DEVELOPMENT AND IMPLEMENTATION OF A FAMILY-CENTRED NUTRITION AND EXERCISE PROGRAMME FOR DIABETES MELLITUS PATIENTS OF BLOUBERG MUNICIPALITY, LIMPOPO PROVINCE

by

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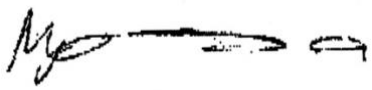
DECLARATION

I, **Mphasha "Pitso" Mabitsela Hezekiel**, declare that **DEVELOPMENT AND IMPLEMENTATION OF A FAMILY-CENTRED NUTRITION AND EXERCISE PROGRAMME FOR DIABETES MELLITUS PATIENTS OF BLOUBERG MUNICIPALITY, LIMPOPO PROVINCE,** is my own original research work. All sources that I have used or quoted have been indicated and acknowledged by means of complete references. Moreover, I declare that this work has not been submitted before for any other degree at any other institution.



25/04/2022

Mphasha "Pitso" Mabitsela Hezekiel Date

DEDICATION

This thesis is dedicated to my wife Lebo, and first-born child Azania Mphasha.

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ABSTRACT

Background: The increase in diabetes prevalence is often accompanied by comorbidities and complications, which negatively impact on the quality of life of patients. Poor dietary intake and physical inactivity lead to obesity and contribute to diabetes prevalence and poor outcomes. Non-diabetic family members of patients are already at risk of developing diabetes due to a family history of the disease. Therefore, this study was aimed at developing and implementing a family-centred nutrition and exercise diabetes care programme for better outcomes and fewer new cases.

Methodology: This study employed a mixed method approach, where convergent parallel design was used where quantitative and qualitative data were collected. For the quantitative strand, 400 subjects participated in the study (i.e., 200 diabetes patients and 200 family members). Diabetes patients were selected using stratified random sampling from rural clinics, while family members were selected using the sampled patients. For the qualitative strand, 17 diabetes patients were purposively sampled, and data saturation was reached. Two set of questionnaires (for patients and family members) were used to collect quantitative data, while one-on-one interviews with patients were used to collect qualitative data. Phase 2 involved development and validation of an intervention program. The validation involved a process where professional experts were used for validation using Delphi technique. Phase 3 included implementation and program evaluation wherein post-implementation quantitative survey was conducted on 100 participants (50 patients and 50 family members), who were purposively sampled from list of those who participated in Phase 1. Quantitative data was analysed using SPSS Software v27.0, while qualitative data analysed using 8 Steps of Tesch's inductive, descriptive open coding technique.

Results: In Phase 1, the results showed that over half of patients (57%), compared to 38% of family members, were obese; and that most patients (75%), compared to 55% of family members, had abdominal obesity. Close to half of patients (45%), compared to 31% of family members, had overall excellent nutrition and exercise diabetes care knowledge. The majority of patients (73%), compared with 25% of family members, had overall positive attitudes towards nutrition and exercise diabetes care. Only 15% of diabetes patients compared with 9% of family members had overall good practice

related to nutrition and exercise diabetes care. In Phase 3, it was reported that the majority of both patients (84%) and family members (100%), respectively indicated that the organization of the educational intervention was commendable. All patients (100%) and family members (100%) indicated that the health education strategies used stimulated their interest and were very helpful to their learning.

Conclusion: A family-centred nutrition and exercise diabetes care programme was developed, implemented and evaluated. Diabetes patients and family members indicated that the intervention was helpful to their learning and met their expectations. Therefore, there is an urgent need for the adoption of the family-centred nutrition and exercise diabetes care programme to achieve healthy eating and increased physical activity. The adoption of healthy eating and physical activity among diabetes patients and their non-diabetic family members will subsequently lead to better diabetes outcomes, and minimizing new cases, respectively.

Key Concepts

Family-centred Nutrition and Exercise Diabetes Care Programme; Diabetes Patients; Family Members; Development; Implementation

ABBREVIATIONS

AADE: American Association of Diabetes Educators

ADA: American Diabetes Association

CLR: Comprehensive Literature Review

DOH: Department of Health

DSME: Diabetes Self-Management Education

DSMS: Diabetes Self-Management support

FCC: Family-Centred Care

IDF: International Diabetes Federation

MNT: Medical Nutrition Therapy

NCDs: Non-Communicable Diseases

POT: Practice Orientated Theory

RDM: Research Data Management

SA: South Africa

SEMDSA: Society for Endocrinology, Metabolism, and Diabetes of South Africa

SSA: Sub-Saharan Africa

SPSS: Statistical Package for the Social Science

STATSSA: Statistics South Africa

T1DM: Type 1 Diabetes Mellitus

T2DM: Type 2 Diabetes Mellitus

TREC: Turfloop Research Ethics Committee

WHO: World Health Organisation

DEFINITION OF CONCEPTS

CLINIC

The KwaZulu-Natal Department of Health (2018) defines a *clinic "*as a facility at and from which a range of primary health care services are provided and that is normally open for eight or more hours a day, based on the need of the community to be served". In this study, *clinic* is defined as the primary healthcare facility providing medical diabetes treatment to people living with diabetes mellitus in Blouberg Municipality, Limpopo Province.

DEVELOPMENT

The Society for International Development Israel Branch (2018) defines *development* "as a process that creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components". In this study, *development* is defined as the procedure by which the outcomes of the investigation prompt the planning of actions to be tested for appropriateness, and finally consolidated as detailed activities of family-centred nutrition and exercise programme to be implemented.

