In this quantitative research, the researcher carefully measured and quantified the effects of modified diet and planned physical activity using anthropometric measurements. The focus was on the cause and effect relationship, implementation of the intervention or treatment, and on the outcome. The researcher in this study was interested in reducing complications to low-risk and high-risk pregnant women with GDM. The aim was also to promote a healthy lifestyle in low- and high-risk pregnant women using modified diet and planned physical activity within a specific context. Previous studies done on diet and physical activity tend to emphasis a western diet. Physical activity also emphasis on exercises that are western in nature, such as aerobics, exercising using machines, and attending gyms. A contextually appropriate modified diet and planned physical activity strategy would emphasis food available to the women among whom it is promoted and exercise that does not involve expenditure of money.

**3.3.2 Research question: Phase 1**

What anthropometric measurements are needed for modified diet and planned physical activity for low- and high-risk pregnant women in Buffalo City Metropolitan Municipality, Eastern Cape?

**3.3.3 Research objectives: Phase 1**

The objective of Phase 1 was to identify and describe the anthropometric measurements needed for a modified diet and planned physical activity for low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape.

**3.3.4 Population**

Population is the entire element, whether individuals or objects, that meet inclusion criteria in a given universe (Polit & Beck, 2014:273).
The population of Phase 1 were all low- and high-risk pregnant women attending Buffalo City Metropolitan Community Health Care Centres, Frere Hospital and CMH. Low-risk pregnant women were those who had no complications, were healthy with no chronic conditions, and had healthy infants. High-risk pregnant women with GDM were those diagnosed with GDM during their second trimester at 24 to 26 weeks’ gestation.

The target population is the entire population (in this case, low-risk and high-risk pregnant women with GDM) in which a researcher is interested and from which the researcher would like to generalise the study results (Polit & Beck, 2014:766). The target population for Phase 1 was low-risk pregnant women and high-risk pregnant women with GDM.

3.3.4.1 Target group: Low-risk pregnant women

The population group for Phase 1 was low-risk pregnant women attending antenatal care during their second trimester, with gestational age at entry being 16 weeks to 24 weeks, in a CHC in Buffalo City Metropolitan Municipality, Eastern Cape.

Most pregnancies are low-risk because most women are healthy and have few or no complications. They attend antenatal care frequently, which allows for birth preferences to be followed by the midwifery team. When the weight, overall health, and age are within the safe range (18 years to 35 years old), and when the woman has had one to three babies already, then both mother and the baby are assured of a safe pregnancy and delivery (Department of Health, 2015:13). In this study, low-risk pregnant women referred to all healthy pregnant women from 20 weeks’ gestation attending community CHCs for antenatal care in Buffalo City Metropolitan Municipality.

a) Inclusion criteria for low-risk pregnant women

Inclusion sampling criteria refers to characteristics that allow individuals to form part of the target population (Burns & Grove, 2013:45). For this study, inclusion sampling criteria referred to the following:

- low-risk pregnancies;
- 20 weeks’ to 26 weeks’ gestation;
- attendance at ANC clinics in a CHC;
- child-bearing age (18 – 35 years);
• ability to speak Xhosa and English;
• pregnant with a singleton

All low-risk pregnant women meeting these criteria were approached by the researcher and research assistant (the midwife) and, if they showed an interest in the project were recruited during their first antenatal visit.

b) Exclusion criteria for low-risk pregnant women
Burns and Grove (2013:345) describe exclusion criteria as the characteristics that make a participant not fit the description of the target population. In this case, exclusion criteria were:
• the presence of abnormalities;
• mentally disturbed.

c) Sampling of low-risk pregnant women
In this study the sample comprised low-risk and high-risk pregnant women with GDM. The researcher used stratified random sampling for drawing a sample of low-risk pregnant women. Stratified random sampling divides the population into sub-groups or strata, so that each population belongs to one strata (Polit & Beck, 2014:280). In this study, 20 – 26 weeks’ gestation was used as a stratifying variable. Low-risk pregnant women were the one group, and high-risk pregnant women with GDM were the second group or strata in this study. Stratified random sampling was relevant for this study because of the different sub-groups of the population (Brink et al., 2014:1130). The sample was randomly selected from low-risk pregnant women registered in each community health care centre to avoid any unfairness (De Vos, Strydom, Fouche & Delport, 2013:230; Creswell 2014:156). Random sampling involves a selection process in which each element in the population has an equal chance of being selected (Polit & Beck, 2014:280).
d) Sample framework of low-risk pregnant women

Polit and Beck (2014:765), perceive the sampling frame as the list of elements in the population from which the sample will be chosen. The sampling frame in this study was all the low-risk pregnant women on the registers of Dimbaza, Gompo, DVHD and Nontyantyambo Community Health Care Centres in Buffalo City Metropolitan Municipality in the Eastern Cape.

e) Sample size for low-risk and high-risk pregnant women

Power analysis was used based on a significance level of 5% and minimum significant difference and within participant correlations of at least 0.5. The sample size was 132 for the controls and 264 for experimental group of low-risk pregnant women; for the experimental group of women with GDM the sample size was 30 (Grove et al., 2013:367).

f) Data collection for low-risk and high-risk pregnant women

Data collection was divided into two phases, namely Phase 1, stage 1 and Phase 1, stage 2. Stage 1 was to describe the instrument and stage 2 was to discuss the anthropometric measurements used during the data collection procedure for low- and high-risk pregnant women. These stages took place in Buffalo City Metropolitan Municipality, Eastern Cape during February to April 2017.

g) Data collection procedure for low-risk pregnant women

Data collection is a practice that every researcher has to undertake. It plays a crucial role in any study because the study depends on the data collected for its accuracy (Brink et al., 2014:147). The researcher collected data from low-risk pregnant women. Data was collected at four community health care centres, Empilweni and DVHD in East London, Nontyantyambo in Mdantsane and Dimbaza CHC near King Williams Town. The first three CHCs were in the urban areas, whereas Dimbaza CHC served the rural community surrounding King Williams Town.

Questionnaires were distributed by the researcher to low-risk pregnant women to obtain information on their initial entry for baseline data at 20 to 24 weeks’ gestation. After the initial visit there were three follow-up visits at 26, 30 and 34 weeks’ gestation.
On the women’s second to fourth visit, the researcher and research assistants implemented the intervention and used the checklist guide for recommending the modified diet and planned physical activity. They were also engaged in the activities of taking of blood pressure, pulse, blood glucose levels, BMI, MUAC, weight and urine testing. Suggested to be removed from here to data collection page 92

3.3.4.2 Target group: high-risk pregnant women with GDM

a) Target population

High-risk pregnant women with GDM were another population group attending antenatal clinics during the second trimester of pregnancy, at gestational age 24 to 26 weeks.

A high-risk pregnancy is one that threatens the health or life of the mother and her unborn baby especially where diabetes or GDM is present (Department of Health, 2015:101; Melnyk & Morrison-Beedy, 2012:1; Burns & Grove, 2013:42).

GDM is a temporary condition diagnosed for the first time in pregnancy, surfacing at 24 to 26 weeks’ gestational age (Sellers, 2014:247). GDM is the onset of abnormal carbohydrate metabolism diagnosed during pregnancy (Littleton-Gibbs & Engebretson, 2013:366). Also, GDM may viewed as glucose intolerance first recognised in pregnancy.

In this study GDM refers to all pregnant women from 24 – 28 weeks, diagnosed with gestational diabetes and attending a tertiary hospital diabetic clinic during antenatal care. Women with GDM attend diabetic clinic in the tertiary hospital during antenatal care in the second trimester because GDM generally appears at 24 weeks to 26 weeks’ gestational age.

b) Inclusion criteria for high-risk pregnant women with GDM

Inclusion sampling criteria refers to characteristics that allow a person to form part of the target population (Burns & Grove, 2013:345). For this study inclusion sampling criteria for high-risk women were:

- the presence of high-risk GDM;
- 24 – 26 weeks’ gestation;
- attendance at an ANC diabetic clinic in Frere or Cecilia Makiwane Hospital;
- child bearing age (18 – 35 years);
- ability to speak Xhosa and English because pregnant women could be a Xhosa, Coloured, Indian and any other English speaker
- pregnant with a singleton.

All pregnant women with GDM meeting these criteria were approached by the researcher and research assistant (the midwife) if they showed an interest in the project. Research assistant is the midwife who is helping the researcher during data collection from initiation until the last visit in different institution used. Pregnant women with GDM were recruited at approximately 24 to 26 weeks’ gestation, when they had been diagnosed with GDM, and following a visit to the diabetes educator and a visit to the dietician.

c) Exclusion criteria of high-risk pregnant women with GDM

Burns and Grove (2013:345) described exclusion criteria as the characteristics that make a participant not fit the description of the target population. In this case exclusion criteria were:
- abnormalities;
- mentally disturbed;
- the presence of pre-diabetes (Type-1 or Type-2 diabetes mellitus).

Table 3.4 shows the characteristics of low- and high-risk pregnant women in this study.

Table 3.3: Characteristics of low-risk and high-risk pregnant women with GDM

<table>
<thead>
<tr>
<th>Low-risk pregnant women</th>
<th>High-risk pregnant women (GDM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy women</td>
<td>Risky health condition like GDM</td>
</tr>
<tr>
<td>Pregnant with no complications</td>
<td>Temporary condition induced by pregnancy</td>
</tr>
<tr>
<td>Delivered in midwifery-led centres</td>
<td>Delivered in hospital by doctors</td>
</tr>
<tr>
<td>Singleton pregnancy</td>
<td>Condition appears for the first time</td>
</tr>
<tr>
<td>From 20 – 26 week’s gestation when data collection is initiated to LRPW because GDM started during these weeks.</td>
<td>GDM usual occurs during 24 – 26 weeks gestation, hence data collection is initiated at that time</td>
</tr>
<tr>
<td>Aged between 18 and 35 years old</td>
<td>Aged between 18 and 35 years old</td>
</tr>
<tr>
<td>Attending ANC and delivered in community health care centres</td>
<td>Attending ANC diabetes clinic in the hospital</td>
</tr>
</tbody>
</table>
d) Sampling of high-risk pregnant women with GDM

The researcher used stratified random sampling for drawing the sample of high-risk pregnant women with GDM. Stratified random sampling divided the population into sub-groups or stratas, so that each population belonged to one strata. In this study 22 – 26 weeks’ gestation was used as a stratifying variable (Polit & Beck, 2014:281).

Stratified random sampling was relevant for this study because of the different sub-groups of the population (Brink et al., 2014:130). Random sampling enabled the researcher to select women with GDM from the ANC diabetes register and the M4 ward at Frere Hospital where high-risk women were admitted during pregnancy.

In CMH, women with GDM were randomly selected from the high-risk clinic register and the ward 16 register, to avoid any unfairness (De Vos, Strydom, Fouche & Delport, 2013:230; Creswell, 2014:156). Random sampling involves a selection process in which each element in the population has an equal chance of being selected (Polit & Beck, 2014:280).

e) Sample framework for high-risk women with GDM

Polit and Beck, (2014:765) perceive the sampling frame as the list of elements in the population from which the sample is chosen. The sampling frame in this study was all the high-risk women on the ANC diabetic clinic register and M4 ward register in Frere Hospital, and all the women with GDM in the high-risk clinic and ward 16 registers in CMH. Table 3.5 shows the sample criteria for both the low- and high-risk groups.
Table 3.4: Sampling for low- and high-risk women with GDM

<table>
<thead>
<tr>
<th>Low-risk pregnant women</th>
<th>High-risk pregnant women (GDM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-risk pregnant women were selected for the control and intervention groups.</td>
<td>All pregnant women with GDM were in the intervention group.</td>
</tr>
<tr>
<td>Low-risk pregnant women were selected from the ANC register.</td>
<td>All women on the ANC register at Frere Hospital diabetes clinic and women admitted to M4 ward and diagnosed with GDM</td>
</tr>
<tr>
<td>Healthy low-risk women with no disease</td>
<td>Women with other conditions were not allowed to take part in the study.</td>
</tr>
<tr>
<td>Gestational age from 20 – 26 weeks</td>
<td>Gestational age of 22 – 26 weeks of for women with GDM</td>
</tr>
<tr>
<td>Age group 18 – 35 years old</td>
<td>Age group of 18 – 35 years old</td>
</tr>
<tr>
<td>Women attending ANC visits at the community health care centres (Dimbaza, Gompo, DVDH and Nontyanhayamo)</td>
<td>Women attending ANC visits at CMH and Frere Hospital</td>
</tr>
<tr>
<td></td>
<td>All women with sugar levels above 5.5 mmol/l</td>
</tr>
</tbody>
</table>

f) Data collection procedure for high-risk women (GDM)

Data was collected from high-risk pregnant women with GDM at two hospitals, namely Frere Hospital in East London and Cecilia Makiwane Hospital (CMH), a regional hospital in Mdantsane. Questionnaires were also distributed by the researcher to high-risk pregnant women with GDM to obtain baseline data of all the anthropometric measures of weight, BMI, MUAC, BP, pulse, glucose levels and urine at their initial entry at 20 to 24 weeks’ gestation.
On the second to fourth visit the researcher and assistants implemented the intervention strategy of recommending the modified diet and planned physical activity to high-risk pregnant women with GDM. They also engaged in activities such as taking blood pressure, pulse, blood glucose levels, BMI, MUAC, weight and urine for testing.

Both low- and high-risk pregnant women participated in this study, after receiving an explanation of the study by the researcher, research assistant or midwife at the clinic or hospital. Each participant signed the consent form as a sign of voluntary agreement and engagement in the study. After randomisation was conducted, the questionnaire was handed out and anthropometric measurements were taken. Lastly, the modified dietary and planned physical activity information was explained. Participants in the low-risk intervention group and high-risk pregnant group were all given log books for recording. All three groups (control group and intervention groups of low-risk women, and intervention group of high-risk women) were visited three subsequent times and continued to have measurements taken – blood pressure, pulse, blood glucose levels, BMI, MUAC, weight and urine testing, as explained above.

3.3.5 Validity

Validity refers to the accuracy of the tools and their ability to consistently measure the phenomenon they purport to measure (De Vos, Strydom, Fouche & Delport, 2013:1773). The tool was assessed and approved by experts in physical movement and the dietician. The tool was retested for consistency to see if it yielded the same results. To confirm the thoroughness of the implementation of the intervention, the research assistants and midwives underwent training (De Vos, Strydom, Fouche & Delport, 2013:1773).

3.3.5.1 Content validity

Content validity is an assessment of how well all the components of the variable are represented during development of the instrument (Brink et al., 2014:160; De Vos et al., 2013:173). In this study the questionnaire covered all the elements of the content to be measured. Furthermore, the instrument was sent to the statistician for assessment.
3.3.5.2 Face validity
Face validity is the obvious and weakest point of validity and is based on intuitive judgement. It is subjective. Both content and face validity were ensured at the beginning of the development of the questionnaire; it was found to answer the research objectives of the study, with the help of a statistician and experts in midwifery, (Brink et al., 2014:160).

3.3.5.3 Criterion-related validity
Criterion related validity refers to a pragmatic approach that establishes the relationship between the instrument and the external criteria by comparing them to another measure that is valid. It involved using the same instrument to collect data from two group of participants. In this study, the intervention and control groups from the sample of low-risk pregnant women were used for correlation purposes (De Vos, et al., 2013:1774).

3.3.5.4 Predictive validity
Predictive validity places the emphasis on future outcomes, comparing the research instrument results obtained from a particular population with the result that is expected to occur in that population in the future. In this study the researcher believed in the value of the modified diet and planned physical activity as lifelong aspects of a healthy lifestyle, a belief that was supported by the literature (Brink et al., 2014:160).

3.3.5.5 Concurrent validity
Concurrent validity in this case focused on comparing the normal diet and levels of physical activity with the newly constructed modified diet and planned physical activity (Brink et al., 2014:160).

3.3.6 Reliability
Reliability is a method used by the researcher to check whether the devices, tools and techniques used yield what is expected. Furthermore, reliability tests the consistency of the questionnaire among all participants (De Vos et al., 2013:1773). The questionnaire in this study was composed in easy, understandable language and had simple, standardised instructions for all the participants. In addition, the researcher used a pilot study to test for any pitfalls and errors that may have provided problems
in the actual study. As soon as the pilot study was completed, any such errors were identified and corrected.

3.3.6.1 The pilot study

The researcher conducted the pilot study before commencing with data collection to identify and correct any questions and concepts the participants did not understand. The rationale for doing the pilot study was to establish its feasibility on a small cohort of participants (Brink et al., 2014:56). The pilot enabled the researcher to detect what aspects did not work as well as planned, and which might have affected the data collection instrument (Brink et al., 2014:56). In this study, 10% of the questionnaires handed out to the low-risk pregnant women in the four community health care centres – Nontyantyambo, DVDH, Gompo and Dimbaza – and the two hospitals – Frere and Cecilia Makiwane – were selected for the pilot and were not part the study.

In total 27 low-risk pregnant women and three high-risk pregnant women participated in the pilot study. The researcher collected the data herself, with the help of research assistants, after getting permission from the community health centres and hospitals. The results were analysed separately with the assistance of the statistician.

One adjustment was then made: The question regarding gender was removed from the section on demographic information, since the study was for females only. All other questions were relevant and the questionnaire was adopted in format and scale as it was. The questionnaire adequately covered all the content and elements to be measured. Lastly the questionnaire was sent again to the statistician for assessment.

The questionnaires were all numbered, and included the telephone numbers of participants. The researcher anticipated the risk of being given incorrect telephone numbers or of participants changing numbers, but included these since ethically, names and addresses could not be asked. Telephone numbers allowed some possibility of tracing participants who might otherwise have slipped out of the study for various reasons and been lost to data collection. An additional 10% of participants had already been added to the total number to accommodate the anticipated problem of losing participants during the research process.
3.3.7 Data analysis for all the phases

Data generated through the questionnaire were captured into Microsoft Excel and transferred into the Statistical Package for Social Sciences (SPSS) version 24. Before performing the analysis, simple frequencies were run to check data for errors and outliers. Questionnaires were revisited to correct observed errors. Descriptive statistics for all study variables were compiled. To examine potential differences in the study groups (control and intervention) and study variables (weight increase, BMI increase, MUAC increase, changes in modified diet and exercise), a factorial analysis of variance was used for continuous variables and the chi-square test was used for categorical variables. Variables were examined to ensure they did not violate the criteria for performing analysis of factorial analysis of variance. Data were checked to ensure there were no outliers. Levene’s test was used to examine equality of variances between the groups at repeated measures. Mauchly’s Test of Sphericity was observed. The alpha value for statistical significance was set at 0.05, with a Bonferroni correction applied for comparisons of continuous variables between study groups. In this study the researcher used list-wise deletion of cases with missing data.

3.3.8 Description of the questionnaire for all the phases

3.3.8.1 Research instrument tool

The structured questionnaire with closed and open-ended questions was developed by the researcher with the help of the statistician and used to collect data in this study. Various types of questions were used in the questionnaire in order to understand the participants. Closed questions required a ‘yes’ or ‘no’ response and open questions required more complete and considered answers. Other questions required participants to choose the relevant answer in the box that best defined their situation. Some questions made use of the Likert scale, where participants had to rate answers as ‘strongly disagree’, ‘disagree’, ‘uncertain’, ‘agree’ or ‘strongly agree’. Likert-scale questions were used to ascertain the opinions of low- and high-risk pregnant women.
Questionnaires were distributed by the researcher and research assistants during the first visit to the low- and high-risk pregnant women and collected on the same day. Data were collected daily from Monday to Thursday for the initial visits of low- and high-risk pregnant women, from February to mid-May 2017.

No data were collected on Fridays because the day was set aside for scans in all CHCs that rendered ANC services. Data collection was done on Mondays and Wednesdays only from February 2017 to mid-May 2017 from participants visiting Nontyantyambo CHC. From mid-May 2017 to mid-August 2017, the researcher and research assistants implemented the intervention strategy of recommending the modified diet and planned physical activity to the low- and high-risk pregnant in the intervention group.

The questionnaire was divided into ten sections, as follows:

A) Demographic
The demographic section focused on age, marital status, setting, employment, ethnicity, level of education and home language. The rationale for demographic data was to gain an understanding of the participants.

b) Anthropometric measures
The anthropometric measures used in this study were those that are relevant to low-risk pregnant women and high-risk pregnant women with GDM. The anthropometric measures were used to monitor the women’s health in order to detect any abnormalities during pregnancy and to intervene accordingly.

c) Medical history
Medical history was used for screening any undiagnosed problems of low- and high-risk pregnant women. The medical history was also relevant for the matter of participants’ eligibility; the inclusive criteria stated that only low-risk women with no pre-existing conditions and high-risk women with GDM, not Type-1 or Type-2 diabetes, were eligible for the study.
d) Past and present obstetric history
Past and present obstetric history was obtained to ascertain parity and gravida and detect possible problems related to different deliveries, types of delivery and outcomes for the baby.

e) Lifestyle history
Lifestyle history focused on describing lifestyle behaviour, especially the use of alcohol, smoking and drugs during pregnancy. The rationale for the lifestyle history was to detect any substance abuse and educate about the dangers of smoking, alcohol and drug use during pregnancy that would negatively affect the unborn baby. The researcher advised the pregnant to stop using alcohol, drugs and smoking during pregnancy.

f) Diabetes mellitus and gestational diabetes mellitus (GDM)
Diabetes mellitus and GDM questions were aimed at the pregnant women who were at risk due to poor lifestyle (obesity and overweight) and genetic risk factors (family history of diabetes).

g) Stakeholders
Stakeholders in this study were the midwife, dietician, an obstetrician and the physical movement specialist who emphasised education about modified diet and planned physical activity. The pregnant women were asked to describe their understanding of the roles of the various stakeholders in the diabetic antenatal care clinic in the hospital.

h) Theoretic framework
The theoretic framework formed part of the questionnaire which was based on the principles of the theories chosen by the researcher. The researcher was interested in how to empower pregnant women to maintain self-care, promote health and manage GDM, using the help offered by the midwife, dietician, obstetrician and physical activity movement specialist.
i) Planned physical activity

Planned physical activity, which formed part of the core of this study, questioned participants on their awareness of the benefits of physical activity, the type of physical activity, engaged in, and its duration and frequency in relation to WHO (2015) physical activity guidelines for pregnant women.

j) Modified diet

Modified diet formed another core aspect of this research study. The benefits of correct, appropriate diet were emphasised, including carbohydrates, vegetables, protein and fruit. Correct and culturally relevant meals were described and prescribed by the dietician (WHO, 2015; NICE, 2008).

3.3.8.2 Anthropometric measurements for all the phases

3.3.8.2.1 Research questions

What were the anthropometric measurements needed for modified diet and planned physical activity for low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape?

3.3.8.2.2 Objectives

To identify and describe the anthropometric measurements needed for modified diet and planned physical activity for low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape.

The questions in section two of the questionnaire were based on activities conducted on the initial visit and subsequent visits. These involved the taking of:

- blood pressure,
- pulse,
- blood glucose levels,
- BMI,
- MUAC,
- weight and
- urine.

Data were collected from February 2017 to mid-May 2017.
Anthropometric measurements comprise various human body measurements used for comparison over a period of time. Anthropometric measurements can also be used when studying groups of people to evaluate health trends and concerns in various populations; for example, when assessing nutritional status. All the anthropometric measurements for both the low- and high-risk pregnant women with GDM were briefly explained during the initial visit and taken during the first trimester for baseline data, as explained below:

- **Blood pressure**: Normal blood pressure is $<100/60$ to $130/80$. If blood pressure was above these figures, the test was repeated after an hour, and if it was still elevated, the participant was referred immediately to avoid complications such as pre-eclampsia (Sellers, 2014: 189). Pregnant women should not have a diastolic pressure of 90 or above due to the dangers of high blood pressure in pregnancy, especially if it is accompanied with protein in the urine and oedema of the lower extremities. Such cases were referred.

- **Pulse**: Normal pulse rate in pregnancy is 80 – 100 beats per minute or lower (Sellers, 2014:189). Low-risk and high-risk pregnant women with abnormal pulse rates (above 100 beats or below 80 beats per minute) were monitored closely and referred if abnormal pulse rate persisted.

- **MUAC**: Mid-arm circumference is measured using a tape measure placed midway between the tip of the shoulder (acromion) and the tip of the elbow (olecranon) (Department of Health, 2015:33; Sellers, 2014:186). MUAC measures the risk of obesity, pre-eclampsia and maternal diabetes; 33cm and above is considered an indication of these risks. If it is 23cm or under, it indicates malnutrition and potential for smaller babies.

The MUAC gives useful information on nutritional status (Department of Health 2015:33; Sellers, 2014:186) and pregnancy risk, and is easily done during the antenatal period and during labour. MUAC is advantageous over BMI because height does not need to be measured, accurate scales are not required, the woman does not have to stand up straight and no calculations are needed. Lastly, MUAC, unlike weight, does not normally increase significantly during pregnancy.
Body weight: This was measured in light clothes to the nearest 100g (0.1 kg) using a Soehnle scale (Soenle-Waagen GmbH Co, Murrhardt, Germany). Body weight increases as pregnancy progresses. Weight is a significant indicator for the woman’s health and for whether the foetus is growing well during pregnancy.

Body mass index (BMI): BMI is internationally based on the World Health Organisation’s standards. It is calculated as weight divided by height squared (kg/m²) (Kasiam Lasi On’Kin, Longo-Mbenza, Nge Okwe, Kabangu, Mpandamadi, Wemankoy, 2008; Fattah et al., 2010:1). BMI is categorised as underweight (if below 25kg/m2), overweight (if 26kg/m2 – 30 kg/m2) and obese (if 30 kg/m2 or above).

Blood glucose level: At each morning visit, blood glucose was taken by finger pricking of all participants before they had eaten. Participants were instructed not to take anything orally that morning until taken blood had been taken in the clinic or hospital. A glucose level of 7mmol/L before meals is labelled as high and the test is repeated; if it is still the same, the woman with GDM will be referred to hospital.

Urine tests were done to assess bladder or kidney infections, diabetes, dehydration and preeclampsia by screening for high blood pressure, oedema of lower extremities, high levels of sugars, proteins, ketones and bacteria. High levels of sugars in the urine may suggest GDM (www.mayoclinic.org/tests-procedures/urinalysis/home/ovc-20253992).

