AN INTERVENTION FOR HIGH-RISK TYPE 2 DIABETIC CLIENTS DURING PRECONCEPTION AND INTERNATAL IN RE-ENGINEERING OF PRIMARY HEALTH CARE

A Dissertation Submitted in Fulfilment of the Requirements for the Degree Master of Nursing Science (Magister Curation Is) Community Health Nursing

BY

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October 2018

DECLARATION

I, Siphokazi Amanda Ngoma the undersigned, declare that this dissertation titled "*an intervention for high-risk type 2 diabetic clients during preconception and internatal in re-engineering of primary health care*", is my original work with exemption to the citations used. I further declare that this work has not been submitted to any other University in part or entirely for the award of any degree.

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Signature: …….

Date: …….

CERTIFICATION

This dissertation entitled ‘an intervention for high-risk type 2 diabetic clients during preconception and internatal in re-engineering of primary health care’ meets the regulations governing the award of the degree of Magister Curationis (Community Health) of the University of Fort Hare and is approved for its contribution to scientific knowledge.

Dr N.M Vellem

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Supervisor Date

DEDICATION

This dissertation is dedicated to the community healthcare workers and the community of Peddie; more especially the staff at Peddie Extension clinic for bearing with me and helping in my work.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr Nonceba Mercy Vellem as well as my co-supervisor Mrs Ntombana Rala for the great support, guidance and their endless contribution to my academic journey especially in achieving my master's degree. They moulded me into becoming a researcher and a critical thinker during the study. They have assisted me in every possible way such as financial support from Govern Mbeki Research Development Centre. I further acknowledge their commitment and time they spent during the course of my study, which extended even during the weekends. Their contribution is highly noted and greatly appreciated.

I would also like to thank Peddie Extension Clinic staff for their assistance, especially the support of the community health care workers who helped significantly in data collection and screening of participants.

Moreover, I thank Miss Sisipho Jack (Dietician) from Nompumelelo Hospital for agreeing to be part of my study. Her health education talk on nutrition to the participants was a pertinent issue that should be implemented in our communities as a health promotion and preventative measure.

I also express my gratitude to Noluvo Hlekani for agreeing to assist me as a lay coach, guiding and the training of the participants in the control group.

Further, I would like to thank the community of Peddie, especially the participants who agreed to be part of my research. Without these people, I would not have been able to conduct this research. Those who were part of the control group and through health education offered to them managed to change their lifestyle to some degree, I salute you. I am even more grateful to the experimental group; people who had re-arranged their schedules and daily routine so as to attend the exercise sessions.

A special thanks to my family for supporting me from the beginning to the end of my research project. My daughter Thandokuhle, she had to understand that she can't

always have mommy's attention and mommy cannot attend all her extra curriculum activities. Thanks to my mom who has always supported me and encouraged me to stay focused, even when I felt like giving up.

Lastly, I would like to appreciate my course mates Mrs Tokwe-Krwempe and Mrs Dasheka who played a fundamental role in my success because of their endless support, guidance, motivation and moral support. We started this journey together and you guys have built me to be who I am today; thank you for sharing my troubles and joy with me.

LIST OF ACRONYMS

ADA	: American Diabetes Association
ANC	: Antenatal Care
BMI	: Body Mass Index
BP	: Blood Pressure
CDC	: Centre for Disease Prevention and Control
CDE	: Centre for Diabetes and Endocrinology
CHC	: Community Health Care
CHW	: Community Health Workers
DH	: Department of Health
DM	: Diabetes Mellitus
DPP	: Diabetes Prevention Programme
FCG	: Fasting Capillary Glucose
FPG	: Fasting Plasma Glucose
GDM	: Gestational Diabetes Mellitus
HbA1c	: Haemoglobin A1c
HPM	: Health Promotion Model
HPT	: Hypertension
HT	: Height
IDF	: International Diabetes Federation
IDFA	: International Diabetes Federation Atlas
MNCH	: Maternal, New-born, and Child Health
NCDs	: Non-Communicable Diseases
NHI	: National Health Insurance
OGTT	: Oral Glucose Tolerance Test
PCC	: Preconception Care

PCH : Primary Health Care

RBG : Random Blood Glucose

RPCH : Re-Engineering of Primary Health Care

SA : South Africa

SADG : South African Diet Guidelines

SAHR : South African Health Review

SAMRC : South African Medical Research Council

SANHANES : South African National Health and Nutrition Examination Survey

SD : Standard Deviation

SEMDSA : Society for Endocrinology Metabolism and Diabetes of South Africa

SPSS : Statistical Package for Social Sciences

SSA : Sub-Saharan Africa

T2DM : Type 2 diabetes mellitus

UK : United Kingdom

USA : United States of America

WC : Waist Circumference

WHO : World Health Organization

ABSTRACT

The South African disease profile has changed significantly and has increasing prevalence of overweight and obesity in relation to body mass index. Type 2 diabetes mellitus is greatly associated with increased body mass index and poses a great health concern for women of childbearing age. Complications of type 2 diabetes mellitus in pregnancy has life-threatening for the mother and baby. South African women have a tendency of avoiding and neglecting routine screening before pregnancy, that is part of preconception care or internatal care. The aim of the study sought to identify women of childbearing age with predisposing factors of type 2 diabetes, in order to intervene, using a lifestyle modification to delay and prevent the occurrence of type 2 diabetes.

A quantitative intervention study using parallel group randomized control trials was used. One hundred and forty-six women of childbearing age (18-45 years) were recruited and assigned to either control (n=73 + 9) or experimental group (n=73 +9). using a computer software randomizer application to avoid bias in selection of participants by the researcher. Both groups received health education from the researcher and the dietician from hospital. The control group had no intervention done, whereas the experimental group attended physical activity sessions which were administered by a hired lay coach.

The findings showed that both groups are at risk of developing type 2 diabetes although they both groups lose weight. The weight loss of the control group was owed to education during recruitment. Vegetable consumption was minimal to the younger age group than the older age groups. Waist circumference above 105cm consumed less vegetables, a higher waist circumference is associated with insulin resistance. There was also minimal exercises and knowledge about the preconception care. Diabetes prevention is vital for the women of childbearing age as it affects both mother and child. The study recommends lifestyle modification (exercise and healthy diet) to prevent and delay of type 2 diabetes and gestational diabetes mellitus. The study also recommends Preconception care and Re-

engineering of Primary health care uses community health care workers for screening high risk women during home visits.

Key Concepts: high-risk type 2 diabetic clients, preconception care, internatal care.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

South Africa is faced with epidemic infectious diseases as well as a rise in non-communicable diseases like diabetes Ahli *et al.* (2016) stated that in a situational analysis in South Africa. As the incidence of diabetes continues to increase and affect individuals of all ages, women of childbearing age were and still at higher risk and threat of diabetes during pregnancy (World Health Organization, 2012). Thus, an intervention for high-risk type 2 diabetic women of childbearing age during preconception and internatal is needed.

Worldwide, health care has been focusing on major contributors to mortality rate, such as HIV/AIDS, TB and other communicable diseases. From these interventions, there has been a decline in communicable disease contribution to mortality rates, while non-communicable diseases is on the rise (Ahli *et al.*, 2016). International Diabetes Federation (2017) report on age adjusted (20-79 years), estimated a death toll of 4.0 million that was attributed to diabetes in 2017. Furthermore, the IDF report stated that the death toll of diabetes is more than of HIV and TB (1.1 million and 1.8 million) combined. This is proof that South Africa needs to look at strategies to reduce the impact and consequences of diabetes as it has done for HIV and TB reduction.

Mbanya *et al.* (2010), stated that there was an increased prevalence of the diabetes type 2 rises with increasing Body-Mass Index (BMI) above 25 kg/m²; waist-to-hip ratio and waist circumference of above 102 cm for males and above 88 cm for females. To achieve optimum health, the median body mass index for an adult person should be in the range of 21 to 23 kg/m², while the goal for individuals should be to maintain body mass index in the range of 18.5 to 24.9 kg/m². On the other hand, Society for Endocrinology Metabolism and Diabetes of South Africa (2017) suggest that people with BMI of 25kg/m²-29kg/m^2 are “at risk” and people with BMI above 30 kg/m² are at high risk. In addition, waist circumference greater or equal to

90 -104 cm for males; and 80 -88 cm for females indicates risk of developing type 2 diabetes.

International diabetes federation (IDF) (2017) reported a prevalence of diabetes between age 20-79 years to be 424.9 million (8.8%) in 2017. Diabetes is estimated to increase to 628.6 million (9.9%) in 2045. This estimation is linked to lifestyle such as unhealthy diet and inactivity, and the increase of diabetes is also parallel to the increase in obesity (IDF, (2017); SEMDSA Guideline Committee, 2017). Consequently, Africa and South Africa has experienced an increased diabetes prevalence.

The regional prevalence of diabetes for the Africa region for 2015 was 3.2% and it was expected to increase to 3.7% (2.6-7.3%) by 2040. This region has the highest proportion (66.7%) of undiagnosed diabetes (SEMDSA Guideline Committee, 2017). In South Africa, there were 2.286 million adults (20-79 years) with diabetes with the national prevalence of 7.0%. Out of the 2.3 million people with diabetes, 1.3968 million (61.1%) were undiagnosed. This stresses the importance of community screening for case findings of high-risk individuals and early detection of diabetes. This will enable prompt intervention and management and therefore reducing complications of diabetes (SEMDSA Guideline Committee, 2017).

In South Africa Erasmus *et al.* (2012) in a study conducted in Cape Town, the crude prevalence of diabetes was 28.2% amongst the coloured population. They also found that the percentage of undiagnosed type 2 diabetes was 7.7 % for females. The predicted increase is inextricably linked to changes towards a western lifestyle (high-energy diets with reduced physical activity) and the rise in the prevalence of overweight and obesity (Nolan, Damm & Prentki, 2011). However, Kraschnewski *et al.* (2013) found that the majority of women of childbearing age are already overweight or obese in Pennsylvania. Whereas, Marchi *et al.* (2015) in a systematic review of literature conducted on 638 electronic data sources, they found that, obesity prior to pregnancy, and during pregnancy, predisposes women to gestational diabetes mellitus (GDM) and early onset of type 2 diabetes. Marchi *et al.* (2015) also state that the obesity also elevates the risk of other complications such as caesarean

deliveries because of masocromial infants. Children born to diabetic mothers are exposed to hyperglycaemia in utero and stand high chances of being diabetic.

The risks of type 2 diabetes can be minimised by optimal glycaemic control, BMI and use of waist circumference, both prior to and throughout the pregnancy. This is best achieved through comprehensive preconception and internatal care, where other issues such as diabetic risk score, genetic risks, health status, and reproductive history are screened (Mahmud & Mazza, 2010). Morever, lifestyle risk factors can also be addressed through a multidisciplinary approach in the community-based management of diabetes before and during pregnancy (Mahmud *et al*, 2010).

Hence, the focus of the study was on ward-based outreach teams. Identification of an intervention for women, particularly those at high risk of developing diabetes in pregnancy, information about their pre-pregnancy health is important so that they can manage their risks and where overweight or obesity is a factor, interventions aimed at weight management could be implemented (Marchi *et al.*, 2015). South Africa currently lacks policy guidelines for preconception or internatal care.

Berglund and Lindmark (2016) stated that, PCC is widely recognized as a way to optimize women's health and improving pregnancy outcomes. This was because of the growing body of evidence that, very early pregnancy is a critical period for both maternal and foetal health. PCC address health behaviour such as weight management (increased BMI), and testing for T2DM, counselling, health promotion and prevention. The aim of PCC is to adjust the modifiable determinants of ill health, for improved pregnancy outcomes. Furthermore, Berglund *et al.* (2016) identify PHC as a model that can help reach the community effectively. This is because PHC is easily accessible, and the nurse midwives can utilise the model in meeting with women of childbearing age in different settings. This provides platforms for counselling services to them on health behaviours from their locale.

The South African system of delivering health services to the people has changed over the years. The district health system, which is the primary system of providing

health care services to local communities, was introduced in 1996 (Naledi, Barron & Schneider, 2011). Although this system of providing health services has been running since 1996, South African health system is still facing many challenges and more changes in health services are occurring. The need for improved services has led to a new system, the Primary Health Care (PHC) re-engineering model. This model focuses on three streams or parts of the district health system. Naledi *et al,* (2011) report of: ward-based PHC Outreach teams; improving school health services, and district-based specialist teams to support PHC teams. One of the core principles of PHC re-engineering is prevention of illness, promotion of health, and good quality and essential care (Naledi *et al* 2011).

Naledi *et al* (2011) on the 2011 South African Health Review report state that, the ward-based PHC outreach team services offer an integrated health services at a community, household & individual level. The core components of the integrated service are:

- Promote health (child, adolescent and women's health),
- Prevent ill health,
- Provide information and education to communities and households on a range of health and related matters, and
- Screening for early detection and intervention of health problems and illnesses.

The increase of diabetes mellitus continues to be reported irrespective of the SEDMSA guidelines developed by the government to manage it. The guidelines include screening and diabetes prevention. The statistics from IDF, (2017), (SEMDSA Guideline Committee, (2017) and Erasmus, *et al*. (2012) proved that diabetes is increasing in all age groups, hence intervention strategies are needed to prevent the increase of diabetes and promote a healthy lifestyle. Therefore, the researcher was interested in introducing the healthy lifestyle to childbearing women through diet and physical activity in this study.

1.2 Problem statement

Women of child bearing age do not present themselves to the clinic to report planning for pregnancy in order for preconception screening to be done. When women of child bearing age became pregnant and visited the antenatal care they are diagnosed with gestational diabetes without being screened before pregnancy. Failure to undergo preconception screening and health prevention intervention for type 2 diabetes as a missed opportunity for those at high risk of developing T2DM and/or GDM (Chuang, Velott & Weisman, 2010). Addressing these health risk yields better pregnancy outcome for both the mother and the baby, as T2DM and GDM is prevented or chances are greatly reduced (Lassi *et al.,* 2014). Therefore, this study seeks to prove or disprove that community health screening for high risk type 2 diabetes individuals and intervention in the preconception and early pregnancy will reduce the chances of developing T2DM and or GDM.

Therefore, the study is trying to answer the crisis South Africa is facing by finding the strategies that will reduce the burden of this epidemic. The SEMDSA Guideline Committee, (2017) also support the urgent need for improved screening for diabetes because more 30% of diabetes remain undiagnosed. In South Africa there is scanty literature on diabetes prevention on women of childbearing age. Obesity, unhealthy lifestyle (inactivity and unhealthy diet) are seen as a major fuel and modifiable factors for type 2 diabetes and gestational diabetes (Breeze *et al*., 2017). The IDF Atlas, (2017) recommends physical activity at least between three to five days a week for a minimum of 30-45 minutes.

1.3 Aim of the study

This study sought to identify women of childbearing age with predisposing factors of type 2 diabetes, in order to intervene, using a lifestyle modification to delay and prevent the occurrence of type 2 diabetes.

1.4 Objectives of the study

The study endeavoured to achieve the following objectives:

I. To identify and describe women of childbearing age with predisposing factors of type 2 diabetes.
II. To identify and describe women with type 2 diabetes before 24 weeks of pregnancy.
III. To describe the effect of exercise and healthy balanced diet to women with predisposing factors for type 2 diabetes and type 2 diabetes before 24 weeks of pregnancy.

1.5 Significance of the study

The findings of this research will promote a healthy lifestyle for women of childbearing age who might not have understood the advantages of a healthy lifestyle in preventing type 2 diabetes. Women of childbearing age and pregnant women involvement in healthy lifestyle activities will promote good health and prevent conditions related to poor lifestyle. The early and frequent screening will enhance the early detection of pre-diabetes and prevent the development of type 2 diabetes and gestational diabetes in women for the better maternal health outcomes. The research study will also promote the attendance of the preconception and internatal care. Moreover, the study will inform on the guidelines of the PHC reengineering practice. The findings from this study will add into the body of knowledge related to preconception and internatal care and the nursing science in general.

1.6 Definition of concepts

Preconception Care

Preconception care is comprised of interventions that aim to identify and modify biomedical, behavioural, and social risks to a women's health or pregnancy outcome through prevention and management, emphasizing on those factors which must be acted on before conception or early days in pregnancy to have a maximal impact (Berglund and Lindmark, (2016) and Kotelchuck, (2013). In this study, preconception care and interconception care are used interchangeably. The care is given to women of childbearing age, with the aim to counsel and educate women of childbearing age

who are at risk of developing T2DM or GDM. This care also involves intervention by changing the lifestyle of those women who are at risk of T2DM and GDM.

Internatal/Intercenception Care

Internatal care refers to “a package of healthcare and ancillary services provided to a woman and her family from the birth of one child to the birth of her next child” (Kotelchuck, 2013) . Interconception and preconception are used interchangeably in this study. While preconception is the care before pregnancy and may apply to first time mothers, interconception is the care between the pregnancies. Peconception and inter conception periods are meant for providing the same counselling and health education for a planned pregnancy.

Primary Health Care Reengineering

Primary Health Care Reengineering is the revitalization of Primary Health Care initiative by providing proactive household and community-focused interventions (Kinkel *et al.*, 2013). In this study, it means screening of risks to pre-diabetes mellitus and type 2 diabetes mellitus. It is also early detection before 24 weeks of pregnancy to women in their household and intervenes. This is to be achieved through the use of the community healthcare workers (CHWs).

High-risk Type 2 diabetes client

High-risk individuals refer to all adults (18-45 years) with body mass index (BMI) ≥ 25 kg/m2 (overweight or obese), a waist circumference of more than 88 cm and a Random plasma glucose of 5.6-11 mmol/L, plus one or more additional risk factors, Physical inactivity, Hypertension [blood pressure (BP) ≥ 140/90 mmHg), Family history of diabetes (first degree), Gestational diabetes or baby weighing > 4 kg- Previous Impaired Fasting Glucose (IFG) or Impaired Glucose Test (IGT) (SEMDSA Guideline Committee, 2017)

Intervention

According to Grove, Burns, and Gray (2013), there were deliberative cognitive, physical and verbal activities performed with the participants, directed towards

preventing or delaying the onset of diabetes. In this study, intervention was lifestyle modification, which includes health education on the disease and how it relates to the women in the study. The complications of T2DM and of GDM, and how to prevent T2DM and GDM through modifying diet which is low in sugar, fat content, salt content and more vegetable and fruit consumption forms part of the concept intervention in this study. The other part of intervention was engaging in exercises/physical activity, with the aim of reducing weight and subsequently BMI.