DIABETES OR DIABETES MELLITUS

Escott-Stump (2015) defines *diabetes* "as a group of diseases described by high blood glucose coming about because of deformities in insulin action emission, insulin action or both". In this study, *diabetes mellitus* is defined as an individual with either Type 1 and/or Type 2 diabetes mellitus or receiving medical diabetes treatment in clinics of Blouberg Municipality, Limpopo Province.

EXERCISE

WHO (2018) defines *exercise* "as any real development created by skeletal muscles that requires vitality consumption". In this study, *exercise* alludes to moves made to bring down glucose control through any real development delivered by skeletal muscles that requires vitality use.

FAMILY-CENTRED CARE

Silva *et al.,* (2011) define *family-centred care "*as an approach to healthcare delivery which empowers the family as an ally in the care of an individual". In this study, *family*

-centred care is defined as the process of capacitating families about their roles and responsibilities in the life modification programme through good nutrition and exercise in the care of diabetes mellitus patients for better management of the disease.

FAMILY MEMBERS

The Institute for Patient and Family-Centered Care (2014) defines family members "as at least two people who are associated in any way i.e., biologically, legally, or emotionally". In this study, *family members* are defined as non-diabetic persons residing in the same household with diabetes patients.

IMPLEMENTATION

Escott-Stump (2015) defines *implementation* "as the component of the nutrition care process that translates assessment data into strategies, activities, or intervention that will enable the client to meet the established objectives". In this study, *implementation* is defined as the execution of the developed family-centred nutrition and exercise programme using theoretical framework and the outcomes of the situational analysis.

NUTRITION

The World Health Organisation (2018) defines *nutrition* "as the admission of food, considered in connection to the body's needs". In this study, *nutrition* refers to the admission of food appropriate for diabetes management.

PATIENT

The World Health Organisation (2012) defines *patient* "as a person who is a recipient of health care". In this study, *patient* is defined as a person living with diabetes of any type and getting medical diabetes treatment in clinics of Blouberg Municipality, Limpopo Province.

PROGRAMME

The Programme Management Institute (2018) defines "a *programme* as a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually". In this study, a *programme* is alluded to as a point-by-point design of activities that will direct the researcher to encourage family members to get engaged in caring for diabetes mellitus patients through nutrition and exercise in Blouberg Municipality, Limpopo Province.

TYPE 1 DIABETES MELLITUS

The World Health Organisation (2018) defines *Type 1 diabetes mellitus* “as a type of diabetes mellitus in which the pancreas fails to produce the insulin which is essential for survival”. In this study, *Type 1 diabetes mellitus* is defined as an insulin-dependent type of diabetes mellitus.

TYPE 2 DIABETES MELLITUS

The World Health organisation (2018) defines *Type 2 diabetes mellitus”* as a type of diabetes mellitus which results from the body’s inability to respond properly to the action of insulin produced by pancreas.” In this study, *Type 2 diabetes mellitus* is defined as non-insulin dependent type of diabetes mellitus.

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CHAPTER ONE:
INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This chapter introduces the study by providing background on diabetes as a condition, its prevalence, predisposing factors, importance of nutrition and exercise in diabetes care, and family involvement in diabetes care. Furthermore, the chapter outlines the problem statement and purpose of the study, as well as the significance of the study. It also briefly discusses a summary of the literature review and research methodology. In addition, the chapter outlines an overview of chapters of the study.

1.2 BACKGROUND

According to the International Diabetes Federation (IDF) (2015), Diabetes Mellitus remains a public health problem with 422 million people living with diabetes, constituting a global prevalence rate of 9% (World Health Organization (WHO), 2017). The prevalence of diabetes amongst people aged between 18-99 years was reportedly at 8.4% in 2017 and predicted to rise to 9.9% by 2045 (IDF, 2014). In 2016, diabetes mellitus was the direct cause of 1.6 million deaths and the seventh cause of death globally (WHO, 2017). Diabetes has recently been found to be a high-risk Non-Communicable Disease (NCD) linked to COVID-19 deaths worldwide. Diabetes prevalence has been increasing more rapidly in less developed countries than in developed countries (WHO, 2017). In Africa, South Africa (SA) has the fifth-highest population of diabetes patients, which is estimated at 2.6 million, and more than 1.5 million people with undiagnosed diabetes mellitus (IDF, 2013). Type-2 Diabetes Mellitus (T2DM) remains more common, with 2 million persons being diagnosed with T2DM in SA (IDF, 2015; Stats SA, 2014). Limpopo Province has the fourth highest prevalence of diabetes at 5.2% (Statistic South Africa (Stats SA), 2014).

According to the South African National Burden of Disease Team, Medical Research Council, and Personal Communication (2016), South Africa faces multiple burdens of disease, namely Communicable diseases, Perinatal, Maternal and Nutritional (Comm/Mat/Peri/Nutr) conditions; NCDs, and injuries. Mortality rates in South Africa increased between 1997 and 2006 and declined thereafter until 2015, mainly due to the HIV epidemic and the roll-out of ARTs (Stats SA, 2016). There has been a

significant decline in HIV and TB and Comm/Mat/Peri/Nutr conditions in 2015, while there has been an increase of prevalence and burden of NCDs such as diabetes (Stats SA, 2016). Diabetes has been reported as the seventh highest cause of death in SA (Stats SA, 2014). However, HIV remains the priority of the National Department of Health (NDOH), while perinatal and maternal health remains a priority in Limpopo Province (South African National Burden of Disease Team, Medical Research Council, and Personal Communication, 2016), despite declining Comm/Mat/Peri/Nutr conditions and increasing burden of NCDs such as diabetes. Diabetes is amongst the leading causes of death in the districts of SA, including Limpopo (Stats SA, 2014). Central to diabetes mellitus prevalence is obesity, which has been identified as one of the main predisposing factors to all NCDs (Ganu, Fletcher & Caleb, 2016). Obesity results from bad eating habits and physical inactivity characterized by imbalance in energy intake and expenditure, leading to increased body fat stores (Tuei, Maiyoh & Chung-Eun, 2010).