3.4 Phase 2: Experimental

The experimental group was used in Phase 2 of this study. The rationale for using the experiment group was to compare results in the experimental and control groups. The two groups are explained below.

3.4.1 Experimental design

In experimental design, the emphasis is on the manipulation of one or more variables and the involvement of random selection to divide participants into experimental and control groups. All experimental design has three components; randomisation, control and experimental groups (Grove, Burns & Gray, 2013:245). The manipulation in this
study was the action taken by the study participants. The researcher manipulated the independent variable by allocating some participants to the intervention group and others to the control group (Polit & Beck, 2014: 251); Burns & Grove, 2013:198). The manipulation of events related to patients and their environment was ultimately for the improvement of their health.

3.4.2 Research question
What is the effect of diet and physical activity intervention on low-risk pregnant women and women with GDM on pregnancy outcomes in Buffalo City MM, Eastern Cape?

3.4.3 Objective
The objective was to describe the effect of the modified diet and planned physical activity intervention on low-risk pregnant women and high-risk pregnant women with GDM in Buffalo City MM, Eastern Cape.

3.4.4 Population
In this study there were two groups of low-risk pregnant women and one group of high-risk pregnant women with GDM.

3.4.4.1 Low-risk pregnant women
Only the low-risk pregnant women were randomised to the experimental/intervention group and the control group. The rationale for this design was to test and compare the groups for differences between the outcomes of the intervention. The two experimental groups – one low-risk women and one high-risk women – received treatment during the study whereas the control group did not receive treatment but continued with the standard or routine treatment for antenatal care.

The control group was also called the comparison group for the interventions or treatments. The rationale for the existence of a control or comparison group was to ensure the credibility of the study (Grove, et al., 2013:196 – 197).

3.4.4.2 High-risk pregnant women with GDM
All the high-risk pregnant women with GDM were in the experimental/intervention group. The rationale for assigning women with GDM to this group was to minimize potential pregnancy complications in women with GDM and to promote healthy
lifestyle modification. Experimental group are the pregnant women who will be counselled on modified diet and planned physical activity received the treatment during the study.

3.4.5 Data collection for both low- and high-risk women

Data was collected using questionnaires distributed by the researcher to low-risk pregnant women to obtain information for baseline data on their initial entry at 20 to 24 weeks’ gestation. After the initial visit there were three follow-up visits at 26, 30 and 34 weeks’ gestation. Low-risk pregnant women were assigned to either experimental/intervention group or the control group using research randomiser software during the second visit (26 weeks’ gestation).

3.4.6 Data analysis for both low- and high-risk women

Data generated through by questionnaire were captured into Microsoft Excel and transferred into the Statistical Package for Social Sciences (SPSS) version 24. Before performing the analysis, simple frequencies were run to check data for errors and outliers. Questionnaires were revisited to correct any observed errors. Descriptive statistics for all study variables were compiled to examine potential differences between the control and intervention groups in their variables (weight increase, BMI increase, MUAC increase, changes in modified diet and exercise).

3.4.7 Control group

The control group was also used in Phase 2. The control group was used to enable comparison with the experimental group. A control is used in research to enable manipulation of the factors that achieve a desired outcome (Grove, Burns & Gray, 2013:247).

The control group does not receive the treatment or intervention, and their performance regarding a dependant variable is used to evaluate the performance of the treatment group on the same dependable variable (Polit & Beck, 2014:89). In this study, the researcher was interested in comparing the dependable variable of the modified diet and planned physical activity amongst low-risk pregnant women and high risk pregnant women with GDM.
3.4.7.1 Control group for low-risk pregnant women

The low-risk pregnant women fell into both the control and the intervention groups in this study. The rationale for the existence of the control group was to evaluate the effect of the modified diet and planned physical activity as a solution to conditions related to a sedentary lifestyle.

The low-risk pregnant women in the control group had the same characteristics as those in the intervention group, and had been assigned one group or the other by the research randomiser programme used for allocation. Both groups were given sealed envelopes with information relating to whether they were in the control or intervention group. Low-risk women in the control group received the standard care given during antenatal visits at public hospitals and clinics. Standardise cared is routine care used to treat the patients, clients or participants in a study (Polit & Beck, 2014:252). Participants in the control group received no form of intervention in the study.

All low-risk pregnant women in the control group received the standard care and were monitored by midwives at each antenatal (ANC) visit, at 20, 26, 30 and 34 weeks’ gestation. In every follow-up visit, a checklist was used to record weight, blood pressure, blood glucose, MUAC, BMI and urine. Midwives informed the obstetrician in the hospital and referred women if there was any deviation from normal measurements.

The rationale for the referral of low-risk pregnant women to the obstetrician in hospital was to prevent any complications, irrespective of whether the pregnant woman was in the control group or the intervention group. The control group participants were used for comparison purposes with the intervention group. The main interest of the researcher was to study the effects of the lifestyle interventions on gestational weight gain and obesity-related complications during pregnancy.

3.4.7.2 Data collection

Data collection commenced at 26 weeks’ gestation for both the low- and high-risk pregnant women. All the anthropometric measurements discussed above were implemented at this stage. Data collected on the low-risk women in the control group were more or less the same as that collected for the low-risk women in the intervention group; the only difference was that one group received the modified diet and planned
physical activity input, and the other did not. Anthropometric measurements were taken in order to compare results of the groups.

3.4.7.3 Data analysis for all the phases

Data generated through the questionnaire were captured into Microsoft Excel and transferred into the Statistical Package for Social Sciences (SPSS) version 24. Before performing the analysis, simple frequencies were run to check data for errors and outliers. Questionnaires were revisited to correct observed errors. Descriptive statistics for all study variables was conducted. To examine potential differences in study groups (control and intervention) and the study variables (weight increase, BMI increase, MUAC increase, changes in modified diet and exercise), a factorial analysis of variance was used for continuous variables and the chi-square test was used for categorical variables. Variables were examined to ensure they did not violate the criteria for performing analysis of factorial analysis of variance. Data were checked to ensure there were no outliers. Levene’s test was used to examine equality of variances between the groups at repeated measures. Mauchly’s Test of Sphericity was observed. The alpha value for statistical significance was set at 0.05, with a Bonferroni correction applied for comparisons of continuous variables between study groups. In this study the researcher used list-wise deletion of cases with missing data.

3.5 Conclusion

Chapter 3 introduced the methodology and the five phases used in this study. The design, data collection, data analysis, reliability and validity were also discussed. Quantitative experimental intervention design is relevant for pregnant women in the control and experimental groups. Phase 1 was identifying the anthropometric measures and the questionnaire. Phase 2 was the identification and describing the effect of the modified diet and planned physical activity intervention in low- and high-risk pregnant women. Phase 3 was for the randomisation of low-risk pregnant women to participate in the intervention/experimental and control groups of which women with GDM were all in the experimental group and no control group. Phase 4 was for the identification and description of the relationship between the use of the modified diet and planned physical activity intervention in the low-risk pregnant women and in the high-risk pregnant women. Phase 5 was for the developing and description of the guidelines to promote a healthy lifestyle to women with low- and high-risk pregnancies.
CHAPTER 4
PRESENTATION OF DESCRIPTIVE RESULTS

4.1 Introduction

The previous chapter described the methodology phases, descriptive and experimental. This chapter presents the results of the descriptive data for low and high-risk pregnant women with GDM before being exposed to a modified diet and planned physical activity programme in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa. This chapter reveals the findings from all sections of the questionnaire, namely: section A – demographic data, section B – anthropometric measurements, section C – medical history, section D – obstetric history, section E – lifestyle history, section F – diabetes mellitus and gestational diabetes mellitus G – stakeholder’s role, section H – theoretical framework information, section I – modified diet and section J – planned physical activity.

In this chapter, the focus is on the descriptive data of the low-risk pregnant women attending antenatal care in four community health care centre in Buffalo City Metropolitan Municipality in Eastern Cape Province. The number of low-risk pregnant women who participated in the study was 291. The data reflects results for only the low-risk pregnant women who participated, and excludes values pertaining to women who suffered miscarriages, or who could not be traced due to loss of telephone or relocation.

High-risk pregnant women who participated in the study were n = 34. One from this group lost her baby due to stillbirth. Figures 1 and 2 illustrate the low and high risk pregnant women who participated from each community health care centres (CHC) and hospital with diabetic clinic.
4.2 Sample Distribution of Low-risk Pregnant Women in the CHCs

Figure 4.1 shows the distribution of the low-risk pregnant women sample. The overall distribution comprised low-risk pregnant women in four community health care centres in Buffalo City Metropolitan Municipality, Eastern Cape.

A total of n=291 (100%) questionnaires were distributed to low-risk pregnant women in the community health care centres. Out of the total, n=148 (100%) were from Nontyantyambo CHC, n=98 (100%), were from the DVDH CHC, n=36 (100%) were from Dimbaza CHC and n=9 (100%) were from Gompo CHC.

The distribution of low-risk pregnant women in urban areas was not balanced due to the high coverage of some antenatal care clinics (Nontyantyambo and DVDH) compared to others (Gompo CHC and Dimbaza CHC). Gompo’s coverage is very low because it is surrounded by many clinics. Dimbaza’s coverage was low because it is situated in a rural area, and most women prefer to attend clinics in urban areas. Also, urban areas tend to attract younger people seeking work; as a result, rural areas have a higher proportion of older people, many of whom are over the child-bearing age.
Figure 4.2: Sample distribution across hospitals

4.3 Sample Distribution of High-risk Pregnant Women with GDM

Figure 4.2 shows the distribution of the high-risk pregnant sample. The number of high-risk pregnant women (HRPW) with GDM who participated was 34 (100%). Returned questionnaires were from Cecilia Makiwane Hospital (CMH), n=13 (100%), and from Frere Hospital, n=21 (100%). The sample distribution of women with GDM was higher in Frere Hospital (n=21) than in CMH because all high-risk pregnant women from the surrounding referral clinics and community health care centres attended the Frere Hospital diabetes clinics on one particular day (Wednesday) of the week. In CMH diabetes clinic was open every day of the week from Monday to Friday, and so the figures tended to be lower each day and other days none.

4.4 Section A: Demographic Characteristics of Participants

The demographic profile included employment status, age, setting, marital status, education, ethnic group and language of the pregnant women in Buffalo City Metropolitan Municipality in Eastern Cape. The total number of participants was n=324. High-risk pregnant women with GDM were n=34 (10.5%). The demographic profile from section A of the questionnaire is discussed below.
Table 4.1: Demographic characteristics of the participants, n=291 and n=34

<table>
<thead>
<tr>
<th>Variables</th>
<th>LRPW</th>
<th>HRPW with GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>291 (100.0)</td>
<td>34 (10.5)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-21</td>
<td>34 (11.6)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>22-29</td>
<td>143 (49.1)</td>
<td>9 (26.5)</td>
</tr>
<tr>
<td>30-35</td>
<td>114 (39.3)</td>
<td>24 (70.6)</td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1-7</td>
<td>16 (5.5)</td>
<td>7 (20.6)</td>
</tr>
<tr>
<td>Grade 8-12</td>
<td>258 (88.6)</td>
<td>22 (64.7)</td>
</tr>
<tr>
<td>Diploma</td>
<td>12 (4.2)</td>
<td>5 (14.7)</td>
</tr>
<tr>
<td>Degree</td>
<td>5 (1.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>47 (16.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Employed</td>
<td>70 (24.0)</td>
<td>14 (41.2)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>161 (55.3)</td>
<td>18 (52.9)</td>
</tr>
<tr>
<td>Self-employed</td>
<td>13 (4.4)</td>
<td>14 (5.9)</td>
</tr>
<tr>
<td><strong>Setting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>251 (86.2)</td>
<td>24 (75.0)</td>
</tr>
<tr>
<td>Rural</td>
<td>40 (13.7)</td>
<td>8 (25.0)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>39 (13.4)</td>
<td>17 (50.0)</td>
</tr>
<tr>
<td>Single</td>
<td>250 (85.9)</td>
<td>17 (50.0)</td>
</tr>
<tr>
<td>Divorced</td>
<td>1 (0.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Widowed</td>
<td>1 (0.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>278 (95.5)</td>
<td>29 (85.3)</td>
</tr>
<tr>
<td>Coloured</td>
<td>11 (3.7)</td>
<td>5 (14.7)</td>
</tr>
<tr>
<td>Others</td>
<td>2 (0.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Home Language</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xhosa</td>
<td>277 (95.1)</td>
<td>27 (79.4)</td>
</tr>
<tr>
<td>English</td>
<td>14 (4.8)</td>
<td>7 (20.6)</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

4.4.1 Age

As Table 4.1 shows, the total number of LRPW and HRPW was n=325 (100%). The LRPW were n=291 (100%) and the HRPW were n=34 (100%).

Participants falling into the age group 18–21 of the LRPW were n=34 (11.6%); those aged 22–29 were n=143(49.1%); those aged 30–35 were n=114 (39.3%).
However, for HRPW, the total number aged 18–21 was only = 1 (2.9%); those aged 22–29 were n=9 (26.5%) and those aged 30–35 were n=24 (70.6%).

According to Table 4.1 LRPW aged 18–21 formed the healthy group and had no complications. This age group was the minority in this study for both low-risk and high-risk pregnant women because many in this age group are still engaged in schooling. This result is confirmed in a study done by Lawrence, Finer, Mia and Zolna (2016:3) in the United States between 2008 and 2011, which indicated lower figures for teenage and unintended pregnancies due to various socio-economic and ethnic group factors.

The majority of LRPW, n=143 (49.1%), fell into age group 22–29, the child-bearing age where minimal complications are expected, and age group 30–35, which, according to the literature, is usually associated with the beginnings of complications during pregnancy. According to Sellers, (2014:240), at the age of 32, a woman's chances of conceiving decrease gradually, and from age 35 they decrease significantly. Even from age 30, the chances are around 5% of what they were during the peak period. At 40, the chances are around 20% of what they were during the peak period. The risks of birth complications and Caesarean sections increase with age and are particularly high for women with GDM or hypertension. These risks include post-partum haemorrhaging and birth defects or genetic abnormalities (Sellers, 2014:240).

4.4.2 Education

The total number of LRPW with Grades 1 to 7 were n=16 (5.5%), those with a secondary education were n=258 (88.6%); those who had a diploma were n=12 (4.7%) and those with degrees were n=5 (1.7%). Amongst HRPW, the total number with Grades 1 to 7 was n=7 (20.6%); those with secondary education were n=22 (64.7%), and those with diplomas were n=5 (14.7%). There were no graduates amongst HRPW.

The information above suggests that majority of pregnant women were educated enough to understand the processes of pregnancy, but required empowerment regarding modified diet and physical activity.
The majority of LRPW and HRPW had either a secondary-level education or tertiary-level education and were in need of knowledge regarding healthy pregnancy. A study done in Tshwane, South Africa, suggested that pregnant women were ready for and in need of any knowledge regarding health improvement and complication prevention (Wright, Biya & Chokwe, 2014:1).

4.4.3 Employment status
Amongst LRPW, n=47(16.1%) were students, n=70(24.0%) were employed, n=161(55.3) were unemployed and n=14(4.3%) were self-employed. Amongst HRPW there were no students, n=0 (0.0%), n=14(41.2%) were employed, n=18(52.9%) were unemployed and n=2(5.9%) were self-employed.

Table 4.1 shows that many pregnant women were attending schooling or employed and involved in activities which are safe during the first and second trimester. Pregnant women should not be given work that is physically strenuous, which might increase the risk of injury (Government Gazette; 1998:1). Nolte (2008:127) suggests that pregnancy during the late third trimester can exhaust both LRPW and HRPW and that they should rest frequently. Therefore, maternity leave is a necessity for working mothers (Nolte 2008:127). The data also reflects the high unemployment rate in Buffalo City, at an estimated 24.3%. Eastern Cape Socio-economic Consultative Council (ECSECC) (2009:3) claims that the relative affluence of the majority of Buffalo City residents remains low, with only some 36% of the households in the area earning more than R1 500 per month.

Table 4.1 also illustrates that the number of self-employed pregnant women were 13 (4.4%). The self-employed group do not have maternity leave, and if pregnancies among this group progress to the third trimester, close monitoring and health education about rest is crucial for the safety of their pregnancies. The Government Gazette (1998:2) also suggests that pregnant employees who work in a standing or sitting position should be given frequent rest breaks for mobility, to encourage blood circulation and to prevent swelling of the lower extremities.
4.4.5 Setting

Table 4.1 shows that the total number of LRPW in urban areas were \( n=251 \) (86.2\%) and rural were \( n=40 \) (13.7\%). The HRPW in urban areas were \( n=24 \) (75\%) and rural were 8 (25\%). The majority of the participants (LRPW and HRPW) lived in an urban setting. The rural setting was represented in the study by only one community health care centre, resulting in lower numbers of rural women, whereas three CMHs were in urban centres. Some LRPW and HRPW were attending antenatal care in hospital. BCM is an industrial hub and people naturally tend towards urban areas for the employment opportunities. Urban and rural settlements differ in any respects due to industrialisation in urban areas (Census 2011).

The study was conducted in both the urban and rural setting of BCM in order to compare the lifestyles of LRPW participants in the two different settings. BCM is one of the Eastern Cape’s metropolitan areas; its main industry is the auto industry. Despite this presence of this large employer, unemployment and poverty are high in the area. BCM includes the urban areas of Bisho, Dimbaza, East London, Kidd’s Beach, King William’s Town, Mdantsane, Phakamisa and Zwelitsha. Each urban area in BCM has a rural area attached to it (Census 2011).

4.4.6 Marital status

The majority of the LRPW in this study were single, \( n=250 \) (85.9\%); \( n=39 \) (13.4\%) were married and \( n=1 \) (0.3\%) were widowed or divorced. For HRPW, the number of single women were 17 (50\%) and married were also \( n=17 \) (50.0\%).

Single pregnant women were the biggest group and clearly contribute to South Africa’s high figures for single parenting and single families. Single parenting has increased at an alarming rate and tends to be characterised by minimal support from partners during the women’s pregnancy. Research conducted by the South African Institute of Race Relations (2011) showed that this is a real crisis, with more than 40\% of babies and children being fatherless in South Africa.

There is minimal support, both financially and emotionally, for LRPW and HRPW would increase stress during pregnancy. Stress may result in complications during pregnancy, during labour and post-natal.
For this reason, the South African Institute of Race Relations (2011) reinforces that all LRPW and HRPW should use family, friends and colleagues as a support structure to avoid loneliness and enhance the ability to cope during pregnancy.

**4.4.7 Race**

The prominent ethnic group in Buffalo City Metropolitan Municipality (BCM) in this study were blacks, at \(n=278\) (95.5\%); coloureds were \(n=11\) (3.7\%) and other groups \(n=2\) (0.6\%). Among the HRPW, blacks were \(n=29\) (85.3\%) and coloureds \(n=5\) (14.7\%). Eastern Cape Socio-economic Consultative Council (ECSECC), (2009:3) suggests that BCM is a predominantly African province.

**4.4.8 Language**

The dominant language used by participants in this study was Xhosa. In total \(n=277\) (95.1\%) of LRPW were Xhosa speaking; English speakers were \(n=14\) (4.8\%) and no Afrikaans speakers. Among HRPW, Xhosas were \(n=27\) (79.4\%) and English were \(n=7\) (20.6\%). In BCMM, Xhosa speakers constitute 86\% of the total population, while English and Afrikaans speakers constitute 7\% of the total (ECSECC, 2009:3). BCMM is in the Eastern Cape Province and is dominated by Black Africans.

**4.4.9 Summary of demographic characteristics of the participants**

Participants were divided into three age groups; 18–21, 22–29 and 30–35 years old. The second age group (22–29) constituted the prime child-bearing age and formed the majority (\(n=143\)) in this study. The third group (30–35) also had high numbers \(n=114\). It is in this age group where complications may be found. HRPW with GDM age 30-35 were \(n=24\) out of \(n=34\); and is this age group that healthy lifestyle training is particularly important.

Of the LRPW, \(n=258\) were educated and of the HRPW, \(n=22\) were educated, the majority of pregnant women having attended school up to Grades 8 to 12. Some \((n=28)\) had diplomas or degrees \((n=9)\). The pregnant women therefore had the ability and potential to learn and understand healthy lifestyle if empowered. This result confirms the need for coaching and guidance for pregnant women, since the majority are educated, can understand and benefit from such coaching.
LRPW and HRPW figures for employment were estimated as 24.3%, with only 36% of households employed in 2009. Self-employed of LRPW and HRPW contribute minimally to the wealth of BCM. However, it is assumed that LRPW and HRPW students would contribute in the near future to the economy of BCM.

The study was conducted in BCM, a poor metropolitan area characterised by many rural people, most of whom are unemployed. However, the LRPW in this study were more urban, at n=251. There were fewer rural participants, at n=40, because many rural participants prefer the health services in urban areas and because rural areas tend to have lower numbers of younger women.

This study reflects the high rate of single parenting in the Eastern Cape Province. The status of being single during pregnancy can contribute to high levels of stress due to an absence of emotional and financial support. Such stress during pregnancy is detrimental to the mother and the unborn baby. BCM is characterised by high numbers of Black Africans who are Xhosa speakers, and who outnumber all other groups.

### 4.5 Section B: Anthropometric Measurements

Anthropometric measurements refer to measurements of the human body and are usually used comparatively. Anthropometric measurements can also be used when studying groups of people to evaluate health trends and concerns in various populations; for example, when assessing nutritional status.

**Table 4.2: Baseline anthropometric measurements: Weight n= 291 and n=34**

<table>
<thead>
<tr>
<th>Variables</th>
<th>LRPW</th>
<th>Normal</th>
<th>Abnormal</th>
<th>HRPW (GDM)</th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>289</td>
<td>275</td>
<td>14</td>
<td>34</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>BMI</td>
<td>268</td>
<td>260</td>
<td>8</td>
<td>34</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>MUAC</td>
<td>263</td>
<td>252</td>
<td>11</td>
<td>34</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Glucose levels</td>
<td>290</td>
<td>290</td>
<td>0</td>
<td>34</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>290</td>
<td>290</td>
<td>0</td>
<td>34</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>Pulse</td>
<td>291</td>
<td>270</td>
<td>21</td>
<td>34</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Urine</td>
<td>291</td>
<td>277</td>
<td>14</td>
<td>34</td>
<td>24</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 4.2 indicates that the number of LRPW weighed was (99%); those measured for MUAC were (90%) those measured for BMI were (92%), those measured for glucose level were (99%), those measured for blood pressure were (99%), those measured for pulse were (100%) and those measured for urine were (100%). Some pregnant women had protein, (21%), glucose, (17.5%), leucocytes, (19.5%) or blood, (6.5%) their urine, all of which are signs of certain conditions during pregnancy. This indicates problems of the kidneys amongst low-risk pregnant women. The HRPW participants for all anthropometric measurements were (100%) attendance.

4.6 Section C: Medical History

Table 4.3 Medical history of all participants, n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>LRPW</th>
<th>HRPW with GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>No</td>
<td>290 (98.5)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Missing values: 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.00</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>No</td>
<td>290 (98.5%)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Missing value: 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LRPW in the study had no hypertension as the criteria precluded those with hypertension. The total number of LRPW were n=291 and HRPW were n=34. In this study the majority of the LRPW were healthy.

4.7 Section D: Past and Present Obstetric History

Obstetric history is the personal information taken from all women during pregnancy and includes name, age, gravida, parity, menstrual and gynecological history, regular or irregular cycles, length of the cycle, Last menstrual Period (LMP) details estimated date of delivery (EDD) using Naeglele’s rule and current problems or complaints with the pregnancy. The history of the current pregnancy includes details of the first, second and third trimester laboratory tests and scans (U/S). In this study, the researcher was interested in the parity and gravida of the LRPW and HRPW (Sellers, 2014:182).
Table 4.4: Past obstetric history, n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>LRPW</th>
<th>HRPW with GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravida</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>11 (3.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>1</td>
<td>101 (34.7)</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>2</td>
<td>110 (37.8)</td>
<td>6 (17.6)</td>
</tr>
<tr>
<td>3</td>
<td>51 (17.5)</td>
<td>14 (41.2)</td>
</tr>
<tr>
<td>4</td>
<td>11 (3.7)</td>
<td>6 (17.6)</td>
</tr>
<tr>
<td>5</td>
<td>6 (2.0)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>6</td>
<td>1 (0.3)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>129 (44.3)</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>1</td>
<td>106 (36.4)</td>
<td>12 (35.3)</td>
</tr>
<tr>
<td>2</td>
<td>41 (14.0)</td>
<td>11 (32.4)</td>
</tr>
<tr>
<td>3</td>
<td>9 (3.0)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>4</td>
<td>5 (1.7)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>5</td>
<td>1 (0.3)</td>
<td>1 (2.9)</td>
</tr>
</tbody>
</table>

4.7.1 Past obstetric history

Past obstetric information focused on previous pregnancies, and was obviously not applicable to women pregnant for the first time (primi-gravida). According to Sellers, (2014:182), parity is the number of births that occur after 24 weeks’ gestation. Table 4.4 shows that the parity of the majority of low-risk pregnant women were 0 for n=129(44.3%), parity 1 n=106(36.4%), parity 2 n=41(14.0%), parity 3 n=9(3.0%), parity 4 n=.5(1.7%) and parity 5 n=1(0.3%). In this study, parity 0, 1 and 2 were in the majority among LRPW; these are acceptable numbers that are manageable and associated with fewer complications. Higher parity is associated with higher risks of coronary heart disease and deep vein thrombosis, even after adjustment for maternal age. It less strongly relates to intracranial haemorrhage and stroke/transient ischemic attack, according to a study by Valery et al., (2014:5).

Gravidity is the total number of pregnancies, including current one, regardless of the outcome of the pregnancy (Sellers, 2014:182). In this study the numbers were: gravida 0 n=11(3.7%); gravida 1 n=101(34.7%); gravida 2 n=110(37.8%); gravida 3 n=51(17.5%); gravida 4 n=11(3.7%); gravida 5 n=6(2.0%) and gravida 6 n=1(0.3).
In this study gravida 1, 2 and 3 formed the majority, with few women in gravida 0, 4, 5 and 6. In this study LRPW tended to fall in the gravida 0 and 1 group, with few in gravida 3, 4, 5 and 6, where health complications usually commence.