1.7 Literature review

1.7.1 Preconception and Internatal care

There has been limited growth and recognition of pre-conceptual/internatal care in developing countries according to Lassi *et al* (2014). This is despite the importance of maternal health before pregnancy that has been noted by many research studies. There has been however, an increasing realization that a gap exists in the continuum of care, especially when women with GDM need intervention, through lifestyle changes (diet and exercise) in order to reduce GDM in subsequent pregnancies and prevent the onset of T2DM. A growing body of evidence has shown that preconception care, increase the health and well-being of women, couples, improve subsequent pregnancy and child health outcomes (Berglund & Lindmark, 2016).

Moreover, there is growing experience in delivering preconception care in countries around the world. Women and couples of reproductive ages are generally unaware of the effects their own health conditions and health-related behaviours may harm the fetus during pregnancy. Although antenatal care is set in the maternal, newborn, and child health (MNCH) continuum, it neglects the most critical time of embryonic development, which often occurs before a woman even realizes she is pregnant (Dean *et al* 2013).

WHO (2012) reported the growing evidence on extended maternal, newborn and child health continuum of care, with this care commencing from preconception or internatal period. This increases the well-being of women and foetus and neonates

and improves subsequent pregnancy and child health outcomes. WHO (2012), Spence, *et al*, (2013), Chuang, Velott, and Weisman (2009), argue that women do not plan pregnancy nor seek preconception services if available in other countries This means that health screening for high risk conditions such as T2DM and or GDM is not done and before antenatal care. T2DM and GDM can be prevented by exercise and health diet. However, this intervention is more effective when done before conception (Tobias *et al.,* 2011).

According to Chuang *et al. (*2010) in exploring knowledge and attitudes related to pregnancy and preconception health in women with a chronic medical condition, women do not use preconception care services. They also found that woman with chronic conditions such as diabetes do not plan for their pregnancies and yet they are fully aware of the pregnancy complications, for them and the unborn baby. On the other hand, women with obesity did not perceive the risk of obesity in their pregnancy.

Draper *et al.* (2014) also report that, increased BMI and GDM are independent risk factors for perinatal complications, and GDM has been independently associated with an increased maternal and neonatal morbidities. Hence, in light of these risks, preconception care is crucial, and optimizing health in the pre-pregnancy period is especially important for glycaemic control. However, Draper *et al.* (2014) also argue that many adolescent girls and women in low and middle-income countries (LMICs) do not have access to preconception care. It is for this reason that WHO, (2012), has called for broadening the reach of current preconception interventions, particularly those that are cost-effective in LMICs. Social meadia for example is widely used and accessible to most of the wolrd population. It is for this reason that preconception care makes use of mobile electronic technologies of these social media services (SMS, Facebook, YouTube, Twitter) to convey health messages and information) to the population WHO, (2012).

Dean *et al.* (2013) in discussing the United Nations Millennium Development Goals (MDGs) aimed to reduce childhood mortality and improve maternal health, argue

that, while significant progress towards these targets has been achieved, it is recognized that progress in reducing newborn deaths is slow and major challenges remain in reducing maternal mortality. Moreover, improving birth preparedness and the health of the mother is a critical step in achieving these targets that has received relatively less attention. It is therefore imperative that preconception care is seen as an earlier opportunity and not just for family planning or to reduce maternal and neonatal mortality, but also to improve long-term outcomes for adolescent girls, women, and children. Adolescent health and reproductive health must increasingly be considered as crucial stages in the continuum of care. Health research investment and policy should be pursued in a more balanced way, in promoting increased access and delivery of an essential package of preconception interventions to prevent risk factors that predispose women to diabetes (Dean *et al.,* 2013).

1.7.2 High risk as predisposing factors to type 2 diabetes

In a study conducted in North Queensland, Australia by Campbell *et al.* (2012) found a convincing evidence between increasing pre-pregnancy BMI and risk for gestational diabetes mellitus. Thus, women of childbearing age need to be counselled about healthy lifestyle, especially diet and physical activity to prevent gestational diabetes. A systematic review and meta-analysis done by Campbell *et al.* (2012) found a linear increase in risk with increasing BMI. However, the prevalence of overweight and obesity was high among all the women of childbearing age and their nutritional status demonstrated low intake of fruit and poor vegetable intake. Further, Campbell *et al.* (2012) advises that, intervention is needed for these women to optimise glycaemic control and prevent GDM and T 2 DM.

They highlight that there is a high cost associated with treating obesity and limited success rates suggest that prevention is the best strategy. However, among overweight and obese individuals, even modest weight loss is likely to produce significant health benefits. The report by Johnson *et al.* (2014) also agrees with Campbell *et al.* (2012) in noting that BMI has been associated with pregnancy

complications including gestational diabetes mellitus, preeclampsia, and other adverse health outcomes.

Nyenwe *et al.* (2011) and SEMDSA Guideline Committee, (2017) maintain that predisposing factors are divided into two. These are; non-modifiable – that is the age which used to be above 45 years of age, but recent research shows that type 2 diabetes occurs at very young age, as young as 20 years. Secondly, genetics; the family history of diabetes especially of the first-degree relative predisposes a person to diabetes. The modifiable causes are due to lifestyle choices that are poor diet and exercise (inactivity). These include weight/body mass index (BMI more than 25 Kg/M^2, central adiposity (waist circumference of more than 102 cm in males and 88 cm in females), and sedentary lifestyle (life without exercise). The current study sought to identify women with predisposing factors, conduct an experiment to assess whether or not intervention (life style change: diet and) exercise will reduce and or delay onset of diabetes.

Jones and Wilson, (2010) conducted a retrospective audit on a cohort of 291 gestational diabetic women at an East London maternity unit, the results showed that six weeks post delivery, the screening of those who had GDM; 4% progressed to T2DM. International Diabetes Federation, (2017) state that babies born to mothers with gestational diabetes also have a higher lifetime risk of obesity and developing type 2 diabetes. An intervention study for childbearing age and women with type 2 diabetes is an urgent need to reduce risk and complications of type 2 diabetes mellitus even for future generation.

Impaired glucose tolerance/ pre-diabetes, in which glucose tolerance, fasting glucose, or both are impaired, is associated with increased probability of incident of diabetes. Effective management of pre-diabetes can prevent or delay the onset of diabetes. Lifestyle interventions (improved diet, increased exercise, or both) can lower the risk of incident diabetes by 28–59% as shown in studies such as The Finnish diabetic prevention study conducted in Finland, Da Qing study in China,

United State diabetes prevention programme in America among others (SEMDSA Guideline Committee, 2017)

Similarly, Mbanya *et al.* (2010) investigated culture and diabetes and found that, in most rural and some urban African settings, health beliefs, knowledge, lay perceptions, and health behaviour interact strongly. In the African culture, being obese is a sign of good living. Mbanya *et al.* (2010) further argue that these misconceptions indicated by popular health beliefs, many people in Africa fail to take appropriate measures for prevention and control of diabetes and its risk factors. Therefore, an intervention is needed to change this mindset, and women of childbearing age need to perceive the threat of T2DM and GDM as real.

1.7.3 Primary health care re-engineering

After the ministerial and MEC visit to Brazil in May 2010, the Minister requested Dr Yogan Pillay, Deputy Director General (DDG) strategic programmes and head of PHC sub-committee on the NHI Ministerial Advisory Committee, to develop a strategy for “re-engineering PHC in South Africa” (South African Health Review, 2011). In the South African Health Review, Naledi, Barron & Schneider *et al* (2011) reported that other countries such as Brazil and Thailand have implemented similar programs to PHC re-engineering, resulting in improved health outcomes. Brazil’s report by (Aquino, Oliveira and Barreto, 2009) demonstrated that, a primary health care program based on decentralized universal access can affect an important indicator of population health. International organizations such as WHO and the Pan American Health Organization have emphasized the need to reinforce the values, principles, and approaches of primary health care as essential to providing accessible health promotion and health prevention.

Moreover, experiences in developed and developing countries are a clear demonstration that this strategy can be implemented under various political, social, and cultural contexts. Primary health care has been considered ‘‘the best route to universal access, the best way to ensure sustainable improvements in health

outcomes and the best guarantee that access to care will be fair'' (Aquino *et al* 2009). In South Africa, le Roux *et al.* (2015) conducted a study on the role of community health workers in the re-engineering of primary health care in rural Eastern Cape where the RPHC was piloted. Le Roux *et al.* (2015) argue that access to health services in South Africa remains a challenge, especially for poor rural dwellers. The access is hindered by bad roads which are poor or non-existent, transport is scarce and expensive, clinics are poorly staffed and lacking equipment and medication, and hospitals are isolated, with overwhelmed medical staff. Le Roux *et al.* (2015) further state that there will be a global shortage of healthcare personnel until 2050. Hence, shifting tasks and care responsibilities from professional physicians and nurses to trained CHWs is necessary in order to meet the need for health care services.

The aim of the study is in line with Le Roux *et al.* (2015) by outlining a model for integrating CHWs with PHC clinics and hospital health teams to improve maternal and child health that has had success in its early stages in a rural area. In Zithulele Hospital where Le Roux *et al.* (2015) conducted their study, intergration of CHW has been able to improve health outcomes for mother and child health, increased hospital deliveries and reduced in maternal mortality. Good relations between PHC and Zithulele hospital proved that collaboration can improve health outcomes, from the community, to the facilities (hospital and clinics, to the government). Given the current training of CHW, community screening and intervention on high-risk individuals can be shifted to the CHW.

Hence, the title of the study: an intervention for high-risk type 2 diabetic clients during preconception and internatal in the re-engineering of primary health care. Community screening of high risk women of childbearing age can be done by CHW, as well as health education on lifestylechanges . CHW can then refer those patients whom they think need further management such as formal diabetes blood test to the hospitals.

1.8 Paradigms perspective

The study is using positivism perspective which is relevant for the quantitative studies. Positivism is the paradigm that was used to guide the research. Brink, Walt and Rensburg, (2016) stated that positivism paradigm is a systemic way of doing research. Positivism stress the importance of observable facts. The researcher wanted to prove that lifestyle modification (exercise and diet) will translate to weight loss and hence reduction on body mass index.

Theoretical framework

The Health Belief Model (HBM) was used this study. The model has the following components: perceived susceptibility, perceived severity, modifying factors, perceived barriers and benefits, perceived threat, cues to action, and self-efficacy.

Perceived susceptibility describes an individual's belief in the risk of getting the disease, which in this case are T2DM complications. For example, people who are at risk of developing diabetes complications such as an eye or foot disorders. Perceived severity addresses the question of how serious the individual perceives the complications to be: how bad can the complications potentially be? Can the complications lead to permanent disability? Perceived threat describes the urgency of a complication: how likely are the complications to get worse soon? On the other hand, perceived benefits and barriers vary by context; will I be able to cook a separate meal from my family to accommodate diabetes?

Self-efficacy is a part of the HBM model that assesses the individual's confidence in the ability to perform self-management behaviours: can the participant able to travel farther to a grocery store with fresh produce? Further, cues to action describe how likely an individual will act: will the family disparage changing the diet to accommodate the T2DM? The modifying factors such as age, sex, socioeconomic status, education level may alter the levels of perceived severity and barriers and are therefore included in the theoretical framework (Ahli *et al.*, 2016).

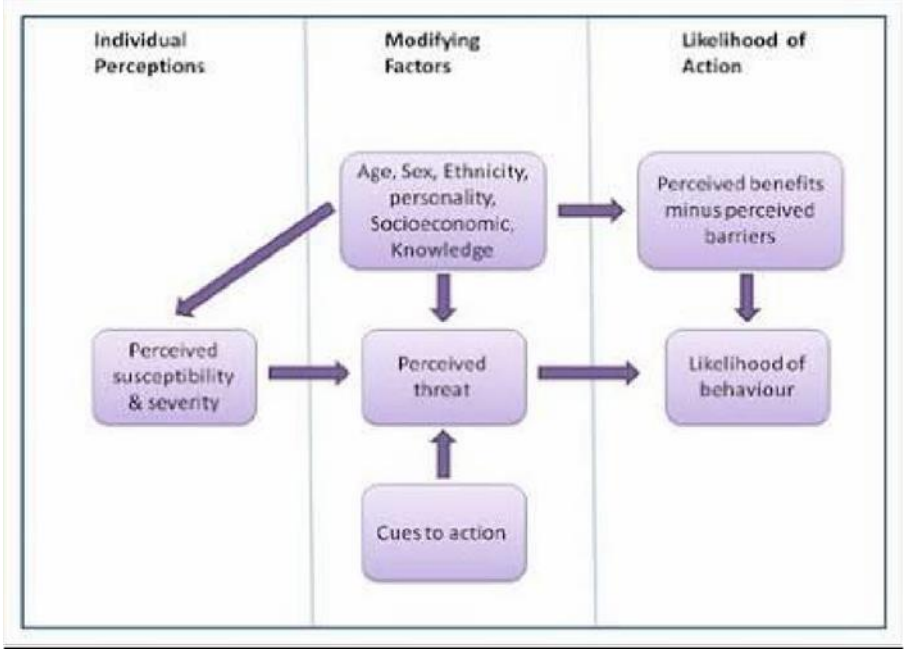

Figure 1.1: Health belief model

1.9 Conclusion

This chapter has introduced the alarming problem of obesity in low and high-risk pregnant women, a problem that requires urgent intervention to minimize 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 by the findings at the end of this study.

1.10 Chapter outline

Chapter 1: Introduction and background

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

- ✓ Incidents of type 2 diabetes mellitus and gestational diabetes.
- ✓ Prevalence of type 2 diabetes mellitus and gestational diabetes.
- ✓ Risk factors for type 2 diabetes mellitus and gestational diabetes.
- ✓ Complications of type 2 diabetes mellitus of poor lifestyle due to poor diet and lack of exercise. Re-engineering of primary health and its benefits in improving health outcomes, such as prevention of type 2 diabetes.

The chapter also explained the problem statement, the aim, objectives and research questions that guided the study, the significance of the study and the theory that underpinned the study (The Health Belief Model).

Chapter 2: Literature review

Chapter 2 provides an overview of the literature on T2DM and GDM, the prevalence of T2DM and GDM, the definition of the two diseases, screening (history taking, family and medical history of other chronic conditions such as hypertension), diagnostic test done, the at-risk population, pre-conception counselling, pre-gestational diabetes, management, monitoring, the grey area of pre-diabetes and obesity and their contribution to the epidemic of diabetes. The complications that affect the mother and the child leading to poor pregnancy outcomes, challenges, NHI

(2011) issues, guidelines and the role players and team leaders in the prevention and management of T2DM GDM to improve pregnancy outcomes for mother and child are discussed. Also, discussion of primary health care system, more especially Re-engineering of Primary Health Care (RPHC) services, incorporation of Pre-Conception Care (PCC) in RPHC has been presented. Lifestyle Modifications that have been proven to delay or reduce the risk of T2DM and or GDM is discussed. Theoretical Framework: assumptions that guide the study, predicting health behaviour formed part of chapter two. This study uses the Health Belief Model (HBM).

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 an exercise program.

Phase 3 was the community health education on diet and selection of study sample, then randomization of high-risk women of childbearing age in the study sample to make two groups, control group (without intervention) and experimental group (continued health education on diet and planned exercise)

Phase 4 was the implementation of the modified diet and exercise program.

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

Other parameters of the methodology are also discussed, such as setting, sample, data collection, validity, ethical considerations, data analysis and dissemination of results.

Chapter 4: Results and discussion

This chapter is about the interpretation of data. It involves a careful examination, organizing, and gives meaning and the statistical significance of the data. It also provides discussion of the current findings against the existing literature such as

diabetes prevention, incorporation of pre-conception care in primary health care. Issues such willingness to change the lifestyle that affected the dropout rate in the experimental group was explained by Health Belief Model. The researcher provides the clinical significance of the data and show the clinical importance of the findings, therefore adding to the body of knowledge.

Chapter 5: Interpretation of research findings

Chapter 5 is about the summary of the study-what was done by the researcher, the findings and what is was the literature about the study. It also states the justification for the study, implications of the study findings, limitations encountered by the researcher in the study and finally recommendations based on the literature and study findings.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Chapter one provided an overall introduction to the study, the problem statement, the purpose of the study, significance, theoretical framework and the outline of the entire study. This chapter will focus on a discussion of the literature on prevalence of type 2 diabetes on women of childbearing age and pregnant women. The literature review made use of a variety of sources, including online sources such as EBSCOhost, Google Scholar, Science Direct and PubMed. The keywords used in the search for articles were ‘type 2 diabetes mellitus’ ‘overweight and obesity’, Primary Health Care (PHC), Re-engineering Primary Health Care (PHC), preconception and interconception care, lifestyle change and non-communicable disease, and active lifestyle. The search was limited to literature between 2013 and 2017 and to papers published in English. Furthermore, the researcher focused on the review of literature related to pre-diabetes, the prevalence of diabetes mellitus, predisposing factors and complications of diabetes mellitus.

2.2 Diabetes mellitus

Diabetes mellitus is said to be a chronic metabolic disorder whereby there is a defect in insulin secretion or action of insulin is reduced or completely blocked(SEMDSA Guideline Committee, 2017). Diabetes is caused by either restriction in the secretion of enough insulin from the pancreas or the cells of the body not responding properly to the insulin produced (International Diabetes Federation, 2017; Pradeep & Haranath,2014). Cerf (2013) argues that beta cell dysfunction is mostly attributed to the development of type 2 diabetes; however, this is compounded by insulin resistance. Furthermore, the relationship between beta cell dysfunction and insulin resistance is said to be a complicated one. The beginning of hyperglycemia can be triggered by both beta cell dysfunction and insulin resistance.

Beta-cell dysfunction is more severe than insulin resistance. With beta cell dysfunction, insulin secretions are impaired, while with insulin resistance, insulin may still be secreted but insulin insensitivity is found in target tissues cells. As beta cell

dysfunction and insulin resistance progress, hyperglycemia increases leading to to type 2 diabetes (Cerf 2013). The spread and development of diabetes has concurrently been promoted by social and cultural beliefs according to Okop *et al*, (2016) in South Africa, where for instance commonly, women are required (by culture) to be overweight. Okop *et al*, (2016), in a study entitled “perceptions of body size, obesity threat and the willingness to lose weight among black South African adults, found that, in accordance to the culture, women are expected to have large bodies to be respected.