It has been reported that relentless obesity upsets metabolic processes which control blood glucose, blood pressure and lipids (James, Rigby & Leach, 2004). Physical inactivity and unhealthy eating habits are contributing significantly to rising diabetes prevalence (WHO, 2016). Aging, gender and the number of ethnic groups of high risk in the population contribute to the increasing prevalence rates of T2DM (Marín-Peñalver *et al.,* 2016). The growing diabetes mellitus epidemic has been associated with rapid urbanization and changing lifestyles in low- and middle-income countries (Blas & Kuru, 2010). The diabetes mellitus epidemic is associated with increased prevalence and mortality rates (Cho *et al.,* 2018). Environmental factors have also been found to significantly contributing to the diabetes epidemic (Yang *et al.,* 2019; Compean-Ortiz *et al.,* 2017). A family history of diabetes, as well as smoking, also increase the risk of acquiring T2DM (WHO, 2016).

Diabetes patients are at an increased risk of complications and other health problems (van Wyk, 2015), particularly if the disease is poorly managed. Over time, when diabetes is poorly managed, high blood glucose damages the body's blood vessels, disrupting the usual blood flow (van Wyk, 2015) and causing complications such as cardiovascular disease, hypertension, erectile dysfunction, retinopathy and kidney disease. Several studies posit that identification of risk factors can be used as benchmarks to design appropriate prevention measure to minimize the risk and

severity of complications (Shiferaw, Akalu & Aynalem, 2020; Esposito & Giugliano, 2011). Diabetic patients require ongoing evaluation of complications and should regularly monitor glucose levels (IDF, 2015). According to the National Institute of Diabetes (2015), patients should be examined 2-3 times a year in order to acquire information on nutrition, exercise and overall management of diabetes, as well as diabetes-related complications. According to the World Health Organization (WHO) (2014), diabetes is costly to manage, and more costly in the presence of complications. The management cost of diabetes amounts to $1.31 trillion, which accounts for 1.8% of the 2015 global gross domestic product (Seuring *et al.,* 2015). Maintenance of blood glucose, blood pressure and cholesterol at or close to normal would assist in the prevention and control of complications, and subsequently reduce the financial healthcare burden of diabetes-associated complications. Therefore, there is a need for governments to introduce and implement regulations to decrease risk factors for T2DM and gestational diabetes and ensure appropriate access to treatment for all diabetes mellitus patients (Cho *et al.,* 2018).

Nutrition and exercise are essential in the management of diabetes for all age groups and gender (IDF, 2013; Colberg *et al.,* 2016). Furthermore, WHO (2016b) points out that a series of cost-effective interventions are required in diabetes management, irrespective of the type, to improve health outcomes. Because of high food costs, most South Africans including diabetes mellitus patients eat less fruits and vegetables, fatty food, sugar and other refined starches (Shisana *et al.,* 2017; National Department of Health, 2015). Studies reported that those staying in urban areas turn to change from eating the healthy traditional diet to eating food high in refined carbohydrate, saturated fats, and cholesterol, and low in fibre (Sobngwi, Mauvais-Jarvis, Vexiau, Mbanya, & Gautier*,* 2001; Misra & Khurana, 2008). Large cohort studies have reported that normal exercise is associated with decrease in cardiovascular and general mortality of 39-70%, a more than 15-to-20-year time frame in patients with T2DM (Hu *et al.,* 2005; Society for Endocrinology, Metabolism, and Diabetes of South Africa (SEMDSA), 2017).

Diabetes has been widely studied, including assessment of Knowledge, Attitude and Practices (KAP) related to nutrition and exercise among diabetes patients. However, family-centred nutrition and exercise diabetes care have not yet being thoroughly explored in SA and other less developed countries. However, in developed countries

such as Sweden and Canada, Family-Centred Diabetes Care has been studied and adopted as an important chronic care model (Reynolds, Dennis, Hassan, Slewa, Chen, Tlan, Bobba & Zwar, 2018). Family involvement in self-care interventions may positively influence patients' diabetes outcomes (Baig *et al.,* 2015). A study of more than 5000 participants with diabetes by Kovacs *et al.,* (2013) indicate the importance of family, relatives and colleagues in improving well-being and self-management of diabetes. The family members may be distressed by the diabetes status of their loved ones, particularly when they have poor knowledge of the condition or not knowing how best to provide support (Rosland *et al.,* 2010). At times, family members may have misconceptions, like believing that their loved ones with diabetes know more about the management of the disease than the patients actually report or also not understanding their loved ones' needs in diabetes management (Baig *et al.,* 2015). Knowledge about diabetes management, strategies to change family lifestyle through nutrition and exercise, and other means to cope with conditions are some of the diabetes self-care management tools the family needs (Hu *et al.,* 2013). Most of patients' diabetes management take place inside their families and social surrounding (Baig *et al.,* 2015). Therefore, the researcher developed Family-Centred Nutrition and Exercise Diabetes Care in SA for the improvement of the diabetes outcomes and quality of life of diabetic patients.