Among HRPW in this study, Table 4.3 shows the figures as: gravida 0 for n=0(0.0%), gravida 1 for n= 4(11.8%), gravida 2 for n=6(17.6%), gravida 3 for n=14(41.2%), gravida 4 for n=6(17.6%) gravida 5 for n=3(8.8%) and gravida 6 for n=1(2.9). The majority of HRPW fell in the gravida 3 group; few women were in gravida 1, 2, 4, 5 and 6. This confirms that GDM is a condition that affects child bearing, with poor lifestyle contributing to the risk.

Table 4.4 shows that the numbers for high-risk pregnant women with GDM were parity 0 for n=4(411.8%), parity 1 for n=12(35.3%), parity 2 for n=11(32.4%), parity 3 for n=3(8.8%), parity 4 for n=3(8.8%) and parity 5 for only n=1(2.9%). In this study the majority of the HRPW with GDM fell into the parity 1 and 2 group. Other parities were minimal. Many women of child-bearing age had GDM. A programme of modified diet and physical activity urgently needs to be implemented to minimise the risks of GDM complications (Valery et al. 2014:5).

Table 4.5 Present obstetric history, n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>LRPW</th>
<th>HRPW with GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravida</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>103  (35.3)</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>2</td>
<td>116  (39.8)</td>
<td>6 (17.6)</td>
</tr>
<tr>
<td>3</td>
<td>50   (17.1)</td>
<td>14 (41.2)</td>
</tr>
<tr>
<td>4</td>
<td>15   (5.1)</td>
<td>6 (17.6)</td>
</tr>
<tr>
<td>5</td>
<td>6    (2.0)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>6</td>
<td>1    (0.3)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>122  (41.9)</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>1</td>
<td>111  (38.1)</td>
<td>12 (35.3)</td>
</tr>
<tr>
<td>2</td>
<td>41   (14.0)</td>
<td>11 (32.4)</td>
</tr>
<tr>
<td>3</td>
<td>10   (3.4)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>4</td>
<td>6    (2.0)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>5</td>
<td>1    (0.3)</td>
<td>1 (2.9)</td>
</tr>
</tbody>
</table>
4.7.2 Present obstetric history

Gravidity refers to the total number of pregnancies, including the current pregnancy, regardless of the pregnancy’s outcome, (Sellers, 2014:182). In the questionnaire, present obstetric history sought information on the women’s current pregnancy. Table 4.5 shows that for low-risk pregnant women, the numbers were as follows: gravida 1 n=103(35.3%), gravida 2 n=116(39.8%), gravida 3 n=50(17.1%), gravida 4 n=15(5.1%), gravida 5 n=6(2.0%) and gravida n=1(0.3%). The majority of LRPW fell in the gravida 1 and 2 group, with few LRPW in gravida 3, 4, 5 and 6. Minimal pregnancies are safer than higher numbers of pregnancies for LRPW’s health.

Parity, on the other hand, is the number of births that occurred after 24 weeks’ gestation (Sellers, 2014:182). Current obstetric history focussed on the current pregnancy. Table 4.5 indicates that parity for LRPW were as follows: 0 n=122(41.9%), parity 1 n=111(38.1%), parity 2 n=41(14.0%), parity 3 n=10(3.4%), parity 4 n=6(2.0%) and parity 5 for n=1(03%). The majority of LRPW fell into the parity 0 and 1 group with few in the parity 2 to 5 group. This was probably because these women were relatively young, and therefore at their child-bearing age (Sellers, 2014:182).

4.8 Section E: Lifestyle

Table 4.6: The lifestyle history of participants, n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>LRPW</th>
<th>HRPW with GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>45 (15.4)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>No</td>
<td>246 (84.5)</td>
<td>32 (94.1)</td>
</tr>
<tr>
<td>Frequency of alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly</td>
<td>1 (1.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Monthly</td>
<td>3 (5.5)</td>
<td>1 (50.0)</td>
</tr>
<tr>
<td>Occasionally</td>
<td>51 (92.7)</td>
<td>1 (50.0)</td>
</tr>
<tr>
<td>Do you smoke?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12 (3.7)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>No</td>
<td>279 (96.3)</td>
<td>33 (97.1)</td>
</tr>
<tr>
<td>Smoking frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>6 (54.5)</td>
<td>1 (100.0)</td>
</tr>
<tr>
<td>Occasionally</td>
<td>5 (45.5)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>
For LRPW, alcohol users were in the minority, at n=45(15.4%), of which n=51(92%) were occasional, only n=1(1.8%) was a weekly drinker and n=3(5.5%) used alcohol monthly. However, the majority of LRPW were non-drinkers n=246(84.5%).

For HRPW with GDM only n=2(5.9%) were alcohol users. The majority of HRPW with GDM, n=32(94.1%), were non-alcohol users. Alcohol users were in the minority for both groups, both LRPW and HRPW, which confirms one good lifestyle habit. Nevertheless, the minority who were regular alcohol users need consistent counselling on the dangers of alcohol during pregnancy. Infants may suffer foetal alcohol syndrome (FAS), which causes mental retardation and personality disorders later in life (Sellers, 2014:756).

The majority of LRPW were non-smokers, at n=279(96.3%). Amongst HRPW, too, the majority were non-smokers, at n=33(97.1%). LRPW smokers, at n=12(3.7%), and HRPW smokers, at n=1(2.9%), were in the minority. Sellers, (2014:150) claims that smoking has negative outcomes during pregnancy and can cause pre-term labour and the birth of pre-term babies with low birth weight.

4.9 Section F: Diabetes and GDM

GDM is a condition that develops during 24–28 weeks’ gestation, especially amongst LRPW who have the risk factors of obesity and diabetes in the family. GDM has negative outcomes in pregnant women and unborn babies. Some of the negative effects of GDM are Type 2 diabetes and cardiovascular disease in later life (Kessous et al., 2013:119).

Table 4.7 shows the prevalence of risk factors GDM amongst all participants.
Table 4.7: Risk factors for GDM, total participants, n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family history of diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90 (30.9)</td>
<td>20 (58.8)</td>
</tr>
<tr>
<td>No</td>
<td>201 (69.0)</td>
<td>14 (41.2)</td>
</tr>
<tr>
<td>Who is at risk of diabetes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of the grandparents</td>
<td>34 (38.2)</td>
<td>8 (50.0)</td>
</tr>
<tr>
<td>Both of the grandparents</td>
<td>7 (7.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>One of the parents</td>
<td>33 (37.1)</td>
<td>3 (18.8)</td>
</tr>
<tr>
<td>Both of the parents</td>
<td>4 (4.5)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>One or more of the siblings</td>
<td>8 (9.0)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>One of the grandparents and one or more of the siblings</td>
<td>1 (1.1)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>All the options</td>
<td>1 (1.1)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Who is at high-risk of GDM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age over 30</td>
<td>4 (2.9)</td>
<td>1 (3.6)</td>
</tr>
<tr>
<td>Obese</td>
<td>45 (32.6)</td>
<td>5 (17.9)</td>
</tr>
<tr>
<td>Overweight</td>
<td>18 (13.0)</td>
<td>5 (17.9)</td>
</tr>
<tr>
<td>Family history of diabetes</td>
<td>48 (34.8)</td>
<td>9 (32.1)</td>
</tr>
<tr>
<td>Obesity and family history</td>
<td>12 (8.7)</td>
<td>6 (21.4)</td>
</tr>
<tr>
<td>Overweight and family history</td>
<td>11 (8.0)</td>
<td>2 (7.1)</td>
</tr>
</tbody>
</table>

Low-risk pregnant women who were at risk of diabetes included n=90(30.9%) who had a family history of diabetes. The specific figures for family history of diabetes were: one grandparent, n=34(38.2%), both grandparents, n=7(7.9%), one of the parents, n=33(37.1%), both parents, n=4(4.5%) and one or more siblings, n=8(9.0%). In this study the LRPW who were at high-risk of acquiring GDM were those above 30 years of age, those who had poor lifestyles, n=4(2.9%), those who were obese, n=45(32.6%), those who were overweight n=18(13.0%), those who had a family history of diabetes, n= 48(34.8%), those who had both obesity and a family history of diabetes, n=12(8.7%), and those who were both overweight and had a family history of diabetes n=11(8.0%). Wahabi et al., (2014:1) claim that overweight and obesity are risk factors that could predispose low-risk pregnant women to GDM, with negative adverse outcomes for the pregnant woman and foetus.

Amongst HRPW with GDM, n=20(58.8) had a family history of diabetes. The specific figures for family history of diabetes amongst HRPW were: one grandparent, n=8(50.0%), both grandparents, n=0(0.0%), one of the parents, n=3(18.8%), both parents, n=1(6.3%) and one or more siblings n=1(6.3%).
HRPW who were at high-risk of GDM were those aged 30 years and over, those who had poor lifestyles, n=1(3.6%), those who were obese n=5(17.9%), those who were overweight, n=5(17.9%), those with a family history of diabetes, 9(32.1%), those who had both obesity and a family history of diabetes, n=6(21.4%) and those who were both overweight and had a family history of diabetes, n=2(7.1%), Wahabi et al., (2014:1) state that high-risk pregnant women with GDM could have negative pregnancy outcomes, including Caesarean section (CS), macrosomia and preeclampsia (Wahabi et al., 2014:1).

According to a study done in Eastern Cape, by Cort et al. (2017), the diabetes risk parameters are waist circumference, age, sedentary life and a family history of diabetes. In this study, amongst LRPW and HRPW women with GDM, age above 30 years, sedentary lifestyles (overweight and obesity) and family history of diabetes were included. The only parameter excluded was waist circumference, because of pregnancy. Gestational diabetes is associated with hospitalisation during pregnancy and the development of diabetes later in life. Although high-risk pregnant women with GDM risk acquiring Type 2 diabetes later in life, there are also fatalities associated with GDM and diabetes, brought on by conditions such as heart failure, intracranial haemorrhage, and coronary heart disease (Valery et al. 2014).

4.10 Section G: The Role of Stakeholders in GDM

Stakeholders for GDM in this study were the maternity staff (midwives) involved in care from antenatal up to the post-natal period, the obstetrician and the dietician. A physical movement specialist is supposed to be available at diabetes antenatal clinics, but is not yet available in public institutions for women with GDM. HRPW were questioned about stakeholders in order to understand whether HRPW had any knowledge on the role of stakeholders. Table 4.8 below shows perceptions of HRPW regarding stakeholders.
Table 4.8: Stakeholders in GDM, n=34

<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Uncertain</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The obstetrician is supporting women with GDM.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (14.7)</td>
<td>29 (85.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Obstetrician is always monitoring my progress in the management of DM.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>18 (52.9)</td>
<td>15 (44.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Obstetrician forms part of frequent meetings to monitor women with GDM.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>11 (32.4)</td>
<td>22 (64.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Obstetrician uses GDM machines to monitor glucose levels.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>12 (35.3)</td>
<td>21 (61.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Obstetrician always ready to answer any questions related to diabetes.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>20 (58.8)</td>
<td>13 (38.2)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Dietician is always reminding women with GDM about correct diet.</td>
<td>0 (0.0)</td>
<td>6 (17.6)</td>
<td>5 (14.7)</td>
<td>23 (67.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Dietician is friendly and willing to answer questions on correct diet.</td>
<td>0 (0.0)</td>
<td>6 (17.6)</td>
<td>3 (8.8)</td>
<td>23 (67.6)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Dietician is always advising women with GDM about ways to improve diet.</td>
<td>0 (0.0)</td>
<td>6 (17.6)</td>
<td>4 (11.8)</td>
<td>22 (64.7)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Dietician is fair and unbiased in their treatment of women with GDM.</td>
<td>1 (2.9)</td>
<td>4 (11.8)</td>
<td>5 (14.7)</td>
<td>24 (70.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Midwife maintains close contact with pregnant women.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>8 (23.5)</td>
<td>26 (76.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Midwife is always emphasising the importance of diet and management of DM.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>24 (70.6)</td>
<td>9 (26.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Midwives are always there for pregnant women whenever they need help.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>9 (26.5)</td>
<td>25 (73.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Midwives are effective in solving any problems faced by pregnant women.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (14.7)</td>
<td>29 (85.3)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

4.10.1 Obstetrician

The majority of HRPW agreed that the obstetrician was supportive, n=29(85.3%). Other figures were: obstetrician gave GDM glucose machines for monitoring at home frequently, n=21(61.8%), frequent monitoring (two-weekly visits), n=22(64.7%). Some
women with GDM were uncertain about frequent visits, and a few were uncertain, n=12(35.3%), regarding the use of the glucose measuring machine.

The responses of HRPW with GDM clearly confirm the availability and dedication of the obstetrician regarding the care of the women with GDM. The obstetrician’s role is that of monitoring, improving and promoting the good health of the mother and baby during pregnancy, labour and post-natal by managing complications (Deborah & Conway, 2007:1).

4.10.2 Dietician

The majority of the HRPW, n=23(67.6%), agreed that the dietician in the hospital reminded them about correct diet and always answered their questions about diet. In total, n=22(64.7%) agreed that the dietician was always advising them about correct diet, and n=24(70.6%) agreed that the dieticians treated all HRPW with fairness and respect. The role of the dietitian in the management of GDM is very central to this study. This study aimed to examine current dietician practices in the management of GDM, and ascertain whether they made recommendations that were appropriate to the women’s contexts (WHO, 2015:1).

4.10.3 Midwives

The role of the midwives was highly rated by the HRPW with GDM. The majority, n=26(76.5 %), agreed that midwives kept close contact with them. For solving their problems, n=29(85.3%) agreed, and for always being there to give help n=25(73.5%) agreed. However, when it came to midwives encouraging a healthy diet n=24(70.6%) were uncertain. Midwives, as the primary carers for women in pregnancy and childbirth, are ideally positioned to educate women and engage with them on lifestyle and behaviour that prevents the onset of Type 2 diabetes (Peacock et al. 2014).

4.11 Section H: Theoretical Framework

Theoretic framework refers to the principles of the theories chosen by the researcher to form the background of the study.
The researcher was interested in how to empower pregnant women in self-care, general health management and the management of GDM using knowledge given by the midwife, dietician, obstetrician and physical activity movement specialist, if available. Questions were asked of LRPW and HRPW in relation to obstetricians, dieticians, midwives and physical movement specialists to ascertain to what extent these specialists were, in fact, empowering them to manage their health.

**Table 4.9: Questions testing the theoretical framework**

<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Uncertain</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am actively participating in managing my diabetes.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>28 (82.4)</td>
<td>6 (17.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>I am motivated to manage my diabetes.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>21 (61.8)</td>
<td>13 (38.2)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>I am able to apply and manage diabetes in ways that I have learned from the midwife, dietician and obstetrician.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>27 (79.4)</td>
<td>7 (20.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>The language used by the dietician, midwife and obstetrician is understandable.</td>
<td>0 (0.0)</td>
<td>1 (2.9)</td>
<td>4 (11.8)</td>
<td>27 (79.4)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>The attitude of the dietician, midwife and obstetrician is welcoming.</td>
<td>0 (0.0)</td>
<td>2 (5.9)</td>
<td>4 (11.8)</td>
<td>28 (82.4)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>I seek help if I don't understand what was taught to me by the dietician, midwife and obstetrician.</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>14 (41.2)</td>
<td>20 (58.8)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

Table 4.9 shows that the majority of high-risk pregnant women, n=28(82.4%), were uncertain regarding their participation in managing diabetes. Only n=6(17.6%) agreed that they managed the condition. Responses on motivation were n=21(61.8%) uncertain and n=13(38.2) agreeing. Lastly, the majority of high-risk pregnant women, n=27(79.4%), found the language used by stakeholders clear and were able to apply the lessons they learned from stakeholders 7(20.6%). Only n=1 (2.9%) disagreed that language was clear.
The empowerment of low- and high-risk pregnant women on practising self-care is suggested by Orem’s self-care theory, which is one of the theories underpinning this study. However, ideal self-care includes regular physical activity as well as appropriate dietary practices to promote and achieve optimal glycaemic control and prevent complications (American Diabetes Association Guidelines (ADA) 2013:36).

Table 4.9 shows that the majority of high-risk pregnant women agreed that they were able to manage their conditions based on the input of stakeholders, and were motivated to do so \( n=1 \) \((2.9\%)\). Other high-risk pregnant women’s responses were: \( n=28 \) \((82.4\%)\) agreed that attitude of stakeholders was good; \( n=4 \) \((11.8\%)\) gave a response of ‘uncertain’ and \( n=2 \) \((5.9\%)\) disagreed. The matter of seeking help when unsure elicited responses of agree, \( n=20 \) \((58.8\%)\) and uncertain, \( n=14 \) \((41.2\%)\). This shows that most pregnant women had a good knowledge of managing diabetes and were proactive in taking care of the condition (Peacock, Bogossian, McIntyre & Wilkinson 2015).

4.12 Summary

4.12.1 Medical history

According to the inclusive criteria used in the study, low and high-risk pregnant were not supposed to have any conditions other than GDM for the high-risk women. At the beginning of the study there were no such conditions, but results showed protein, blood, leucocytes and nitrates in the urine. High-risk with GDM and low-risk pregnant women had many high-risk factors; overweight, obesity and family histories of diabetes. These findings clearly show that the pregnant women of child-bearing age were at risk, making the modified diet and planned physical activity intervention a necessity.

4.12.2 Summary of obstetric history

The majority of low-risk pregnant women had gravida 1, \( n=112 \), and gravida 2, \( n=120 \). Parity of 0 applied for \( n=139 \), and parity 1 applied to \( n=116 \) women. Gravida 3 to 6 were in the minority. For high-risk pregnant women, gravida 3 applied to \( n=14 \) women, parity 1 applied to \( n=12 \) and parity 2 applied to \( n=11 \). This show that women of child-bearing age tended to gravida and parity 1 to 3.
4.12.3 Summary of lifestyle
Lifestyle questions examined low-risk and high-risk pregnant women’s engagement with alcohol and smoking. Amongst low-risk pregnant women, alcohol users were n=57 and smokers were n=12. Amongst high-risk pregnant women, alcohol users were n=2 and smokers were n=1. The finding of n=57 low-risk pregnant using alcohol means that a fairly high number of women were at increased risk of causing alcohol foetal syndrome to their unborn children.

4.12.4 Summary of risk factors
The findings for risk factors amongst LRPW in this study were overweight n=18, obesity n=45 and family history of diabetes, n=48. For high-risk pregnant women, the figures were overweight, n=5, obese, n=5 and family history of diabetes, n=9. The findings therefore suggest that the prevalence of overweight, obesity and family history were high, increasing these women’s susceptibility to hypertension and diabetes. This susceptibility has been explained using Becker’s Health Belief Model.

4.12.5 Summary of stakeholders
The stakeholders in this study were the midwives, dieticians and obstetricians who supported the women with GDM. The responses of high-risk pregnant women were categorised according to agree, disagree and uncertain. The majority of high-risk pregnant women, n=29, agreed to the questions relating to the obstetrician; n=23 agreed to questions relating to the dietician and n=29 agreed to the questions relating to the midwife.

4.12.6 Summary of theoretical framework
For HRPW, ‘uncertain’ was the predominant response in this section, indicating that these pregnant women required more information in relation to managing their diabetes. However, responses regarding the attitude and language used were mainly ‘agree’; in addition, the majority of LRPW and HRPW were eager to ask when they did not understand something. This attitude is in line with the health promotion theory and Orem’s theory, which speak of empowering pregnant women with information relevant for pregnancy.
4.13 Section H: Modified Diet

The principle of the modified diet was to adhere to the normal diet but to augment it with more vegetables, fruits and proteins, depending on availability, and to decrease the intake of carbohydrates and fats. The rationale for the use of the modified diet was to avoid overweight and obesity, which are largely due to the excessive intake of starches and fats.

Table 4.10: What do you include in your diet n=291 and n=34

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is in your diet</td>
<td>290 (99.2)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>290 (99.2)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>291 (100.0)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Protein</td>
<td>289 (95.4)</td>
<td>25 (97.8)</td>
</tr>
<tr>
<td>Fruit</td>
<td>289 (95.4)</td>
<td>25 (97.8)</td>
</tr>
<tr>
<td>Fats</td>
<td>290 (99.2)</td>
<td>34 (100.0)</td>
</tr>
</tbody>
</table>

The study promoted a modified diet adapted from diet and nutrition guidelines which stipulate the inclusion of vegetables, carbohydrates, proteins, fats and fruit. Almost all the low-risk pregnant women, n=290(99.2%), included vegetables, n=290(100.0%) included carbohydrates, n=290(99.2%) included protein and n=289(95.4%) included fruit. For high-risk pregnant women with GDM, the figures were: n=34(100.0%) for vegetables, fats and carbohydrates and n=25(97.8%) for proteins and fruit.

It can be concluded that LRPW and HRPW had an understanding of the principles of a balanced diet; however, it must be pointed out that the questions did not examine proportions. Many pregnant women were overweight or obese, according to their measurements for weight, BMI and MUAC, discussed above. A balanced diet is a plate that contains correct proportions of vegetables, carbohydrates, protein, fruit and fats (NHS, 2011).
4.14 Section I: Planned Physical Activity

Table 4.11: Types of physical activity

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Walking</td>
<td>173</td>
<td>7</td>
</tr>
<tr>
<td>Work activities</td>
<td>43</td>
<td>6</td>
</tr>
</tbody>
</table>

The study promoted planned physical activity adapted from physical activity guidelines relevant for low and high-risk pregnant with GDM. The majority of low-risk pregnant women, n=173, walked regularly, n=43 moved in the course of work activities and n=14 were involved in running. Walking was thus the preferred and most prevalent form of physical activity. Among high-risk pregnant women, n=7 walked regularly, n=6 moved in the course of work activities and n=0 were involved in running. Thus it is clear that high-risk pregnant women were minimally engaged in planned physical activities and were at risk of developing complications of GDM and other conditions related to overweight and obesity. Furthermore, the maintenance of physical activity is critical for blood glucose management and overall health in individuals with diabetes and prediabetes (Colberg, Sigal, Yardley, Riddell, Dunstan, Dempsey, Horton, Castorino, 2016:3).

4.15 Critical Discussion of Results

Majority of both the low and high risk pregnant women with GDM were single, unemployed, and unemployment indicating a possible lack of emotional and financial support during pregnancy, and a possible source of stress. The anthropometric results showed increased glucose levels, weight, BMI and MUAC and were a signal of overweight and obesity and risk to GDM and hypertension. Diet used had more vegies and low protein but surprisingly had increased weight, MUAC and BMI. Pregnant women also engage in low levels of planned physical activity, hence pregnant women need more education and motivation on modified diet and planned physical activity in order to be able to apply self-care and enjoyed healthy lifestyle.

4.15 Critical discussion of results

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were increased glucose levels, weight, BMI and MUAC and were an indication of overweight and obesity and risk to GDM and hypertension. Diet more vegies and low protein but have increased weight and BMI. Pregnant women also engage in low levels of planned physical activity. Pregnant women need more education and motivation in order to be able to apply self-care and enjoyed benefits of planned physical activity.

4.16 Conclusion

In this chapter, the findings for the demographic and anthropometric measurements were presented in tables, using frequencies and percentages. According to the demographic findings, the majority, n=143, of low-risk and high-risk pregnant women with GDM were aged 22 to 29, the prime child-bearing age. Those aged 30 to 35 were also represented by a high number at n=114. It is this age group where complications may frequently be found. The number of pregnant women with GDM aged 30 to 35 was n=24 out of n=34; these women were particularly in need of healthy lifestyle counselling. The majority of low and high-risk pregnant women were educated, unemployed and lived in urban areas. The participants were mostly Xhosa speakers rather than speakers of English and Afrikaans or coloureds, since BCM has a predominantly Xhosa population. Educational levels indicated that the majority of high-risk pregnant women had the ability and potential to learn and understand the principles of a healthy lifestyle. A very high percentage of low-risk pregnant women were single, which has implications for their need of emotional and/or financial support during their pregnancies. Single status during pregnancy can predispose the pregnant woman to stress.

Low-risk and high-risk pregnant women had high measurements for weight, BMI and MUAC. This is an indication of overweight and obesity amongst both groups. Overweight and obesity promote gestational hypertension and high glucose. Gestational hypertension was a problem in this study, in that low-risk pregnant women had urine protein of 3+. Many also had high blood pressure, which results in negative outcomes if not detected early. High blood pressure or gestational blood pressure may be traced back to unhealthy lifestyle choices, which confirms the need for a modified diet and planned physical activity.
Glucose levels were also high and are associated with GDM, which has negative outcomes for pregnancies, both for the mother and the unborn baby. Glucose level during pregnancy should be normal; some infant mortalities have been traced back to high and untreated glucose levels. In this study, low and high-risk pregnant women with GDM had normal ranges for pulse rate; only a few had high pulse rates. The results of urine tests were concerning, with protein 3+, glucose 3+, leucocytes 3+ and blood 3+. All these abnormalities could result in devastating complication that may be fatal if intervention is delayed.

The findings related to modified diet suggest that the majority of low and high-risk pregnant women tend to consume more balanced diets once pregnancy is advanced. Green vegetables (cabbages, spinach, green pepper) were consumed more than red vegetables (carrot, beetroot, butternut and pumpkin). Vegetables, fruit, carbohydrates and fibre were consumed more by the low-risk pregnant women than the high-risk pregnant women. However, consumption of protein was fairly low by all.

Lastly, the physical activity findings showed that low-risk pregnant women were more motivated and engaged in physical activity than high-risk pregnant women. The guidelines for physical activity suggest correct exercises and their duration for pregnant women. Planned physical activity is critical and needs some maintenance; a low level of physical exercise may increase complications in pregnant women with GDM, and result in obesity among low-risk pregnant women, thus predisposing them to risk.
CHAPTER 5

PHASE 3: RANDOMISATION

5.1 Introduction
The previous chapter described the results of the descriptive data for low and high-risk pregnant women with GDM before being exposed to a modified diet and planned physical activity programme in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa. In this chapter the focus was on randomisation of low risk pregnant women for the modified diet and planned physical activity. Randomisation was focusing on the selection of experimental and control group from the risk pregnant women.