Furthermore, the ageing population has contributed to the increasing burden of diabetes. Adeniyi, Longo-Mbenza and Ter Goon (2015) also noted ageing as contributing factor to the prevalence of type 2 diabetes in South Africa. The reason for the increase is that, as a person ages, the pancreas ability to produce insulin reduces and hence elevated blood sugar and subsequent diabetes (Cerf, 2013). Urbanization and dietary changes have also been implicated in an increase of diabetic prevalence. Urbanization came with an increase in processed and fast food consumption. This has led to the consumption of diet with high fat and sugar content which leads to increased BMI that is directly linked to diabetes. In urban areas also, there is reduced physical activity; hence, people have adopted a more sedentary lifestyle. This, lifestyle leads to obesity because people are not burning fat and sugar that has been consumed (International Diabetes Federation, 2017).

The literature shows that diabetes has various complications that affect the quality of life and the survival of mother and the foetus/and or the baby. The high blood sugar leads to frequent urination, increased thirst, sore that takes too long to heal, and increased hunger (International Diabetes Federation, 2017).
Early diagnosis done in primary health care during screening is vital for management, control, and prevention of diabetes complications. Diabtes pregnancy complications such as ‘big baby’ include shoulder dystocia, birth trauma for mother and the baby, and intrauterine death that is as a result of fast dropping of blood sugars (Lassi *et al.*, 2014 ; Macaulay, Dunger & Norris, 2014).

Primary health care in many countries just as in South Africa is seen as the backbone of health care system (Naledi, Barron & Schneider, 2011). Health promotion and health education are key in reducing the burden of disease caused by diabetes (Nojilana *et al.*, 2016). Moreover, with an effective primary health care with programs such as preconception care / interconception care for women of childbearing age can make a huge difference in identifying women at risk of developing diabetes and thus modifying those risks for a better outcome of pregnancy (Berglund & Lindmark, 2016). It is imperative therefore that women of childbearing age are exposed to these programmes to minimize the occurrence of conditions related to sedentary lifestyle.

2.3 Epidemiology of diabetes

2.3.1 Diabetes prevalence

International Diabetic Federation (IDF) (2013) estimated that 382 million people were living with diabetes. Further, International Diabetes Federation (2017) reported that 424.9 million people between 20-79 years (8.8%) in the world are living with diabetes. Notably, diabetes is estimated to increase to 628.6 million (9.9%) in 2045. This estimation is linked to lifestyle such as diet and inactivity, and the increase in obesity (International Diabetes Federation, 2017; SEMDSA Guideline Committee, 2017) From the above statistics, it clear that diabetes is on the rise all over the world and countries are struggling to manage it. The International Diabetes Federation, (2017) reported that diabetes is no longer the disease for rich as people used to know.

This assertion was supported by the findings from International Diabetes Federation, (2017) report in Africa which revealed that about 16 million people between ages of 20 -79 years are diabetic, where this number is estimated to increase to 41 million by 2045 (156% increase).

African countries are considered are mostly rural in nature, hence the demystifying notion that the disease is for the urban rich. International Diabetes Federation, (2017) further notes that, African countries are experiencing rapid transitions (sedentary life style) that are bringing previously unheard rates of obesity and diabetes to the rural communities. Therefore, developing countries are facing a 'firestorm' of ill health with inadequate resources to protect their population. In the same manner, South Africa was ranked fifth in the African region for the prevalence of diabetes (Muchiri, Gericke & Rheeder, 2016). This is similar to what Mash *et al.* (2014) noted as the highest recorded prevalence in urbanized communities in South Africa was in Cape Town, with a prevalence of 28%.

The worldwide proportion of live births affected by diabetes is 16.2% which translates to 21.3 million live births. About 86.4% are GDM cases, with 7.4% due to other types (1 or 2) detected for the first time in pregnancy. Hyperglycaemia in pregnancy increases with age, with 20-24 years at 9.8%, 25-29 years at 14.2%, 30-34 years at 20.3%, 35-39 years at 28.0%, and 40-44 years at 36.4% and lastly 45-49 years 45.4% (International Diabetes Federation, 2017). In the African region diabetes also affects women of childbearing age and complicates pregnancy outcomes.

In Africa, hyperglycaemia in pregnancy is estimated to be 9.5% (affecting 3.4 million of live births) (International Diabetes Federation, 2017). Hyperglycaemia in pregnancy is linked to complications that pose a health threat for the mother, the foetus and the neonate. Hence, SEMDSA Guideline Committee (2017) recommends preconception care to those with diabetes, but the guidelines fail to advice preconception care for those at risk of diabetes so as to intervene prior to pregnancy to reduce or prevent GDM and or T2DM.

2.3.2 Mortality

Nojilana *et al* (2016) in their study found that, although there is a decline in mortality caused by some non-communicable disease (NCDs) such as cardiovascular disease, diabetes mortality is on the rise. Nojilana *et al.* (2016), further reported that

in South Africa between 1997-2010 there was an emerging trend in non-communicable disease mortality in the country with approximately 594 071 deaths in 2010, and 38.9% were due to NCDs. Diabetes mellitus accounted for about 8% of the 38.9% of the mortality percentage due to NCD's. This increase in diabetes mortality is also related to increases in overweight and obesity observed in national surveys, urbanization, and the observation that diabetes mellitus has increased rapidly in all age groups in urban settings. Furthermore, in a similar study done by Pillay-van Wyk *et al.*, 2016) titled Mortality trends and differentials in South Africa from 1997 to 2012', diabetes mellitus is ranked the second in National Burden of Disease Study.

2.4 Diabetes classification

The three main types of diabetes are: type 1 diabetes, type 2 diabetes, and gestational diabetes which occur when the body cannot produce enough of the hormone insulin or cannot use insulin effectively. Insulin acts as a key that lets the body's cells take in glucose and use it as energy. In this study, the focus is on type 2 diabetes and gestational diabetes. In both instances International Diabetes Federation, (2017) state that pathology in type 2 diabetic individuals, body has insulin, but for one reason or the other, the blood glucose levels are high.

According to International Diabetes Federation, (2017) type 2 diabetes has the following pathophysiology that occurs in two ways. Firstly, there is little insulin being produced as compared to the glucose in the system. This is because of a defective pancreas; and islets of Langerhans that are not producing enough insulin. This form of type 2 diabetes is associated with genetics, poor lifestyle and ageing.
Secondly, there is adequate insulin, but the action of insulin is blocked, and the glucose is not utilised by the cells to make energy as it is supposed to be. This is mostly associated with fat/adipose tissue especially around the abdominal area. Hence, there is a link between increased waist circumference and type 2 diabetes.

2.5 Diagnosis of diabetes mellitus

To diagnose diabetes, blood sugar levels are considered, with clinical manifestations reported by the patient. The Society for Endocrinology, Metabolism and Diabetes in South Africa (2017) has the following criteria for the diagnosis of type 2 diabetes:

Table 2.1: Diagnostic tests and values in type 2 diabetes

Glucose Test			
Fasting plasma glucose (FPG) (mmol/L)	<5.6 Diabetes excluded	6.0 6.9 Impaired fasting glucose	≥ 7.0 Diabetes
2hr-plasma glucose (2-hr PG) (mmol/L)	<7.8 Normal glucose tolerance	7–11.0 Impaired glucose tolerance	≥ 11.1 Diabetes
Glycated haemoglobin A1c (HbA1c) (%)	<6.5 Inconclusive		≥ 6.5 Diabetes
Random plasma glucose (RPG) (mmol/L)	<5.6 Diabetes excluded	5.6-11.0 Inconclusive	≥ 11.1 Diabetes

However the values for diagnosis in gestational diabetes are not exactly the same, (SEMDSA Guideline Committee, 2017). The following table shows the values for gestational diabetes.

Table 2.2: Diagnostic tests and values in gestational diabetes versus overt diabetes

Glucose Test	Gestational diabetes	Diabetes mellitus in pregnancy /overt diabetes
Fasting plasma glucose (FPG)	≥ 5.1- 6.9 mmol/l	≥ 7.0 mmol/l; or
One-hour post-glucose load (75 g) plasma glucose	≥ 10.0 mmol/l	Not applicable
Two hours post-glucose load (75 g) plasma glucose	≥ 8.5-11 mmol/l	≥ 11.1 mmol/l

Sellers (2009), Fraser, Cooper, and Nolte (2009), and Macaulay, Dunger, and Norris (2014) agree that pregnancy is a diabetic viable state of body. The diabetic state is caused by pregnancy hormones oestrogen, progesterone and human placental lactogen. The hormones cause resistance to insulin in the maternal tissue. The diabetic genetic state is to ensure that more glucose is readily available for the growing foetus. However, the diagnosis of gestational diabetes can be made after 24-28 weeks of pregnancy. Any elevated glucose levels before 24 weeks of gestational age have been considered chronic undiagnosed diabetes (American Diabetes Association, 2015).

Certain factors including having a family history of diabetes, being over 25 years of age, being overweight and obese (BMI of above 25 kg/m2), belonging to an ethnic group (African American, Hispanic, Indian) and having previously given birth to a baby weighing 4 kg or more (macrosomia), put women at greater risk of developing GDM (Macaulay et al, 2014). Gestational diabetes though after delivery, blood glucose levels normalizes for some patients, some are not as lucky and will be diabetic even after delivery.

It is estimated that 95% of GDM cases of maternal glucose metabolism returns to normal postnatal (Macaulay *et al.*, 2014). However, for some of the patients, though blood glucose levels return to normal after giving birth, they will later become diabetic. Furthermore, an investigation into the long-term effects of poor maternal glucose metabolism on the unborn baby has revealed that offspring born to mothers with GDM are susceptible to IGT and obesity. With these evidences provided in the literature, it would be important to identify pregnant women at risk for GDM so that prevention management such as lifestyle modifications can be implemented.

2.6 Pre-diabetes

Pre-diabetes is defined as a state where blood sugar levels are high, but not high enough to diagnose diabetes. Without intervention, about 5–10% of people per year with pre-diabetes will progress to diabetes (Grundy, 2012). Pre-diabetes is on the rise worldwide like diabetes International Diabetes Federation, (2017). Researchers such as Grundy (2012) have projected that more than 470 million people will have pre-diabetes by 2030. (International Diabetes Federation, 2017) also has the similar prediction that IGT is to rise from 352.1 million in 2017 to 531.6 million in 2045. Pre-diabetes can be identified as either impaired fasting glucose (IFG) or impaired glucose tolerance (IGT). Both IFG and IGT are risk factors for type 2 diabetes, and risk is even greater when IFG and IGT occur together.

Furthermore, there is link between obesity, pre-diabetes and diabetes; because an increase in adipose tissue results in elevations of circulating free fatty acids (FFA). An increase in FFA induces insulin resistance (IR) in muscle, which contributes to an elevation of plasma glucose (Cerf, 2013). Pre-diabetes is associated with the simultaneous presence of insulin resistance and β-cell dysfunction abnormalities that start before glucose changes are detectable (Grundy, 2012; ATLAS 2013) state that most people at the point of diagnosis of diabetes would already have complications because of pre-diabetes. Subsequently, more interventions are needed at pre-diabetes stage, to prevent and or delay the onset of diabetes and its complications. Lifestyle modification such as diet and exercise are found to be valuable in

preventing or delaying the onset of diabetes by 31%-58% in diabetic prevention studies reported in the SEMDSA Guideline Committee (2017).

2.7 Predisposing factors to the development of type 2 diabetes

SEMDSA Guideline Committee, (2017) state that high-risk individuals are adults that have one or more of the following; body mass index ((BMI) ≥ 25 kg/m^2 that indicate overweight or obese), one or more additional risk factors, namely physical inactivity, hypertension [blood pressure (BP) ≥ 140/90 mmHg]. Also, family history of diabetes especially a first degree relative, medical history of high cholesterol. SEMDSA guideline Committee also reports that high-risk ethnic group like those of South Asian descent are at a greater risk of type 2 diabetes. Other factors to consider when screening for diabetic risk are cardiovascular disease history, gestational diabetes or baby weighing > 4 kg; and previous impaired fasting glucose.

2.8 Complications of type 2 diabetes

The complications of type 2 diabetes mellitus are cardiovascular disease, including ischemic heart disease and stroke; lower limb amputations, and increased rates of hospitalizations. In the developed world, type 2 diabetes is the largest cause of non-traumatic blindness and kidney failure.

Moreover, pregnancies affected by type 2 diabetes mellitus pose a risk for invasive procedures such as the need for caesarean sections due to foetal macrosomia (Sellers, 2009). The macrosomia occurs because of accelerated foetal growth caused by maternal hyperglycaemia. In addition, forceps deliveries and birth trauma caused by shoulder dystocia due to a big baby are also some of complications associated with diabetes. From these complications, there are increased incidences of foetal death due to uncontrolled diabetes.

There are also reports of congenital abnormalities and polyhydramnios that can cause complications such as placental abruption and preterm labour (Sellers, 2009; Cronje & Grobler, 2008).

2.9 Clinical features of type 2 diabetes

The symptoms of DM type-2 are; polyuria (frequent urination), polydipsia (increased thirst), polyphagia (increased hunger) and weight loss. Other symptoms commonly include visual disturbances, itchiness, peripheral neuropathy, recurrent vaginal infections and fatigue (International Diabetes Federation, 2017). Other symptoms are: dry mouth, nausea and sometimes vomiting, numbness or tingling of the hands or feet, frequent infections of the skin, urinary tract, or vagina sores that are slow to heal also appear (Pradeep & Haranath, 2014).

2.10 Primary health care

Dookie and Singh, (2012) suggest that Primary health care (PHC) is impactful to the needs of individuals, families and populations through a comprehensive, inter-sectoral approach that focuses on communities as the unit of intervention. Intersectoral approach means the governmental sectors teaming up to fight the social determinants of ill health. Moreover, a comprehensive primary care using strategies of the primary health care approach could focus on integrated health care delivery, where individuals and communities are managed holistically (Dookie &Singh, 2012). One of the unhealthy dietary practices the whole world is facing now is obesity. Obesity is closely linked to development of T2DM and or GDM in women of childbearing age. Therefore, intervention strategies addressing overweight and obesity are crucial to reduce the prevalence and complications associated with T2DM and or GDM (Okop *et al.*, 2016).

2.10.1 Primary health care re-engineering in South Africa

In 2010, Re-engineering of PHC in South Africa was introduced. This was because despite the interventions that were being undertaken in primary health care, the health outcomes were poor. This strategy was then constructed around a three-pronged approach to achieving a population-based family health programme (Naledi, Barron & Schneider, 2011). The focus of the reengineered health care programme is

the health promotion and prevention. This gave rise to the streams that form the backbone of the PHC Re-Engineering Strategy, namely: Ward-based PHC Outreach Teams (WBOTs), School Health Teams, and District Clinical Specialist Teams (Naledi *et al.,* 2011).

The guideline for Ward-Based Outreach Teams recommended for a team comprising of six community health workers (CHWs), a professional nurse (as team leader) and one environmental health and health promotion practitioner, whom are all linked to a PHC clinic. The purpose of the multisector team was enhance to working together to promote health and prevent disease through a variety of interventions based on the concept of a healthy individual, a healthy family, a healthy community, and a healthy environment (Moosa, Derese & Peersman, 2017).

The RPHC strategy was basically taking health and PHC /clinic to the people in their homes using community health care workers. Similar approaches have proved to work in countries such as Brazil and Thailand. The Brazilian Family Health Programme (FHP) assigned the team consisting of a doctor, nurse, nurse assistant and community health workers to a population of 3500. The team was responsible for population health, as well as providing PHC services and making necessary referrals to other levels of care. The FHP was credited for significant declines in infant mortality rates over 12 years (Naledi, Barron, & Schneider, 2011).

This study is reinforcement of what was already in place such as screening for high-risk type 2 diabetic women of childbearing age during preconception at primary health care. After screening, then implementing interventions such as lifestyle modification to delay or prevent the development of T2DM and or GDM is undertaken.

2.11 Preconception and inter-conception care and type 2 diabetes prevention

Preconception care refers to the care provided to women and her spouse before pregnancy. In this study, women and couples of reproductive ages were noted to be

unaware of their own health conditions, and how these conditions and health-related behaviours may affect the foetus during pregnancy. Conducting a test to determine conditions and health history that can aid in addressing health issues before conception is of significance important to the live of the child. Health education and promotion of health are key activities in preconception program (Dean *et al*., 2013). Furthermore, Draper *et al*. (2014) argued that many adolescent girls and women in low and middle-income countries (LMICs) do not have access to preconception care. There has been a call to broaden the reach of current preconception interventions, particularly those that are cost-effective for the low and middle-income countries.

Additionally, the results of the first (Shisana *et al.*, 2014), reported the combined prevalence of overweight and obesity in women (15 years and older) at 65%. The high level of female overweight and obesity has serious implications for the intergenerational transfer of metabolic disease risk, particularly regarding altered maternal glucose metabolism during pregnancy and the related consequences for the infant. High maternal body mass index (BMI) and gestational diabetes mellitus (GDM) are independent risk factors for perinatal complications, and GDM has been independently been associated with an increased risk of neonatal morbidities. That means that children of mothers who had GDM during pregnancy are also at increased risk for obesity and T2D later in their lives (Draper *et al*., 2014).

2.12 Lifestyle modification

The Finnish Diabetes Prevention Study and the Diabetes Prevention Program (DPP) in the USA showed that, lifestyle change can significantly reduce the risk for development of type 2 DM by 58% in individuals with Impaired Glucose Tolerance Test (IGTT) and demonstrated that, modest weight change and achievable physical activity goals can translate into significant risk reduction. The Indian Diabetes Prevention Programme (IDPP) showed that progression to DM from Impaired Glucose Tolerance (IGT) can be prevented by 28.5% with Life-Style Modification (LSM) and 26.4% with metformin (MET) in individuals who were younger, leaner, and more insulin resistant as compared with the IDPP control group. However, there

was no added benefit from combining LSM + MET (28.2%) (Mohan, Seedat & Pradeepa, 2013).