The Department of Health (DOH) in SA, in an attempt to manage chronic diseases including diabetes mellitus introduced Chronic Disease Outreach Program (CDOP) to follow-up on patients, particularly those with Non-Communicable Diseases (NCDs) (Mayega, Guwatudde, Makumbi, *et al.,* 2014). In line with CDOP, health professionals such as dietitians and physiotherapists among others regularly visit Primary Health Care (PHC) facilities to see patients requiring specialist attention. The patients seen at these facilities by visiting health professionals are referred by PHC staff particularly nurses. Thus far, the CDOP aided in improving poorly-controlled patient care, improved nurses' knowledge and confidence, and in early detection of new cases (Mayega *et al.,* 2014). However, in spite of the growing prevalence of diabetes mellitus in the Blouberg municipality, dietitians and physiotherapists see few referred diabetes patients during clinic outreach services. The few patients seen during outreach services have uncontrolled diabetes mellitus, are obese and show symptoms of complications, with additional non-communicable diseases and comorbidities which

could have been a result of poor control of diabetes. The researcher believes that one of the factors which contribute to diabetes patients not honouring their dietetics and physiotherapy appointments, could be a lack of family support, since family members are not mobilized on the importance of nutrition and exercise in diabetes management.

1.2.1 Problem Statement

Physical inactivity and poor nutritional status remain a problem among the general South African population, including diabetes patients, who should be adopting an active lifestyle. Rural areas such as Senwabarwana in Limpopo have been progressively urbanized resulting in rising levels of physical inactivity and unhealthy eating. Most of the poor families eat more of porridge and vegetables such as spinach, cabbage and traditional vegetables, however, the problem is the cooking method. Vegetables are overcooked and with lot of water resulting in the loss of nutrients which are essential in diabetes management. Food portioning is critical in diabetes management, meaning, intake of large food portion sizes is discouraged since it increases blood glucose (IDF, 2013). However, most of the families in South Africa consume large portion sizes, while engaging in less physical activity, resulting in imbalance between energy intake and output. The family culture of food intake of large portions, eating patterns and lifestyle have serious impact on the dietary behaviours of patients and subsequently influencing diabetes outcomes for those who already suffer from diabetes. In the event the family embraces culture of eating healthy food and taking part in physical activity, it will also encourage diabetes mellitus patients to lead a healthy lifestyle and ultimately improving diabetes management (IDF, 2013).

Less developed countries are burdened by NCDs and communicable diseases, yet they still emphasize preventative care even without enough financial power to manage diseases. Developed countries such as Sweden and Canada have advanced their strategies in the management of diabetes and included family-centred care, which has been found to be positively influencing diabetes outcomes and improving quality of life of diabetes patients (Reynolds *et al.,* 2018). However, it is a concern that less developed countries such as South Africa have not incorporated and implemented the family-centred care in diabetes management. So far, in SA, the family-centred diabetes care has been successful and produced better diabetes outcomes among children who are helped by family members to carry certain relevant task related to

self-care practices (Ingerski *et al.,* 2010). Less focus has been given to older patients, who have been found to be mostly affected by diabetes. Therefore, this study focuses on diabetes patients aged 18 years and above and seeks to close the gap. It is against that background that the researcher seeks to develop and implement family-centred nutrition and exercise programme in order to involve and capacitate family members in diabetes management through nutrition and exercise interventions, to improve diabetes control in Limpopo Province.

1.3 PURPOSE OF THE STUDY

The purpose of this study is described according to aim, objectives and research questions, as follows:

1.3.1 Aim

The aim of this study was to develop and implement a family-centred nutrition and exercise programme for diabetes mellitus patients in Blouberg Municipality, Limpopo Province.

1.3.2 Objectives

The aim of this study was achieved through the eight objectives which were categorized according to the following phases:

Phase 1: Situational analysis

- To determine knowledge of nutrition and exercise in the management of diabetes among patients and family members at Blouberg Municipality, Limpopo Province.
- To determine attitude towards nutrition and exercise in the management of diabetes among patients and family members at Blouberg Municipality, Limpopo Province.
- To determine practice of nutrition and exercise in the management of diabetes among patients and family members at Blouberg Municipality, Limpopo Province.
- To determine anthropometric parameters (BMI and waist circumference) of diabetes patients in Blouberg Municipality, Limpopo Province.

- To explore diabetes mellitus patients' perceived quality of life post diagnosis in Blouberg Municipality, Limpopo Province.

Phase 2: Development and validation of family-centred nutrition and exercise diabetes care programme.

- To develop and validate family-centred nutrition and exercise programme for diabetes mellitus patients in Blouberg Municipality, Limpopo Province.

Phase 3: Implementation of family-centred nutrition and exercise diabetes care programme.

- To implement family-centred nutrition and exercise programme for diabetes mellitus patients in Blouberg Municipality, Limpopo Province.

Research question

- Can diabetes patients' benefit from a family-centred nutrition and exercise programme?

1.4 PROCESS OF LITERATURE SEARCH

Comprehensive Literature Review (CLR) was used as a method to collect supporting literature related to family-centred diabetes care. Literature review involved evaluating discoveries of other researchers. We started literature search using keywords such as "family centered care"; "nutrition and exercise diabetes management"; "Prevalence, risk factors and complications of diabetes"; "Knowledge, attitudes, practices of diabetes patients"; "Quality of life and anthropometric measurements in diabetes"; and "Development and implementation of health interventions". The sources used included books, department of health reports, databases, journal articles such as Google Scholar, PubMed, Science Direct, J STOR Scholars, Portal Journals and more. Only sources written in English were included and sources were limited to the past 10 years so as to use recent literature, however, older sources were used in the absence of recent publications.

1.5 SUMMARY OF RESEARCH METHODOLOGY

1.5.1 Research design

The overall study design applied in this study is intervention study design. The design enabled the researcher to develop and implement family-centred nutrition and exercise diabetes care programme. The study was conducted in 3 phases and involved application of various research design per phase.