5.2 Randomization Design
Randomisation is the random assignment or random allocation of participants to control and intervention groups. Randomization was the best method to equalizing groups but there was no guarantee that the tool used, (research randomizer) was yielding equal groups (Polit & Beck, 2014:254). Randomization was the responsibility of the researcher to allocate the participants to the control and experimental group or intervention group on a random basis. The two groups of participants were randomized, one receiving the intervention or treatment and the other group receive no treatment but routine standard care (Polit & Beck, 2014:251 and Grove, Burns & Gray, 2013:245). The rationale for using randomisation was to reduce chances of bias when selecting the participants to different groups (experimental and control). In this chapter the researcher would focus on the process of choosing the respondents that will be in the experimental group and control group from the low risk pregnant women using the research randomizer.

5.3 The Aim of Randomization
The aim of the randomisation was to yield equal group of participants to assess the impact of the modified diet and planned physical activity.

5.3.1 Research question
What is the effect of modified diet and planned physical activity intervention on low risk pregnant women of pregnancy outcomes in Buffalo City, Eastern Cape?
5.3.2 Research objective
To identified and describe the effect of modified diet and planned physical activity on low risk pregnant women of pregnancy outcomes in Buffalo City, Eastern Cape.

5.4 Data Collection for Low risk Pregnant Women
At 26 weeks’ gestation sealed envelopes stating control and experimental/intervention group was distributed by the researcher and research assistants to low risk pregnant women during data collection. The experimental design for low risk pregnant women were assigned to experimental/intervention and control group using the research randomizer software during the second visit (26 weeks’ gestation) (Kim & Shin, 2014:5).

Low risk pregnant women participated in this study were recruited from the four community health care centres voluntarily. Data was collected using open and ended questionnaires designed by the researcher and the statistician. The data was collected by the researcher and research assistance during May to August 2017 to all women eligible for the study. The research assistant meets the participant in the morning between 8:00 and 12:00 am at the community health care centre. Women signed the consent during the visit, for our record. The baseline anthropometric measures of weight, BMI, MUAC, blood pressure, blood glucose, pulse and urine in every visit from 26 weeks to 34 weeks’ gestation.

5.5 Randomisation of Low risk Pregnant Women
Participants were randomly assigned to the control and the intervention or experimental group to reduce selection bias (Polit & beck, 2014:253). Research randomiser from software program was used to select the participants to be in control and intervention group applied. Research randomiser gave participants numbers and the groups (A and B) that the participant belong to. Randomization was performed using a computer-generated randomization called research randomizer to allocate the participants. After randomization, participants received a sealed envelope labelled with the assigned randomization number and group, which contained instructions for participants in the control group nor the intervention group inside. Some low risk pregnant women discontinued during the participation due to miscarriages relocation and phone lost.
No complaint was reported by the low risk pregnant women about the modified diet and planned physical activity. Randomisation of low risk pregnant women were illustrated in the figure 3.2 below:

318 low risk pregnant women recruited in CHC centres in BCM

Screen for eligibility of low risk participants

Eligible: 294
Not eligible: 24

Enrolled: 294
Refused to participate: 3

Randomised (291 participants)

Control group: 142
Intervention group: 149

Standardize care
Modified diet and planned PA

Failure to complete due to:
Miscarriages (n = 2)
Phone lost or change number (n = 6)
Relocation (n = 1)

Failure to complete due to:
Miscarriages (n = 2)
Phone lost or change number (n = 10)
Relocation (n = 1)

Total n = analysed n = 135

Figure 5.1: Diagram showing randomisation of low risk pregnant women
5.6 Explanation of the Randomisation Diagram for the low risk Pregnant Women

The total number of low risk pregnant women were \( n = 318 \) recruited in four community health care centres namely Gombo, Dimbaza, Nontyantyambo and DVDH in Buffalo City Metropolitan. Only \( n = 294 \) low risk pregnant women in the register were eligible for the study, \( n = 24 \) were not legitimate because of higher gestational age of above 20 weeks’ gestation and age over 35 years.

Only \( n = 294 \) low risk pregnant women were enrolled for the study but from that 294 participants, three low risk pregnant women were not interested and refused to participate in the study. Then the total number of low risk pregnant women was 291 eligible.

Randomisation of \( n = 291 \) low risk pregnant women took place and were assigned to the control group and intervention group. 142 participants were in the control group and 149 in the intervention group. The research randomizer programme in Excel select the groups for intervention and control groups to avoid bias.

Intervention group were the group of low risk pregnant women selected by the research randomiser software that allocate low risk pregnant women into intervention group using numbers from 1 to 291. The intervention group of low risk pregnant women were given the modified diet plan and planned physical activity log book. Total number of low risk pregnant women allocated in the intervention group were \( n = 149 \). The number was further reduced due to the following reasons for the low risk pregnant women explained below:

- Some low risk pregnant women (\( n = 1 \)) relocated to other places
- Due to miscarriages (\( n = 3 \))
- Change phone numbers or loss of phone (\( n = 10 \)), unable to trace

The total number of low risk pregnant women were \( n = 135 \) allocated to intervention group. Control group were another group of low risk pregnant women selected by the research randomiser software that allocated low risk pregnant women into control group and assigned the number from 1 to 291.

The control group of low risk pregnant women were given the standardized care given to all pregnant women attending antenatal care.
Total number of low risk pregnant women allocated in the control group were \( n = 142 \). The rationale for this number was due to the following reasons for the low risk pregnant women explained below:

- Some low risk pregnant women \( (n = 1) \) relocated to Private hospital
- Due to miscarriages \( (n = 2) \)
- Change of phone number and loss of the phone \( (n = 6) \)

The total number of low risk pregnant women were \( n = 135 \) allocated to control group.

Figure 5.2: Illustrating a diagram showing of high risk pregnant (GDM) participant
5.8 High risk Pregnant Women with GDM

The diagram above showing the total number of high risk pregnant women with GDM were $n = 55$ recruited selected in hospital antenatal care clinics selected from the Frere and CMH hospital register in Buffalo City Metropolitan. The high risk pregnant women with GDM $n = 22$ not legible because of high gestational age above 26 weeks and above age 35 years old.

All 33 high risk women with GDM were all enrolled in intervention group. All the high risk women with GDM who were interested in the study sign the informed consent. Then assigned to the intervention or experimental group only where all the high risk women in the intervention group were receiving modified diet and planned physical activity intervention.

The total number of high risk pregnant women with GDM analysed in the intervention group were $n = 32$. The rationale for this number was due to the following reasons for the high risk pregnant women with GDM explained below:

- Some low risk pregnant women ($n = 1$) relocated to Pretoria
- There were no miscarriages but baby died at 32 weeks’ gestation ($n = 1$)
- Delivered at 32 weeks with only two monitoring instead of three monitoring like other GDM women ($n = 4$)

5.8.1 Research question

What is the effect of modified diet and planned physical activity intervention on high risk pregnant women with GDM of pregnancy outcomes in Buffalo City, Eastern Cape?

5.8.2 Research objective

To identified and describe the effect of modified diet and planned physical activity on high risk pregnant with GDM women of pregnancy outcomes in Buffalo City, Eastern Cape.

5.9 Data Collection of High Risk Pregnant Women

At 26 weeks’ gestation sealed envelopes stating control and experimental/intervention group was distributed by the researcher and research assistants to high risk pregnant women during data collection.
The experimental design for high risk pregnant women were assigned to experimental/intervention and control group using the research randomizer software during the second visit (26 weeks’ gestation) (Kim & Shin, 2014:5).

High risk pregnant women participated in this study were recruited from the four community health care centres voluntarily. Data was collected using open and ended questionnaires designed by the researcher and the statistician. The data was collected by the researcher and research assistance during May to August 2017 to all women eligible for the study. The research assistant meets the participant in the morning between 8:00 and 11:00 am at the hospital. Women signed the consent during the visit, for the record. The baseline anthropometric measures of weight, BMI, MUAC, blood pressure, blood glucose, pulse and urine in every visit from 26 weeks to 34 weeks’ gestation (Kim & Shin, 2014:5).

5.11 Conclusion

Low risk pregnant women were randomized to experimental and control groups by the research randomizer. But the number of low risk pregnant women did not finish the intervention program due to relocation, miscarriages and phone loss. However, the high risk pregnant women were not randomizer but all were in the intervention group.
CHAPTER 6
MODIFIED DIET AND PLANNED PHYSICAL ACTIVITY INTERVENTION

6.1 Introduction

In this chapter the researcher focuses on phase 5 of the study. This phase was the implementation of intervention, in the form of a modified diet and planned physical activity programme among low and high-risk pregnant women with GDM.

6.2 Modified dietary instructions

A modified diet was introduced to the low-risk pregnant women and high-risk pregnant women with GDM, adapted from the WHO (2015) nutritional guidelines. Consultation was done initially and then at three subsequent visits to monitor and adapt for individual preferences, so that the diet remained contextual and relevant (Sevenhuysen & Gross, 2014:335).

Pregnant women, midwives, obstetrician, researcher and dietitians jointly shared nutritional information, especially about type of food, portion sizes and frequency of consumption. The modified diet constituted the nutritional intervention component; its aim was to create a personalised, achievable dietary plan, with consideration for participants’ contexts and the availability of various foods. Monthly follow-ups were conducted, comprising diet consultation and the taking of anthropometric measurements.

6.3 Planned Physical Activity Instructions

Physical activity (PA) was advised between the first trimester and the third trimester. Getting proper planned physical activity is equally important as following the correct diet. Regular, mild, planned physical activity allows the body to respond correctly to insulin and to use it more effectively.

Planned physical activity implies engagement in any type of physical activity as long as it is performed daily, or twice or three times a week at the same time for the same duration (Diabetes Care, 2013:3).
Low and high-risk pregnant women with GDM should select any physical activity that is comfortable, easy, suitable and applicable for their ability. Planned physical activity is beneficial for women during pregnancy, labour and the post-partum period (Nascimento et al., 2012:389).

6.4 Intervention Design

Intervention design has to do with the development, implementation and testing of an intervention (Polit & Beck, 2014:294). The intervention is an alternative treatment or condition administered to participants, differing in how it is implemented according to circumstances. The aim of intervention is to improve people’s lives and promote behavioural changes in real life settings, using evidence-based practice. The intervention in this study was to introduce a modified diet and a programme of physical activity to low and high-risk pregnant women with GDM.

The rationale for the intervention was to test the results of the modified diet and planned physical activity programme on pregnant women, and ascertain whether the intervention produced appreciable lifestyle modifications. Furthermore, the researcher was interested in encouraging the adoption of a healthy lifestyle among low-risk and high-risk pregnant women who suffered various complications due to poor lifestyle choices.

6.4.1 Intervention process

The modified diet and planned physical activity intervention were planned for the low and high-risk pregnant women with GDM. All low and high-risk women completed the questionnaires and signed the informed consent form before commencing the intervention programme. Anthropometric measurements were taken from all participants at the initial visit for baseline data. The information from the questionnaires and the anthropometric measurements were used to develop the intervention programme of modified diet and planned physical activity. Low and high-risk pregnant women with GDM in the intervention group received detailed information about lifestyle intervention during pregnancy in the form of a booklet. The researcher also provided the intervention group only with detailed individualised modified dietary advice consistent with current diet standards and planned physical activity related to the guidelines.
The low and high-risk women attended a consultation with the dietician at the initial visit for education about proper diet. The modified diet included a balance of carbohydrates, fats, and proteins and advocated a reduction in foods high in refined carbohydrates and saturated fats. The dietician also educated pregnant women on increasing their intake of fibre, and the consumption of two servings of fruit, five servings of vegetables, and three servings of dairy each day. Dietary counselling was given once in each trimester but monthly for poorly managed pregnant women with GDM.

The researcher provided low and high-risk pregnant women in the intervention group with pedometers to monitor the number of steps taken each day. Each was also given a log book in which to record numbers of steps taken. The pregnant women were also given instructions for home physical activity; it should occur three to five times a week during weeks 26 to 38 weeks’ gestation.

6.4.2 Data collection during intervention

At 20 weeks’ gestation low-risk pregnant women were recruited to initiate the intervention. Anthropometric measurements were taken for baseline data. A closed- and open-ended questionnaires were distributed manually by the researcher and research assistants to the low and high-risk pregnant women with GDM. Section 10 of the questionnaire included three items; types of physical activity, enhancers of physical activity and barriers to physical activity. These three items were asked to assess what they felt most in need of to help or enhance their physical activity engagement, and what they found the biggest hindrance or barrier to their physical activity engagement. The low and high-risk pregnant women with GDM completed and signed the questionnaires. The collection of questionnaires was done at the same visit.

A total of 318 low-risk pregnant participants were approached to participate. In total n=291 low-risk pregnant women were allocated to the control and intervention groups because n=24 were not eligible to participate and three declined to take part. Low-risk women participants were randomised into the intervention and control groups. Participants in the control group did not receive the intervention activities mentioned above, but only standardised care.

The researcher and research assistants monitored the low and high-risk pregnant women with GDM using a checklist designed to test the effectiveness of the modified diet and planned physical activity.

The high-risk pregnant women with GDM, n=34, were all enrolled in the intervention group so that they received the modified diet and planned physical activity. There was no control group for high-risk women with GDM.

6.5 Planned physical activity intervention

6.5.1 Planned physical activity
Physical activity refers to regular, planned body movements that lead to energy expenditure, whether moderate or vigorous (Moss & Lubbe, 2011:14). The energy expenditure was any movement the low-risk pregnant women and high-risk pregnant women with GDM engaged in at home, such as household chores and walking (Moss & Lubbe, 2011:14). In this study the researcher emphasised planned physical activities that were relevant, available and comfortable to do by the low and high-risk pregnant women with GDM.

6.5.2 Research question
The research question was, ‘What is the effect of the modified diet and the planned physical activity intervention on low and high-risk pregnant women with GDM?’

6.5.3 Objective
The objective was to identify and describe the effects of the modified diet and planned physical activity intervention on low and high-risk pregnant women with GDM.

6.5.4 Planned and instructed physical activity intervention
Some low and all high-risk pregnant women with GDM were assigned to the intervention group and received planned physical activity instruction based on a video and pictures produced in a previous study (Hui, Ludwig, Gardiner, Huysen, Murray, Morris & Shen, 2006:331).

Low and high-risk pregnant women with GDM kept a logbook of their physical activity as a record of their activities and to help motivate them to achieve goals.
The planned physical activity comprised a programme which included mild-to-moderate physical activities such as walking, running and doing household chores. Low and high-risk pregnant women were also given a video showing antenatal exercises to follow at home. Participants were encouraged to exercise three to five times a week, for a duration of 30 to 45 minutes at each session. The exercise intervention was started at 26 weeks’ gestation and continued to 34 weeks’ gestational. Participants were also given pedometers to record the amount of planned physical activity taken at home and the number of times it was engaged in over the course of a week. The researcher educated low and high-risk pregnant women with GDM at each visit about the benefits of planned physical activity during and after pregnancy, and gave tips to increase incidental activity and walking (Turnbull, et al., 2014:34; Dodd et al., 2014:161). Women were encouraged to set achievable goals for planned physical activity and to self-monitor their progress using pedometers given in the beginning of the intervention, at 26 weeks’ gestation.

The goal for planned physical activity was 150 minutes per week, comprising 30 minutes a day for five days. Pregnant woman who were not used to planned physical activity were advised to start gradually, with ten to 30 minutes of planned physical activity per session. The researcher advised the pregnant women to use multiple ways of accumulating the total of 150 minutes per week. The concept of accumulation referred to meeting the goal of 150 minutes per week by performing activities in multiple shorter bouts, of at least ten minutes each, spread throughout the week, and then adding together the time spent during each of these bouts: for example, 30 minutes of moderate-intensity activity five times per week (WHO Guidelines, 2015).

This information was reinforced during subsequent visits at 26, 30 and 34 weeks’ gestation by the researcher and assistants. Women who showed poor attendance, failed to do planned physical activity at home or failed to keep a record of planned physical activity in the logbook were considered as having withdrawn from the study.
6.6 Research Design and Methods for Planned Physical Activity Intervention

6.6.1 Population

The target population is the entire population, in this study, low- and high-risk pregnant women with GDM in which a researcher is interested and to which the researcher would like to generalise the study results (Polit & Beck, 2014:766). Population stratified sampling was used and low and high-risk pregnant women with GDM were randomly selected from pregnant women aged between 18 and 35 years in Buffalo City Metropolitan Municipality, Eastern Cape.

6.6.2 Data collection during planned physical activity intervention

Data for the planned physical activity was collected using a checklist of planned physical activities, namely walking, running, household chores, and using a logbook where pregnant women recorded their numbers and the duration of planned physical activity sessions (WHO, 2015). Less attendance of three or fewer antenatal visits, failure to record exercises, and lack of interest in planned physical activity were considered indications of the person’s withdrawal from the study (Ludwig, Gardiner, Sevenhuysen, Morris & Shen, 2014:36).

Low and high-risk pregnant women were also given a video with antenatal exercises to assist them at home. Participants were encouraged to do planned physical activity three to five times a week, for a duration of 30 to 45 minutes at a time (WHO, 2015). The planned physical activity intervention period was from 26 weeks’ gestation to 34 weeks’ gestation for low-risk pregnant women and high-risk women with GDM. A checklist was given on which women could record the type of activity done at home.

The planned physical activities recorded on the checklist were walking, running and household chores. The women were encouraged to engage in 30 minutes of exercise five days a week, but to build up to it gradually where they were not accustomed to this amount of exercise. The researcher checked the checklist for the planned physical activity at each visits for antenatal care at 26, 30 and 34 weeks’ gestation (Hui, Ludwig, Gardiner, Sevenhuysen, Morris & Shen, 2014:35).
The researcher used the checklists and logbooks to ascertain what forms of planned physical activity, and how much of it, were engaged in by the low-risk pregnant women and high-risk pregnant women with GDM. The researcher also recorded the anthropometric measures of the pregnant women at each antenatal care visit, i.e., at 26, 30 and 34 weeks’ gestation.

During each visit the researcher tested whether participating in physical activity was enabling participants to maintain correct weight, strength and energy (Moss & Lubbe, 2011:14). Anthropometric measurements were taken at 26, 30 and 34 week’s gestation; these were weight, BMI, MUAC, glucose level, blood pressure, pulse and urine.

The 10-item questionnaire was distributed manually by the researcher and research assistants to the low and high-risk pregnant women with GDM. The researcher motivated and educated the low and high-risk pregnant women about the benefits of engaging frequently in planned physical activity which was constantly emphasised for the intervention group.

Data collection by the low and high-risk pregnant women was done quantitatively. Data was also recorded on the women’s logbooks and transcribed to the researcher’s checklist. Out of 291 low-risk pregnant women, 149 participated in the planned physical activity intervention programme There were n=142 low-risk pregnant women in the control group. The number of high-risk pregnant women in the study was n=34 but only n=13 participated in the planned physical activity. No high-risk pregnant women participated in the running category; n=7 participated in walking and n=6 participated in household chores.

6.6.5 Data analysis for planned physical activity intervention

Data generated through the questionnaire were captured into Microsoft Excel and transferred into the Statistical Package for Social Sciences (SPSS) version 24. Before performing the analysis, simple frequencies were run to check data for errors and outliers. Questionnaires were revisited to correct observed errors. Descriptive statistics for all study variables were gathered.
6.7 Modified Dietary Intervention

Modified diet was an intervention based on healthy dietary guidelines for low and high-risk pregnant women with GDM. In this study the modified dietary intervention was a modified diet based on what the women were familiar with but modified to include correct proportions of carbohydrates, proteins, vegetables and fruit, all of which had to be locally available.

6.7.1 Research question

The research questions were, ‘What are the effects of the modified diet and planned physical activity intervention on low and high-risk pregnant women with GDM?’

6.7.2 Objective

The objective was to identify and describe the effects of the modified diet and planned physical activity intervention on low and high-risk pregnant women with GDM.

6.7.3 Modified diet

The modified diet was a balanced diet of carbohydrates, vegetables, protein, fats and fruits. The dietician played a major role in empowering low and high-risk pregnant women with GDM throughout the implementation of the modified diet by conducting group counselling sessions.

6.7.4 Dietary intervention counselling

Low and high-risk pregnant women with GDM in the intervention group had a group dietary consultation at initial visit and monthly thereafter with the dietician. More frequent consultations were held with the high-risk women with GDM who had uncontrolled glucose levels. These women were monitored fortnightly. The dietician explained the key food choices according to the WHO (2015) nutrition guidelines. Both low and high-risk women with GDM were given dietary booklets with information about the diet to read at home.

The focal point of education by the dietician was the issue of correct proportions and amounts of each food type. Participants were advised to decrease carbohydrate content and to increase vegetable and protein content during pregnancy.
With high-risk pregnant women with GDM, education on types of fruit to eat differed from advice given to low-risk pregnant women. Generally, the information focussed on quantity, types of foods (carbohydrates, protein, vegetables and fruits) and frequency of consumption.

The dietician was available at each visit from 26 weeks’ gestation to 34 weeks’ gestation, giving high-risk pregnant women with GDM individual counselling regarding correct choices of foods. The nutrition intervention was for educating the participant and imparting a personalised healthy lifestyle which was accessible and achievable, taking into considerations what was available to the pregnant women (Özlem Aşcı & Gülay Rathfisch, 2016:2).

The researcher also engaged in individual consultations at each visit, explaining the nutritional value of each common food. Benefits for the unborn baby were explained. The researcher and midwives took into consideration personal food preferences, food beliefs and availability, and found ways to adjust and adapt what was already consumed so as to optimise its nutritional value. The researcher focused on modifying existing food beliefs and preferences, and tried to base all recommendations on what the women already had in their homes, with modifications for portion sizes and balance. The ideas were to create a personalised, achievable dietary plan with consideration for low and high-risk pregnant women’s reasons for food choice decision making (ADA, 2010).

The best way to gain weight would be gradually. Pregnant women should aim for weight gains of between 10kg and 12.5kg during pregnancy (Department of Health (DH) 2009). The recommendations for pregnant women are to take two important supplements during pregnancy; folic acid every day for the first 12 weeks and vitamin D every day throughout the pregnancy. It is also recommended that calcium intake is doubled during pregnancy (WHO, 2015; NICE, 2008). Most guidelines on nutrition for pregnant women suggest supplementation for pregnant women to prevent conditions related to shortages of calcium, iron or vitamin A and D. Pregnant women should have a variety of foods from the four main food groups at each meal, as is explained in the food standards (NHS, 2011:2):
- Fruits and vegetables: Use fresh, frozen, tinned, dried or juiced fruits and vegetables. Aim for at least five portions each day.
- Starchy food: These include bread, pasta, rice and potatoes. Wholegrain options are best.
- Foods rich in protein: These include lean meat and chicken, fish, eggs and pulses (such as beans and lentils), with at least two portions of fish a week, including oily fish.
- Dairy foods: These include milk, cheese and yoghurt, which contain calcium.
- For iodine, sea fish and sea salt should be consumed.

### 6.7.5 Data collection

Low and high-risk pregnant women with GDM received one-on-one dietary counselling initially and group consultations at 26, 30 and 34 weeks’ gestation. During consultations, participants recalled their food intakes and preferences and discussed how they were able to adapt according to the suggestions given. This information was recorded by the low and high-risk pregnant women at home and included food items, portion sizes and the frequency of consumption of each food.

At each antenatal visit, the researcher recorded the information on her checklist, along with the anthropometric measurements. Anthropometric measurements were weight, pulse rate, BMI, MUAC, blood pressure and blood glucose levels. These were taken at 26, 30, and 34 weeks’ gestation.

During data collection, the anthropometric measurements were compared with the initial measurements to see if participants maintained the correct weight, and to prevent conditions related to overweight.

### 6.7.6 Data analysis for modified diet

Data generated through the questionnaire were captured into Microsoft Excel and transferred into the Statistical Package for Social Sciences (SPSS) version 24. Before performing the analysis, simple frequencies were run to check data for errors and outliers. Questionnaires were revisited to correct observed errors. Descriptive statistics for all study variables were gathered.
To examine differences between the control and intervention groups regarding weight increase, BMI increase and MUAC increase, factorial analysis of variance for repeated measures was used. Continuous variables and chi-square test were used for categorical variables.

Variables were examined to ensure they did not violate the criteria for performing analysis of factorial analysis of variance. Data were checked to ensure there were no outliers. The alpha value for statistical significance was set at 0.05, with a Bonferroni correction applied for comparisons of continuous variables between study groups.

6.8 Conclusion

Some low- and high-risk pregnant women enjoyed the physical activities and strove to make changes in the interests of their unborn babies. Others reported minimal engagement in physical activity due to tiredness or lack of support from significant others. The modified diet results showed that low- and high-risk pregnant women consumed balanced diets, but anthropometric results showed consistent overweight and obesity, as is explained and discussed in the next chapter.
CHAPTER 7
PRESENTATION OF RESULTS OF MODIFIED DIET AND PLANNED PHYSICAL ACTIVITY INTERVENTION

7.1 Introduction

The previous chapter presented results from the descriptive data of low-risk pregnant women (LRPW) and high-risk pregnant women (HRPW) with GDM. This chapter presents the results of the modified diet and planned physical activity intervention.

7.2 Baseline Anthropometric Measurements of both Control and Experimental Group of LRPW

Table 7.1 below presents the baseline anthropometric measurements of both control and experimental group of LRPW for comparison purposes.

<table>
<thead>
<tr>
<th>Study groups</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Level test of equality of variance (Sig)</th>
<th>T</th>
<th>Mean difference</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>141</td>
<td>75.1 (16.5)</td>
<td>0.082</td>
<td>-0.797</td>
<td>-1.7</td>
<td>0.46</td>
</tr>
<tr>
<td>Intervention group</td>
<td>148</td>
<td>76.8 (20.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.1 shows that the total number of LRPW in the control group was n=141 (99.2%) and the number in the intervention group was n=148 (99.3). The average weight of the LRPW in the control group was 75.1 kg (SD 16.5 kg). The average weight of LRPW in the intervention group was 76.8 kg (SD 20.3 kg). The level test of equality of variance reveals that there was no significant difference (0.082) between the weights of the control group and the intervention group of LRPW. The P-value of 0.46 also indicates that the difference between the baseline values of the two groups was statistically insignificant. The independent T-test statistic also reveals that there was no significant difference between the weight of LRPW in the control group and those in the intervention group at baseline.
Weight in this study is significant because it is the indicator for overweight and obesity amongst LRPW and HRPW. Wahabi et al. (2014:2) confirm that overweight and obesity have negative effects on pregnancies.