2.13 Conclusion

The literature review found that the prevalence of diabetes is a worldwide problem. Remarkably, the escalating rates of diabetes and its prevalence is not only among the rich as it was previous believed, but also among the poor in rural communities. The prevalence of diabetes in rural communities is attributed to the increased westernized lifestyle and cultural beliefs. Among other segment of the population at risk of diabetes, women of childbearing age are at higher risk as their increase in weight causes them to be obese, factors which are closely linked to development to T2DM.

Therefore, there is need to conduct community screening and conduct intervention on the high-risk individuals; because previous studies have shown diabetic intervention can be successful. The review of literature has also shown that primary health care is based on health promotion and health prevention; hence it is the best model for the country to utilize in reaching the communities. The new RPHC views community health workers as health care delivery vehicles (taking health care services to the people). Literature advises a shift of duties, where CHW are equipped with skills and knowledge to conduct health screenings and to conduct health education and promotions.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter focused on a literature review related to diabetes mellitus issues such as diabetes prevalence, mortality, and diabetes classification, and pre-diabetes. This chapter focuses on the research design and methods used in the study. The study followed the quantitative intervention research design as discussed in the subsequent headings.

3.2 Research design

Research design forms the “blueprint” of the study and determines the methodology to be used by the researcher to obtain the information needed for answer or solve the research problem. It further determines on other elements such as participants, unit analysis and interpretation of the results (Grove, Burns, & Gray, 2013). Brink, Walt and Rensburg, (2016) on the other hand indicated that research design is a set of logical steps taken by the researcher to answer the research question, or in this case, prove or disprove the null hypothesis of the study.

This study adopted quantitative approach and an intervention study design. The researcher employed the parallel group randomized control trials (RCTs) to gather the necessary data to develop an intervention model. This two-group randomized control trial study used pre-test/post-test design and structurally equivalent comparison groups (Grove, Burns & Gray, 2013). The rationale for this design was the fact that, an intervention research takes place in field settings and requires an understanding of social meanings and social processes (Grove *et al*, 2013). This design has been found to be the most rigorous way of determining whether a cause-effect relationship exists between intervention and outcome (Brink *et al,* 2016) . Furthermore, it assesses the effectiveness of an intervention, as the null hypothesis of the study state that, exercise and diet will not reduce the chances of developing type 2 diabetes in high-risk individuals.

3.2.1 Quantitative research

Quantitative research is the investigation of phenomena with precise measurement and quantification, often involving a rigorous and controlled design (Pilot & Beck, 2017). This formal, objective, systemic study process is used to describe and test relationships among variables (Grove *et al*, 2013). Pilot *at al* (2017) argue that, basic distinction in quantitative studies is between experimental and non-experimental research. Moreover, in experimental research (also known in medical term as a clinical trial), the researcher purposefully introduces an intervention so as to answer therapy questions. There is also non-experimental research (also known in medicine as observational). With this kind of research, the researcher collects data without intervening.

3.2.2 Intervention study design

Grove *et al* (2013) states that an intervention design is helpful in verifying the efficacy, effectiveness, and efficiency of interventions that are beneficial to the health and well-being of patients. This design is preferred in nursing and in the medical field as it develops evidence-based nursing practice. Furthermore, this design investigates the effectiveness of a nursing intervention and achievement of the desired outcome in a natural setting (Grove *et al*, 2013). This study sought to identify women of childbearing age with predisposing factors of type 2 diabetes, in order to intervene, using a lifestyle modification to delay and prevent the occurrence of type 2 diabetes. This is significant to the reduction of mortalities and morbidities caused by type 2 diabetes in the natural setting, that is, the community in which the pregnant women live in. The intervention was carried using two groups, one controlled and the other was experimental. These two groups were compared during analysis.

Furthermore, the researcher utilized randomized control trial (RTC). Grove *et al*, (2013) note that RTC offers a high degree of scientific rigor in determining the effectiveness if the comparison group includes a control group receiving no treatment, as it was in this study. The study used the two-group randomized control trial with pretest/posttest design and structurally equivalent comparison groups. This

study design offers the researcher an oppurtunity to experiment whether or not intervention changing lifestyle (diet and exercise) reduces or delays the onset of diabetes in women of childbearing age.

3.3 Study setting

A setting is a physical location where the study is conducted and conditions in which data collection takes place in a study (Grove *et al*, 2013). The setting used in this study was the areas served by Peddie town, within the 5-km radius of Peddie Extension Clinic catchment area in Amahlathi sub-district, Amathole District, Eastern Cape, South Africa. The researcher visited participants in their homes with the help of the community healthcare workers.

3.4 Study population

Grove *et al*, (2013) and De vos *et al* (2011) view a study population as a group of individuals who meet the sample criteria for inclusion in a study. The population of this study was women of childbearing age (18-45 years) in the Peddie Extension, Amahlathi sub-district, Amathole Health District. The study targeted the population of women of childbearing age who were at high risk of type 2 diabetes. The table below presents the inclusion and exclusion creitria used in recruiting the study participants.

Table 3.1 Inclusion and Exclusion criteria.

The following inclusion criteria was applied	The following exclusion criteria was applied
Women of childbearing age who are: ✓ 18 – 45 years' old ✓ Staying in Peddie ✓ If pregnant below 24 weeks' gestation	Women: ✓ who are mental handicap – not able to consent ✓ whom exercise may pose danger ✓ Women who are already diabetic

3.5 Sampling

This refers to the researcher's process of selecting the sample from a population in order to obtain information regarding a phenomenon in a way that represents the population of interest (Brink *et al*, 2016). In this study, random sampling method was used to select the participants. The researcher controls the sampling process but not the individuals selected. In the end, whether an individual is selected or not is determined purely by chance and not by choice of the researcher (Joubert, *et al,* 2010). Grove *et al*, (2013) suggested many ways to achieve random selection. The most common of these is the use of a computer, which can be programmed to select a sample randomly from the sampling frame. Probability simple random sampling was used in this study using PASS 13 software after getting the sample size. In a random sample, each person in the population has the same known probability to be representatively selected which permits the researcher to compute an estimate of the accuracy of the sample even before the study is done (Delport, *et al* 2012).

Sample framework of low-risk pregnant women

Polit *et al*, (2014) perceive the sampling frame as the list of elements in the population from which the sample will be chosen. The sampling frame in the study was all the households registered by the CHW of women between 18-45 years of age, and served by Peddie Extension clinic Amahlathi health District in the Eastern Cape where re-engineering health care programme is being implemented.

3.6 Randomisation

In this study randomisation is the random selection or allocation of childbearing age women and pregnant women (participants) to take part in the study. Randomization was used in this study to balance the experimental and control groups and to avoid bias (Polit *el at*, 2014). Random sampling was used through research randomizer computer software set. The research randomizer calculated the number of participants for the experimental group and the control group which gave the researcher 73 participants for the control group and 73 for the experimental group. To allow for participates that would drop out in the sample size the researcher added 12 participants.

3.7 Sampling process and sample size

This refers to the researchers' process of selecting the sample from the entire population in order to obtain information regarding a phenomenon in a way that represents the population of interests. The study conducted in Cape Town by Erasmus *et al* (2012), on prevalence was used in this study to calculate the sample size with a confidence level of 95%. There researcher in the study use the Epi-info software, the number of participants needed for this study was generated, which was 146. These participants were divided into two equal groups. One group was an experimental or intervention group, and the second was the control group.

The software needed a number of participants (that was 178) and how many groups to create (that was 2). This gave the researcher a unique number set for each group, and researcher rechecked that there was no duplication of the numbers, (where one number was appearing on both groups).

3.8 Data collection

Grove *et al*, (2013) indicated that data collection is the process of gathering information from the participants. This intervention study was carried out in Peddie Town, ward 10 Amatole District. The researcher was assisted by six CHW employed

at Peddie Extension Clinic as this Clinic was a pilot site for RPHC, these CHW were already working within the community. The CHW were trained on how to use the data collecting tool, how to use the scale (to measure weight and height). These CHW were also were trained on how to use tape measure to do waist circumference and lastly CHW were trained on how to use the Blood Pressure machine. The researcher did the finger pricking herself for random blood glucose test. During the intervention of diet and physical activity to the participants, a lay coach and a dietician assisted in training of the participants. The researcher also trained the CHW for 10 days on how to collect the data. Data was collected over a period of 3 months and the intervention was also implemented over a period of 3 months.

3.9 Data collection instrument

A self-administered questionnaire adapted from The Finnish Diabetes Risk Score was used for screening of high-risk type 2 diabetes (Saaristo, Peltonen, Lindström, Saarikoski, Sundvall, Eriksson and Tuomilehto, 2005). The adapted questionnaire covered the demographic profile of the participants, and other measures such as weight and height for BMI, waist circumference (except pregnant women), and random blood glucose levels, family history of diabetes, dietary profile and a number of pregnancies. The questionnaire had 15 closed questions. The adapted questionnaire was piloted to test for face validity among 12 of women who met the inclusion criteria.

The community health workers assisted in the filling of the diabetic screening tool/questionnaires. This baseline data helped to assess each participants' risk of developing diabetes mellitus. The finger prick blood glucose was also done (by the reasecher) to screen for undiagnosed diabetes or pre-diabetes. Those diagnosed during the screening were then excluded from the study. For those who had increased blood glucose levels were referred to Peddie Extension Clinic for further management. Unfortunately, due to limited funding for the study from the university, the researcher was not able to conduct a more conclusive test to diagnosis diabetes

such as FBG and GTT. Hence, the referral to the clinic was done for those found to have finger prick glucose of more than 6,9 mmol/L.

After the recruitment, posters were put up around the community of Peddie to inform more people about the study. The idea was to get more women of child bearing age to be screened for eligible clients for the study. The researcher involved the dietician from Nompumelelo Hospital (having requested permission from the CEO of the hospital) to give health education on diabetes (what is diabetes, who is at risk, the signs and symptoms, the complication,the prevention and management of diabetes). The reseacher also talked about diabetes using the diabetic map used in Peddie Extension clinic to health educate on diabetes, this was used as a visual aid as it shows images and maps ups the topics the statistician talked about.

3.10 Intervention

Intervention design is putting more emphasis on testing and implementing diet and physical activity (Polit *et al*, 2014). The intervention was more focused on the implementation of treatment to the experimental group, while control group was given the standard care. The intervention in this study was to test the diet and physical activity on women of childbearing age and pregnant women below 24 weeks' gestation.

The services of a dietician were used for the purpose of relevent health education on foods preparation and consumption. The purpose of the intervention was to improve people's lives and promote behavioral changes in real life settings, using evidence-based practice. Therefore, the researcher was interested in encouraging the adoption of a healthy lifestyle among women of childbearing age and those women who were pregnant.

3.10.1 Intervention process

The control and intervention/experimental group were given the same health education during recruitment. A lay person (someone who is not a professional personal trainer) from the community was selected, the cost of a professional personal trainer was expensive and the reseacher could not afford. Venditti et al ., (2014) used a similar methods and tearned them as lifestyle coaches. Furthermore Venditti et al (2014) advocates for the use of lay lifestyle coaches as a cost effective measure for a bahavioural change in diabetes prevention. She was chosen on basis that she was already involved in sporting activities such as netball and she was the captain. In the absense of the coach she would lead the training session which at times included running and earobic sessions. She was then given a training course on physical activity and exercise for training people on how to prevent injuries and fainting during exercises, the different types of earobics she can use such as the steps. The training took a period of two weeks by the facilitator of a well-established gym in East London. The training involved different effective exercises for weight loss and how to guide participants during training to prevent injuries and people fainting. A contract was signed between her and the researcher to conduct exercise classes for the intervention/experimental group for 3 months.

Subsequently, monthly weighing was done for participants in experimental/intervention group. The participants in the control group were weighed at the beginning and end of the study. The variables that were most important to the study was weight and waist circumference reduction with exercise and diet.

3.11 Validity

Validity is a way to determine if data collecting instrument accurately measures what it is supposed to measure, given the context in which the instrument is applied (Brink *et al*, 2016). In this study, the instruments were the glucometer, the scale, and tape measure. Content validity is an assessment of how the instrument represents all the components of the variable to be measured. Moreover when one component

is neglected, the researcher cannot claim to be measuring whatever the research is interested in. This type of validity was used in the development of the questionnaire (Brink *et al*, 2016). Content validity was also used in this study to take medical and family history of the research subjects. The researcher introduced the experimental situation to eliminate threats to validity. One way of controlling was using the control group that had been assigned through the process of randomization.

Content and face validity pertains to the instruments that were used in the research. The questionnaire was adapted from the Finnish type 2 diabetes risk assessment form. The form was developed by DEHKO project by the National Public health Institute in Finland in 2001. The tool was proven to be valid by Saaristo *et al*, (2005). In 2005, they concluded that the sensitivity cut off risk score of 11 to identify undiagnosed diabetes was 66% in men and 70% in women; and the corresponding false-positive rates were 31% and 39%, respectively.
They also recommended that the Finnish Diabetes Risk Score can be used as a self-administered test to screen participants at high risk for type 2 diabetes. Further, it can also be used in the general population and clinical practice to identify undetected type 2 diabetes.

Other instruments that were used include blood glucose machine, weight scale which were carefully calibrated. In addition, a tape measure which doesn't need to be calibrated was used.

Statistical conclusion validity: literature has proven repeatedly that there exists a relationship between predisposing factors of diabetes such as diet and exercise, high BMI, high waist circumference, higher blood glucose levels (insulin resistance) and development of type 2 diabetes.

Internal validity: the relationship between exercise with healthy diet and T2DM and or GDM is causal. It has been proven that following a healthy lifestyle (diet and

exercise) chances of T2DM and or GDM are greatly reduced (Society for Endocrinology, Metabolism, and Diabetes in South Africa, 2017).

Construct validity: the cause and effects construct involved sedentary lifestyle predisposes women of childbearing age to type 2 diabetes. PHC re-engineering is all about promoting health and preventing illness through health education and screening. These will make people health conscious and encourage early screening for early management. All these effort are geared towards reduction of the complications brought by the disease.

External validity: though type 2 diabetes, prevalence differs across ethnicity and class, lifestyle (exercise and diet), higher BMI, higher waist circumference, higher/elevated blood glucose, family history are still the general causes and triggering factors to developing type 2 diabetes.

3.12 Reliability

According to Grove *et al*, (2013), reliability is the consistency of the measurements obtained from an attribute, item, or situation in a study or clinical practice. The researcher used the questionnaires in the pre-test that showed its ability to give same results when used repeatedly, thus determining its reliability. Brink *et al.* (2016) showed that an instrument should accurately measure what is supposed to measure; given the context in which it is applied. In this study, the pilot study was used to test the questionnaire for reliability and validity. The questionnaire was also given to experts to confirm face, content and criterion validity.

3.13 Pilot study

A pilot study is a smaller version of proposed study which is conducted to refine the measuring instrument (Grove *et al*, 2013). The pilot study was conducted under similar conditions of the actual study. The questionnaire was used in a smaller group of participants to check the weakness and vagueness. The researcher managed to obtain 15 participants who participated in the pilot study. The aim of the pilot study

was to show the feasibility and flaws of the study and eliminate any form of errors from the questionnaire.

3.13.1 The results of the pilot study

The pilot was done in the month of June 2015 for one month only. The researcher was able to obtain 15 participants who were recruited with the help of the community healthcare workers of Peddie Extension clinic through their door to door health promotion, prevention and rehabilitation in the RPHC programme in Peddie community. Health care workers invited the members of the community to the campaigns, and the recruitment was done by the researcher while educating the participants about type 2 diabetes and how to prevent or delay the onset.

The inclusion and exclusion criteria were assessed and 15 participants were obtained. The participants were randomly assigned to either control or treatment group. The data collecting tool was administered to both control and treatment group, information was read to the participant by community health workers and the researcher. Baseline weight, height, BMI, waist circumference were recorded.

The experimental group agreed and arranged to meet from Monday to Thursday at Ncumisa Nkondlo hall for aerobic classes and jogging from time to time. Initially, the aerobics were favored as similar research on weight loss was concucted by Daniel, Dikki and Ibrahim (2014) a topic titled; ‘Aerobic dance exercise improves blood glucose level in pregnant women with gestational diabetes mellitus’. The plan was to acquire aerobic steps for the treatment group to use. This failed because of finances. The second option was to use an aerobic video by Shaun T: Hip Hop Abs. The exercises was done for 45 min to an hour.

The layperson who was selected from the community would lead the classes and motivate the participants. During the intervention, the experimental group lost three members due to some personal problems and could not make it to the training sessions. At the end of the pilot period, both groups (experimental and control), were

called back for end results of the intervention. In the experimental groups, 5 out of 8 participants were exercising and lost between 0.5-1.0 kg.

3.14 Data analysis

Data was analyzed using descriptive statistics computed to reveal characteristics of the sample data set. Descriptive statistics was crucial in understanding the fundamental elements of the variables being studied (Grove *et al*, 2013). The univariate descriptive (description of a single variable) statistics measures of frequency (prevalence and count) and extent (means-is the arithmetic average of all the values of a variable in a study) were used. Moreover, the measures of central tendency were used to present the data.

Standard deviation is a measure of dispersion, that is, the square root of the variance (Grove *et al*, 2013). The multivariate on the hand (factor analysis and principal components analysis-PCA- are statistical techniques designed to examine interrelationship among large numbers of variables to reduce them to a smaller set of variables and to identify cluster of variables that are most closely linked together (Grove *et al*, 2013). Relationships, difference, association, and independence (correlations and F-tests) were computed using SPSS programs. A P value of <0.05 was considered significant.
According to Brink *et al*, (2016) before analysis of data, the researcher must examine the data for completeness and accuracy.

3.15 Ethical considerations

Ethical consideration makes research to be humane, by making it caring, ensuring that research is for good of humanity (Peta, & van Tonder., 2009). Adhering to these principles and rights of participants and having bodies ensuring that researchers adhere to guidelines, ensures that research is useful and can add value to the body of knowledge. Peta *et al*, (2009) state that ethics in research is about doing what is right and good. Ethics in research focusses on the researcher strategies for taking care of the stakeholders of the research. The researcher adhered to the stipulated

research guides for this study, such as requesting permission, adhering to the principle of respect for person, beneficence, and principle of justic. Moreover the reseacher ensure that the human rights of participants in research are adhered to, these include a right to privacy, autonomy (self-determination) and confidentiality, right to fair treatment, right to protection and avoidance of discomfort and harm (Brink et al, 2016)

Permission: Letters requesting for ethical clearance were written to the prospective institutions and for the Department of Health. The study also followed the ethical principles as stipulated by the National Commission for the protection of human participants of biomedical and behavioral research.