Phase 1 applied convergent mixed method parallel design which involved collection of quantitative and qualitative data at the same time. Quantitative strand used cross-sectional descriptive design to determine anthropometric measurements, knowledge, attitudes and practices regarding nutrition and exercise diabetes care, and included both patients and family members as participants. Qualitative strand used phenomenological exploratory design to explore QoL post-diagnosis and included only diabetes patients as participants. Phase 2 applied cross-sectional developmental and validation design based on the results of phase 1 and involved professional experts for validation of developed programme. Phase 3 applied implementation and evaluation design where researcher educated and demonstrated to patients and family members on nutrition and exercise in diabetes care, and consisted of post implementation quantitative survey, which included for both diabetes patients and family members as participants.

1.5.2 Study setting

The study was conducted at the clinics of Blouberg Municipality in the Senwabarwana area of Capricorn District Municipality, Limpopo Province of South Africa. The study was implemented in the clinics of Blouberg Municipality which had 20 or more diabetes patients receiving treatment.

*1.5.3 **Population***

The target population in this study were diabetes mellitus patients (406) receiving treatment at clinics of Blouberg municipality, and one family member per diabetes patient.

1.5.4 Sampling

A multi sampling method was used in this study, which enabled the researcher to cluster clinics per area within Blouberg Municipality, and thereafter a suitable sampling technique was used per phase. Phase 1 applied mixed method sampling, which enabled the researcher to apply suitable sampling technique per quantitative and qualitative approaches. The quantitative approach included the selection of 200 diabetes patients using systematic random sampling where every second patient was selected in a clinic. Each selected patient was requested to bring one family member yielding a total of 200 family members. Qualitative approach included selection of 17 patients using purposive sampling, and that sampling was depended on data saturation. Phase 2 included the use of 2 professional experts from universities to verify the applicability and content of the family-centred nutrition and exercise programme. Phase 3 included 50 diabetes patients and 50 family members selected using convenient sampling.

1.5.5 Data collection

Data collection was done per phase. Phase 1 used both quantitative survey and qualitative interview. Two quantitative surveys were conducted for patients and family members using 2 close-ended questionnaires. The questionnaire for patients had 5 sections i.e., (1) Socio-demographic profile, (2) Anthropometric measurements, (3) Knowledge, (4) Attitudes and (5) Practices related to nutrition and exercise diabetes care. Whilst, questionnaire for family members only had 4 sections i.e., (1) Socio-demographic profile, (2) Knowledge, (3) Attitudes, and (4) Practices. Qualitative data were collected through unstructured interviews using voice recorders, and field notes for non-verbal cues observed which couldn't be captured by the voice recorder during interviews. A central question was used and asked to each participant and further probing were done based on their responses. Phase 2 involved 2 experts who made recommendations and comments on the drafted programme, while phase 3 included use of one questionnaire with five questions.

1.5.6 Data quality

Data quality involved rigor of both quantitative and qualitative research. Quantitative measure of rigor was ensured through reliability and validity. Reliability was ensured through piloting the questionnaire in non-participating clinics and yielded no changes.

Content validity was ensured by using peers (dietitians and supervisors). Qualitative measure of rigor was ensured through trustworthiness, by ensuring credibility, transferability, confirmability and dependability. Credibility was ensured by follow-up interviews with participants; Transferability was ensured through probing; Confirmability was ensured through independent coder after researcher own independent analysis, and Dependability was ensured through depending on the supervisors and use of both voice recorders and field notes.

1.5.7 Data analysis

Quantitative data analysis was done through coding data and entered it into the Statistical Package for Social Sciences for analysis. Descriptive statistics was used where frequency distributions, means and standard deviations were calculated. Chi-squared test was used to calculate associations @ 95% confidence interval where p-value of <0.05 was considered statistically significant. Qualitative data analysis was analysed using 8 steps of Tesch's open coding (Cresswell, 2014). Researcher firstly analysed data from individual in-depth interviews and also submitted data in the form verbatim transcripts to independent coder. A researcher and independent coder met in a consensus meeting and agreed on themes and sub-themes based on the ones which emerged when analysing independently. Participants direct quotations are also made and captured in italic format to support findings. Literature is also used to support findings.

1.5.8 ***Bias***

The researcher avoided researcher bias through addition of research assistants during data collection, while sampling bias was minimized through adherence to systematic random sampling method in clinics with many diabetic patients. The systematic bias was minimized through calibration of weighing scale each day before and after weighing patients and taking measurements thrice.

1.5.9 ***Ethical consideration***

Turfloop Research and Ethical Committee (TREC) granted ethical approval to conduct the study before commencement (Appendix A). The Department of Health (DOH) Limpopo Province gave permission to administer questionnaires and interview participants (Appendix C). Additionally, Operational Nursing Managers at each clinic

of Blouberg Municipality also gave verbal approval. Informed consent was used to obtain information from participants, which they filled and signed before data collection. Confidentiality and privacy of participants was ensured by only availing information obtained from participants to people involved in the study, i.e., researcher, supervisor, co-supervisor, and independent coder. Anonymity was ensured through ensuring that participants, instead coding was done.