This section presents findings on the effect of the modified diet and planned physical activity intervention on the anthropometric measurements of pregnant women. The aim was to examine whether there was a significant difference between the anthropometric characteristics of pregnant women in the control group and the intervention group. In order to establish this, a mixed-factor, two-way repeated analysis of variance was computed for each anthropometric characteristic. This was done after ensuring that there were no outliers in the data, there was equal variance between the two groups and the data were normally distributed.

As shown in Table 7.1, the mean weight for pregnant women in the control group was 75.1kg (SD ±16.5) and 76.8kg (SD±20.3) in the intervention group at baseline measurement. There was weight gain at every repeated interval. Mean weight in August was 82.5kg (SD±16.7). Women in the intervention group gained less weight than those the control group at repeated intervals, from a mean weight in April of 75.6kg (SD±19.3) to a mean weight of 80.9kg in August.

**Table 7.2: Tests of within-subject contrasts**

<table>
<thead>
<tr>
<th>Source</th>
<th>Weight increase</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Increase</td>
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<td>1</td>
<td>5472.311</td>
<td>650.076</td>
<td>.000</td>
<td>.712</td>
</tr>
<tr>
<td></td>
<td>Quadratic</td>
<td>25.807</td>
<td>1</td>
<td>25.807</td>
<td>10.335</td>
<td>.001</td>
<td>.038</td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>.008</td>
<td>1</td>
<td>.008</td>
<td>.007</td>
<td>.935</td>
<td>.000</td>
</tr>
<tr>
<td>Effect of Intervention</td>
<td>Linear</td>
<td>95.909</td>
<td>1</td>
<td>95.909</td>
<td>11.393</td>
<td>.001</td>
<td>.042</td>
</tr>
<tr>
<td></td>
<td>Quadratic</td>
<td>.133</td>
<td>1</td>
<td>.133</td>
<td>.053</td>
<td>.817</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>2.465</td>
<td>1</td>
<td>2.465</td>
<td>2.082</td>
<td>.150</td>
<td>.008</td>
</tr>
<tr>
<td>Error (Weight increase)</td>
<td>Linear</td>
<td>2213.924</td>
<td>263</td>
<td>8.418</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quadratic</td>
<td>656.716</td>
<td>263</td>
<td>2.497</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>311.384</td>
<td>263</td>
<td>1.184</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tests of within-subject effects**
Tables 7.2 and 7.3 show repeated weight gains in the intervention groups, which were statistically significant at 0.00 to 0.05 with data frequency of the average or mean squares. In this study the results in Table 7.2 and 7.3 were interpreted using mean average, Sphericity, Greenhouse Geisser or Huynh-feldt. The tests shown in these tables illustrate that the weight increase and the effect of the intervention were statistically significant. According to a study done in Winnipeg by Hui et al. (2014:5), weight gain was significantly lower in women whose baselines weights were normal than in those whose baseline measurements showed them as being overweight.

### 7.3 Effects of Intervention on Weight Gain

This section presents findings on the effect of the modified diet and planned physical activity intervention on the anthropometric characteristics of pregnant women.
The aim was to examine whether there was a significant difference between the anthropometric characteristics of pregnant women in the control group and that of pregnant women in the intervention group. A mixed factor, two-way repeated analysis of variance was computed for each anthropometric characteristic. This was done after ensuring that there were no outliers in the data, that equal variance was assumed between the two groups and that the data were normally distributed.

In this study overweight was assumed to have a negative effect on the woman and the unborn baby. Hui, Ludwig, Gardiner, Huysen, Murray, Morris & Shen, (2006:331) confirm that an increase in overweight and obesity carries a high risk of GDM, maternal morbidity and infant mortality.

Figure 7.1: Baseline data for weight gain

Figure 7.1 shows the difference between the low-risk control group and the low-risk intervention group, where the difference was not statistically significant.
The duration of the intervention was three months; if the study had been conducted over a longer period, the statistical difference may well have been greater. Bogaert and Linas (2008) claim that weight gain is normal in a pregnant woman, but should be in the region of 9kg to 11kg over the three trimesters. Unhealthy weight gain increases the possibility of many health conditions including hypertension and diabetes, and prevents positive, healthy pregnancy outcomes.

Table 7.4: Middle upper arm circumference (MUAC) at base line

<table>
<thead>
<tr>
<th>Study groups</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Level test of equality of variance (Sig)</th>
<th>T</th>
<th>Mean difference</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>136</td>
<td>28.6 (16.5)</td>
<td>0.362</td>
<td>-0.268</td>
<td>-0.2</td>
<td>0.789</td>
</tr>
<tr>
<td>Intervention group</td>
<td>141</td>
<td>28.8 (20.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.4 shows that the total number of LRPW in the control group was n=136 and the number in the intervention group was n=141. The average MUAC of the LRPW in the control group was 28.6cm (16.5cm). The average MUAC of LRPW in the intervention group was 28.8cm (20.3cm). The level test of equality of variance reveals that there was no significant difference between the MUAC of the control group and the intervention group of LRPW. The independent T-test statistic reveals that there was no significant difference between the MUAC of LRPW in the control group and that of LRPW in the intervention group at baseline.
Table 7.5: Test of within-subject effects

Measure: Repeated measures

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUAC increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphericity Assumed</td>
<td>824.887</td>
<td>3</td>
<td>274.962</td>
<td>176.858</td>
<td>.000</td>
<td>.404</td>
</tr>
<tr>
<td>Greenhouse-Geisser</td>
<td>824.887</td>
<td>1.631</td>
<td>505.809</td>
<td>176.858</td>
<td>.000</td>
<td>.404</td>
</tr>
<tr>
<td>Huynh-Feldt Lower-bound</td>
<td>824.887</td>
<td>1.646</td>
<td>501.163</td>
<td>176.858</td>
<td>.000</td>
<td>.404</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>824.887</td>
<td>176.858</td>
<td>.000</td>
<td>.404</td>
</tr>
<tr>
<td>MUAC Increase intervention effect</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sphericity Assumed</td>
<td>33.001</td>
<td>3</td>
<td>11.000</td>
<td>7.075</td>
<td>.000</td>
<td>.026</td>
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<tr>
<td>Greenhouse-Geisser</td>
<td>33.001</td>
<td>1.631</td>
<td>20.236</td>
<td>7.075</td>
<td>.002</td>
<td>.026</td>
</tr>
<tr>
<td>Huynh-Feldt Lower-bound</td>
<td>33.001</td>
<td>1.646</td>
<td>20.050</td>
<td>7.075</td>
<td>.002</td>
<td>.026</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>33.001</td>
<td>7.075</td>
<td>.008</td>
<td>.026</td>
</tr>
<tr>
<td>Error MUAC increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphericity Assumed</td>
<td>1217.338</td>
<td>783</td>
<td>1.555</td>
<td>2.860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse-Geisser</td>
<td>1217.338</td>
<td>425.646</td>
<td>2.860</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huynh-Feldt Lower-bound</td>
<td>1217.338</td>
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<td>2.834</td>
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<td></td>
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</tr>
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<td></td>
<td>1217.338</td>
<td>4.664</td>
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<td></td>
</tr>
</tbody>
</table>

7.4 Effects of Intervention on MUAC

This section presents findings on the effect of the modified diet and planned physical activity intervention on the anthropometric characteristics of the pregnant women. The aim was to examine whether there was a significant difference between the anthropometric characteristics of pregnant women in the control group and those in the intervention group.

A mixed-factor, two-way repeated analysis of variance was computed for each anthropometric characteristic. This was done after ensuring that there were no outliers in the data, that equal variance was assumed between the two groups and that the data were normally distributed.
Table 7.5 and 7.6 show that the mean MUAC for pregnant women in the control group was 28.6cm (16.5) at baseline measurement. There was an increase in MUAC at every repeated interval (that is from 26, 30 and 34 weeks’ gestation). Similarly, women in the intervention group gained in MUAC at repeated intervals of MUAC from 28.8cm (20.3%) at baseline to 34.9cm.

Table 7.6: Tests of within-subject contrasts

Measure: Repeated measures

<table>
<thead>
<tr>
<th>Source</th>
<th>MUAC_gains_measures</th>
<th>Type III</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUAC_gains_measures</td>
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<td>812.6</td>
<td>43</td>
<td>812.6</td>
<td>43</td>
<td>235.4</td>
<td>.00 0</td>
</tr>
<tr>
<td></td>
<td>Quadratic</td>
<td>9.081</td>
<td>1</td>
<td>9.081</td>
<td>1</td>
<td>12.09</td>
<td>.00 1</td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>3.163</td>
<td>1</td>
<td>3.163</td>
<td>1</td>
<td>6.853</td>
<td>.00 9</td>
</tr>
<tr>
<td>MUAC_gains_measures *</td>
<td>Linear</td>
<td>30.61</td>
<td>8</td>
<td>30.61</td>
<td>8</td>
<td>8.870</td>
<td>.00 3</td>
</tr>
<tr>
<td>control_intervention</td>
<td>Quadratic</td>
<td>.119</td>
<td>1</td>
<td>.119</td>
<td>1</td>
<td>.159</td>
<td>.69 0</td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>2.264</td>
<td>1</td>
<td>2.264</td>
<td>1</td>
<td>4.904</td>
<td>.02 8</td>
</tr>
<tr>
<td>Error</td>
<td>Linear</td>
<td>900.9</td>
<td>26</td>
<td>3.452</td>
<td>1</td>
<td>.462</td>
<td>.02 8</td>
</tr>
<tr>
<td>(MUAC_gains_measures)</td>
<td>Quadratic</td>
<td>195.9</td>
<td>26</td>
<td>.751</td>
<td>1</td>
<td></td>
<td>.462</td>
</tr>
<tr>
<td></td>
<td>Cubic</td>
<td>120.4</td>
<td>26</td>
<td>.462</td>
<td>1</td>
<td></td>
<td>.462</td>
</tr>
</tbody>
</table>
The Greenhouse-Geisser test reveals that there was a significant increase in MUAC at every follow-up visit \((p<0.001)\). The Levene's Test of Equality of Error Variances indicates that equal variance was present between the groups at every repeated interval.

Both control and intervention groups had similar means, indicating that LRPW were within normal ranges of MUAC. The normal MUAC is from 24cm to 32cm; 33cm or over indicates obesity which may result in big babies, pre-eclampsia and GDM in pregnant women. A MUAC of 23cm or below suggests under-nutrition, with a possible outcome of small babies for gestational age (SGA). In this study, low-risk pregnant women with a MUAC of below 23cm would have required more frequent counselling and monitoring of the diet (Seller 2014:186). In this study, there were no instances of malnutrition or underweight, but a preponderance of obesity, meaning that underweight is becoming a rare problem and obesity is increasing, with all of its attendant conditions.

According to Sellers, (2014:186) and current research, MUAC is the preferred measure for pregnant women to ascertain malnutrition, overweight and obesity rather than BMI. In this study many low-risk pregnant women had a MUAC over 33cm, and were at risk of having increased blood pressure and pre-eclampsia. Also, low-risk pregnant women who were obese were at high-risk of having GDM, which has negative outcomes for pregnant women and babies if not treated early (Dennedy & Dunne, 2010:7).
Figure 7.2: MUAC baseline data and MUAC gains

Figure 7.2 shows that the MUAC of the control group increased more rapidly than that of the intervention group, although there is no statistical significance in these figures. The third monitoring of the intervention group showed a MUAC almost equivalent to the MUAC at second monitoring of the control group. The more rapid the increase of MUAC in the control group of LRPW, the higher the risk of negative outcomes such as increased blood pressure that results in pre-eclampsia if not treated early. The risk of developing GDM and other cardio-vascular diseases was high in these pregnant women. Dennedy and Dunne, (2010:7) confirm high MUAC is a possible precursor to big babies, instrumental delivery and sometimes neonatal death for unknown reasons.
7.5 Effect of the Intervention on BMI

Table 7.7: Body mass index (BMI) at baseline

<table>
<thead>
<tr>
<th>Study groups</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Level test of equality of variance (Sig)</th>
<th>T</th>
<th>Mean difference</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>132</td>
<td>29.0 (5.9)</td>
<td>0.401</td>
<td>-0.251</td>
<td>-0.3</td>
<td>0.802</td>
</tr>
<tr>
<td>Intervention group</td>
<td>136</td>
<td>29.2 (7.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.7 illustrates that the total number of LRPW in the control group was n=132 and in the intervention group, n=136. The average BMI of the LRPW in the control group was 29.0kg (5.9kg). The average BMI of LRPW in the intervention group was 29.2kg (7.0kg). The level test of equality of variance reveals that there was no significant difference in the BMI variation between the two groups of LRPW. The independent T-test statistic also reveals that there was no significant difference between the BMI of LRPW in the control group and the intervention group at baseline.

As shown in Table 7.7 the mean BMI for pregnant women in the control group was 29.0 (5.9) at baseline measurement. There were BMI gains at every repeated interval and the mean BMI was 29.0 (7.0). Similarly, women in the intervention group gained BMI at repeated intervals, moving from BMIs of 29.2 (7.0).

The Greenhouse-Geisser test reveals that there was a significant increase in BMI at every follow-up visit (p<0.001). The Levene's Test of Equality of Error Variances indicates that equal variance was present between the groups at every repeated interval. See Table 7.8, Levene's Test of Equality of Error Variance.
Table 7.8: Tests of within-subject’s effects

<table>
<thead>
<tr>
<th>Measure: MEASURE_1</th>
<th>Source</th>
<th>Type III Sum of Squares</th>
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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>186.617</td>
<td>50.450</td>
<td>.000</td>
<td>.161</td>
</tr>
<tr>
<td></td>
<td>Greenhouse-Geisser</td>
<td>559.852</td>
<td>1.418</td>
<td>394.744</td>
<td>50.450</td>
<td>.000</td>
<td>.161</td>
</tr>
<tr>
<td></td>
<td>Huynh-Feldt</td>
<td>559.852</td>
<td>1.429</td>
<td>391.737</td>
<td>50.450</td>
<td>.000</td>
<td>.161</td>
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<tr>
<td></td>
<td>Lower-bound</td>
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<td>1.000</td>
<td>559.852</td>
<td>50.450</td>
<td>.000</td>
<td>.161</td>
</tr>
<tr>
<td></td>
<td>BMI * Intervention</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sphericity Assumed</td>
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<td>Greenhouse-Geisser</td>
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<td>1.418</td>
<td>30.600</td>
<td>3.911</td>
<td>.034</td>
<td>.015</td>
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<tr>
<td></td>
<td>Huynh-Feldt</td>
<td>43.399</td>
<td>1.429</td>
<td>30.367</td>
<td>3.911</td>
<td>.034</td>
<td>.015</td>
</tr>
<tr>
<td></td>
<td>Lower-bound</td>
<td>43.399</td>
<td>1.000</td>
<td>43.399</td>
<td>3.911</td>
<td>.049</td>
<td>.015</td>
</tr>
<tr>
<td></td>
<td>Error (BMI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sphericity Assumed</td>
<td>2918.541</td>
<td>789</td>
<td>3.699</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greenhouse-Geisser</td>
<td>2918.541</td>
<td>373.004</td>
<td>7.824</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Huynh-Feldt</td>
<td>2918.541</td>
<td>375.867</td>
<td>7.765</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower-bound</td>
<td>2918.541</td>
<td>263.000</td>
<td>11.097</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to WHO (2015), body mass index (BMI) is a common measure of overweight and obesity locally and internationally.

BMI is measured using weight and height. The system classifies a BMI of below 18kg/m as underweight, 19 – 25kg/m as normal, 26kg/m – 29.9kg/m as overweight and 30kg/m – 39.9kg/m as obese (WHO, 2010). The researcher in this study promoted a healthy lifestyle during pregnancy in order to prevent the ills associated with overweight and obesity during pregnancy. The adverse effects of overweight and obese are GDM, foetal macrosomia, shoulder dystocia, unexplained foetal death and instrumental delivery (Fattah et al. 2010:1).
Figure 7.3 illustrates an acceleration of BMI amongst LRPW in the control group compared to the intervention group. As pregnancies progressed, BMI at the second and third monitoring increased at an alarming rate. All pregnant women are supposed to gain weight gradually as pregnancy progresses, but in this study, LRPW underwent a rapid increase in BMI, which is a risk factor for developing GDM, hypertension, pre-eclampsia, and Type 2 diabetes in the future. Type 2 diabetes is an epidemic worldwide (Bhattacharya et al. 2007; WHO 2010). Current guidelines from the Centre for Disease Control and Prevention and the World Health Organisation stipulate a BMI of 18.5 to 24.9kg/m² for pregnant women.
Table 7.9: Anthropometric characteristic of participants with GDM at baseline

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEIGHT</td>
<td>34</td>
<td>63.20</td>
<td>131.00</td>
<td>89.9471</td>
<td>16.17659</td>
</tr>
<tr>
<td>MUAC</td>
<td>34</td>
<td>21.00</td>
<td>40.00</td>
<td>31.3029</td>
<td>4.32095</td>
</tr>
<tr>
<td>BMI</td>
<td>34</td>
<td>23.00</td>
<td>45.00</td>
<td>31.3994</td>
<td>4.85899</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. STUDY GROUP = GDM

7.6 Weight for GDM

The total number of HRPW with GDM was n=34, with all in the intervention group. The maximum weight was 133kg, indicating obesity. Obesity gives rise to GDM, gestational hypertension and cardiac problems ([Hui, Ludwig, Gardiner, Huysen, Murray, Morris & Shen, 2006:331]).

7.7 MUAC for GDM

The total number of HRPW with GDM was n=34, with all in the intervention group. The maximum MUAC was 40cm which is well above the normal values of 24 to 32cm. A MUAC of 33cm and above indicates overweight and obesity ([Sellers, 2014:186]). Overweight and obesity have negative outcomes for the mother and the foetus ([Dennedy & Dunne, 2010:7]). Modified diet and the planned physical activities are crucial for women in this category.

7.8 BMI for GDM

The total number of HRPW with GDM was n=34, with all participants in the intervention group. The maximum BMI was 45kg/m, which is very high; the universal cut-off values for BMI are 18kg/m for underweight, 19 – 25kg/m for normal, 26kg/m – 29.9kg/m for overweight and 30kg/m – 39.9kg/m for obese ([WHO, 2010]). A BMI of 26kg/m and above indicates overweight and obesity, which have been shown to have negative outcomes for mother and foetus. The modified diet and planned physical activity are crucial for women in this category.

The researcher in this study promoted a healthy lifestyle during pregnancy in order to prevent the ills associated with overweight and obesity ([Fattah, et al., 2010:1]).
Table 7.10: Effect of the intervention on glucose levels at repeated intervals

<table>
<thead>
<tr>
<th>Glucose level</th>
<th>Baseline measure</th>
<th>First monitoring</th>
<th>Second monitoring</th>
<th>Third monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Abnormal</td>
<td>1 (0.7)</td>
<td>2 (1.5)</td>
<td>4 (3.1)</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>140 (99.3)</td>
<td>130 (98.5)</td>
<td>127 (96.9)</td>
</tr>
<tr>
<td>Intervention</td>
<td>Abnormal</td>
<td>2 (1.3)</td>
<td>1 (0.7)</td>
<td>2 (1.5)</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>147 (98.7)</td>
<td>134 (99.3)</td>
<td>132 (98.5)</td>
</tr>
<tr>
<td>GDM</td>
<td>Abnormal</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (11.6)</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>34 (100)</td>
<td>34 (100)</td>
<td>32 (88.4)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
<td>0.000</td>
<td>0.008</td>
<td>0.405</td>
</tr>
</tbody>
</table>

The total number of LRPW in the control group was n=141(99.3%) and in the intervention group, n=147(98.7%). During the first monitoring, control group was n=130(98.5%), at second monitoring n=127(96.9%) and at third monitoring n=126(96.2%), with numbers decreasing due to miscarriages, relocation of pregnant women and loss of phones to monitor the pregnant women. The intervention group followed the same trend as the control group, because the total number of LRPW decreased as the study progressed. For the interventions group, numbers were n=147(98.7%); at first monitoring n=134(99.3%), at second monitoring n=132(98.5%) and at third monitoring n=131(97.8). The prevalence of GDM increased from the baseline measurements to the values at third monitoring.

The total number of HRPW with GDM in the intervention group was n=34(100%). The HRPW comprised an intervention group only. During the first monitoring, n=34(100%), and at both second and third monitoring, n=32 (88.4%). As pregnancies progressed the number of HRPW decreased due to a miscarriage and a relocation.
Figure 7.4: Comparison of glucose levels at baseline

Figure 7.5: Comparison of glucose levels between control and intervention groups at first follow-up visit
There was a significant decrease in glucose level values from the baseline to the last measurements taken in the intervention group compared to the control group, as indicated in Figure 7.4 to Figure 7.7.
Table 7.11: Hypertension at repeated intervals for LRPW

<table>
<thead>
<tr>
<th>Hypertension</th>
<th>Baseline measure</th>
<th>First monitoring</th>
<th>Second monitoring</th>
<th>Third monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High BP</td>
<td>9 (6.4)</td>
<td>7 (5.3)</td>
<td>10 (7.6)</td>
<td>34 (26.0)</td>
</tr>
<tr>
<td>Normal BP</td>
<td>132 (93.6)</td>
<td>125 (94.7)</td>
<td>121 (92.4)</td>
<td>97 (74.0)</td>
</tr>
<tr>
<td>Intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High BP</td>
<td>9 (6.0)</td>
<td>3 (2.2)</td>
<td>5 (3.8)</td>
<td>10 (7.5)</td>
</tr>
<tr>
<td>Normal BP</td>
<td>140 (94.0)</td>
<td>132 (97.8)</td>
<td>128 (96.2)</td>
<td>124 (92.5)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.904</td>
<td>0.185</td>
<td>0.174</td>
<td>0.000</td>
</tr>
<tr>
<td>GDM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High BP</td>
<td>0 (0.0)</td>
<td>4 (11.7)</td>
<td>3 (8.9)</td>
<td>4 (11.7)</td>
</tr>
<tr>
<td>Normal BP</td>
<td>34 (91.2)</td>
<td>30 (883)</td>
<td>31 (91.1)</td>
<td>30 (88.3)</td>
</tr>
</tbody>
</table>

Table 7.11 presents the baseline and repeated measurements for hypertension amongst of LRPW where n=132(93.6%). During the first monitoring, n=125(94.7%), at second monitoring n=121(92.4%) and at third monitoring n=97(74.0%). As pregnancies progressed the number of LRPW decreased due to miscarriages, relocation of pregnant women, and loss of phones to monitor the pregnant women. The intervention group followed the same trend as the control group because the number of LRPW decreased pregnancies progressed. At baseline, n=140(94.0%), at first monitoring n=132(97.8%), at second monitoring n=128(96.2%) and at third monitoring n=124(92.5). Gestational hypertension increased from the baseline measurements to the measurements at third monitoring.

In this study the total number of high-risk pregnant women with GDM was n=34(100%). During the first monitoring n=30(93.8%), at second monitoring n=31(96.9%) and at third monitoring n=24(85.7%). As pregnancies progressed the number of HRPW with GDM decreased due to miscarriages, relocation of pregnant women and loss of phones to monitor the pregnant women. Gestational hypertension is associated with heart failure, whereas preeclampsia may be strongly associated with all pregnant women with high blood pressure. It is less strongly associated with diabetes (Valery, et al., 2014).
Table 7.12: Changes in pulse rates at repeated intervals

<table>
<thead>
<tr>
<th>Pulse level</th>
<th>Baseline measure</th>
<th>First monitoring</th>
<th>Second monitoring</th>
<th>Third monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>24 (16.9)</td>
<td>21 (16.0)</td>
<td>24 (18.3)</td>
<td>43 (32.8)</td>
</tr>
<tr>
<td>Normal</td>
<td>118 (83.1)</td>
<td>110 (84.0)</td>
<td>107 (81.7)</td>
<td>88 (67.2)</td>
</tr>
<tr>
<td>Intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>21 (14.1)</td>
<td>13 (9.7)</td>
<td>20 (14.9)</td>
<td>32 (23.9)</td>
</tr>
<tr>
<td>Normal</td>
<td>128 (85.9)</td>
<td>121 (90.3)</td>
<td>114 (85.1)</td>
<td>102 (76.1)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.309</td>
<td>0.087</td>
<td>0.282</td>
<td>0.069</td>
</tr>
<tr>
<td>GDM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>9 (26.5)</td>
<td>8 (25.0)</td>
<td>8 (25.0)</td>
<td>14 (50.0)</td>
</tr>
<tr>
<td>Normal</td>
<td>25 (73.5)</td>
<td>24 (75.0)</td>
<td>24 (75.0)</td>
<td>14 (50.0)</td>
</tr>
</tbody>
</table>

Table 7.12 shows that the number of LRPW in the control group who had a normal pulse rate at baselines measuring was n=118(83.1%), while n=24(16.9%) had an abnormal pulse rate. During first monitoring n=110(84.0%) had normal pulse rates, at second monitoring n=107(81.7%) had normal pulse rates, and at third monitoring n=88(67.2%) had normal pulse rates. Normal pulse rates were measured for n=128(85.9%) LRPW in the intervention group at baseline measuring; thereafter, n=121(90.3%) were normal at first monitoring, n=114(85.1%) were normal at second monitoring and n=102(76.1%) were normal at third monitoring.

For HRPW with GDM, all in the intervention group, the total number of women with a normal pulse rate was n=25(73.5%) at baseline measuring. During first monitoring n=24(75.0%) were normal, at second monitoring n=24(75.0%) were normal and at third monitoring n=14(50.0%) were normal.