The principle of Respect: The principle of respect for a person holds that the person has the right to self-determinant and the freedom to participate or not participate in research (Brink *et al*, 2016). The participants were treated as autonomous agents by informing them about a proposed study and allowing them to voluntarily choose to participate or not. In addition, the subjects have the right to withdraw from a study at any time without a penalty. In maintaining the right to self-determinant there was no coercion, covert data collection, and deception (Grove *et al*, 2013).

The principle of beneficence:This requires the researcher to do good and above all, do no harm. The principle of justice also holds that human subjects should be treated fairly. Therefore, in this study, the respected the rights according to Grove *et al*, (2013). No harm was being done on participants as the procedure was a minimally invasive and was done by a trained professional nurse. Moreover, the researcher was fair in the sense that all participants were treated equally, the random sampling from the sample frame and randomiser app ensured that no one was given special treatment. Fairness was done on group allocation, a computer application software was used to assign participants. This ensured that the researcher does not pick and choose who is in which group.

Right to fair treatment: is based on the principle of justice. The participants were treated with dignity and equally. In this study fairness was observed through on group allocation, a computer application software was used to assign participants. This ensured that the researcher did not pick and choose who to belong which group. By doing so, researcher was fair to all participants.

Right to Privacy: Privacy is an individual's right to determine the time, extent, and general circumstances under which personal information will be shared with or withheld from others. This information consists of one's attitude, beliefs, behaviors, opinion, and records. Privacy and confidentiality was ensured to the participants In this study the researcher ensured privacy by allocating case numbers to the participants, this was to ensure when the questionnaire is sent to statistician only case numbers are on it.

Right to Autonomy:On bases of the right to privacy, the research subject has the right to anonymity and the right to assume that the data collected will be kept confidential. Anonymity exists if the subject's identity cannot be linked, even by the researcher, with his or her individual responses.
In this study participants were informed of the right to autonomy; that is they can withdraw from the study if they felt they want to do so, without any penalties or treatment being withdrawn.

Confidentiality: confidentiality is the researcher's management of private information shared by a subject that must not be shared with others without the authorization of the subject. The names of the participants were translated into codes, so that the researcher would also not know them and these were be kept under lock and key**.** In this study, the participants were assigned case numbers and those case numbers were written on the data collecting tool.

Right to protection and from discomfort and harm: The researcher conducted the research and protected the subjects from discomfort and harm. The researcher

tried to bring balance of benefits with harm as possible. Discomfort and harm can be physiological, emotional, social, and economical in nature. In this study, the participant were explained that the only discomfort would be from a needle prick that was on testing random blood glucose of participants.

3.16 Conclusion.

The study used an intervention research design using quantitative research approach, and randomized controlled trial expereiments. This two-group randomized control trial was chosen as it provides evidence-based results applicable to practical situations. The intervention was done in a natural setting, hence it makes it practical to implement. The Peddie Extension Clinic had just implemented the RPHC. The population was women of childbearing age, the sample size was derived from a study done in Cape Town, which reported a prevalence of 28%,. The smaple size was comptuter generated which provided 176 participants. The participants were divided into two groups: the experimental group (with no intervention – comparison group), and the intervention group (would engage in exercise as means of losing weight).

The aim was to identify women of childbearing age with predisposing factors of type 2 diabetes, in order to intervene, using a lifestyle modification to delay and prevent the occurrence of type 2 diabetes. CHW assisted greatly by assisting participants in filling in the questionnaire. A lay gym instructor was identified and offered training to guide the exercise classes and collect data on weight that was the aim of the exercise. Reducing weight, thereby reducing BMI would translate to reducing chances of developing diabetes.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The previous chapter described the methodology followed in this study which was descriptive and experimental. This chapter covers data presentation analysis and interpretation. The data is organized, given meaning and the statistical significance. In addition, the researcher gives the clinical significance of the data and show the clinical importance of the findings. Inferential statistics was used and enabled the researcher to make meaning of the numbers, by reducing, summarising, organizing, manipulating, evaluating, interpreting and also communicating research findings (Grove *et al*, 2013).

The null hypothesis was used in this study to be proved or disproved. Another reason for choosing inferential statistics was to determine whether the difference that was found between two groups was the scientific difference or it was by chance that these differences exist (Brink *et al* , 2016; Grove *et al,* 2013).

4.2 Demographical information of Participants

The study participants were women of childbearing age, (18 to 45 years) only. The reason for choosing women of childbearing age was due to the likely complication in women of bearing age when eventually become pregnant. The complications of diabetes in pregnancy do not only affect the mother, but the baby as well. The women participants in this study had predisposing factors to type 2 diabetes, such as BMI above 25 kg/m2, family history of diabetes, living an inactive lifestyle.

The total number of participants for the study was 146 and was calculated using Epi Info with the prevalence of 28.2% (obtained from a research study by Erasmus *et al* (2012), conducted in Cape Town and Confidential level of 95%. However, to make up for the expected dropouts, the researcher enrolled 164 participants (added 18 more participants). The participants were randomly assigned into two groups, each comprising of 82 participants; this was accomplished using the randomizer computer

application. The mean weight, BMI, waist circumference, blood pressure readings were evenly distributed across experimental and control group.

Table 4.1: Age, height, Blood Pressure and weight of participants

Comparison of the two groups

Variable	Control (n=82)	Intervention (n=82)	Mann-Whitney Z	p-value
Weight	81.8	80.3	1.4	0.1739
Height	1.5	1.6	3.4	0.0007
Systolic BP	121.3	125.4	2.1	0.0327
Diastolic BP	73.7	75.9	1.3	0.1902
Weight loss	0.9	1.3	-3.7	0.0002

The results show that the treatment groups were significantly different in terms of height, systolic blood pressure and weight loss. The intervention group was significantly taller, had significantly higher systolic blood pressure and had a significantly higher weight loss compared to the control group. The height is used in calculation of body mass index (BMI). The intervention group being significantly taller would mean that participants of the same weight in the experimental group would have a lower BMI, compared to the experimental group.

However, Table 4.7 showing a comparison between the control group and the experimental group, shows that although the experimental group was taller, the experimental group weight (85.7kg), was more than the control group weight (81.8kg). As a result, the control group in Table 4.7 has a lower BMI of 33.7kg/m2, as compared to the experimental group of 34.3kg/m2. Both groups are obese class according to SEMDSA Guideline Committee (2017). Being obese is one of the factors resulting to the individual or group susceptible to T2DM and or GDM. However, pre-gravid overweight and obesity, and excessive weight gain during pregnancy, are associated with several adverse pregnancy outcomes for the mother

and the foetus (Pearson *et al.,* 2015). Lifestyle intervention therefore is needed in this group to reduce poor pregnancy outcomes due to T2DM and or GDM

Blood pressure is one of the variables that were looked at, this is because of the close linkage between diabetes and increased blood pressure readings. The (SEMDSA Guideline Committee, 2017) report people with BMI of above 25kg/m2 (as most of the participants in this study) coupled with BP above 140/90 mmHg, to be high risk. The presence of both diabetes and elevated blood pressure causes more organ damage. SEMDSA Guideline Committee, (2017) report that in lifestyle modification weight loss of 1.6-2.5 kg can reduce systolic BP by -4mmHg and diastolic BP 1.5 mmHg. However, participants in this study had normal BP readings (that is systolic BP of less than 140, and diastolic BP of less than 90) (SEMDSA Guideline Committee, 2017)

Table 4.2 Age distribution of participants.

Frequency Percent Row Pct Col Pct	Table of AGE by TRMT			
	AGE	TRMT		
		CONTROL	EXP	Total
	18-24yrs	12	11	23
		7.32	6.71	14.02
		52.17	47.83	
		14.63	13.41	
	25-30yrs	40	34	74
		24.39	20.73	45.12
		54.05	45.95	
		48.78	41.46	
	31-45yrs	30	37	67
		18.29	22.56	40.85
		44.78	55.22	
		36.59	45.12	
	Total	82	82	164
		50	50	100

The frequency distribution of age group, shows that 25-30 years group of the participants (n=74) was the highest, followed by the age group of 31-45 years (n=67). However, the age group of 18-24 years (n=23) was the lowest. Given the fact that risk of diabetes increases with age, this makes the 31-45 years group to be at higher risk, while that of 25-30 years somewhat medium risk and 18-24 years somewhat lower risk.

SEMDSA Guideline Committee (2017) and Mbanya *et al.* (2010) reported that ageing is regarded as a major contributor to the diabetes epidemic. Congruent to the ageing report by SEDMSA Guideline Committee (2017), findings of a study conducted in South Africa by Adeniyi, Longo-Mbenza and Ter Goon (2015). Furthermore, Carolan *et al.* (2012) in a study conducted in Australia found that, GDM is also associated with aging and therefore, concluded that GDM is associated with adverse maternal and infant outcomes for older age groups, and a considerably

increased risk of later acquiring T2DM. Carolan *et al*. (2012), suggested the important of exploring ways of preventing GDM.

Therefore, strategies for managing diabetes (T2DM and GDM) were put in place to manage GDM well during pregnancy using diet and exercise in order to reduce later the risk of developing type 2 diabetes. The current study aimed at testing the theory that lifestyle change (diet and exercise) will reduce weight, then BMI and reduce the risk of T2DM and GDM, in the South African context using community screening that can be implemented in the RPHC.

Table 4.3: Comparison of body measurements across age groups

Variable	Overall (n=164)	Under 25yrs (n=23)	26-35yrs (n=74)	Over 35yrs (n=67)	Kruskal-Wallis χ^2	p-value
Weight	83.7	72.2	82.7	88.9	15.9	0.0003
Height	1.6	1.6	1.6	1.6	6.7	0.0360
Systolic BP	123.3	116.0	121.8	127.6	12.1	0.0024
Diastolic BP	74.8	70.6	73.5	77.8	8.4	0.0152
Weight loss	1.3	1.0	1.2	1.4	3.4	0.1810

The average height, between the three age groups, was the same (1.6 m), while the weight was lower in under 25 years' where overall average weight was 72.2kg, giving a BMI of 28kg/m2. This means that this group is classified as overweight. For age group 26-35 years, the average weight was 82.7kg, and the BMI was 32kg/m2 making this group obese class 1. In the over 35 years age group, the average weight was 88.9kg, with a BMI of 35kg/m2, this group was obese class 2.

This clearly showed that weight gain increases with age and so does the BMI, which poses a higher risk to all the conditions related to overweight and obesity especially

T2DM. SEMDSA Guideline Committee (2017) states that aging is a risk factor for the development of diabetes. Marchi *et al.* (2015) conducted a systematic review of the literature on risks associated with obesity in pregnancy, for the mother and baby and concluded that obesity before or during pregnancy increases the rate of GDM and other pregnancy complications for both the mother and the child. It is therefore vital to intervene and change the behaviour of such women before they conceive or in their early pregnancy.

Elevated Blood pressure (BP more than 140/90mmHg) is one of the conditions associated with ageing as reported in SANHANES-1 by Shisana et al., 2014). In this study the mean blood pressure was observed to increase with in both systolic and diastolic blood pressure. However, the increase was not in the hypertension diagnostic rage (that is systolic of above 140 mmHg and diastolic of above 90 mmHg).

Table 4.4: Number of pregnancies

Variable	No Pregs (n=19)	1-2 Pregs (n=59)	3-4 Pregs (n=58)	Over 5 Pregs (n=28)	Kruskal-Wallis X^2	p-value
Weight	76.0	83.2	84.0	89.6	0.7	0.0645
Height	1.6	1.6	1.6	1.6	5.3	0.1518
Systolic BP	117.8	120.9	124.5	129.8	10.9	0.0123
Diastolic BP	71.3	72.3	76.6	78.9	10.7	0.0135
Weight loss	1.3	1.1	1.0	1.2	2.4	0.4980

The table above shows that n=19 participants had never been pregnant, and their average weight was 76.0kg, with BMI = 30kg/m2. Those with 1-2 pregnancies n=59, had average weight of 83.2kg and a BMI of 33kg/m2. Those in the group of 3-4 pregnancies n=58, the average weight was 84kg, and BMI of 33kg/m2. The group

that has had more than 5 pregnancies n=28, had average weight of 89.6kg and BMI of 35kg/m2.

The average height, as compared among the three age groups was the same (1.6 m), while the weight seems to be lower in under 25 years' where the average weight was 72.2kg, and a BMI of 28kg/m2. This means that this group is classified as overweight. For age group 26-35 years' average weight was 82.7kg, and the BMI was 32kg/m2 making this group obese class 1. In the over 35 years' age group average weight was 88.9kg, with a BMI of 35kg/m2, thus the group was obese class 2.

In this study increasing, BMI was associated with increasing number of pregnancies. Participants across all 4 groups managed to lose weight. Unfortunately, the study was conducted over a very short period, hence no significant change in BMI. The study was conducted for a short period of time (three months) due to lack of funding. The increase in BMI with increasing parity was found by Chinese *et al*. (2016) in a systematic review and meta-analysis for prevalence of type 2 diabetes mellitus in women of childbearing age in Africa during 2000–2016. Chinese *et al.* (2016) found that multiparty may increase a woman's risk of obesity and resultant T2DM. However, they also found that this evidence was not consistence throughout.

It is interesting to note that there is a relationship between the number of pregnancies and increasing in blood pressure. However, the researcher could not find literature to support these observations. Future research can develop insight as to how increasing number of pregnancies is associated with increasing blood pressure.

Table 4.5: Glucose level

Variable	3.5-5.5mmol/L (n=95)	5.6-10.9mmol/L (n=67)	Mann-Whitney Z	p-value
Weight	82.0	86.5	1.8	0.0696
Height	1.6	1.6	1.3	0.2007
Systolic BP	119.9	127.9	3.5	0.0005
Diastolic BP	74.1	76.0	1.2	0.2437
Weight loss	1.2	1.2	-0.2	0.8210

In this study, n=95 (58.6%) participants had normal random blood glucose (RBG), and n=67 (41.4%) participants had hyperglycemia. The elevated blood glucose was not high enough to diagnose diabetes. Normal blood glucose levels using random blood glucose test (finger prick) are 3.5 – 5.5 mmol/L, 5.6-10.9 mmol/L is inconclusive and may even be considered pre-diabetes, while 11.0 mmol/L and more is considered diabetic. The random blood glucose inconclusive levels need further investigations, but the SEMDSA Guideline Committee (2017) does not use RBG for diagnosis of pre-diabetes.

Pre-diabetes refers to intermediate hyperglycemia, with impaired fasting glucose (IFG) of 6-6.9 mmol/L or impaired glucose tolerance (IGT) of 7.8-11.0 mmol/L (Grundy, 2012; SEMDSA Guideline Committee, 2017). Pre-diabetes eventually converts to diabetes if no intervention is done, hence Grundy (2012) advocate for the intervention of people who are said to be diabetic.

Participants with elevated than normal RBG (5.6-10.9) weighed more than those with normal blood glucose. Also, the blood pressure reading of the participants with elevated RBG are higher than those with normal RBG levels. This shows the relation

between blood pressure and blood glucose stated by the SEMDSA Guideline Committee, (2017).

Table 4.6: Body mass index

Variable	Under25kg/m^2 (n=3)	25-30kg/m^2 (n=36)	Over30kg/m^2 (n=102)	Kruskal-Wallis χ^2	p-value
Weight	70.5	70.3	89.2	55.3	<0.0001
Height	1.7	1.6	1.6	10.0	0.0067
Systolic BP	115.7	116.0	125.9	15.8	0.0004
Diastolic BP	71.0	71.7	75.7	2.6	0.2775
Weight loss	1.5	1.1	1.2	1.3	0.5298

The table above shows that n=3 (1.9%) participants had a BMI under 25kg/m2, n=36 participants (22.2%), had BMI of 25-30kg/M2, and n=102 participants n=6 (76.2%) had a BMI of over 30kg/m2. All three groups lost weight during the intervention. Overweight and BMI indicate risk to the women of children bearing age and pregnant women of GDM and other conditions related to overweight and high obesity. Stanley and Nirmal (2017) support that, BMI greater than 30kg/m2, or body weight greater than 90kg are independent risk factors for venous thromboembolism (VTE) and risk assessment should be completed and signed on the drug chart.

Moreover, the relationship between increasing MBI was discussed in table 4.1. The researcher did not screen blood pressure readings at the end of the study, the participants all had normal BP readings. However in hind sight this would have given the researcher an opportunity to associate reduction in weight loss with reduction in blood pressure as reported in the guidelines by SEMDSA Guideline Committee, (2017)

Table 4.7: Comparison of Control group with the Experimental group

Group	Variable	N	Mean	Median	SD	SE
CONTROL (N=82)	Initial weight	82	81.8	77.5	17.983	1.986
	Final weight	52	81.0	76.1	18.572	2.575
	Initial BMI	82	33.7	32.5	6.950	0.768
	Final BMI	52	33.1	31.9	7.171	0.994
	Waist circumference	81	2.1	2.0	1.062	0.118
	Height	82	1.6	1.6	0.054	0.006
	Systolic blood pressure	82	121.3	120.0	14.465	1.597
	Diastolic blood pressure	82	73.7	70.0	10.865	1.200
	Weight loss	52	0.9	0.7	0.655	0.091
EXPERIMENTAL (N=82)	Initial weight	82	85.7	79.3	20.278	2.239
	Final weight	58	85.2	77.5	21.768	2.858
	Initial BMI	81	34.3	33.2	7.476	0.831
	Final BMI	57	34.2	32.5	8.151	1.080
	Waist circumference	80	2.3	2.0	1.178	0.132
	Height	81	1.6	1.6	0.064	0.007
	Systolic blood pressure	81	125.4	120.0	13.074	1.453
	Diastolic blood pressure	81	75.9	78.0	10.858	1.206
	Weight loss	58	1.3	1.3	0.427	0.056

In table 4.7 the control group with n=82, had a mean weight of 81.8kg, median of77.5kg, with a SD of 17.983, and the mean BMI was 33.7, with as SD of 6.950. Similarly, the experimental group n= 82, had a mean weight of 85.7kg, median of79.3kg, with an SD of 20.278, and a mean BMI of 34.3kg/m2 with an SD of 7.476. The mean BMI was way above 30kg/m2, which makes both groups obese and at high risk of developing T2DM and GDM (when they become pregnant). This is

supported by a study by Bo *et al.* (2018) in Denmark, where they found that, BMI predisposes women to early onset of T2DM. Moreover, increased BMI in women of childbearing age predisposes them to GDM, and T2DM. This is also stated in the International Diabetes Federation (2017).