1.6 SIGNIFICANCE OF THE STUDY

This study developed a programme to promote effective and appropriate participation of family members in the care of diabetes patients through nutrition and exercise care in Blouberg Municipality, Limpopo Province. The programme also promotes the adoption of family-centred nutrition and exercise diabetes care by the clinics in the area. The developed programme sought to encourage adoption of healthy eating and an active lifestyle. Again, the programme sought to improve diabetes control, delay or prevent complications and also minimise chances of family members who are at risk due to family history from being diagnosed with diabetes. The findings of the study also informed the Department of Health of the quality of life of diabetes patients, enabling the improvement in the diabetes care strategy. Also, the findings of the study informed the Department of Health of the high prevalence of obesity among diabetes patients and their family members, enabling improvement in health education to curb increase in prevalence. The developed programme assembled diabetes team at clinic levels and also defined their roles for effective family-centred nutrition and exercise diabetes care. The programme also encourages collaboration between the healthcare facilities and the families of diabetes patients in providing an ongoing support. Family members of patients will also benefit from the programme by improving knowledge on how best to care for loved ones through nutrition and exercise.

1.7 OVERVIEW OF CHAPTERS

This thesis has seven chapters as outlined below:

CHAPTER 1: INTRODUCTION AND BACKGROUND OF THE STUDY

This chapter provides the overview of the whole study ranging from source and background of research problem, problem statement, purpose of the study, theoretical framework, literature review, research methodology and ethical considerations. The

chapter further provides the significance of the study and provides outline of what subsequent chapters are all about.

CHAPTER 2: LITERATURE REVIEW

The literature review provides critical review of available literature relating to the research problem. It gives overview of diabetes, its causes, classification, complications, and nutrition and exercise diabetes care management. The literature review is further discussed according to the objectives of the study, and provides overview of family involvement in diabetes care, knowledge, attitudes, and practices related to diabetes, anthropometric measurements, quality of life of patients, and the development of health programmes. This chapter discusses the theoretical framework which guided the study. The study used Practice Orientated Theory (POT) to develop a family-centred nutrition and exercise diabetes care programme based on the six components, which are: Agents, Recipients, Context, Process, Resources, Dynamics and Outcomes. The six components of the POT are explained and discussed.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter discusses the research approach and methodology used in this study. It discusses research design, site, and population and sampling. The overall design used in this study is intervention study design. Phase 1 applied mixed method convergent parallel design. The quantitative strand used cross-sectional descriptive design, while the qualitative strand applied phenomenological exploratory design. Phase 2 used cross-sectional developmental and validation design using professional experts to validate family-centred nutrition and exercise diabetes care programme. Phase 3 applied implementation design where researcher educated patients and family members on the benefits of nutrition and exercise in diabetes care. Data quality, analysis, bias and ethical considerations are further discussed in detailed.

CHAPTER 4: PRESENTATION AND DISCUSSIONS OF RESULTS OF PHASE 1

This chapter focuses on the presentation, interpretation and discussion of the results of phase 1. Convergent mixed method parallel study design was applied in this phase, where diabetes patients participated in both quantitative and qualitative stands, therefore, quantitative and qualitative results of patients are presented, interpreted and discussed. The mixed method results of diabetes patients are presented through joint display through merging and comparison. Family members only participated in the

quantitative strands, therefore, results are presented, interpreted and discussed. Literature support is used in the discussion of the results.

CHAPTER 5: DEVELOPMENT AND VALIDATION OF THE FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

The chapter outlines and describes the development of family-centred nutrition and exercise diabetes care programme. The draft programme is presented first pending validation. Programme validation is discussed including involvement of 2 professional experts from Universities in SA were used to validate the development programme. The final family-centred nutrition and exercise diabetes care programme is further presented after it has been validated.

CHAPTER 6: IMPLEMENTATION OF FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

This chapter focuses on the implementation of the family-centred nutrition and exercise diabetes care programme. The chapter further outlines and discusses the results of the evaluation of implementation of the educational programme.

CHAPTER 7: CONCLUSION, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

This chapter presents the conclusion, recommendations and limitations of the study. The conclusion and recommendations of the study are based on the outcomes of all phases, i.e., phase 1-3. The contribution of the study to the body of knowledge on family-centred nutrition and exercise diabetes care is also outlined and discussed.

1.8 SUMMARY

This chapter introduced the study and further outlined diabetes mellitus as a public health problem by highlighting its prevalence and mortality rates. The chapter further discussed risk factors, complications, and nutrition and exercise diabetes management, as well as the importance of family involvement in diabetes care. The aims, objectives and research question of the study were discussed, as well as the problem statement. The chapter also discussed literature review, research methodology, data quality and analysis, as well as ethical considerations. The chapter also discussed the significance of the study as well as overview of chapters. The next chapter discusses the literature review related to the research problem.

Chapter TWO:
LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter background, problem statement, purpose and outline of the entire study. This chapter outlines literature sources, and also discusses diabetes according to classification, diagnosis, and nutrition and exercise diabetes care management. The objectives of this study were taken into account in the discussion of the literature review. This chapter is comprised of eleven sub-sections. The *first sub-section* discusses literature sources, the *second sub-section* discusses nutritional and exercise management of diabetes, while the *third sub-section* discusses family-centred care. The *fourth sub-section* discusses prevalence of diabetes, and classification, risk factors and complications of diabetes, the *fifth sub-section* discusses anthropometric measurements in diabetes. The *sixth sub-section* discusses knowledge related to diabetes management, while the *seventh sub-section* discusses attitudes related to diabetes management and the *eighth sub-section* discusses practices related to diabetes management. The *ninth sub-section* discusses quality of life of diabetes patients, while the *tenth sub-section* discusses development and implementation, and the *eleventh sub-section* discusses theoretical framework.