During pregnancy, the body undergoes changes, especially in cardiac output, which increases; the heart rate at rest speeds up from a normal pre-pregnancy rate of about 70 beats per minute to 80 or 90 beats per minute. The amount of blood pumped by the heart (cardiac output) increases by 30% to 50% (Sellers, 2014:162).
Table 7.13: Urine test results at repeated intervals for LRPW

<table>
<thead>
<tr>
<th>Urine tests</th>
<th>Baseline</th>
<th>First monitoring</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAD</td>
<td>277 (85.8)</td>
<td>240 (81.4)</td>
<td>241 (82.0)</td>
<td>217 (74.8)</td>
</tr>
<tr>
<td>Blood+</td>
<td>3 (0.9)</td>
<td>4 (1.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood ++</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td></td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Blood+++</td>
<td>2 (0.6)</td>
<td>2 (0.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leucocyte</td>
<td>5 (1.5)</td>
<td>5 (1.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leucocyte +</td>
<td>4 (1.2)</td>
<td>6 (2.0)</td>
<td>12 (4.1)</td>
<td>6 (2.1)</td>
</tr>
<tr>
<td>Leucocytes ++</td>
<td>6 (1.9)</td>
<td>3 (1.0)</td>
<td>3 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Leucocyte +++</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>2 (0.6)</td>
<td>2 (0.6)</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Protein trace</td>
<td>2 (0.6)</td>
<td>2 (0.6)</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Protein +</td>
<td>5 (1.5)</td>
<td>7 (2.4)</td>
<td>3 (0.9)</td>
<td>14 (4.8)</td>
</tr>
<tr>
<td>Protein++</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>4 (1.4)</td>
<td></td>
</tr>
<tr>
<td>Protein +++</td>
<td>1 (0.3)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose +</td>
<td>3 (0.9)</td>
<td>12 (3.7)</td>
<td>6 (1.8)</td>
<td>14 (4.8)</td>
</tr>
<tr>
<td>Glucose ++</td>
<td>7 (2.2)</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>7 (2.4)</td>
</tr>
<tr>
<td>Glucose +++</td>
<td>4 (1.2)</td>
<td>2 (0.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose ++++</td>
<td>2 (0.6)</td>
<td>2 (0.6)</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Nitrite positive</td>
<td>3 (0.9)</td>
<td>1 (0.3)</td>
<td>2 (0.6)</td>
<td></td>
</tr>
<tr>
<td>Blood and leucocyte</td>
<td>-</td>
<td>1 (0.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood + leucocyte +++</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Protein + Glucose +</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>3 (1.0)</td>
</tr>
<tr>
<td>Protein+ Glucose++</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Protein + Glucose trace</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Ketone</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protein +, leucocyte +</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protein +, leucocyte ++</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td>-</td>
</tr>
<tr>
<td>Blood +, protein +, leucocyte +</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bilirubin +, protein +</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nitrite positive, leucocytes +</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Blood ++++, leucocyte +++</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glucose ++++, protein, leucocytes+++</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protein +, blood +++</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ketones +, bilirubin, protein</td>
<td>1 (0.3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urobilinogen and leucocyte</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td>-</td>
</tr>
<tr>
<td>Nitrite, blood, leucocyte</td>
<td>-</td>
<td>-</td>
<td>1 (0.3)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>323</td>
<td>295</td>
<td>294</td>
<td>290</td>
</tr>
<tr>
<td>Missing System</td>
<td>2</td>
<td>30</td>
<td>31</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>325</td>
<td>325</td>
<td>294</td>
<td>325</td>
</tr>
</tbody>
</table>
Table 7.13 presents the urinalysis for LRPW in this study. The majority of the LRPW, n=277 (85.8%), had normal urinalysis. During the first monitoring LRPW were n= 240 (81.0%), at second monitoring n=241(82.0%) and at last third monitoring n=217 (74.8%). LRPW had the following abnormalities of the urine: protein, n=63, glucose, n=51, leucocytes, n=57 and blood, n=19. These figures indicate problems of the kidneys in low-risk pregnant women.

Table 7.14: Urine test results at repeated intervals for HRPW

<table>
<thead>
<tr>
<th>Urine test</th>
<th>Baseline</th>
<th>First monitoring</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAD</td>
<td>24 (72.7)</td>
<td>19 (61.3)</td>
<td>17 (54.8)</td>
<td>15 (55.6)</td>
</tr>
<tr>
<td>Blood +</td>
<td>-</td>
<td>1 (3.2)</td>
<td>3 (9.7)</td>
<td>-</td>
</tr>
<tr>
<td>Blood++</td>
<td>1 (3.0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Leucocytes +</td>
<td>-</td>
<td>-</td>
<td>3 (9.7)</td>
<td>1 (3.7)</td>
</tr>
<tr>
<td>Leucocytes ++</td>
<td>2 (6.1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glucose +</td>
<td>2 (6.1)</td>
<td>4 (12.9)</td>
<td>1 (3.2)</td>
<td>6 (22.2)</td>
</tr>
<tr>
<td>Glucose ++</td>
<td>2 (6.1)</td>
<td>1 (3.2)</td>
<td>1 (3.2)</td>
<td>2 (7.4)</td>
</tr>
<tr>
<td>Glucose +++</td>
<td>-</td>
<td>3 (9.7)</td>
<td>2 (6.5)</td>
<td>-</td>
</tr>
<tr>
<td>Glucose ++++</td>
<td>2 (6.1)</td>
<td>2 (6.5)</td>
<td>2 (6.5)</td>
<td>-</td>
</tr>
<tr>
<td>Protein +</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2 (7.4)</td>
</tr>
<tr>
<td>Glucose +</td>
<td>-</td>
<td>1 (3.2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protein</td>
<td>+ Glucose +</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urobilinogen +</td>
<td>-</td>
<td>-</td>
<td>1 (3.2)</td>
<td>-</td>
</tr>
<tr>
<td>Glucose ++, Protein +</td>
<td>-</td>
<td>-</td>
<td>1 (3.2)</td>
<td>-</td>
</tr>
<tr>
<td>Leucocytes ++, Protein ++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 (3.7)</td>
</tr>
</tbody>
</table>

Missing baseline =1, first follow up = 3, second follow up =3 and last follow up =7

Table 7.14 illustrating GDM urine results at repeated tests.

Table 7.14 above shows the urinalysis of the HRPW. The majority of the HRPW, n=24 (72.7%), had normal urinalysis. During the first monitoring, there were n=19(61.3%) HRPW, at second monitoring n=17(54.8%) and at third monitoring n=15 (55.6%). HRPW had fewer abnormalities of the urine than LRPW. The highest abnormality was glucose n=30, which indicates poor control of GDM. Also notable were protein, n=4, leucocytes, n=6 and blood, n=5.

One of the procedures performed on LRPW during antenatal care is urinalysis to detect any abnormality that might harm the mother or unborn baby.
Urine testing is always done to check high levels of glucose, protein, leucocytes, ketones and blood to prevent GDM, hypertension and infections. The implications of high levels of protein, glucose, ketones and leucocyte are discussed briefly below.

Protein in the urine is an indication of kidney problems, specifically, permeability of the glomerular filtrate in the kidneys. Sometimes the presence of protein suggests a urinary tract infection, but in pregnancy, if it is accompanied by high blood pressure, it is often a precursor to pre-eclampsia. Pre-eclampsia always has negative effects on other organs and can be fatal to the mother and unborn baby. However, by detecting protein in the urine early, midwives and obstetricians can prevent the development of pre-eclampsia. Nolte (2008:79) suggests that counselling during pregnancy about maintaining a healthy modified diet and engaging in physical activities will help women to lower their blood pressure levels and, in consequence, the prevalence of GDM.

Higher than normal glucose levels in the urine of a LRPW also indicate health problems and are a risk to the mother and unborn baby. Some glucose may be present in the urine, but at very low levels – usually only if very sweet food has been consumed the previous day. Nolte (2008:79) says that high glucose levels in the urine is called glycosuria, while in pregnant woman it is called gestational diabetes mellitus. In this study, the researcher was interested in preventing the occurrence of GDM by emphasising regular physical activity, reduced intake of fats and carbohydrates, and raised intake of fibre, together with monitoring of the blood glucose levels (Nolte, 2008:79).

Ketones are another abnormality found in the urine. High levels of ketones indicate that the person is eating insufficient quantities of food, or is dehydrated. Ketones may also arise when the body is breaking down fats instead of carbohydrates for energy. Nolte (2008:80) says that if there are high levels of ketones in the urine of a pregnant women followed by nausea and vomiting, the woman would be hospitalised.

Bacteria and leucocytes (white blood cells) in the urine may be a sign of urinary tract infection. When leucocytes are present in a pregnant woman, a specimen of midstream urine will be taken to detect which bacteria caused the infection.

Early treatment would prevent damage to the kidneys and reduce the risk of having a low birthweight or premature baby. Pregnant women who have bacteria in the urine
should always be treated with antibiotics, even when they show no symptoms. According to Nolte (2008:80), several types of antibiotics are considered safe for pregnant women.

7.9 Summary of Anthropometric Measures (weight, MUAC, BMI, urine, glucose, hypertension and pulse)

Weight, MUAC and BMI reflect conditions such as malnutrition, overweight and obesity that need to be controlled at all costs in pregnant women because of their detrimental effects on the health of the mother and unborn baby. The findings of this study amongst low-risk pregnant women and high-risk pregnant women were that weight, BMI and MUAC were excessively high. This is an indication of overweight and obesity among low-risk pregnant women and high pregnant women with GDM. Overweight and obesity promote GDM. Ongoing counselling involving a modified diet and planned physical activity during pre-pregnancy and early pregnancy would reduce the incidence of overweight and obesity and greatly lower costs for the public health service.

Gestational hypertension was also a problem in this study, with n=63 low-risk pregnant women having protein levels of 3+. Blood pressure is also an anthropometric measure, with high blood pressure having negative outcomes if not detected and treated early. It is usually traceable to an unhealthy lifestyle, hence the modified diet and planned physical activity would be suitable as prevention measures.

Glucose levels during pregnancy should be normal, since there is evidence that some infant mortalities are associated with high and untreated glucose levels. A high glucose level is associated with GDM, which has negative outcomes for mother and unborn baby. A normal resting pulse rate in an adult is around 70 beats per minute. The pulse rate of pregnant women ranges from 80 to 90 beats per minute because of increased cardiac output. In this study, the majority of low-risk pregnant women and high-risk pregnant women with GDM had normal pulse rates throughout. Of some concern is that both LRPW and HRPW in this study had threatening abnormalities in the urine, namely protein, glucose, leucocytes and blood. All these abnormalities can lead to devastating complications that may be fatal if intervention is delayed. In this study the researcher was interested in the promotion of a healthy
lifestyle amongst LRPW and HRPW and sought to prevent complications during pregnancy, intra-partum and post-natal.

7.10 Modified Diet

The modified diet in this study was based on the diet normally consumed by the participants, but adjusted to include more vegetables, protein and fruit within the participants’ context and subject to availability. Women were also urged to decrease the intake of carbohydrates and fats. The rationale for the modified diet was to avoid overweight and obesity.

Table 7.15: The modified diet

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is in your meal?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>316 (99.2)</td>
<td>138 (98.6)</td>
<td>144 (99.3)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>301 (100.0)</td>
<td>130 (100.0)</td>
<td>137 (100.0)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Protein</td>
<td>302 (100.0)</td>
<td>129 (100.0)</td>
<td>139 (46.0)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Fruit</td>
<td>293 (95.4)</td>
<td>130 (97.9)</td>
<td>138 (97.9)</td>
<td>25 (97.8)</td>
</tr>
<tr>
<td>Fats</td>
<td>302 (100.0)</td>
<td>130 (97.9)</td>
<td>138 (97.9)</td>
<td>25 (97.8)</td>
</tr>
</tbody>
</table>

The study made use of what women already ate, and adapted it to suit standard nutrition guidelines, so that it included red and green vegetables, carbohydrates, protein, fats and fruit in correct proportions. Women were asked what they regularly consumed. The total number of low-risk pregnant women who consumed vegetables was n=316(99.2%), n=301(100.0%) consumed carbohydrates, n=302(100.0%) consumed protein and n=293(95.4%) consumed fruit. Amongst high-risk pregnant women with GDM, n=34(100.0%) consumed vegetables, n=34(100.0%) consumed carbohydrates, n=34(100.0%) consumed protein and n=25(97.8%) consumed fats.
It seemed from the data that LRPW and HRPW had an understanding of a balanced diet, yet the majority remained overweight or obese according to their measurements for weight, BMI and MUAC. It needed to be emphasised that a balanced diet means the above food groups in correct proportion to one another and in correct quantities, with each meal including all food groups on the plate (NHS 2011:7; Van der Pump 2011:3).

Generally, there are challenges in getting both underweight and overweight pregnant women to accept and adhere to the correct diet. Becker (1978) speaks about stakeholders having to address perceived threats and perceived benefits to any change of habit for health promotion in order to reach ‘cues for action’ (Dean, Lassie, Imam & Bhutta, 2014:331).
<table>
<thead>
<tr>
<th>How often do you include cabbage on your plate?</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a day</td>
<td>139 (50.5)</td>
<td>54 (45.8)</td>
<td>69 (53.5)</td>
<td>16 (57.1)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>70 (25.5)</td>
<td>31 (26.3)</td>
<td>29 (22.5)</td>
<td>10 (35.7)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>66 (24.0)</td>
<td>33 (28.0)</td>
<td>31 (24.0)</td>
<td>2 (7.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How often do you include spinach on your plate?</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a day</td>
<td>110 (42.8)</td>
<td>47 (40.5)</td>
<td>47 (42.0)</td>
<td>16 (55.2)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>72 (28.0)</td>
<td>31 (26.7)</td>
<td>31 (27.7)</td>
<td>10 (34.5)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>75 (29.2)</td>
<td>38 (32.8)</td>
<td>34 (30.4)</td>
<td>3 (10.3)</td>
</tr>
</tbody>
</table>

| How often do you include butternut on your plate? | --- | --- | --- | --- |
|---|---|---|---|
| Once a day | 84 (37.5) | 37 (33.6) | 42 (43.3) | 5 (29.4) |
| Once in 2 days | 56 (25.0) | 31 (28.2) | 24 (24.7) | 1 (5.9) |
| Once in a week | 84 (37.5) | 42 (38.2) | 31 (32.0) | 11 (64.7) |

| How often do you include pumpkin on your plate? | --- | --- | --- | --- |
|---|---|---|---|
| Once a day | 49 (34.8) | 23 (31.1) | 23 (37.7) | 3 (50.0) |
| Once in 2 days | 32 (22.7) | 16 (21.6) | 16 (26.2) | 0 (0.0) |
| Once in a week | 60 (42.6) | 35 (47.3) | 22 (36.1) | 3 (50.0) |

| How often do you include carrots on your plate? | --- | --- | --- | --- |
|---|---|---|---|
| Once a day | 168 (58.9) | 77 (59.7) | 75 (58.6) | 16 (57.1) |
| Once in 2 days | 72 (25.3) | 31 (24.0) | 36 (28.1) | 5 (17.9) |
| Once in a week | 45 (15.8) | 21 (16.3) | 17 (13.3) | 7 (25.0) |

Beetroot
| Once a day | 56 (30.9) | 23 (27.1) | 30 (34.9) | 3 (30.0) |
| Once in 2 days | 41 (22.7) | 18 (21.2) | 21 (24.4) | 2 (20.0) |
| Once in a week | 84 (46.4) | 44 (51.8) | 35 (40.7) | 5 (50.0) |

Green pepper
| Once a day | 124 (57.7) | 59 (57.8) | 58 (56.3) | 7 (70.0) |
| Once in 2 days | 53 (24.7) | 25 (24.5) | 25 (24.3) | 3 (30) |
| Once in a week | 38 (17.7) | 18 (17.6) | 20 (19.4) | 0 (0.0) |

Lettuce
| Once a day | 43 (42.6) | 17 (32.7) | 25 (58.1) | 1 (16.7) |
| Once in 2 days | 23 (2.8) | 13 (25.0) | 7 (16.3) | 3 (50.0) |
| Once in a week | 35 (34.7) | 22 (42.3) | 11 (31.4) | 2 (33.3) |
The diet plan above illustrates the frequencies at which certain vegetables were consumed by the low- and high-risk pregnant women. Foods that were consumed frequently were carrots, cabbage, spinach and green pepper, while lettuce, pumpkin, butternut and beetroot were consumed less frequently. Both LRPW and HRPW consumed more green vegetables than red vegetables. Green vegetables are loaded with important vitamins and minerals such as vitamin A, vitamin C, potassium and folate, as well as phytochemicals and fibre. (WHO, 2015). It would seem, according to the questionnaire, that the majority of participants were consuming adequate amounts of vegetables. It was heartening to note, however, that the consumption of these nevertheless rose as the study progressed.

Figure 7.8: Changes in vegetable consumption from week 26 to 34

Figure 7.8 showed increases in the low-risk and high-risk pregnant women’s consumption of vegetables. Although there was some decrease in the numbers eating vegetables twice a week, it was likely that these began consuming vegetables daily, due to the input of the study team.
### Table 7.17: Carbohydrate consumption

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How often do you eat samp?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>76 (39.2)</td>
<td>32 (38.6)</td>
<td>33 (36.7)</td>
<td>11 (52.4)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>36 (18.6)</td>
<td>13 (15.7)</td>
<td>18 (20.0)</td>
<td>5 (23.8)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>82 (42.3)</td>
<td>38 (45.8)</td>
<td>39 (43.3)</td>
<td>5 (23.8)</td>
</tr>
<tr>
<td><strong>Maize meal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>163 (56.2)</td>
<td>72 (55.4)</td>
<td>69 (52.3)</td>
<td>22 (78.6)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>80 (27.6)</td>
<td>34 (26.2)</td>
<td>41 (31.1)</td>
<td>5 (17.9)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>47 (16.2)</td>
<td>24 (18.5)</td>
<td>22 (16.7)</td>
<td>1 (3.6)</td>
</tr>
<tr>
<td><strong>Potatoes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>217 (72.8)</td>
<td>93 (71.0)</td>
<td>94 (69.6)</td>
<td>30 (93.8)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>62 (20.8)</td>
<td>29 (22.1)</td>
<td>32 (23.7)</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>19 (6.4)</td>
<td>9 (6.9)</td>
<td>9 (6.7)</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td><strong>Bread</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>240 (78.2)</td>
<td>99 (41.3)</td>
<td>110 (78.6)</td>
<td>31 (96.9)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>53 (17.3)</td>
<td>30 (22.2)</td>
<td>23 (16.4)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>14 (4.6)</td>
<td>6 (4.4)</td>
<td>7 (5.0)</td>
<td>1 (3.1)</td>
</tr>
</tbody>
</table>

**Figure 7.9: Changes in consumption of carbohydrates from week 26 to 34**

Figure 7.9 shows a decreased consumption of carbohydrates amongst low-risk pregnant women and high-risk pregnant women from 26 weeks’ gestation to 34 weeks’ gestation. Although the weekly consumption of carbohydrates increased, this is an indication of lowered overall consumption.
The carbohydrate most eaten by low-risk pregnant women and high-risk pregnant women was bread, n=98(69.5), potatoes, n=88(62.9), rice, n=80(56.3), maize meal, n=67(47.9) and samp, n=29(28.7). Low-carb diets were clearly not favoured; these tend to be high in fat, and may also restrict the amount of fruit, vegetables and fibre the dieter eats. They also deny the baby important vitamins and minerals, such as folic acid and calcium (Vorster, Love & Browne, 2001:1).

The fatigue experienced by many pregnant women is often due to the demands of pregnancy in combination with a high intake of carbohydrates. Carbohydrates deliver energy but are easily broken down into glucose, which travels to the cells and to the baby. Excess carbohydrates in the blood system can be a risk factor for GDM.

Carbohydrates do contain some phytonutrients, which act as antioxidants, which scavenge free radicals, produced by the body in response to pollutants. Some carbohydrates contain fibre and vitamins. Fibre prevents constipation, a minor ailment for pregnant women, and keeps the blood sugar levels steady (Vorster, Love & Browne, 2001:1). It has value; the problem is simply that it is generally consumed in quantities that are too large, to the exclusion of other essential nutrients.
Table 7.18: Protein consumption

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How often do you eat meat?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>48 (38.4)</td>
<td>14 (35.9)</td>
<td>27 (45.0)</td>
<td>7 (26.9)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>26 (20.8)</td>
<td>10 (25.6)</td>
<td>9 (15.0)</td>
<td>7 (26.9)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>51 (40.8)</td>
<td>15 (38.5)</td>
<td>24 (40.0)</td>
<td>12 (46.2)</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>61 (29.0)</td>
<td>23 (23.7)</td>
<td>36 (37.9)</td>
<td>2 (11.1)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>51 (24.3)</td>
<td>24 (24.7)</td>
<td>23 (24.2)</td>
<td>4 (22.2)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>98 (46.7)</td>
<td>50 (51.5)</td>
<td>36 (37.9)</td>
<td>12 (66.7)</td>
</tr>
<tr>
<td><strong>Milk</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>158 (58.7)</td>
<td>72 (59.5)</td>
<td>71 (57.3)</td>
<td>15 (62.5)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>84 (31.2)</td>
<td>37 (30.6)</td>
<td>38 (30.6)</td>
<td>9 (37.5)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>27 (10.0)</td>
<td>12 (9.9)</td>
<td>15 (12.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Eggs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>159 (55.4)</td>
<td>68 (55.3)</td>
<td>72 (54.1)</td>
<td>19 (61.3)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>91 (31.7)</td>
<td>38 (30.9)</td>
<td>45 (49.5)</td>
<td>8 (25.8)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>37 (12.9)</td>
<td>17 (13.8)</td>
<td>16 (12.0)</td>
<td>4 (12.9)</td>
</tr>
<tr>
<td><strong>Beans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>93 (40.8)</td>
<td>31 (32.3)</td>
<td>51 (44.7)</td>
<td>11 (61.1)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>44 (19.3)</td>
<td>22 (22.9)</td>
<td>21 (18.4)</td>
<td>1 (5.6)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>91 (39.9)</td>
<td>43 (44.8)</td>
<td>42 (36.8)</td>
<td>6 (33.3)</td>
</tr>
<tr>
<td><strong>Types of fat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>156 (77.2)</td>
<td>55 (67.9)</td>
<td>76 (80.0)</td>
<td>25 (96.2)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>28 (13.9)</td>
<td>18 (22.2)</td>
<td>10 (10.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>18 (8.9)</td>
<td>8 (9.9)</td>
<td>9 (9.5)</td>
<td>1 (3.8)</td>
</tr>
</tbody>
</table>

All women need extra protein during pregnancy. Beans and lentils are an excellent source and are also high in fibre, which helps to combat constipation. A cup of cooked lentils meets half the daily folate requirement (South African Dietary Guidelines, called Food Based Dietary Guidelines, 2001:1).

It is generally recommended that pregnant women take three to four servings of protein daily for the benefit of the pregnancy and the baby. Some low-risk pregnant women and high-risk pregnant women are at risk of developing GDM because of their excessive carbohydrate consumption. A diet rich in protein helps to stabilise blood sugar levels and most importantly, the amino acids in protein are quite literally the building blocks of the human body, necessary for the growing foetus. Proteins not only repair muscle tissue but also red blood (South African Dietary Guidelines, 2011:3).
Figure 7.10: Changes in protein consumption from week 26 to 34

Figure 7.10 shows that consumption of proteins actually decreased over the course of the study. Weekly consumption increased, while daily consumption decreased.

Protein plays a pivotal role in the body, especially in the immune system. A diet rich in protein stabilises blood sugar levels, contributes amino acids to the body and repairs muscle tissue and red blood cells (Nutrition Guidelines, 2011:13). The majority of LRPW consumed high were fats (oils, margarines and meat fat) at n=70(70.1); eggs were consumed by n=68(50.8), milk was consumed by n=66(50.4), beans were consumed by n=38(32.5) and fish was consumed by n=30(24.0).
**Table 7.19: Fruit consumption**

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How often do you eat oranges?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>41 (29.3)</td>
<td>14 (19.7)</td>
<td>26 (40.0)</td>
<td>1 (25.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>24 (17.1)</td>
<td>14 (19.7)</td>
<td>9 (13.8)</td>
<td>1 (25.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>75 (53.6)</td>
<td>43 (60.6)</td>
<td>30 (46.2)</td>
<td>2 (50.0)</td>
</tr>
<tr>
<td><strong>Grapes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>56 (28.7)</td>
<td>22 (23.9)</td>
<td>29 (31.5)</td>
<td>5 (45.5)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>69 (35.4)</td>
<td>36 (39.1)</td>
<td>31 (33.7)</td>
<td>2 (18.2)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>70 (35.9)</td>
<td>34 (37.0)</td>
<td>32 (34.8)</td>
<td>4 (36.4)</td>
</tr>
<tr>
<td><strong>Apples</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>184 (62.2)</td>
<td>83 (62.9)</td>
<td>83 (61.5)</td>
<td>18 (62.1)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>74 (25.0)</td>
<td>35 (26.5)</td>
<td>32 (23.7)</td>
<td>7 (24.1)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>38 (12.8)</td>
<td>14 (10.6)</td>
<td>20 (14.8)</td>
<td>4 (13.8)</td>
</tr>
<tr>
<td><strong>Bananas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>164 (60.3)</td>
<td>77 (62.6)</td>
<td>70 (57.4)</td>
<td>17 (63.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>77 (28.3)</td>
<td>32 (26.0)</td>
<td>38 (31.1)</td>
<td>7 (25.9)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>31 (11.4)</td>
<td>14 (11.4)</td>
<td>14 (11.5)</td>
<td>3 (11.1)</td>
</tr>
<tr>
<td><strong>Pears</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>89 (47.6)</td>
<td>46 (50.0)</td>
<td>36 (42.9)</td>
<td>7 (63.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>58 (31.0)</td>
<td>26 (28.3)</td>
<td>32 (38.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>40 (21.4)</td>
<td>20 (21.7)</td>
<td>16 (19.0)</td>
<td>4 (36.4)</td>
</tr>
<tr>
<td><strong>Mango</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>43 (30.7)</td>
<td>21 (32.3)</td>
<td>18 (26.1)</td>
<td>4 (66.7)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>30 (21.4)</td>
<td>7 (10.8)</td>
<td>22 (31.9)</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>67 (47.9)</td>
<td>37 (56.9)</td>
<td>29 (42.0)</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td><strong>Peach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>74 (38.7)</td>
<td>37 (38.9)</td>
<td>32 (38.1)</td>
<td>5 (41.7)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>58 (30.4)</td>
<td>25 (26.3)</td>
<td>30 (35.7)</td>
<td>3 (25.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>59 (30.9)</td>
<td>33 (34.9)</td>
<td>22 (26.2)</td>
<td>4 (33.3)</td>
</tr>
<tr>
<td><strong>Apricot</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>27 (23.7)</td>
<td>14 (22.2)</td>
<td>13 (26.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>24 (21.1)</td>
<td>13 (20.6)</td>
<td>10 (20.0)</td>
<td>1 (100.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>63 (55.3)</td>
<td>36 (57.1)</td>
<td>50 (54.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Kiwi</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>14 (16.7)</td>
<td>4 (9.1)</td>
<td>10 (26.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>13 (15.5)</td>
<td>4 (9.1)</td>
<td>9 (23.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>57 (67.9)</td>
<td>36 (81.8)</td>
<td>19 (50.0)</td>
<td>2 (100.0)</td>
</tr>
<tr>
<td><strong>Pineapple</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>38 (28.8)</td>
<td>17 (25.0)</td>
<td>18 (30.5)</td>
<td>3 (60.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>29 (22.0)</td>
<td>11 (16.2)</td>
<td>18 (30.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>65 (49.2)</td>
<td>40 (58.8)</td>
<td>23 (40.0)</td>
<td>2 (40.0)</td>
</tr>
</tbody>
</table>
Figure 7.11: Changes in fruit consumption from week 26 to 34

Figure 7.11 illustrates that fruit consumption also decreased, so that by week 34 most women consumed fruit weekly rather than daily. It was, however, established that both low- and high-risk women understood the importance of daily fruit consumption, but simply could not afford it over the long term. Vitamins and minerals in fruit, it was explained, repair body tissues, heals wounds and cuts, maintain healthy teeth and gums, and are essential for strong immunity from disease.