In conclusion, the control group, the weight loss at the end of the study was observed to be 0.9kg of the 52 (63.4%) participants that presented themselves at the completion of the study. On the other hand, 30 (36.6%) participants did not show up at the end the study due to their busy schedules. BMI in the control group was 33.1kg/m2; and there was a drop of 0.6kg/m2. This weight loss is explained by the Health Belief Model. The participants in the control group through perceived susceptibility to T2DM, decided to act by correcting their lifestyle. While the 30 other participants so barriers to action being greater than the threat posed by the risk of developing T2DM.

The experimental group also had weight loss of 1.3kg among 58 (70.7%) participants that completed the study; there was drop out of 24 (29.3%) participants. BMI in the experimental group at the end of the study was 34.2kg/m2, which had reduced by 0.2kg/m2. Diet and inactive lifestyle are directly linked to type 2 diabetes and gestational diabetes (SEMDSA Guideline Committee, 2017). The lay coach reported that, the attendance was poor in the classes; some participants missed days and would report the personal issue. The poor attendance and the dropping out is explained by the Health Belief Model in that, although the risk is perceived by the participants, perceived barriers to action meant Action (exercise) was not taken.

The results in this study (though was done in a very short time) showed that lifestyle changes can bring about a reduction in weight and subsequently BMI reduction, reducing the risk of developing T2DM. A study by Thow *et al.* (2015) in South Africa, argued that the increase in NCD's such as DM, are due to increased access to processed foods (this food has low nutritional value) and soft drinks within the South African region. The findings of their study proposed that there must be strict laws on

food trade, especially with foods that are responsible for the increase in NDC's. South Africa has introduced a 'sugary tax' as of 1ST April 2018, this is to discourage people from buying these sugary drinks thereby promoting a healthier lifestyle.

Table 4.8 Family history of T2DM

Frequency / Percent / Row Pct / Col Pct	Table of FAMILY HISTORY by TRMT			
	FAMILY HISTORY	TRMT		
		CONTROL	EXP	Total
	Yes	48	52	100
		29.27	31.71	60.98
		48	52	
		58.54	63.41	
	No	34	30	64
		20.73	18.29	39.02
		53.13	46.88	
		41.46	36.59	
	Total	82	82	164
		50	50	100

The analysis revealed that 60.98 % of the participants had a family member (grandparents, parents or siblings) who are diabetic. This family condition subject several of the participants to the risk of early onset of T2DM, and as literature has shown the onset of T2DM with association family history of diabetes. The above statement emphasize the importance of community screening to detect high-risk individuals so intervention can be done to reduce the risk of developing T2DM and or GDM (Bo *et al.*, 2018).

Development of type 2 diabetes and or gestational diabetes is associated with age in the literature that was reviewed. In this study, it was also observed that the BMI for

older groups of age 26-35 years and 36-45 years were obese, while the younger age group 18-25 years was overweight. While being overweight put one at a risk of T2DM and or GDM, obesity is even a much greater risk. Bo *et al.* (2018) in a study conducted in Denmark found that, family history was associated with early onset of T2DM, family history of type 2DM was highest in the early-onset group (64%), decreasing to 52% in the aver-age-onset group, and to 40% in the late-onset group. Moreover, early-onset individuals developed microvascular complications in 13 to 20 years earlier than later-onset individuals.

Elevated blood pressure was also linked to T2DM and or GDM, in this study. However, the blood pressure readings for these participants was normal (Diastolic below 90 mmHg and Systolic of below 140 mmHg). Therefore, the risk factors for T2DM were the same as those of elevated blood pressure, and presence of one could result to the development of other overweight and obese conditions (International Diabetes Federation, 2017).

Blood glucose levels in this study is linked to family history of T2DM and number of pregnancies. This is consistent with research findings of Bo *et al.* (2018), that these individuals need frequent screenings and change of lifestyle (diet and exercise) to reduce chances and or prevent type 2 diabetes mellitus.
Increasing parity is associated with increasing weight gain (increasing BMI), which predisposes individuals to T2DM and or GDM. Inter-conception care services need to be made known to the childbearing age women and utilized to reduce pregnancy complication caused by diabetes.

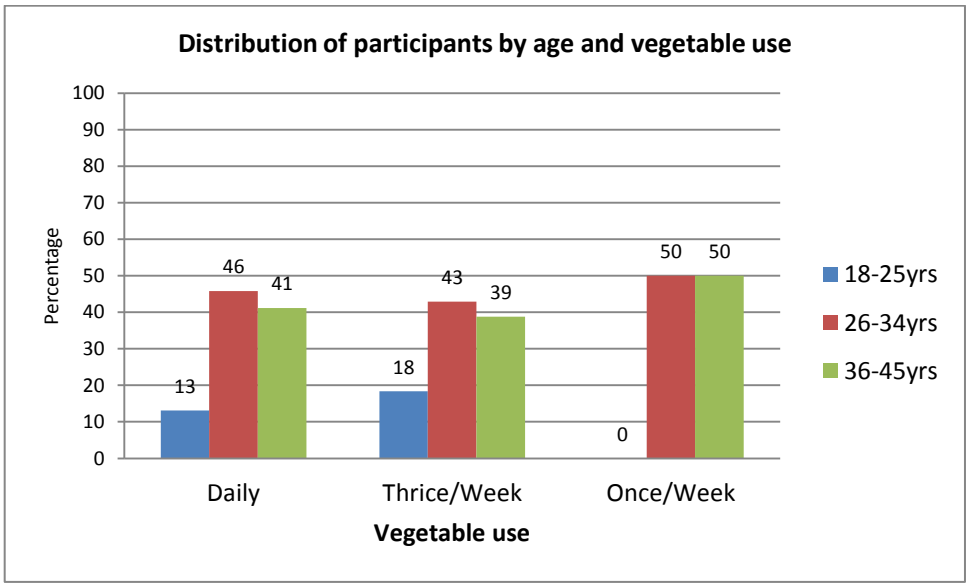

Figure 4.1 Distribution of participants by age and vegetable use

The distribution of participants by age and vegetable use in this study showed that 13% of participants of ages between 18 to 25 years consumed vegetables on daily basis, 46% of the ages of 26-34 years and 41% were 36 years to 45 years consumed vegetables on daily basis as well. The age group 26-34 years scored high on daily consumption of vegetables. Whereas the youngest (18-25 years) group scored low for daily vegetable consumption. Gilis-Januszewska et al. (2018) in a diabetes prevention study done in, found increased vegetable consumption was associated with weight loss and hence reduced chances of developing type 2 diabetes.

Ley *et al.* (2016), conducted a narrative in 36 American states, the review commences from 1976 to 2016. The Nurses' Health Study (NHS) addressed the hypotheses regarding risk factors for type 2 diabetes. Ley *et al*. (2016) found that there was no association between risk of type 2 diabetes and total intake of fruits and vegetables in the NHS cohorts. Nevertheless, Ley *et al.* (2016), discovered that greater intake of green leafy vegetables was associated with lower risk of type 2 diabetes. Moreover, greater consumption of specific whole fruits, such as blueberries, grapes, apples, and pears, was associated with a lower type 2 diabetes risk.

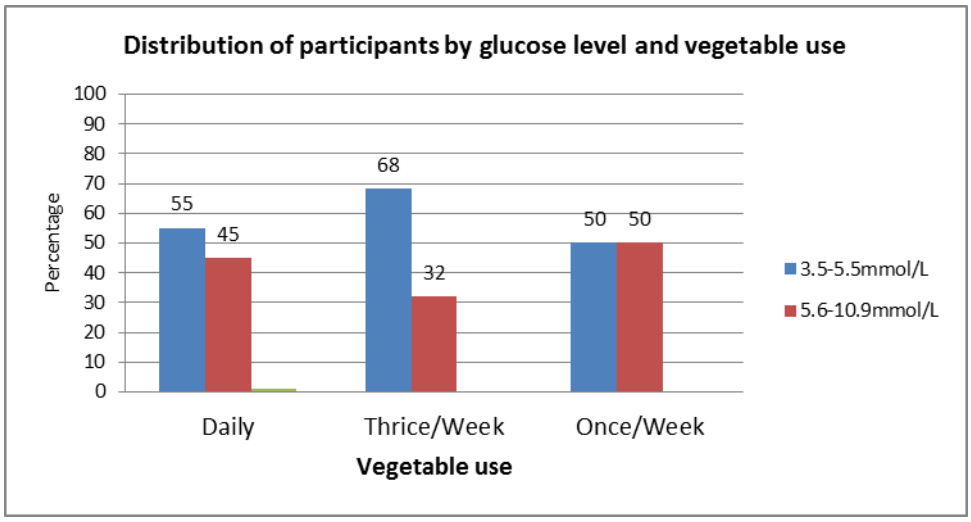

Figure 4.2 Distribution of participants by glucose levels and vegetable use

Figure 4.2 indicates that 55% of participants using vegetables daily were between 3.5-5.5mmol/L and 45% of participants using vegetables daily were between 5.6–10.9mmol/L of random blood glucose (finger pricking). However, 50% of participants using vegetables weekly were between 3.5-5.5mmol/L and another 50% of participants using vegetables weekly were between 5.6 – 10.9mmol/L of random blood glucose (finger pricking). Although 68% of participants using vegetables thrice a week were between 3.5-5.5mmol/L and 32% of participants using vegetables were between 5.6 – 10.9mmol/L of random blood glucose (finger pricking).

Using Random blood glucose (finger prick) in this study normal glucose levels ranged between 3.5-5.5 mmol/L, while the diagnostic value was anything above 11.0 mmol/. Anything in-between normal and diagnostic value (5.6-11.0 mmol/L) was regarded as a possible pre-diabetes. Pre-diabetes was said to be elevated Fasting Plasma Glucose (FPG) or Impaired Glucose Test (IGT), 6-6.9mmol/L and 7.8-11.0 mmol/L respectively (SEMDSA Guideline Committee, 2017).

Many of the participants in this study had pre-diabetes, and those who consumed vegetables daily, 55% of them had normal RBG levels. A similar pattern was seen on those who consumed vegetables thrice weekly. However, for those consuming vegetables once a week, there was a 50/50% chance of being pre-diabetic. These

findings were congruent with the statement made above by Ley *et al.* (2016), with regards vegetable consumption being associated with the glycaemic control.

Tobias *et al*. (2012) stated that fruit and vegetables are rich in antioxidants and photo-chemicals, dietary fiber, and micronutrients such as magnesium and vitamin C. They believe that the combination of these might prevent metabolic deterioration by opposing free radicals and improving systemic oxidative stress.
Tobias *et al*. (2012) in their study found a strong and consistent association between pre-pregnancy adherence to several dietary patterns, such as increased vegetable and fruit diet, and lowered GDM risk.

Glycemic control is vital in the prevention of type 2 diabetes as research from the literature has shown that there were quite a huge number of undiagnosed poor glycaemic controls. Patients with poor glycaemic control are classified by some researchers as pre-diabetes and would in the short or long run develop diabetes if intervention is not done (Grundy, 2012). Using the referral system in RPHC, these participants were then referred to the clinic for further investigations, as the researcher was not responsible for further interventions. These investigations were formal blood Fasting Plasma Glucose and Impaired Glucose Test.

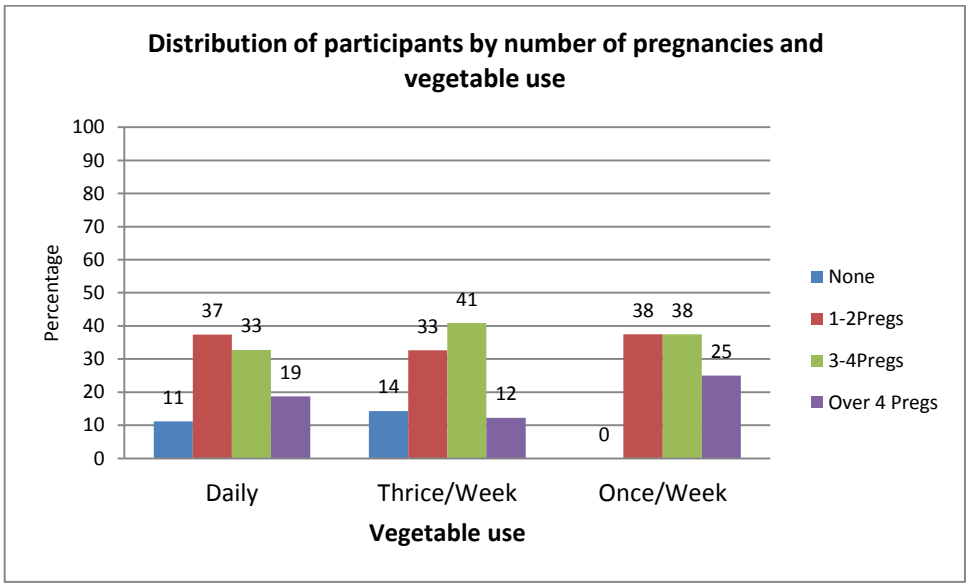

Figure 4.3: Distribution of participants, number of pregnancies and vegetable use

Distribution of participants by a number of pregnancies and vegetable use reveals that for daily consumption, only 11% of participants who have never been pregnant consume vegetables on daily basis. On the other hand, 37% of participants that consumed vegetables on daily basis had one or two pregnancies; those who had three to four pregnancies constituted about 33% and only 19% of participants with more than 4 pregnancies consume vegetables daily. The minority of the study participants were in danger because of low consumption of veggies and were at risk of developing conditions such as high blood pressure and preeclampsia (The American Pregnancy Association (ADA) 2013).

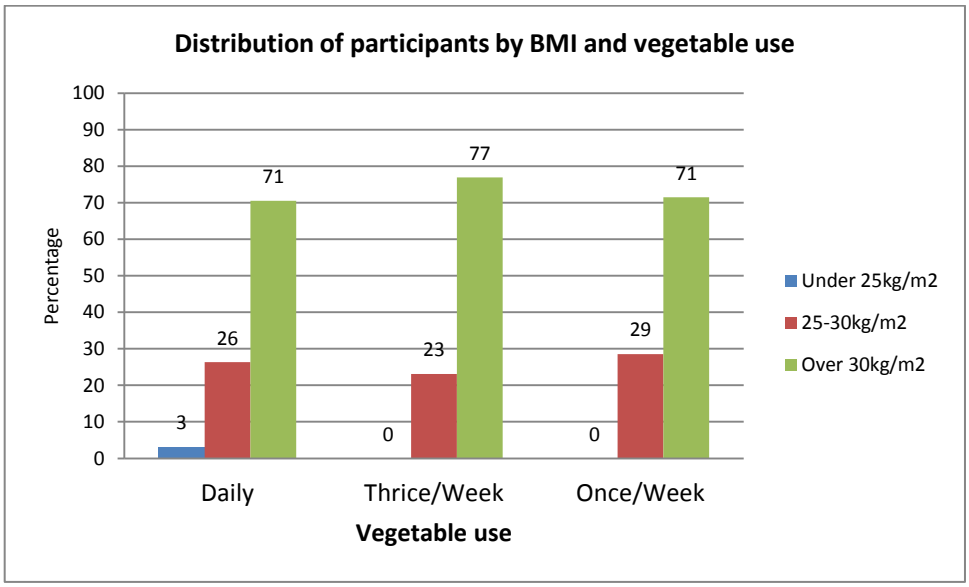

Figure 4.4: The distribution of participants by BMI and vegetables use

The participants with BMI of over 30kg/m2 seem to be the ones consuming more vegetables as compared to the 25kg/m2 and 25-30kg/m2 BMI group. The BMI is a well-known risk factor for the development of type 2 diabetes as cited by American Diabetes Association, (2014). However, in this study regardless of how many times participants consumed fruit, BMI remains high. Having participants that had a higher BMI consume more fruits bring about the question of moderation and other factors that could be attributed to the increased BMI. Ley *et al.* (2016) argued that not only diet alone predisposes to type 2 diabetes, but other factors such as genetics, and dietary intake such as high fat and sugar content play a role in increased BMI. International Diabetes Federation (2017) indicated that BMI is believed to be the major risk factor, more especially to central adipose.

In this study, however, participants were given health education on consuming vegetables on a daily basis. SEMDSA Guidelines Committee (2017) recommends vegetable consumption because the benefits such as high content fiber that enhances satiety, phytonutrients, vitamins, and minerals that combat oxidative stress. However, given the fact that according to SEMDSA Guideline Committee (2017) only a registered dietician could prescribe what to eat given the individual

risks, the dietician was only asked to give health education to the whole group in this study, but it was unfortunate that she could not see and screen individuals and prescribe a diet. The prescription of diet would have meant that at the end researcher would have been able to state whether prescribed diet reduced chances of developing type 2 diabetes as most studies have proven.