2.2 RATIONALE FOR CONDUCTING LITERATURE REVIEW

Literature review is explained as “a systematic and explicit approach to the identification, retrieval and biographical management of independent studies usually drawn from published sources for locating information on a topic, synthesizing conclusions, identifying areas for future studies and developing guidelines for clinical practice” (Brink, van der Walt and van Rensburg, 2016). The literature review in this study was conducted so as to learn from others, generate new ideas, summarise the known and gaps on the subjects related to the objectives of this study.

2.2.1 Literature sources and method

The purpose of the literature review was to evaluate the discoveries of other researchers related to research problem. We started literature search using keywords such as “family centered care”; “nutrition and exercise diabetes management”; “Prevalence, risk factors and complications of diabetes”; “Knowledge, attitudes, practices of diabetes patients”; “Quality of life and anthropometric measurements in

diabetes"; and "Development and implementation of health interventions". The sources used included books, department of health reports, databases, journal articles such as Google Scholar, PubMed, Science Direct, J STOR Scholars, Portal Journals and more. Only sources written in English were included and sources were limited to the past 10 years so as to use recent literature, however, older sources were used in the absence of recent publications.

The literature review method applied in this study was the Comprehensive Literature Review (CLR) (Onwuegbuzie & Frels, 2016), which gave credibility to the research. The data was thoroughly assessed as it were, and furthermore in a moral and culturally progressive way. The following steps were followed:

Step 1: Investigating convictions and themes.

Step 2: Starting the search.

Step 3: Putting away and arranging data.

Step 4: Choosing/deselecting information

Step 5: Growing the pursuit media, perceptions, archives, experts and auxiliary information.

Step 6: Examining and synthesizing data.

Step 7: Displaying the CLR report in a composed shape.

Inclusion criteria for literature sources

- Articles, books, journals and reports on anthropometric measurements and diabetes.
- Articles, books, journals and reports on knowledge, attitudes, and practices related to nutrition and exercise diabetes care.
- Articles, books, journals and reports on the quality of life of diabetes patients.
- Articles, books, journals and reports on family support and involvement in diabetes care.

Exclusion criteria

- Articles, books, journals and reports which are not published in English.

2.3 NUTRITION AND EXERCISE MANAGEMENT OF DIABETES

2.3.1 Nutrition management of diabetes mellitus

Studies have revealed that Medical Nutrition Therapy (MNT) is essential in diabetes management, prevention and delaying of its associated complications, achievement of good glycaemic control, good lipid profile and blood pressure control (Evert *et al.,* 2014; Jain *et al.,* 2014). Diet quality and quantity over the longer period is relevant to the prevention and management of diabetes and its complications through a wide range of metabolic and physiological processes (Forouhi *et al.,* 2018). Energy restricted diet is recommended to achieve weight loss in the management of T2DM, since 80% to 90% of T2DM patients are overweight or obesity (Evert *et al.,* 2014). A weight loss of 5% to 10% of body weight can substantially improve insulin sensitivity, glycaemic control, hypertension and dyslipidaemia in people with and/or at risk of T2DM (Forouhi *et al.,* 2018). Total calories should reflect the weight management goals for diabetes mellitus patients so as to prevent further weight gain, to attain and maintain a healthy or lower body weight for the long term or to prevent weight regain (Sievenpiper *et al.,* 2018).

Carbohydrates (CHO) include available CHO from starches and sugars, including unavailable CHO from fibre. The Dietary Reference Intakes (DRIs) specify a Recommended Dietary Allowance (RDA) for available CHO of no less than 130 g/day for adult women and men >18 years of age, in order to provide sufficient glucose to the brain (Food and Nutrition Board, 2005). The DRIs also recommended that the percentage of total daily energy from CHO should be ≥45% for the purpose of reducing high intake of saturated fatty acids (Food and Nutrition Board, 2005). CHO from low Glycaemic Index (GI) and high-fibre foods contribute up to 60% of total energy, with improvements in glycaemic and lipid control in adults with T2DM (Barnard *et al.,* 2006). As for weight loss, low-CHO diets for T2DM patients have not shown significant advantages for weight loss over the short term (van Wyk *et al.,* 2016). The GI provides an assessment of the quality of CHO-containing foods based on their ability to raise blood glucose (Goff *et al*., 2013). Studies have showed that replacing of high-GI foods

with low-GI foods significantly improves glycaemic control over 2 weeks to 6 months in people with diabetes mellitus (Goff *et al*., 2013; Ajala *et al.,* 2013).

Recommendations for fibre consumption for diabetes mellitus patients is 14g/1000 kcal similar to recommendations for the none-diabetic persons (Academy of nutrition and dietetics, 2013). A systematic review and meta-analysis of randomized controlled trials of ≥2 weeks duration showed that added sugars from sucrose, fructose and honey in isocaloric substitution for starch have a modest fasting TG-raising effect in diabetes patients, which was not seen at doses ≤10% of total energy (Morenga *et al.,* 2014). The RDA for total fat, Monounsaturated Fatty Acids (MUFA), Saturated Fatty Acids (SFA), or dietary cholesterol are not specified by DRIs (Food and Nutrition Board, 2005). However, The RDA for the essential Polyunsaturated Fatty Acids (PUFA) are as follows: 12 g and 11 g per day for women and 17 g and 14 g per day for men aged 19-50 years and >51 years, respectively (Food and Nutrition Board, 2005). There is no evidence that the usual protein of 1 to 1.5 g per kg body weight per day, representing 15% to 20% of total energy intake, needs to be modified for people with diabetes (Hamdy *et al.,* 2011). However, this intake should be maintained or increased with energy-reduced diets. A systematic review and meta-analysis of randomized controlled trials showed that replacement of animal protein with sources of plant protein improved HbA1C, FPG and fasting insulin in diabetes patients over a median follow up of 8 weeks (Viguiliouk *et al.,* 2015).