Fruit is an essential requirement of the body for both low- and high-risk pregnant women and women with GDM. The most popular fruit in this study was apples at n=73(52.1), bananas at n=69(52.1), peaches at n=46(39.0), pears at n=39(39.4), grapes and mango both at n=25(30.9), apricots at n=21(30.4), oranges and pineapple both at n=18(25.0) and kiwi at n=9(18.0). Seasonality obviously affected responses, as the majority were summer fruits and prices tended to be high over the winter months.

Both fruits and vegetables are essential to a healthy diet, being packed with nutrients such as folic acid, which helps prevent neural tube defects and promotes a healthy birth weight. The growing foetus completely relies on the mother’s diet, and it is essential for the mother to include fruits and vegetables in her diet (WHO, 2012:1)
The findings above showed that low-risk and high-risk pregnant women understood the importance of consuming fruit during pregnancy (Nutrition Guidelines, 2011;11).

Table 7.20: Consumption of high fibre food

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How often do you eat oats?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>70 (49.3)</td>
<td>35 (50.7)</td>
<td>30 (47.6)</td>
<td>5 (50.0)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>28 (19.7)</td>
<td>11 (15.9)</td>
<td>14 (22.2)</td>
<td>3 (30.0)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>44 (31.0)</td>
<td>23 (33.3)</td>
<td>19 (30.2)</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td><strong>Matabele</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>59 (46.8)</td>
<td>20 (39.2)</td>
<td>26 (46.4)</td>
<td>13 (68.4)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>30 (23.8)</td>
<td>13 (25.5)</td>
<td>11 (19.6)</td>
<td>6 (31.6)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>37 (29.4)</td>
<td>18 (35.3)</td>
<td>19 (33.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Apples</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>134 (63.8)</td>
<td>59 (64.8)</td>
<td>60 (60.0)</td>
<td>15 (78.9)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>48 (22.9)</td>
<td>20 (22.0)</td>
<td>26 (26.0)</td>
<td>2 (10.5)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>28 (13.3)</td>
<td>12 (13.2)</td>
<td>14 (14.0)</td>
<td>2 (10.5)</td>
</tr>
<tr>
<td><strong>Tomatoes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>89 (46.8)</td>
<td>42 (46.2)</td>
<td>40 (46.5)</td>
<td>7 (53.8)</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>54 (28.4)</td>
<td>26 (28.6)</td>
<td>26 (30.2)</td>
<td>2 (15.4)</td>
</tr>
<tr>
<td>Once in a week</td>
<td>47 (24.7)</td>
<td>23 (25.3)</td>
<td>20 (23.3)</td>
<td>4 (30.8)</td>
</tr>
</tbody>
</table>

A high-fibre diet is crucial for everybody because it prevents constipation. The majority of LRPW, n=134(63.8%), consumed apples daily, n=89(46.8%) consumed tomatoes daily, n=59(46.8%) consumed matabele (sorghum) daily and n=70(49.3%) consumed oats daily. For HRPW n=15 (78.9%) consumed apples daily, n=7(53.8%) consumed tomatoes daily, 13(68.4%) consumed matabele daily and n=5(50.0%) consumed oats daily. In this study the low-risk pregnant women consumed much more fibre than the high-risk pregnant women, taking in more apples, oats and tomatoes, while the HRPW consumed mostly apples and matabele.

High-fibre foods can reduce constipation, and lower the risk of developing conditions such as high blood pressure and preeclampsia (The American Pregnancy Association (ADA) 2013). Dietary fibre is found in all plant materials, and hence an adequate intake of unrefined plant-based foods is essential (ADA, 2013).
Table 7.21: Enhancers of the modified diet

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education on modified diet regarding type</td>
<td>222 (95.7)</td>
<td>103 (97.2)</td>
<td>102 (96.2)</td>
<td>17 (85.7)</td>
</tr>
<tr>
<td>Education on benefits of modified diet</td>
<td>269 (95.1)</td>
<td>116 (92.8)</td>
<td>123 (96.9)</td>
<td>30 (96.8)</td>
</tr>
<tr>
<td>Social support networks and groups pertaining modified diet programmes</td>
<td>154 (87.5)</td>
<td>78 (89.7)</td>
<td>71 (89.9)</td>
<td>5 (50.0)</td>
</tr>
</tbody>
</table>

The majority of LRPW, n=222(95.7%), were interested in education about the modified diet, on its benefits, n=269(95.1%), and in social programmes and networks that might help them, n=154(87.5%). Among HRPW, n= 17(85.7%) were interested in education about the modified diet, on its benefits n=30(96.8%) and in social programmes and networks that might help them, n=5(50.0%).

The researcher in this study continually strove to educate the low-risk pregnant women and high-risk pregnant women with GDM about healthy eating habits and planned physical activities that were relevant to the participants’ contexts and culture. The responses of the participants clearly indicated an urgent need of education. The high level of response to the diet reinforced the need to frequently educate the community at large about the benefits of modifying the diet.

Table 7.22: Barriers to the modified diet

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge related to modified diet</td>
<td>236 (93.3)</td>
<td>106 (91.4)</td>
<td>108 (93.9)</td>
<td>22 (91.8)</td>
</tr>
<tr>
<td>Low motivation regarding modified diet</td>
<td>238 (90.5)</td>
<td>107 (91.5)</td>
<td>103 (88.0)</td>
<td>28 (96.6)</td>
</tr>
<tr>
<td>Lack of information regarding benefits of modified diet</td>
<td>167 (87.9)</td>
<td>85 (90.4)</td>
<td>72 (83.7)</td>
<td>10 (61.0)</td>
</tr>
<tr>
<td>Socio-cultural influences</td>
<td>151 (86.3)</td>
<td>81 (91.0)</td>
<td>62 (80.5)</td>
<td>8 (58.4)</td>
</tr>
</tbody>
</table>

The responses of LRPW revealed that the barriers were a lack of knowledge related to the modified diet (n=236(93.3%)), low motivation regarding the modified diet (n=238(90.5%)), lack of information related to the benefits of the modified diet

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and socio-cultural issues (151(86.3%)). The responses of HRPW were similar; n=22(91.8%) felt that they lacked knowledge about the modified diet, n=28(96.6%) had low motivation regarding the modified diet, 10(61.0%) lacked information regarding the benefits of the modified diet, and n=8(58.34) were affected by socio-cultural issues relating to diet.

The study revealed the need among both groups for information and help regarding a healthy diet that is applicable within their contexts. Studies have revealed that there is a consistent relationship between unhealthy diet and the emergence of a range of non-communicable diseases (NCDs), including coronary heart disease, various cancers, diabetes mellitus, and various bone and joint diseases, often due to lack of knowledge and motivation about modified diet within the cultural and social context (“Physical activity and dietary behaviors associated with weight gain and impaired glucose tolerance among pregnant women, (Latinas., 2012:3; Dietary Guidelines, 2011:1).

Due to poor knowledge and motivation, non-communicable diseases have become a major cause of mortality and morbidity worldwide. The findings in this study indicate barriers to healthy nutrition as perceived by a group of women in Buffalo City. Farahmand, Tehrani, Amiri and Azizi, (2012:1) showed in their study that effective educational programmes are an essential component of changing dietary habits, a finding that can be confirmed in this study.

7.11 Summary of Modified Diet

In summary, fruits and vegetables are nutrient rich and should form an essential and regular part of the diets of low-risk pregnant women and high-risk pregnant women with GDM. A higher consumption of fruits and vegetables would go a long way to preventing heart diseases, some cancers and many conditions related to overweight and obesity in pregnant women.

Fruit consumption also lowers cholesterol levels in the blood, reduces the risk of GDM and limits overall calorie intake. Fruit is low in sodium, fat, calories, and has zero cholesterol. Vegetables are a storehouse of nutrients and it is essential that all pregnant women make special efforts to increase their intake during pregnancy.
7.12 Planned Physical Activity

The study included a focus on regular physical activity, adapted from physical activity guidelines to meet the needs of low-risk and high-risk pregnant women. The majority of low-risk pregnant women, n=173, were engaged in walking, n=43 were engaged in household chores and n=14 were engaged in running. Thus walking was the commonest form of planned physical activity taken by LRPW. Among HRPW, n=7 were engaged in walking, n=6 were engaged in household chores and n=0 were engaged in running. The high-risk pregnant women who were engaged minimally in planned physical activity were at risk of developing complications of GDM and other conditions related to overweight and obesity. Colberg, Sigal, Yardley, Riddell, Dunstan, Dempsey, Horton, Castorino et al., (2016:1) indicated that the adoption and maintenance of physical activity is critical for blood glucose management and overall health in individuals with diabetes and prediabetes.

Table7.23: Prevalence of physical activities

<table>
<thead>
<tr>
<th>Variable</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
<td>14</td>
<td>6</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Walking</td>
<td>173</td>
<td>83</td>
<td>83</td>
<td>7</td>
</tr>
<tr>
<td>Work activities</td>
<td>43</td>
<td>17</td>
<td>20</td>
<td>6</td>
</tr>
</tbody>
</table>
Figure 7.12: Engagement in physical activities

Figure 7.12 shows that low-risk pregnant women performed better in planned physical activities than the high-risk pregnant women with GDM. The types of physical activities were derived from the physical activity guidelines for low-risk pregnant women and high-risk pregnant women with GDM. Types of planned physical activity selected were those that were accessible and relevant to women in this context. The guidelines further explained the duration of planned physical activity sessions per week, and gave special consideration to those who were not yet accustomed to regular physical activity (SEMDSA, 2017; WHO, 2015).

Table 7.24: Enhancers of planned physical activities

<table>
<thead>
<tr>
<th>Enhancers of planned physical activity</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>More education on PA regarding type and frequency</td>
<td>221 (96.9)</td>
<td>104 (97.1)</td>
<td>99 (94.7)</td>
<td>18 (88.6)</td>
</tr>
<tr>
<td>Education on benefits of engaging in PA</td>
<td>268 (97.1)</td>
<td>121 (96.8)</td>
<td>117 (97.5)</td>
<td>30 (96.8)</td>
</tr>
<tr>
<td>Social support networks and physical activity programmes</td>
<td>156 (90.2)</td>
<td>77 (89.5)</td>
<td>71 (92.2)</td>
<td>8 (60.0)</td>
</tr>
<tr>
<td>Convenient locations for PA</td>
<td>149 (89.8)</td>
<td>76 (89.4)</td>
<td>70 (95.9)</td>
<td>3 (37.5)</td>
</tr>
</tbody>
</table>
Table 7.24 shows that amongst LRPW, \(n=221(96.9\%)\) required education about type and frequency of physical activity, \(n=268(97.1\%)\) required information on its benefits, \(n=156(90.2\%)\) required the encouragement of social support networks and \(149(89.4\%)\) felt that they needed more convenient locations for planned physical activity. Amongst high-risk pregnant women, \(n=18(88.6\%)\) required education about type and frequency of physical activity, \(n=30(96.8\%)\) required information on its benefits, \(n=8(60.0\%)\) required the encouragement of social support networks and \(n=3(37.5\%)\) felt that they needed more convenient locations. According to Macaulay, Norris, Micklefield and Watson, (2014:1), physical activity during pregnancy has been associated with lowered risks and may play a role in improving glucose metabolism, and therefore in decreasing risk of GDM. Physical activity during pregnancy has been associated with many favourable maternal and neonatal outcomes.

Table 7.25: Barriers to the planned physical activity

<table>
<thead>
<tr>
<th>Barriers of modified physical activity</th>
<th>All participants</th>
<th>Control</th>
<th>Intervention</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low motivation to planned physical activity</td>
<td>201 (90.1)</td>
<td>94 (87.9)</td>
<td>92 (91.1)</td>
<td>15 (89.0)</td>
</tr>
<tr>
<td>Fatigue and low energy dictate activity</td>
<td>249 (91.9)</td>
<td>105 (88.2)</td>
<td>111 (93.3)</td>
<td>33 (98.6)</td>
</tr>
<tr>
<td>Lack of information related to benefits of modified PA</td>
<td>180 (92.3)</td>
<td>89 (89.9)</td>
<td>79 (94.0)</td>
<td>12 (87.6)</td>
</tr>
<tr>
<td>Lack of resources necessary to engage in modified PA</td>
<td>146 (84.4)</td>
<td>70 (79.5)</td>
<td>67 (88.2)</td>
<td>9 (81.1)</td>
</tr>
<tr>
<td>Socio-cultural influences</td>
<td>140 (83.3)</td>
<td>68 (79.1)</td>
<td>65 (89.0)</td>
<td>7 (77.8)</td>
</tr>
</tbody>
</table>

Table 7.25 shows that amongst LRPW, \(n=201(90.1\%)\) felt a lack of motivation for planned physical activity, \(n=249(91.9\%)\) felt fatigue and low energy, \(n=180(92.3\%)\) lacked information on its benefits, \(n=146(84.4\%)\) lacked resources and \(n=140(83.3\%)\) ascribed their lack of participation in planned physical activity to sociocultural influences. High-risk pregnant women with GDM lacked motivation for planned physical activity \((n=15(89.0\%))\), were fatigued and had low energy \((n=33(98.6\%))\), lacked information on its benefits \((n=12(87.6\%))\), lacked resources \((n=9(81.1\%))\) and were influenced by socio-cultural factors \((n=7(77.8\%))\).
The responses of the low-risk pregnant women to questions concerning barriers clearly suggest the urgent necessity of education, motivation and counselling for planned physical activity. Low- and high-risk pregnant women understand the importance of planned physical activity but culture prohibits many from exercising. It is only through sustained education on planned physical activity that planned physical activities will become habitual for pregnant African women. A low level of physical planned physical activity increases complications in pregnant women with GDM and increases obesity in low-risk pregnant women (Hui, Ludwig, Gardiner, Huysen, Murray, Morris & Shen 2006:331).

7.13 Summary of Planned Physical Activity

The guidelines for physical activity suggested planned physical activity relevant for pregnant women and the duration of each. Planned physical activity is critical and needs some maintenance for reducing the complications of overweight and obesity and related conditions like GDM, hypertension and cardiac conditions. Physical activity during pregnancy has been associated with minimum risks to the pregnant women and may play a role in improving glucose metabolism, thereby decreasing the risk of GDM.

In addition, physical activity during pregnancy has been associated with many favourable maternal and neonatal outcomes. In this study, low- and high-risk pregnant women understood the importance of planned physical activity, but were prohibited by cultural factors from engaging wholeheartedly in planned physical activity. For this reason, it is essential that it be made a particular focus at public health institutions.

7.14 Conclusion

Both low- and high-risk pregnant women in this study showed an increase in weight, BMI and MUAC which are indicators for overweight and obesity. These measurements increased over the course of the study especially on the LRPW control group, and some on HRPW despite the focus on healthy diet and planned physical activities. Overweight and obesity promote high glucose and the development of GDM. Gestational hypertension was also evident in the low-risk pregnant women who had protein levels of 3+. Blood pressure overall tended to be high which may result in negative outcomes if it not detected and treated early. High blood pressure and high
gestational blood pressure may be traced to unhealthy lifestyles; hence the emphasis on modified diet and planned physical activity.

The findings also indicated that glucose levels were increasing. This is associated with GDM, and may have negative outcomes for pregnancy, mother and unborn baby. Glucose levels during pregnancy should be normal, since some infant mortalities have been traced back to high and untreated glucose levels. In this study, low-risk pregnant women and high-risk pregnant women with GDM had normal pulse ranges. The results of the urine tests had abnormalities of protein levels of 3+, glucose 3+, leucocytes 3+ and blood 3+. All these abnormalities could have devastating and fatal complications if intervention is delayed.

The findings related to diet suggest that the majority of low-risk and high-risk pregnant women consumed components of all essential food groups, but consumed more carbohydrates than vegetables and less of fruits and proteins. –Green vegetables (cabbages, spinach, green pepper) were consumed more than red vegetables (carrot, beetroot, butternut and pumpkin). Vegetables, carbohydrates and fibre were consumed more by the low-risk pregnant women than the high-risk pregnant women.

With regards to the planned physical activities, findings showed that low-risk pregnant women were more motivated and engaged than the high-risk pregnant women. Therefore, guidelines for physical activity and modified diet were developed drawn from standard planned physical activitys relevant for pregnant women.
CHAPTER 8
GUIDELINES FOR MODIFIED DIET AND PLANNED PHYSICAL ACTIVITY

8.1 Introduction
The previous chapter described the results of the modified diet and planned physical activity intervention. In this chapter, proposed guidelines for the modified diet and planned physical activity intervention are discussed. The proposed guidelines recommend that clinicians should promote the proposed guidelines and coach low-risk and high-risk pregnant women on healthy lifestyle choices.

The proposed guidelines are developed based on the results of anthropometric measurements taken before and during the intervention of the modified diet and planned physical activity by participants using their context, availability, accessibility and affordability. Recommendations are also given in cognisance of the theories underpinning this study, which were grounded in concepts such as self-care, perceived benefits, cues to action and positive behavioural outcomes and the promotion of health for pregnant women and women with GDM.

8.2 Research Question
The research question relevant here was, 'What guidelines may be given to promote healthy lifestyles amongst low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality in the Eastern Cape?'

8.3 Objective
The objective was to identify and describe the guidelines that promote a healthy lifestyle amongst low-risk and high-risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape.

8.4 Findings of the Study
8.4.1 Demographic characteristics of the LRPW and HRPW
Findings of the majority of pregnancies were occurred in the age groups 22 to 29 years of age and 30 to 35 years of age.
LRPW and HRPW in this study were fairly well educated, unemployed, resided mostly in urban areas and were Xhosa speakers.

8.4.2 Anthropometric measures
The finding of this study showed that both the low and high-risk pregnant women had increased weight, BMI, MUAC and blood pressure. High blood pressure increases the chances of gestational hypertension. In addition, 63 LRPW and HRPW had 3+ of protein in their urine; other abnormalities in the urine included glucose, leucocytes and blood. Findings showed that there was a significant decrease in glucose levels from the baseline measurements to the last measurements taken in the intervention group, while they increased in the control group. Findings showed that pulse rates increased as pregnancies progressed.

8.4.3 Modified diet
Findings revealed that the frequently consumed vegetables by low- and high-risk pregnant women were carrots, cabbages, spinach and green peppers, rather than lettuce, pumpkin, butternut or beetroot. LRPW and HRPW consumed more green vegetables than red; they consumed very little protein and large quantities of carbohydrates. LRPW consumed more fibre and fruit than the high-risk pregnant women, especially during the third trimester. Barriers to a healthy diet were minimal knowledge, lack of motivation and prevailing cultural food preferences.

8.4.4 Planned physical activity
High-risk pregnant women were found to engage in little planned physical activity (walking, household chores, swimming or running) compared to low-risk pregnant women, and were at risk of developing complications of GDM and other conditions related to overweight and obesity. Findings also suggested that barriers for physical activity were lack of motivation, fatigue, lack of information on the benefits, lack of resources and the influence of sociocultural factors.

8.5 Definition of Proposed Modified Diet and Planned Physical Activity
It is recommended that both low- and high-risk pregnant women adopt the modified diet which is the normal and familiar diet with modifications; reduced carbohydrates, more vegetables and proteins in each meal.
Planned physical activity may be any activity that increases heart beat and should be carried out for a total of 150 minutes (two and half hours) a week.

8.6 Operational Guidelines

8.6.1 Screening

Screening should emphasise on the following indicators of overweight and obesity:

**Weight:** 85kg and above counsel immediately about modified diet.

**BMI:** Underweight if below 25kg/m2, counsel immediately about modified diet.

Overweight if 26kg/m2 to 30 kg/m2 counsel immediately about modified diet.

Obese if 30 kg/m2 or above, counsel immediately about modified diet.

**MUAC:** The mid-arm circumference threshold is 33cm;

- Higher than 33cm indicates likelihood of overweight, counsel immediately about modified diet.
- A measurement of 23cm or under indicates under-nutrition and smaller babies.
- MUAC, unlike weight, does not normally increase significantly during pregnancy, counsel immediately about modified diet.

**Blood pressure:** Blood pressure of 140/90 or above is an indication of an increased blood pressure and had negative outcomes if accompanied by overweight and protein in the urine.

**Glucose:** Levels of 8mm/l or more and with glucose in urine counsel immediately about modified diet and refer immediately.

**Urine:** The following in the urine are indications of abnormalities. They may indicate gestational Hypertension, Gestation Diabetes Mellitus and kidney problems:

- Protein
- Glucose
- blood and
o leucocytes

8.6.2 Modified Diet

Counselling should be given on modified diet, emphasising on vegetables, proteins and lower consumption of carbohydrates. Always refer pregnant women with the following anthropometric measures:

- BMI of 26kg/m2 up to 30 kg/m2
- MUAC of above 33cm
- MUAC below 23cm

Dietician should always be available in each antenatal care first visit

Develop social networks and use the media far more effectively than they do to promote a healthy diet.

Social media forums such as ‘Mom Connect’ may be used for daily advertisements regarding modified diet and planned physical activity.

8.6.3 Planned physical activity

- Always refer pregnant women to the physical activity specialist with the following below for counselling:
  
  - BMI of 26kg/m2 up to 30kg/m2
  - BMI of 30kg/m2 and above
  - MUAC of above 33cm and
  - MUAC below 23cm

- Physical movement specialist skills are needed at antenatal visits.
- Pregnant women should be made aware that they do not need many resources in order to engage in planned physical activity, but can use what is locally available, like using stairs up and down, walkies and or playing game that involves physical activity.
- Social networks should be encouraged, as these promote group planned physical activity activities; groups like ‘Mom Connect’ can be created to promote group walking activities in local neighbourhoods.
Physical activities can also be encouraged through a slot in various media; radio and newspaper, for example, could carry a daily or weekly slot on healthy lifestyle tips.

During all antenatal visits emphasize on, education and counselling on planned physical activity recommendations on what is culturally, economically acceptable and familiar to ensure long-term adoption physical activity as a lifestyle.

These must be understood and promoted by midwives, obstetricians and physical movement specialists in public institutions.

8.7 Who is Responsible for the Implementation of Guidelines

- Obstetrician
- Dietician
- Midwives and
- Physical movements specialist

8.8 Who Benefit from the Guidelines

- Low and high risk pregnant women
- Overweight and obese clients
- Elderly clients and the
- Community at large

8.9 Conclusion

This chapter presented guidelines for the implementation of modified diet and planned physical activity for pregnant women in public health institutions. The guidelines are general in nature and apply to all low and high risk pregnant women.
CHAPTER 9
SUMMARY, JUSTIFICATION, IMPLICATIONS AND RECOMMENDATIONS

9.1 Introduction

The previous chapter described the development and description of the proposed guidelines for modified diet and planned physical activity for low and high risk pregnant women. This chapter summarises the quantitative findings, modified diet and planned physical activity intervention, limitations, implications and recommendations of the study.

9.2 Purpose of the Study

The purpose of the study was to describe the effectiveness of the modified diet and planned physical activity amongst low and high risk pregnant women with gestational diabetes mellitus (GDM) in Buffalo City Metropolitan Municipality, Eastern Cape.

9.3 Methodology and Objectives of the Study

Phase 1: Quantitative

Phase 1 was quantitative, and described the research instrument and the anthropometric measurements for the low and high risk pregnant women.

Phase 2: Experimental

Phase 2 was experimental, and identifying the effects of the modified diet and planned physical activity intervention on low and high risk pregnant women with GDM in Buffalo City, Eastern Cape.

Phase 3: Randomisation

Phase 3 was randomisation of low-risk pregnant women. Low-risk pregnant women were randomised to participate in the intervention/experimental and control groups. All high-risk women with GDM were allocated to the intervention group only.

Phase 4: Intervention

Phase 4 was the implementation of the modified diet and planned physical activity, to ascertain the effects on low-risk and high-risk pregnant women with GDM.
Phase 5: Guidelines

Phase 5 was to develop and describe the healthy lifestyle using modified diet and planned physical activity for the pregnant women and incorporate into their daily practice in the post-doctoral phase. The guidelines will be implemented to low- and high-risk pregnant women in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa.

9.4 Summary of the Study

The majority of both the low and high-risk pregnant women with GDM in this study were within the prime child-bearing years of 22 to 29 years, with those in the 30 to 35-year age group forming the second largest age group. It is in this second-largest age group that complications are normally initiated. The majority of low and high-risk pregnant women were secondary-school educated, unemployed, urban residents and Xhosa speakers. There was an increased single parents, indicating a possible lack of emotional and financial support during pregnancy, and a possible source of stress.

The findings of the demographic and anthropometric measures were presented in tables, using the descriptive statistics of frequencies and percentages. The anthropometric measurements for pregnant women showed increased weight, BMI and MUAC which indicate overweight and obesity. However, it is not statistically significant due to a limitation minimal three months’ duration. Overweight and obesity would promote gestational hypertension and diabetes. In addition, urine analysis results of protein 3+, glucose 3+, leucocytes 3+, blood 3+ and high blood pressure suggest the possibility of gestational hypertension and GDM, with negative outcomes for mother and unborn baby. Glucose levels during pregnancy should be normal, if not, some infant mortalities have been found to be related to high and untreated glucose levels.