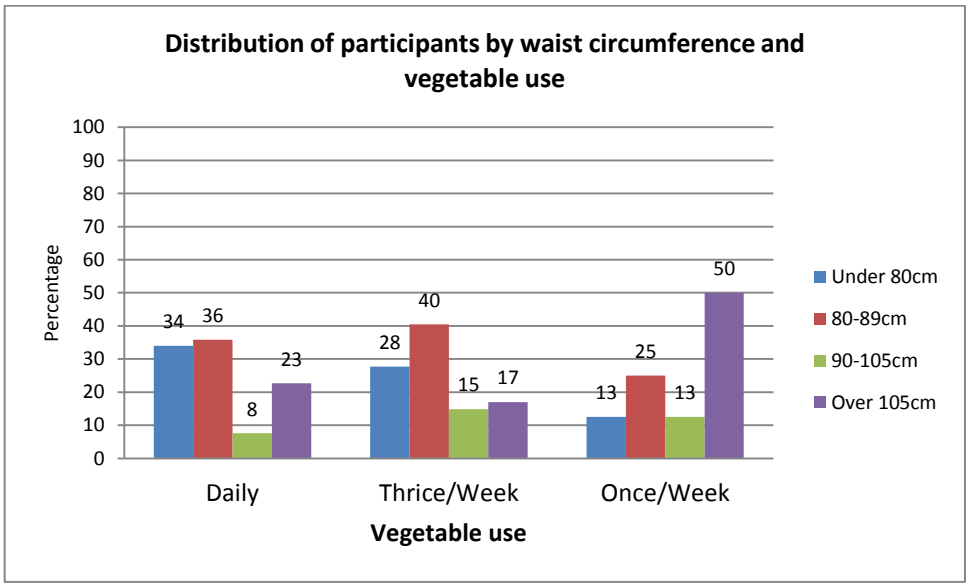

Figure 4.5: illustrate the distribution of participants by waist circumference and vegetable use

Waist circumference (abdominal fat) is associated with increased risk of T2DM (Mohan, Seedat & Pradeepa, 2013). In this study participants that consumed vegetabeles on daily basis 38% was below 80 cm, 36% was between 80-89 cm, this add up to 74% participants that consumed vegetables daily and had a healhy WC according to Crowther and Norris (2012) as they suggested a cut of of 91.5 cm for South African women. Notably, the healthy WC reduced with reduced vegetable consumption, with those that consume vegetable three times a week 68% having WC below 90 cm and in those that consume vegetables once a week only 38% had a WC below 90 cm.

Vegetable consumption and normal healthy waist circumference are associated with good health according to previous research. According to Ley *et al.* (2016), American Diabetes Association (2015), International Diabetes Federation Atlas (2013) and SEMDSA Guideline Committee, (2017), the country-specific waist circumference for sub-Saharan Africa women is ≥ 80 cm. waist circumference has been identified to be linked to the development of type 2 diabetes, as central adiposity is associated with insulin resistance (Cerf, 2013). However, the waist circumference can be reduced with weight loss and is identified as a modifiable risk factor by Mohan *et al*. (2013).

Participants were given health education on the importance of reducing waist circumference for improved glycemic control.

The SEMDSA Guideline Committee (2017), Crowther and Norris (2012) proposed WC of 91.5 cm for South African women, because of findings in the study conducted in South Africa found indicated that as cut off to metabolic diseases such as diabetes.

4.4 Tests for normality

Table 4.9: The tests for normality of body measurements

Body measurement	Shapiro-Wilk's W	p-value
Weight	0.87	<0.0001
Height	0.97	0.0013
Systolic blood pressure	0.93	<0.0001
Diastolic blood pressure	0.93	<0.0001
Weight loss	0.98	0.3997

From the table above, only weight loss is normally distributed as reflected by a p-value of 0.3997, which is greater than the 5% level of significance. All the other variables have p-values less than 5% and are, therefore, not normally distributed. Based on that, all tests for statistical significance were carried out using nonparametric methods, except for tests concerning weight loss. The Kruskal-Wallis tests were used for comparing the body measurements across different categories of the age groups, number of pregnancies, and body mass index variables. The Mann-Whitney was used for comparing body percentages across glucose levels. The results are presented in the tables above.

Diet high in fat, processed foods, salt content, and sugars have been undoubtedly linked to increased body mass index (BMI) and waist circumference (WC). This is a chain reaction because increased BMI and WC caused insulin resistance and lead to

a state of hyperglycemia. If no action is undertaken, the state of hyperglycemia converts to type 2 diabetes mellitus and or gestational diabetes in pregnancy, leading to poor pregnancy outcomes (Draper *et al.*, 2014 : Adeniyi *et al.,* 2015).

Moreover, BMI and WC in this study seem to be increasing with age and a number of pregnancies. This mean that, the older the person and the more pregnancies one has, the higher the risk of developing type 2 diabetes mellitus and or gestational diabetes. Hence, not only pre-conception care is important, but also interconception care (care to the women between pregnancies) is equally important to effect lifestyle changes for the improved health of mother and child (Adeniyi *et al.,* 2015).

Table 4.10: Illustrating Exercise

Exercise – Do you usually have physical activity at work/leisure time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No answer	1	.6	.6	.6
	Yes	2	1.2	1.2	1.8
	No	161	98.2	98.2	100.0
	Total	164	100.0	100.0	

The results on exercise showed that only 2 (1.2%) participants partake on exercise, 1 (0.6%) participant did not answer the question and 161 (98.2%) participants do not have exercises at all. This may explain the high BMI, that indicate overweight and obesity among the study participants. Nojilana *et al.* (2016) conducted a situational analysis on emerging trends in non-communicable disease mortality in South Africa, 1997 – 2010. The findings of the study were that 56% of women in South Africa are inactive and lack of exercise was fuelling the development of non-communicable diseases such as T2DM and GDM.

In addition, International Diabetes Federation (2017) stated that, lack of exercise increases the risk of developing T2DM. Therefore, the recommendations were that, for diabetic prevention in adults aged 18–64 years should at least engage in 150

minutes of moderate-intensity aerobic physical activity (brisk walking, jogging, gardening) spread throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous- intensity activity.

In this study, the chosen type of exercises was jogging (running), aerobics and exercise which was done from Monday to Thursday (4 days), for 60 minutes a day (240 minutes/week). This was more than the recommendation in International Diabetes Federation (2017). The reason for this was that, most participants could not spare more than an hour a day.

Tobias *et al.* (2011) conducted a systematic review and meta analyses on GDM prevention. The results showed that, in most studies greater total physical activity before or during early pregnancy greatly reduced the risk of GDM. Tobias *et al*. (2011) also argued that, seeing the consistency of evidence across several studies, promoting physical activity among women of childbearing age may represent a promising approach for the prevention of GDM and subsequent complications of children born from pregnancies affected by GDM.

Furthermore, SEMDSA Guideline Committee (2017) recommended that those identified as being at high risk of T2DM and or GDM should be offered structured intensive lifestyle interventions programme. The aim of the interventions was a to least achieve >5% weight loss, through dietary modifications and at least moderate intensity exercise for >150 minutes per week. In this study, the 5% weight loss could not be observed due to time constraints.

4.5 Preconception health care services in Peddie

Table 4.11: Preconception care

Do you know of preconception services?

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	No	164	100.0	100.0	100.0

Have you ever used preconception services?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	164	100.0	100.0	100.0

Reason for not utilizing the preconception services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No answer	2	1.2	1.2	1.2
	No knowledge	160	97.6	97.6	98.8
	Other	2	1.2	1.2	100.0
	Total	164	100.0	100.0	

Preconception care is non-existing in the community of Peddie, as none of the participants have never attended or heard of preconception before. Preconception care is widely recognized as a way to optimize women's health and improving pregnancy outcomes for both mother and child (Berglund & Lindmark, 2016). Draper *et al.* (2014) conducted a literature review and found that, in both urban and rural SA, a major challenge with women health was a complex interrelationship between poor maternal nutrition and postnatal stunting.

Moreover, South Africa has seen an increased risk of adolescent and adult obesity, leading to an increased risk of T2DM (Draper *et al*. 2014). The results of this study paint the similar picture and hence it was important to note well the conclusion made by Draper *et al.* (2014) that it is vital to intervene to address NCD's such as T2DM risk and optimise health in SA adolescent girls, particularly pre-pregnancy, to reduce the intergenerational transfer of metabolic disease risk.

This study is in a way responding to that call since it aimed at identifying women of childbearing age with predisposing factors of type 2 diabetes in order to prevent the occurrence of type 2 diabetes, to strengthen preconception or internatal care through the PHC re-engineering programme; and to reduce mortalities and morbidities caused by type 2 diabetes. PHC re-engineering has been adopted in South Africa as seen from countries like Brazil, where it leads to positive health outcomes. The

program task shifts most of the work such as health promotion and health education and screening to CHW. CHW upon identifying those who need further assistance refer them to the clinic for further management.

Lassi *et al.* (2014) conducted a systematic review to ascertain the possible impact of preconception care for preventing and managing chronic diseases and promoting psychological health on maternal, newborn and child health outcomes. Moreover, Lassi *et al*. (2014), found that preconception services were known by diabetic people and had led to reduced complication for mother and child. However, they also found that most women even knowing about these services they do not use them. This is partly because most pregnancies are unplanned.

The study seeks to strengthen the preconception care program, by usurping health promotion and health education in the community done by CHW in the RPHC. Furthermore, after identifying those with risk factors such as risk for T2DM and or risk of GDM, which will affect the mother and or the child, referrals are made to the clinic for prescribed intervention.

Table 4.12: presenting preconception care visits

Do you think you will attend?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No answer	1	.6	.6	.6
	Yes	155	94.5	94.5	95.1
	No	8	4.9	4.9	100.0
	Total	164	100.0	100.0	

When the participants were asked if they will attend preconception care services in the future, 0.6% (n=1), 4.6% (n=8) said no and 94.5% (n=155) said they will. This means most of the participants have perceived the risk of type 2 diabetes, according to the health belief model, the barriers to action as far less than the threat posed by the condition and the likelihood of action (seeking help and correcting lifestyle) has increased.

Pre-conception care is viewed by Berglund and Lindmark (2016) as mainly counselling before or in early pregnancy to improve maternal and infant health. However, Berglund and Lindmark (2016) further stated that pre-conception care often has been limited to single interventions or preconception information and counselling to women with chronic illnesses such as hypertension or diabetes.

Pre-conception care also focused on lifestyle changes such as cessation of smoking and drinking alcohol or supplementation with calcium gluconate and folic acid. Berglund and Lindmark (2016) proposed that, since it has been proven to work in studies such as that done by Lassi *et al.* (2014) pre-conception should be widened to the well-being of the whole family and the offspring, using the concept PHC instead.

4.6 Conclusion

T2DM, GDM, and Obesity are growing health problems, more especially among the women of childbearing age. On the other hand, obesity also posed a health threat to mother and child with the complication that can even be life-threatening. T2DM, GDM, and obesity have modifiable risk factors such as diet and exercise (high fat, high sugar, high salt, processed foods and inactive lifestyle). Intervention to such as lifestyle change to more healthier diet choices, and an active lifestyle have been proven to reduce chances of developing T2DM, GDM and obesity complication.

Participants in this study were all at high-risk individuals for the development of type 2 diabetes. The aim of the study was to prove or disprove that, weight loss in high-

risk individuals would translate to reduced chances of developing T2DM and or DGM. The participants in the experimental group did lose weight as expected; however, the surprising results were that even participants in the control group also reported weight loss. This was not expected as the control group did not receive continuous health education and advice on diet. The theory of planned behaviour was used to explain this phenomenon. This means that after the participants in the control group were told they were at risk of developing T2DM and or GDM they managed their own change of lifestyle.

Diabetes prevention was vital for the prevention of health complication on the health of mother and child. The PCC is one of the ways in which health concerns such as lifestyle and health screening of the mother can prevent complications for future pregnancy. The government can task and shift the use of CHW to drive this program of PCC in RPHC. The RPHC is by its definition health promotion and health education and health screening, hence these to (RPHC and PCC) complement one another. Task shifting has worked very well to improve mother and child in a study conducted by Roux *et al.* (2015) in South Africa in the Eastern Cape. Through health promotion and health education, the CHW managed to increase greatly the number of women giving birth in health care centers. This health-seeking behavior need to be promoted to prevent T2DM, GDM, and obesity.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMENDATIONS

5.1 Introduction

The previous chapter was interpreting and discussing the findings of the study. in this chapter the researcher focused on the overall summary of the study, limitations, implications and recommendations of the study.

5.2 Methodology and the objectives

The study was quantitative experimental and intervention study, where the participants were randomly selected for the control and experimental group. The experimental group were only exposed to diet and exercise intervention and the control group were given standardized care.

5.2.1 Purpose of the Study

The purpose of the study was to identify women of childbearing age with predisposing factors of type 2 diabetes, in order to prevent the occurrence of the disease, and to strengthen preconception or internatal care through the PHC re-engineering programme; thus, reducing mortalities and morbidities caused by type 2 diabetes.

5.2.2 Hypothesis

This study has hypothesised that, exercise and healthy balanced diet to women of childbearing age would not reduce weight and subsequently MBI and thereby decrease chances of developing type 2 diabetes. The findings of the study had proven the positive hypothesis.

5.2.3 Objectives of the study

The study sought to achieve the following objectives:

(i) To identify and describe women of childbearing age with predisposing factors of type 2 diabetes.

(ii) To identify and describe women with type 2 diabetes before 24 weeks of pregnancy.

(iii) To describe the effect of exercise and healthy balanced diet to women with predisposing factors for type 2 diabetes and type 2 diabetes before 24 weeks of pregnancy.

5.3 Findings of the study

The analysis showed that, the average weight of the participants was 76.0kg, with BMI of 30kg/m2. Those with 1-2 pregnancies (n=59), had average weight of 83.2kg and a BMI of 33kg/m2. In the group of 3-4 pregnancies (n=58), average weight was84kg, and BMI of 33kg/m2. The last group that has had more than 5 pregnancies (n=28), had average weight of 89.6kg and BMI of 35kg/m2.

The average height, when comparing the three age groups, was the same (1.6m), while the weight seemed to be lower in under 25 years' who had the average weight of 72.2kg, giving a BMI of 28kg/m2. This means that this group is classified as overweight. For the age group 26-35 years, the average weight was 82.7kg, and the BMI was 32kg/m2; making this group obese class 1. In the over 35 years' age group, the average weight was 88.9kg, with a BMI of 35kg/m2, this group was obese class 2.

Frequency distribution of age group 25-30 years of the participants (n=74) was the highest, followed by the age group 31-45 years (n=67). However, the age group 18-24 years (n=23) participants were the lowest. Given the fact that risk of diabetes increases with age, this makes the participants aged between 31-45 years to be at higher risk, 25-30 years somewhat (medium) risk and 18-24 years somewhat (lower risk).

Fifty-five percent (55%) of the participants using vegetables daily were between 3.5-5.5mmol/L and 45% of participants using vegetables daily were between 5.6 – 10.9mmol/L of random blood glucose (finger pricking). However, 50% of participants

using vegetables weekly were between 3.5-5.5mmol/L and another 50% of participants using vegetables weekly were between 5.6 – 10.9mmol/L of random blood glucose (finger pricking). Moreover, 68% of participants using vegetables thrice a week were between 3.5-5.5mmol/L and 32% of participants using vegetables were between 5.6 – 10.9mmol/L of random blood glucose (finger pricking).

The distribution of participants by age and vegetable use in this study were 13% of participant's ages between 18 to 25 years (that consumed vegetables on daily basis), 46% were between the ages of 26-34 years and 41% were 36 years to 45 years. This means the younger age group (15 to 25 years), do not consume as much as the subsequent age groups.

The control group with n=82, had a mean weight of 81.8kg, median weight was 77.5kg, and with a SD was 17.983. The mean BMI was 33.7, with as SD of6.950. On the other hand, the experimental group (n= 82), had a mean weight of 85.7kg, median of 79.3kg, and a SD of 20.278. The mean for BMI was34.3kg/m2, with an SD of 7.476.

Further, in this study, n=3 (1.9%) participants had a BMI of under 25kg/m2, n=36 participants (22.2%), had BMI of 25-30KG/M2, and n=102 participants (76.2%) had a BMI of over 30kg/m2.

On blood glucose, n=95 (58.6%) participants had normal random blood glucose (RBG), and n=67 (41.4%) participants had hyperglycemia, the elevated blood glucose was not high enough to diagnose diabetes. Normal blood glucose levels using random blood glucose test (finger prick) are 3.5 – 5.5 mmol/L, 5.6-10.9 mmol/L which is inconclusive and may even be considered pre-diabetes and 11.0 mmol/L and more is considered diabetic.

Vegetable consumption was associated with a healthy waist circumference (WC) proposed by Crowther and Norris (2012), that is 91.5 cm. in the study 74% of participants that consumed vegetables daily has a WC below 90 cm, followed by those who consumed vegetables three times weekly with 68%. Those who

consumed vegetables less frequently (once a week) only 38% had WC below 90 cm.
.

The study established that, preconception care is non-existing in the community of Peddie, as none of the participants have ever attended nor heard of preconception care. The percentage of participants that will attend preconception care in future 94.5% (n=155). This means quite a number of participants have perceived the risk of type 2 diabetes. According to the health belief model, the barriers to action are far less than the threat posed by the condition and the likelihood of action (seeking help and correcting lifestyle) has increased.

5.4 Summary of the study

This was an intervention study on high-risk type 2 diabetic women during preconception and internatal in the re-engineering of primary health care. The researcher sought to prove or disprove a null-hypothesis that; exercise and healthy balanced diet to women of childbearing age would not reduce weight and subsequently MBI and thereby decrease chances of developing type 2 diabetes/ or gestational diabetes. This study was an intervention study which used quantitative, randomized controlled trial design. The two-group randomized control trial used pre-test/post-test design and structurally equivalent comparison groups. The researcher collected baseline data from demographics such as weighing and measuring height and waist circumference of the participants.

The study comprised of only women of childbearing age (18 to 45 years). The purpose of choosing women of childbearing age was because of the complication diabetes cause in women of children bearing age, when they eventually become pregnant. These complications of diabetes in pregnancy do not only affect the mother, but the baby as well. The complications can be infant death, retarded growth in the uterus, birth trauma for both mother and the baby death (Cronje and Grobler, 2008; ;Sellers, 2009).

Diabetes during pregnancy does not only affect the pregnancy, but even after he pregnancy as research shows that women with gestational diabetes, 5% of them will be diabetic after pregnancy (Macaulay *et al* .2014). Recent research has also shown that children born of women with diabetes can develop insulin resistance and may also develop childhood obesity and subsequently diabetes. Researchers agree that diabetic prevention is vital to reduce maternal and infant morbidity and mortality.

In this study, the results showed that, both control and experimental group had recorded weight loss. This can be attributed to the fact that all participants were given a health education talk by the researcher and the dietician at the beginning. The control group had no further intervention, whereas the experimental group was assigned to a layperson who had been given a crash course on how to conduct weight loss classes. The reason for choosing a layperson was a study done by Hill *et al.* (2017) analysing studies conducted in the United States of America, these were mainly community-based and conducted in minority populations. Using a lay-health coach/lay-gym instructor was proven to be cost effective, South Africa being a developing country faces economic strains and need cost saving interventions.

5.5 Justification

This study sought to identify and manage women of childbearing age with predisposing factors of type 2 diabetes in order to delay/ or prevent the occurrence of type 2 diabetes. This was done through community screening, and particularly to prove or disprove that health education and intervention such as exercising can reduce weight and subsequently reduce body mass index and prevent or delay the onset of diabetes.

Furthermore, the study sought to strengthen preconception or internatal care and to reduce mortalities and morbidities caused by type 2 diabetes in South Africa. According WHO (2012), Spence (2013) and Chuang *et al* (2010), women in most cases do not plan pregnancy and preconception and even where available in other countries is not sort out by women of childbearing age. This means women fall pregnant without even knowing they could be in danger of diseases that are detected

when they are pregnant and can complicate the pregnancy. A growing body of evidence is showing that preconception care, that is care before pregnancy – can increase the health and well-being of women and couples and improve subsequent pregnancy and child health outcomes (WHO 2012)

Additionally, the study sought to strengthen the PHC re-engineering programme. According to Ban *et al* (2013), PHC re-engineering is the revitalization of Primary Health Care' initiative by providing proactive household and community-focused interventions. This kind of PHC programme was benchmarked in countries such as Brazil. The programme makes use of community health care workers as screening agents. As community health workers screen for ailments within the community, they can also screen women of childbearing age for type 2 diabetic risk factors and refer the women they found to be at high risk to the clinic for further testing and management.

5.6 Implications

In the beginning, the researcher had a null-hypothesis that; exercises and healthy balanced diet to women of childbearing age would not reduce weight and subsequently MBI and thereby decrease chances of developing type 2 diabetes. As seen from the analysis, when looking at the final weight loss, both control and experimental groups lost weight, though the experimental group lost more weight (1.3) as compared to control group (0,9). This has implication for practice in the sense that, though health education can caution community about disease prevention, for conditions such as type 2 diabetes exercise can add a more needed effect for health improvement.

5.7 Limitations

Grove, et al (2013) state that limitations is any restrictions or problems identified that will reduce the generalization of the research findings. These limitations are divided into two, (1) theoretical limitations – pertaining to the weakness of the study framework, conceptual and operational definition of study variables. (2)

Methodological limitations, where there is weakness in the study design, thereby limiting the credibility of the study findings (Grove *et al*, 2013). The researcher has identified the following methodological limitations:

- ✓ Time was a major constraint as the study had to be done in 3 months, as compared to other diabetic prevention studies that were done over one year to five years and even 10 years.
- ✓ The budget was a constraint as most of the intervention required money to be carried out.
- ✓ Diabetes prevention is multi-disciplinary team work; not being able to prescribe diet was another limitation, as the researcher was then able to measure the effects of diet on weight loss.

5.8 Recommendations

The South African National Department of health needs to strengthen the RPHC through proper funding and support of WBOT by the District Specialist Team. This will ensure that the RPHC does what it was set up to do, bringing health services to the people, promoting health and healthy lifestyle, preventing ill health and rehabilitation of those affected by ill health. Task shifting of community health program, community health promotion, and community health screening need to be done to identify those women with high risk of developing T2DM and or GDM. CHW can form community intervention groups within the community to promote health for those identified to be a risk of this pandemic.

Moreover, the policymakers need to strengthen preconception or internatal care, to reduce mortalities and morbidities caused by type 2 diabetes and other diseases in South Africa. The department must ensure the implementation and evaluation of such a programme.

5.9 Conclusion

In conclusion, the importance of lifestyle change in order to reduce the risk of developing T2DM and or GDM cannot be overemphasised. This is particularly significant for those who are overweight and obese, as this two contribute greatly to the development of the epidemic. Lifestyle modification to a healthier diet choice and exercise has been proven to reduce weight, which then reduces BMI, which subsequently reduces the risk. It is believed that weight loss of 5-10% of the person weight can make this significant change in the health of the person, and for women, this means improved pregnancy outcomes. Therefore, government needs to strengthen PHC, and PCC for improved health of mother and child. This is because RPHC was developed and implemented, for this reason; hence the implementation of the program should be effectively undertaken.

This study used the theory of health belief model. This theory state that health seeking behaviour and action will occur when one perceives that the disease T2DM and or GDM is a threat to them and they are susceptible to develop, if action is not taken. The theory further state that, the individual then assesses the barrier to taking action, and should barriers be more than the benefit action the action is not taken. In the control and experimental group, 63.4% and 70.7% respectively (n=52 and n=58) completed the study as they perceived T2DM and or GDM to be a threat and perceived the benefits of action to be more than the barriers to action. Health education and health promotion intervention conducted in PHC is vital to change the behaviour.

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Appendix A: Ethical clearance

University of Fort Hare
Together in Excellence

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

Certificate Reference Number:	VEL021SNGO01
Project title:	**An intervention to high risk type 2 diebetic clients during preconception in re-engineering of primary health care.**
Nature of Project:	Masters
Principal Researcher:	Siphokazi Amanda Ngoma
Supervisor:	Ms NM Vellem
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 6 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

Professor Gideon de Wet
Dean of Research

27 October 2014

Appendix B: Permission from the Eastern Cape Province

Eastern Cape Department of Health

Enquiries:	Zonwabele Merile	Tel No:	040 608 0830
Date:	29th January 2015	Fax No:	043 642 1409
e-mail address:	zonwabele.merile@impilo.ecprov.gov.za		

Dear Ms SA Ngoma

Re: An intervention to high risk type 2 diabetic clients during pre-conception in re-engineering of primary health care

The Department of Health would like to inform you that your application for conducting a research on the abovementicned 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 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

PGDP EASTERN CAPE 2004 - 2014

Ikamva eliqaqambileyo!

Appendix C: Permission from the Amathole district

Province of the
EASTERN CAPE
HEALTH

Room 111 • 1st Floor • Medical Centre Building • 19 St James Road • Southernwood • Eastern Cape
Private Bag X9015 • EAST LONDON • 5200 • REPUBLIC OF SOUTH AFRICA
Tel.: +27 (0)43 707 6766 • Fax: +27 (0)43 707 6843• Website: www.ecdoh.gov.za

Dear Ms S.A Ngoma

We acknowledge receipt of your request to conduct the a research in one of our institutions on the subject matter "**AN INTERVENTION TO HIGH RISK TYPE 2 DIABETIC CLIENTS DURING PRE-CONCEPTION IN RE-ENGINEERIG OF PRIMARY HEALTH CARE".**
It is with great pleasure to inform you that permission to conduct your research has been approved, provided the following are met

1. You will abide by the regulation of the hospital and of the nursing council.
2. You may not use the information gathered for any personal gain or as personal leverage.
3. You will report to the District Manager of any findings that you encounter.

Good luck with your future endeavor

Regards
Mrs. S. Gede

District Manager – Amathole Health District

Date.
20/03/2015

Appendix D: Informed consent

S.A. Ngoma Ethics Human 2011

<<Approved >>

OFFICE USE ONLY

Ref:	Date:

University of Fort Hare
Together in Excellence

Ethics Research Confidentiality and Informed Consent Form

Please note:

This form is to be completed by the researcher(s) as well as by the interviewee before the commencement of the research. Copies of the signed form must be filed and kept on record

(To be adapted for individual circumstances/needs)

Siphokazi Amanda Ngoma from the University of Fort Hare, Department of Nursing is asking you to answer some questions, which we hope will benefit your community and possibly other communities in the future.

The University of Fort Hare / Department/ organization is conducting research regarding; an intervention for high-risk type 2 diabetic clients during preconception and internatal in re-engineering of primary health care. Our interest is to identify women of childbearing age with predisposing factors of type 2 diabetes in order to prevent the occurrence of type 2 diabetes and strengthen preconception or internatal care through the PHC re-engineering program; as well as to reduce mortalities and morbidities caused by type 2 diabetes. We are carrying out this research:

- ✓ To identify and describe women of childbearing age with predisposing factors of type 2 diabetes.
- ✓ To identify and describe women with type 2 diabetes before 24 weeks of pregnancy.
- ✓ To describe the effect of exercise and healthy balanced diet to women with predisposing factors for type 2 diabetes and type 2 diabetes before 24 weeks of pregnancy.

Please understand that you are not being forced to take part in this study and the choice whether to participate or not is yours alone. However, we would really appreciate it if you do share your thoughts with us. If you choose not take part in answering these questions, you will not be affected in any way. If you agree to participate, you may stop me at any time and tell me that you don't want to continue answering the questionnaire. Also those who will be requested to exercise and educated on dietary changes may stop any time when they want to. If you do this there will also be no penalties and you will NOT be prejudiced in ANY way. Confidentiality will be observed professionally.

Document approved by UREC: 11 August 2011, V01

S.A. Ngoma Ethics Human 2011

<<Approved >>

OFFICE USE ONLY

Ref:	Date:

The questionnaire you will be requested to fill will not have your name, will only have case number, and no one will be able to link you to the answers you give. Only the researchers will have access to the unlinked information. The information will remain confidential and there will be no "come-backs" from the answers you give.

The questionnaire will take about 10 min to answer, and there will also be measurements done by the researcher such as your weight, height, waist-circumference, and lastly finger prick glucose testing and blood pressure measurement. The questions asked in the questionnaire please be as honest as possible and may ask me or the health workers if you are not sure.
We know that you cannot be absolutely certain about the answers to these questions but we ask that you try to think about these questions. When it comes to answering questions there are no right and wrong answers. When we ask questions about the future we are not interested in what you think the best thing would be to do, but what you think would actually happen.

If possible, our organisation would like to come back to this institution once we have completed our study to inform you and your community of what the results are and discuss our findings and proposals around the research and what this means for people in this area.

INFORMED CONSENT

I hereby agree to participate in research regarding: **An intervention for high-risk type 2 diabetic clients during preconception and internatal in Re-engineering of primary health care in Peddie, Amahlathi sub-district, Amathole Municipality, South Africa**
I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop this interview at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that this is a research project whose purpose is not necessarily to benefit me personally.

I have received the telephone number of a person to contact should I need to speak about any issues which may arise in this interview.

I understand that this consent form will not be linked to the questionnaire, and that my answers will remain confidential.

I understand that if at all possible, feedback will be given to my community on the results of the completed research.

.....
Signature of participant **Date:**.....

Document approved by UREC: 11 August 2011, V01

Appendix E: Data collection tools

Predisposing Factors to type 2 Diabetes Questionnaire

Case No ☐

Age 18-25 ☐
26-35 ☐
36-45 ☐

Number of pregnancies 0 ☐
1-2 ☐
3-4 ☐
5+ ☐

Random Blood Glucose 3.5-5.5 mmol/L ☐
5.6-10.9 mmol/L ☐
11+ mmol/L ☐

Weight (Kg) ☐

Body Mass Index less than 25 kg/m2 ☐
26-30 kg/m2 ☐
+30 kg/m2 ☐

Waist Circumference less than 88 cm ☐
88-89 cm ☐
100-105 cm ☐
+106 cm ☐

How often do you eat vegetables Once a day ☐
Once in two days ☐
Once a week ☐

1

How many serving spoons
1-2 ☐
3-4 ☐
5 ☐

How many serving spoons of carbohydrates in your plate (e.g. rice, samp etc)
1-2 ☐
3-4 ☐
5 ☐

How often do you eat fruit
Once a week ☐
Once in two days ☐
Twice a week ☐

Do you usually engage in physical activity at work and/or during leisure time
Yes ☐
No ☐

If yes how many times a week
1-2 ☐
2-3 ☐
+5 ☐

For how many minutes ☐

Do you have any member of your family diagnosed with Diabetes? (Type 1 or type 2)
Yes ☐
No ☐

If yes what is the your relationship to him/her
Grand Parents ☐
One of the Parents ☐
One of the Siblings ☐

Are preconception care services offered at the clinic? Yes ☐ No ☐

If yes have you ever utilized preconception services at your clinic? Yes ☐ No ☐

If no what were the reasons for not utilizing the preconception services? Choose any relevant answer

1. Transport ☐
2. Not clearly understanding preconception service ☐

3. Now that you know do you think you will attend the ☐

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TYPE 2 DIABETES RISK ASSESSMENT FORM

Circle the right alternative and add up your points.

1. Age

0 p. Under 45 years
2 p. 45–54 years
3 p. 55–64 years
4 p. Over 64 years

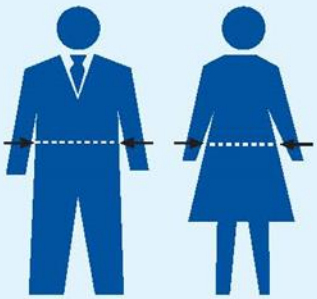
2. Body-mass index

(See reverse of form)

0 p. Lower than 25 kg/m^2
1 p. 25–30 kg/m^2
3 p. Higher than 30 kg/m^2

3. Waist circumference measured below the ribs (usually at the level of the navel)

	MEN	WOMEN
0 p.	Less than 94 cm	Less than 80 cm
3 p.	94–102 cm	80–88 cm
4 p.	More than 102 cm	More than 88 cm



4. Do you usually have daily at least 30 minutes of physical activity at work and/or during leisure time (including normal daily activity)?

0 p. Yes
2 p. No

5. How often do you eat vegetables, fruit or berries?

0 p. Every day
1 p. Not every day

6. Have you ever taken medication for high blood pressure on regular basis?

0 p. No
2 p. Yes

7. Have you ever been found to have high blood glucose (eg in a health examination, during an illness, during pregnancy)?

0 p. No
5 p. Yes

8. Have any of the members of your immediate family or other relatives been diagnosed with diabetes (type 1 or type 2)?

0 p. No
3 p. Yes: grandparent, aunt, uncle or first cousin (but no own parent, brother, sister or child)
5 p. Yes: parent, brother, sister or own child

Total Risk Score

☐ **The risk of developing type 2 diabetes within 10 years is**

Lower than 7	**Low:** estimated 1 in 100 will develop disease
7–11	**Slightly elevated:** estimated 1 in 25 will develop disease
12–14	**Moderate:** estimated 1 in 6 will develop disease
15–20	**High:** estimated 1 in 3 will develop disease
Higher than 20	**Very high:** estimated 1 in 2 will develop disease

Please turn over

Test designed by Professor Jaakko Tuomilehto, Department of Public Health, University of Helsinki, and Jaana Lindström, MFS, National Public Health Institute.

Finnish Diabetes Association

WHAT CAN YOU DO TO LOWER YOUR RISK OF DEVELOPING TYPE 2 DIABETES?

You can't do anything about your age or your genetic predisposition. On the other hand, the rest of the factors predisposing to diabetes, such as overweightness, abdominal obesity, sedentary lifestyle, eating habits and smoking, are up to you. Your lifestyle choices can completely prevent type 2 diabetes or at least delay its onset until a much greater age.

If there is diabetes in your family, you should be careful not to put on weight over the years. Growth of the waistline, in particular, increases the risk of diabetes, whereas regular moderate physical activity will lower the risk. You should also pay attention to your diet: take care to eat plenty of fibre-rich cereal products and vegetables every day. Omit excess hard fats from your diet and favour soft vegetable fats.

Early stages of type 2 diabetes seldom cause any symptoms. If you scored 12–14 points in the Risk Test, you would be well advised to seriously consider your physical activity and eating habits and pay attention to your weight, to prevent yourself from developing diabetes. Please contact a public-health nurse or your own doctor for further guidance and tests.

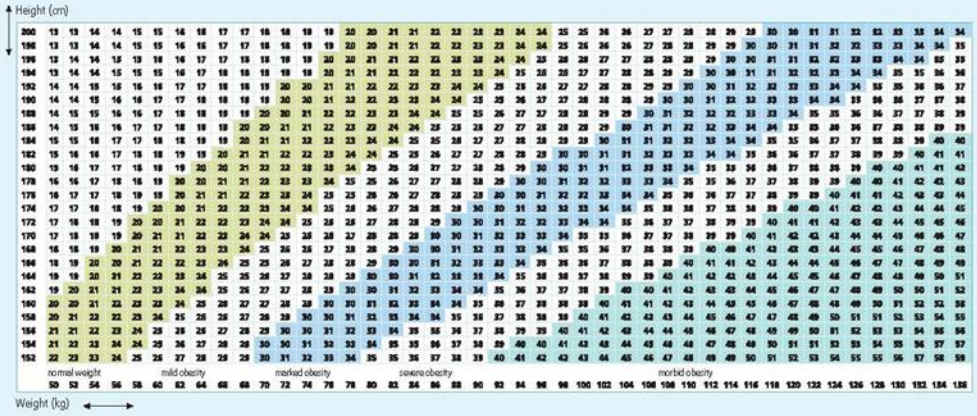
If you scored 15 points or more in the Risk Test, you should have your blood glucose measured (both fasting value and value after a dose of glucose or a meal) to determine if you have diabetes without symptoms.

BODY-MASS INDEX

The body-mass index is used to assess whether a person is normal weight or not. The index is calculated by dividing body weight (kg) by the square of body height (m). For example, if your height is 165 cm and your weight 70 kg, your body-mass index will be 70/(1.65 x 1.65), or 25.7.

If your body-mass index is 25–30, you will benefit from losing weight; at least you should take care that your weight doesn't increase beyond this. If your body-mass index is higher than 30, the adverse health effects of obesity will start to show, and it will be essential to lose weight.

BODY-MASS INDEX CHART



Appendix F: Letter from the Editor

ROMITO Consulting
~Your professional Research Partner~

19 June 2018

Declaration of Professional Edit

I, RM Kajiita, hereby confirm that a dissertation titled:

'An Intervention for High-Risk Type 2 Diabetic Clients during Preconception and Internatal in Re-Engineering of Primary Health Care'
By

Siphokazi Amanda Ngoma

has been edited and proof read by me. My role was restricted to language usage and spelling, completeness, consistency and logic flow of sentences; formatting of headings, captions, and tables of contents. Thus, I did not re-write the content, and therefore, the quality of the content remains entirely to the author.

I am academically and technically qualified to do this work. I am an associate member of Professional Editors Guild of South Africa and I have worked as Language and Writing Consultant for three years at University environment. I edit Masters and Doctoral theses, as well as articles for journal publications.

Disclaimer: The edited work described here may not be identical to that submitted. The author, at his/her sole discretion, has the prerogative to accept, reject, or change amendments made by the editor before submission.

Sincerely,

Dr.RM KAJIITA

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