In this study, the majority of pregnant women reported the consumption of a balanced diet which does not in itself explain the gradual increase in BMI, MUAC and weight. Green vegetables (cabbage, spinach and green pepper) were consumed more than red vegetables (carrot, beetroot, butternut and pumpkin).
Low-risk women consumed more vegetables, fruit, carbohydrates and fibre than high-risk pregnant women. Intervention and control groups consumed insufficient protein for pregnancy recommendations.

Lastly the planned physical activity findings showed that low-risk pregnant women were more motivated and engaged in physical activities than high-risk pregnant women. The guidelines for physical activity suggest planned physical activity relevant for pregnant women and the duration. Planned physical activity is critical during pregnancy and needs frequent motivation. Low levels of planned physical activity increase complications in pregnant women with GDM.

9.5 Justification

The modified diet and planned physical activity intervention for the low and high-risk pregnant women with GDM were designed taking into consideration the women’s context and needs. It is envisaged that the modified diet and planned physical activity should be easy to implement at home with minor adjustments to daily routines. Midwives would be able to empower women by giving the information to pregnant women on what to do at home. Both the modified diet and planned physical activity intervention recommended in this study are aligned with government interventions for maternal and foetal health in Buffalo City.

9.5.1 Modified diet

Modified diet refers to an accessible modification of what women already know and consume; culturally relevant, economical and familiar to pregnant women. The modified diet in this study was individualised according to both culture and individual preferences, keeping the correct basic proportions of nutrients in mind. The modified diet was considered economically viable for low earners to adopt. The educational component was valuable in that it made the nutritional values of various food types known to the participants, so that they could draw direct links between what they consumed and the health of their unborn babies. The booklet distributed gave suggested diet plans, the group and individual counselling sessions further refined the guidelines, making adjustments for personal preferences and finances. For HRPW, it is envisaged that the modified diet would stabilise glucose levels and prevent or delay the onset of Type 2 diabetes.
The rationale for the study was to reduce and prevent the outcomes of overweight and obesity, which is the leading cause of non-communicable, preventable diseases.

9.5.2 Planned physical activity

With the low-risk pregnant women, the researcher was interested in reducing overweight and obesity which contribute to GDM and other conditions associated with overweight and obesity. Government guidelines and other worldwide guidelines support engagement in physical activity for low- and high-risk pregnant women.

The proposed guidelines given to the women emphasised simple and accessible activities that could be done within the participants’ contexts. Types of activity and duration were well explained. Those who were unaccustomed to take planned physical activity were advised to start with light planned physical activity for short periods and to build up to the ideal of 30 minutes a day, five times a week, bringing the total for moderate or light planned physical activity to 150 minutes per week. Planned physical activity aimed to strengthen the muscle tissue, making labour easier and normalising gestational weight gain for all pregnant women.

9.6 Implications

9.6.1 Practice

The introduction of a modified diet and planned physical activity would increase awareness amongst pregnant women in public health institutions on the benefits of the modified diet and planned physical activity for pregnant women and their unborn babies. It would also reduce complications amongst pregnant women and improve the services rendered to the community by obstetricians, dieticians and midwives.

9.6.2 Future research

The intervention study on modified diet and planned physical activity amongst pregnant women highlights the need for empowerment and motivation of the pregnant community. Government interventions should aim to use the innovative aspects of this study, which were the recommendations for modified diet and planned physical activity by women during their visit in public health facilities. Further research could be done on ways to evaluate the proposed modified diet and planned physical activity and extend the intervention to the community at large.
9.7 Limitations

Below, the researcher briefly explains the study’s limitations and reasons for those limitations:

9.7.1 Duration of the research

The research was limited to three months. If the study had been continued over six months, more comprehensive information might have been possible, including effects of the modified diet and planned physical activity on labour and the post-natal period. However, the literature reviewed by the researcher included intervention studies from three months to 12 months in duration; in this case, three months was the period allowed by the university.

9.7.2 Setting of the study

The setting was Buffalo City Metropolitan Municipality; it may have been valuable to include another, more rural municipality so that rural and urban results could be compared. The rural input in this study was limited because the researcher accessed only one community health care centre in a rural area, Dimbaza. The rationale for the limited setting of Buffalo City Metropolitan Municipality was the limited funds available for research.

9.7.3 Guidelines for the intervention description

It is envisaged that proposed guidelines for modified diet and planned physical activity for low and high-risk pregnant women with GDM be developed and implemented post-doctoral in Buffalo City Metropolitan Municipality. The reason for postponing further implementation is simply time; the researcher is eager to continue implementing the programme in the coming years.

9.8 Recommendations

- The proposed modified diet and planned physical activity guidelines presented in this study should be emphasised regularly at every visit of the antenatal care by midwives and health care practitioners.
- Midwives and diabetic nurse educators should frequently highlight the benefits of the modified diet and planned physical activity for the unborn baby in every antenatal visit.
• Women with GDM should be given more frequent information and counselling about the condition and benefits of the modified diet and planned physical activity.
• The Department of Health should embark on campaigns in the community, media and social networks to promote healthy food choices and planned physical activity suggested by WHO guidelines of 150 minutes per week.

9.9 Contribution to the Existing Body of Knowledge
The modified diet which is the diet that is available, affordable, feasible according to different race and within individual pregnant women context. Different context, that is rural and urban setting of the pregnant women will be easily, convenient and beneficiary to women to use in modified diet. Every pregnant woman and their unborn baby whether poor or rich will be able to use the modified diet available to them to improve their healthy lifestyle.

The low and high risk pregnant women will increase their levels of using planned physical activity anywhere; whether at home, work and in schools. Planned physical activity is easily applicable, affordable and within their context. No need for expensive gyms and equipment. Frequent motivation and education of the pregnant women will encourage them to engage in physical activity. Improvement of their healthy lifestyle will be the end product of this study.

9.10 Conclusion
This chapter has presented a justification for the study, limitations of the study and recommendations arising from the study. During this study, the researcher worked with midwives, obstetricians, and dieticians as a team, and it is this whole-team approach which resulted in changes made to the participants’ dietary and planned physical activity habits. Both the low and high-risk pregnant women with GDM seemed to understand the importance and benefits of the intervention; what remains is for pregnant women to become highly involved in planned physical activity and use of modified diet recommended in this study.
REFERENCES


Farahmand, M., Tehrani, F.R., Amiri, P. and Azizi, F. (2012). Barriers to healthy nutrition: perceptions and experiences of Iranian women. Reproductive Endocrinology Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.


APPENDENCES

Appendix A: Ethical Clearance from the University Of Fort Hare

ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number: SEE031SVEL01

Project title: Intervention strategy for women with gestational diabetes mellitus (GDM) Eastern Cape, South Africa

Nature of Project: PhD

Principal Researcher: Nonceba Mercy Vellien

Supervisor: Prof E Seekoe
Co-supervisor:

On behalf of the University of Fort Hare’s Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research
The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

**Special conditions:** Research that includes children as per the official regulations of the act must take the following into account:

Note: The UREC is aware of the provisions of s71 of the National Health Act 61 of 2003 and that matters pertaining to obtaining the Minister’s consent are under discussion and remain unresolved. Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 5 June 2013, university ethics committees may continue to grant ethical clearance for research involving children without the Minister’s consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research’s office.

The Ethics Committee wished you well in your research.

Yours sincerely

[Signature]

**Professor Gideon de Wet**

Dean of Research

13 March 2015
Appendix B: Permission from the Eastern Cape Province D. Health (BISHO)

Eastern Cape Department of Health

Enquiries: Zonwabale Malebela
Tel/Nx: 040 308 0200
Date: 16th April 2015
e-mail address: zonwabale.marle@echoth.gov.za
Fax Nr: 043 542 1400

Dear Ms NM Vellien

Re: Intervention strategy for women with gestational diabetes mellitus (GDM) Eastern Cape, South Africa (EC_2016RF95_417)

The Department of Health would like to inform you that your application for conducting a research on the abovementioned topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress report on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Epidemiological Research & Surveillance Management. You may be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE
# Appendix C: Permission from the Buffalo City District

**Province of the

EASTERN CAPE

HEALTH**

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**BUFFALO CITY METRO HEALTH DISTRICT**

**OFFICE OF THE SUB-DISTRICT MANAGER**

9 Vincent Road • Vincent Post Office • 6002, Eastern Cape

Private Bag X 9015 • Main Post Office, East London • 5200 • Eastern Cape

Tel.: +27 (0)43 711 1100 • Fax: +27 (0)43 711 1972 • Website: www.ecdh.gov.za

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<table>
<thead>
<tr>
<th>TO</th>
<th>Clinic Supervisors and CHC Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>FROM</td>
<td>Buffalo City Sub District</td>
</tr>
<tr>
<td>SUBJECT</td>
<td>REQUEST PERMISSION TO CONDUCT RESEARCH STUDY ON INTERVENTION STRATEGY FOR PREGNANT WOMEN WITH GESTATIONAL DIABETES MELLITUS (GDM) EASTERN CAPE PROVINCE.</td>
</tr>
<tr>
<td>DATE</td>
<td>01 December 2016</td>
</tr>
</tbody>
</table>

Buffalo City Sub District acknowledge the receipt of your research proposal and appreciate the fact that you have chosen our district. We are looking forward to get a feedback as soon as you are done with the research.

This communique serves to inform the CHC Managers, Clinic Supervisors and Operational Managers of Buffalo City Sub District that Ms Nonceba Vellem has been given a permission to conduct research study on intervention strategy for pregnant women with gestational diabetes mellitus (GDM).

The Sub District office requests that the researcher be assisted with the information she needs without compromising confidentiality of both the consumers of the service and the image of the department.

Your co-operation is always appreciated.

---

BUFFALO CITY SUB DISTRICT

[Signature]

01 Dec 2016

[Date]
Appendix D: Permission from Cecilia Makiwane Hospital

Province of the EASTERN CAPE HEALTH

Cecilia Makiwane Hospital • no 4 Billie Road Mdantsane Buffalo City
Tel: 043 708 2360 • Fax: 043 781 11581 • e-Mail: nelmbozyza@gmail.com

Ms. V. M. Veilem
University of Fort Hare
East London Campus
17 June 2015

RE: Request for permission to conduct a research study at Cecilia Makiwane Hospital

Dear Madam

This letter serves to grant permission from the Chief Executive Officer to conduct your research at CMH, we also would like to wish you well with your studies.

Kind Regards

Dr. M. Xamlashe
Chief Executive Officer
Cecilia Makiwane Hospital
Date: 17 June 2015

CECILIA MAKIWANE HOSPITAL
PRIVATE BAG X13003
705-06-17
CAMBRIDGE 5207

Egyptian slogan: United in achieving quality health care for all

24 hour cell centre: 0900 0023 64
Website: www.ecohh.gov.za

PGDP
Appendix E: Permission from the Frere Hospital

Province of the
EASTERN CAPE
HEALTH

Non Interventional Hospital Review Board
Postal Address:
Frere Hospital
Private bag x 9047
Amalinda
East London
5200
Enquiries: B. Willie Tel: 043 709 2389 Email: babalwa.willie@impilo.ecprov.gov.za

Physical Address:
Frere Hospital
4th Floor Room 4.18
Amalinda
East London
5200

28th July 2015

Mrs N.M. Veltman
Fort Hare University
Department of Nursing Sciences
East London
5201

RE: REQUEST FOR APPROVAL TO CONDUCT RESEARCH STUDY

"Intervention strategy for women with gestational diabetes mellitus (GDM) Eastern Cape, South Africa."

We acknowledge receipt of the above mentioned proposal.

Having gone through your proposal, the committee has no ethical problems noted but informed consent and confidentiality should be maintained.

Please be advised that the committee has granted you the consent to do the research.

Yours sincerely

[Signature]

Dr. J. Thomas
Clinical Governance Frere Hospital
CONSENT TO PARTICIPATE IN RESEARCH

Project title: Intervention strategy for low risk pregnant women and high risk pregnant women with gestational diabetes mellitus (GDM)

The study is interested in bringing a strategy for women with GDM using the diet and the planned physical activity in their context.

Purpose of the study:
Describe the intervention strategy that is needed to enhance adherence to modified diet and planned physical activity among pregnant women and women with gestational gestation mellitus (GDM).

Procedures
All women who are willing to participate in this study will be answering the questionnaire about your lifestyle and experiences with GDM. If you feel uncomfortable about answering questions, please feel free to withdraw at any time of the interviews.

If you decided to take part in the study, the researcher will give you a questionnaire to answer and do some anthropometric measurements of Blood pressure, weight, pulse, MUAC, BMI, blood glucose and Urine.

Your participation in this is entirely voluntary.

Potential risks and discomforts: none

Potential benefits to participants and the community at large: Prospective pregnancy and all the child bearing women will benefit from the study

Payment for participation: no payment unless interviews require travel, then transport costs will be provided
**Confidentiality:** any information that is obtained from the study will remain confidential and will be disclosed only with your permission or as required by law. The researcher will make use of pseudonyms and data collected and notes taken will be available to the researcher and researcher assistants.

**Right of participants:** you may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

I declare that I explained the information given in this document to the participant. The conversation was conducted in English or Xhosa and no translator was used.

**Signatures of the investigator and the participant**

Identification of investigator

Name: Nonceba Vellem

Tel: 0849631374

Signature of the investigator:

Date:

**The participant**

The information above described to me by .........................in English and Xhosa and I am in command of the language I choose. I was given an opportunity to asks questions and were answered to my satisfaction before I participate and signed the consent form.

I hereby consent voluntarily to participate in this study.

Signature of the participant:

Date:
Appendix G: QUESTIONNAIRE

Questionnaire for the intervention study for diet and physical activity (PA)

The purpose of the study is to describe the effectiveness of intervention strategy of modified diet and planned physical activity implemented to the low and high risk pregnant women and women with gestational diabetes mellitus (GDM) in Buffalo City Metropolitan, Eastern Cape.

The objective of the questionnaire is:

Describe the effectiveness of intervention strategy of modified diet and planned physical activity implemented to the low and high risk pregnant women and women with gestational diabetes mellitus (GDM) in Buffalo City Metropolitan, Eastern Cape.

Instructions
Please answer all the questions by crossing (x) in the appropriate block of your choice.

An example of how to complete the questionnaire

Gender?

<table>
<thead>
<tr>
<th>Male</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>X</td>
</tr>
</tbody>
</table>

Section 1

Demographic Data

This section of the questionnaire refers to biographic information. The information in this questionnaire will be kept confidential and will be used to compare the responses of the participants. This information will remain anonymous.

1.1 Employment status

<table>
<thead>
<tr>
<th>Student</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td></td>
</tr>
<tr>
<td>Self employed</td>
<td></td>
</tr>
</tbody>
</table>

1.2 Age in years

| 18 – 21       |            |
| 22 – 29       |            |
| 30 – 35       |            |

1.3 Setting
1.4 Marital status

Married
Single
Divorced
Widowed

1.5 Level of education

Grade 1 – 7
Grade 8 – 12
Diploma
Degree

1.6 Ethnicity

Black
Coloured
White
Other

1.7 Home Language

Xhosa
English
Afrikaans

Section 2

Anthropometric measurements

This section of the questionnaire is about describing the Anthropometric measurements of women. Please answer all the questions by crossing (x) in the appropriate block of your choice.

Instructions

Please answer all the questions by writing the measurements of the women in the appropriate block of your choice.

2.1
<table>
<thead>
<tr>
<th>Weight</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MUAC</td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
</tr>
<tr>
<td>Glucose levels</td>
<td></td>
</tr>
</tbody>
</table>

**Urine:**
- Protein
- Blood
- Glucose

2.2 please tick in the appropriate box

**Body mass index:**
- less than 25 kg/m²
- 25 – 30 kg/m²
- Higher than 30 kg/m²

2.3 Glucose levels

**Instructions**
Please answer all the questions by writing the glucose levels in the appropriate block of your choice

<table>
<thead>
<tr>
<th>Glucose levels on diagnosis</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Section 3: Medical History**

**Instructions**
Please answer all the questions by writing yes or no in the appropriate block of your choice

YES    NO

- Diabetes
- Hypertension

**Section 4: Obstetric history**

**Instructions**
Please answer all the questions by writing the relevant answer in the appropriate block of your choice

4.1 Past pregnancy history

<table>
<thead>
<tr>
<th>Gravida</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity</td>
<td></td>
</tr>
<tr>
<td>Birth weight of the baby</td>
<td></td>
</tr>
<tr>
<td>Congenital history</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Present pregnancy history

<table>
<thead>
<tr>
<th>Gravida</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity</td>
<td></td>
</tr>
<tr>
<td>Gestational age at initial entry</td>
<td></td>
</tr>
<tr>
<td>Gestational age last entry</td>
<td></td>
</tr>
</tbody>
</table>

Section 5: Lifestyle history

Instructions

Please answer all the questions by writing yes or no and relevant answers in the appropriate block of your choice

5.1 Alcohol

<table>
<thead>
<tr>
<th>Do you drink alcohol</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If yes, how often</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many glasses per day</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Occasional</th>
</tr>
</thead>
</table>

5.2 Smoking

<table>
<thead>
<tr>
<th>Smoking</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you smoke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, how often</td>
<td>Daily</td>
<td>Weekly</td>
</tr>
</tbody>
</table>


How many cigarettes per day

<table>
<thead>
<tr>
<th>Monthly</th>
<th>Occasional</th>
</tr>
</thead>
</table>

Section 6: Diabetes and GDM

Diabetes

Instructions

Please answer all the questions by write an X next to yes or no and to the appropriate block of your choice

6.1 Have any of your members of your immediate family (father and mother) and other relatives diagnose with diabetes mellitus

6.2 Who is at high risk of diabetes?

Make an X on the appropriate box

- One of the grandparents
- Both of the grandparents
- One of the parents
- Both of the parents
- One or more of the siblings

6.3 Who is at high risk of gestational diabetes mellitus?

Make an X on the appropriate box

- Age
- Obese
- Overweight
- Family history of diabetes

Stakeholders in GDM

The following questions are pertaining to the stakeholders of the diabetes team opinion, perceptions, views using the following 5-point scale using crossing (X).

7.1 Role of stakeholders
<table>
<thead>
<tr>
<th>7.1.1: Obstetrician</th>
<th>Does the following statement meet the role of stakeholders in the diabetic team</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.1.1</td>
<td>The obstetrician is supporting women with gestational diabetes mellitus (GDM).</td>
</tr>
<tr>
<td>7.1.1.2</td>
<td>Obstetrician is always monitoring my progress in the management of diabetes mellitus.</td>
</tr>
<tr>
<td>7.1.1.3</td>
<td>Obstetrician also form frequent meetings to monitor the women with GDM</td>
</tr>
<tr>
<td>7.1.1.4</td>
<td>Obstetrician also borrow all the women with GDM machines to monitor glucose levels.</td>
</tr>
<tr>
<td>7.1.1.5</td>
<td>The obstetrician is always ready to answer any questions related to diabetes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7.1.2: Dietician</th>
<th>Does the following statement meet the role of stakeholders in the diabetic team</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.2.1</td>
<td>The dietician is educating women with GDM about correct diet in every visit.</td>
</tr>
<tr>
<td>7.1.2.2</td>
<td>The dietician is always reminding women with GDM about the correct diet.</td>
</tr>
<tr>
<td>7.1.2.3</td>
<td>The dietician is friendly and willing to answer questions of women with GDM asking related to diet.</td>
</tr>
<tr>
<td>7.1.2.4</td>
<td>Dietician is always advising women with GDM about ways of having the accurate diet.</td>
</tr>
</tbody>
</table>
Section 8: Theoretical framework for pregnant women and women with GDM

This section is about theoretical framework pertaining individual characteristic and behaviour to diabetes mellitus. Indicate your opinion/perceptions/views using the following 5-point scale using crossing (X).

8.1 Principles of managing diabetes

<table>
<thead>
<tr>
<th>What is your opinion regarding the following principles of Orem Becker and Pender's theory for managing diabetes?</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Uncertain</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.1 I am actively participating in managing diabetes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.1.2 I am motivated in managing diabetes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.1.3 I am able to apply and manage diabetes the way I have been learned from the midwife, dietician and obstetrician.

8.1.4 The language used by the dietician, midwife and obstetrician is understandable.

8.1.5 The attitude of the dietician, midwife and obstetrician is welcoming.

8.1.6 I seek help if I didn’t understand what was taught or shown to me by midwife, dietician and obstetrician.

9. Planned diet

Instructions

Please record the type of diet and meals from breakfast to supper including the snacks in between meals in a logbook. Please write an X next to yes or no to the appropriate block of your choice

9.1 What is in your meal

<table>
<thead>
<tr>
<th>What is in your meal</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.2 How often do you eat vegetables in your plate? (cabbage, spinach, pumpkin/butternut, carrots, etc.)
9.3 How often do you eat carbohydrates in your plate? (stamp, rice, pap, potatoes, etc.)

<table>
<thead>
<tr>
<th>Type of vegetables</th>
<th>Once a day</th>
<th>Once in 2 days</th>
<th>Once a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butternut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumpkin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beetroot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green pepper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.4 How often do you eat protein in your plate? (meat, fish, eggs, milk, etc.)

<table>
<thead>
<tr>
<th>Type of protein</th>
<th>Once a day</th>
<th>Once in 2 days</th>
<th>Once a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of meat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Types of fats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.5 How often do you eat fruit? (all types of fruit)
9.6 How often do you eat high fibre food?

<table>
<thead>
<tr>
<th>Type of fruits</th>
<th>Once a day</th>
<th>Once in 2 days</th>
<th>Once a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oranges/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bananas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pears</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apricot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiwi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pineapple</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.7 What encourages modified diet

<table>
<thead>
<tr>
<th>Enhancers of modified diet</th>
<th>Yes</th>
<th>No</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education on modified diet regarding type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education on benefits of modified diet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social support networks and groups pertaining modified diet programs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.8 What are the barriers to the correct diet

<table>
<thead>
<tr>
<th>Barriers of modified diet</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge related to modified diet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low motivation to modified diet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of information related to benefits of modified diet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio cultural influence</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. Modified physical activity

Instructions
Please record the days and time of engaging with modified physical activity in a logbook. Please write an X next to yes or no to the appropriate block of your choice.

10.1 Do you engage in any form of modified physical activity

Yes  | No

10.2 If yes what type of modified physical activity

<table>
<thead>
<tr>
<th>Type of modified physical activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.3 For how long

<table>
<thead>
<tr>
<th>Duration of modified physical activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 minutes once a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes three times a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes twice a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes daily</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.4 What encourages you to do the modified physical activity

<table>
<thead>
<tr>
<th>Enhancers of modified physical activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>More education on PA regarding type and frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education on benefits of engaging in PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social support networks and groups physical activity programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenient locations for PA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.5 What are the barriers to the modified physical activity
### Barriers of modified physical activity

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low motivation to modified physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue and low energy dictate activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of information related to benefits of modified PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of resources necessary to engage in modified physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio cultural influence</td>
<td></td>
<td></td>
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</tbody>
</table>

#### 11. Women additional comments

- 
- 
- 
- 
- 
- 
- 
- 

- **END OF QUESTIONNAIRE-**

THANK YOU FOR PARTICIPATING IN THE STUDY

Researcher’s Name: N.M. VELLEM

Signature: _________________________

Date: _________________________
### Appendix H: Checklist for Modified Diet and Planned Physical Activity

**Anthropometric measurements of the participant DVDH CHC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Anthropometric measurements of the participant Gompo CHC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
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<tbody>
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</tbody>
</table>

**Anthropometric measurements of the participant Nontyantyambo CHC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

**Anthropometric measurements of the participant Dimbaza CHC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
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</tbody>
</table>
Anthropometric measurements of the participant Frere hospital

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
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</thead>
<tbody>
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</tbody>
</table>

Anthropometric measurements of the participant Cecilia Makiwane hospital

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>MUAC</th>
<th>Blood pressure</th>
<th>Pulse</th>
<th>Blood Glucose levels</th>
<th>BMI</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
Checklist for planned physical activity
Check list for anthropometric measurements for planned physical activity checklist

<table>
<thead>
<tr>
<th>Activities</th>
<th>May</th>
<th>June</th>
<th>July</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you engage in any form of physical activity? If t yes what type below:</td>
<td>26wks</td>
<td>30wks</td>
<td>34wks</td>
</tr>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes twice a week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes trice a week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes weekly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total minutes per month</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checklist for modified diet
Check list for modified diet

<table>
<thead>
<tr>
<th>Activities</th>
<th>Daily</th>
<th>Twice a week</th>
<th>Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26wks</td>
<td>30wks</td>
<td>34wks</td>
</tr>
<tr>
<td>1. What is in your meal:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix I: Letter from The Statistician

TO WHOM IT MAY CONCERN
I have over 5 years’ experience in the teaching profession, both at high school and tertiary level. My research experience is well over 6 years and I was a principal investigator on over 3 projects. In my current position, as a post-doctoral research fellow at the Department of Sociology of the University of Fort Hare, I teach both Undergraduate and Postgraduate Research courses, write articles for publication, review manuscripts prior to publication for both local and international journals and evaluate students’ thesis. My training in advanced quantitative technique, demography, statistical reasoning for public health and understanding clinical research: behind the statistics and my over 5 years’ experience in data analysis allowed me to focus on data analysis, research, academic writing and student development.

I hereby certify that I conducted the data analysis for the principal investigator, Mrs Vellem, Nonceba. The project is entitled ‘AN INTERVENTION STUDY FOR LOW RISK PREGNANT WOMEN AND HIGH RISK PREGNANT WOMEN WITH GESTATIONAL DIABETES MELLITUS (GDM) IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA’.

I trust that the data analysis was thoroughly done and accurately reflects the findings of the study. The findings are well aligned about the objectives of the study. The principles of anonymity, confidentiality, accountability and reliability were respected by both parties.

Should there be any questions that arise from this exercise, kindly contact me on ajayianthony@gmail.com.

Anthony Ajayi (Research Fellow and private data analyst)
No 4 Lake street
Vincent
East London
5247
January 5, 18
29 March 2018

To Whom It May Concern

I, Peta Jane Mqamelo, ID number 611120 0014 08 1, do herewith confirm that I have conducted an English proofreading and grammar edit on a doctoral thesis by Nonceba Vellem entitled:

An intervention study for low risk pregnant women and high risk pregnant women with GDM in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa

Yours sincerely

Jane Mqamelo
ProsePerfect
Editing, proofreading, writing