As indicated by Jain *et al.* (2014), the use of vitamin or mineral supplementation among diabetes patients showed no benefit as compared to the general population without underlying deficiencies. Routine supplementation with antioxidants such as vitamins E and C, carotene and chromium is not advised because of lack of evidence of efficacy and concern related to long-term safety (Jain *et al.,* 2014). Optimum micronutrients can be obtained from healthy diet with an optimal composition of macronutrients and minimally processed food items (Jain *et al.,* 2014). The use of multivitamin supplementation among diabetes patients is only recommended for elderly, pregnant or lactating women, strict vegetarians, or individuals on calorie-restricted diets (US Department of Agriculture, 2000).

2.3.2 Exercise management of diabetes mellitus

The therapeutic effects of exercise differ according to type of diabetes. It has been indicated that 80% of T2DM patients are obese and insulin resistant and just around 35% require insulin therapy (Durstine & Moore, 2003). Therefore, exercise is encouraged in combination with a healthy diet and oral anti-diabetes agents, keeping in mind the end goal to accomplish and maintain weight reduction and enhance blood glucose control (Paul *et al.,* 2012). Physical activity should be regular so as to reduce diabetes complications, maintain healthy body weight and reduce increasing prevalence (WHO, 2015). The global target of a 10% relative reduction in physical inactivity is found to be strongly associated with the global target of halting the risk in diabetes (WHO, 2016).

Physical activity has been found to have positive effects on the prevention and/or maintenance of glycaemic control and on the cardiovascular risk factors in this type of patient (Robinson *et al.,* 2016). A systematic review indicated resistance exercise of twelve weeks or more is more effective in promoting an increase in maximum oxygen uptake in diabetes patients, compared to aerobic exercise (Nery *et al.*, 2017). However, its effectiveness on glycaemic control and lipid profile was found to be inconclusive. A randomized control trial study proved that the combination of aerobic and resistance exercises offers significantly more benefits for women with GDM (Sklempe-Kokic *et al.,* 2017)

Durstine and Moore (2003) alludes that exercise is contraindicated in the following circumstances: (1) in the presence of illness or infection; (2) blood glucose is above 13.8mmol/l and ketones is present; or (3) blood glucose is 4.4 to 5.5 mmol/l because the threat of hypoglycaemia is awesome. Prudent steps to be considered before exercise, which includes accessibility of rapidly acting CHO amid exercise; consuming adequate fluids before, during and after exercise; practicing good foot care by wearing appropriate shoes and cotton socks, inspecting feet after exercise and carrying medical identification (Hornsby & Albright, 2003).

2.4 FAMILY-CENTRED DIABETES CARE

Family-Centred Care (FCC) is considered “as an approach of responding to the needs, values and cultural needs of the patient and their families (Kuo *et al.,* 2012), and begins from consultation at the healthcare facility involving healthcare professional,

patients, and family members, being involved in decision-making and shared leadership" (Carman *et al.,* 2013). Family members are often asked to share responsibility in support of the person living with diabetes; this responsibility includes driving patients to appointments, and social and emotional support, among others. The FCC in diabetes care has so far produced better outcomes in younger children who are usually cared for by their parents or families, since younger children are unable to perform certain tasks related to self-care (Ingerski *et al.,* 2010). The aim of the FCC is to maintain and strengthen family bond and roles so as to provide healthy family functioning, and at the same time improving the Quality of Life (QoL) of patients, as well as minimizing new cases involving family members who are already at risk due to family history (Baig *et al.,* 2015).

Living alone is linked with increasing depression, poor diabetes outcomes and increased mortality (Mayberry, Rothman & Osborn, 2014). The family support and care for patients, with daily living activities which includes meal preparation and consumption, physical activity, collection of medication, bathing and clothing, distribution of household chores, , and honouring of medical appointments. Families also help patients cope `with the diabetes and also may be required to financially support the patients so as to daily meet the activities of daily living. Quality of life and better glycaemic outcomes have been associated with family support (Mayberry, Rothman & Osborn, 2012). Actions of family members in providing support to diabetes patients may be harmful and lead to poor diabetes outcomes (Mayberry, Rothman & Osborn, 2014), particularly when family members are not knowledgeable about how best to take care of family member with diabetes. Factors which have been found to negatively impact on the family-centred care includes lack of understanding of the concept of family-centred diabetes care by both healthcare providers and patients, loss of income and insufficient research on family-centred care in diabetes (Hu *et al.,* 2013; Rosland *et al.,* 2013). Benefits of family-centred diabetes care include: (1) reduction of treatment costs (Seuring, Archangelidi & Suhrcke, 2015), (2) reduction/prevention of complications (Mayberry, Rothman & Osborn, 2014), (3) improvement of haemoglobin A1c by 1% in T2DM patients (Healy *et al.,* 2013), and (4) improvement of clinical and psychological impact of diabetes by improving quality of life (Mayberry, Rothman & Osborn, 2014).

2.5 PREVALENCE OF DIABETES MELLITUS

Diabetes Mellitus is a silent pandemic with rising prevalence and affects 3.8% of the global population (Ghane'i & Golkar, 2013). According to World Health Organization (WHO) (2017), over 90% of the diabetes cases are Type 2 Diabetes Mellitus (T2DM) cases and that over 80% of diabetes cases are those living in developing countries (Morrison *et al.,* 2014). The International Diabetes Federation (2017) projected that 592 million people, the equivalent to 1 in 10 people worldwide, will have diabetes by 2035. In developed countries such as United States (US), around 21 million people were diagnosed with diabetes in the year 2012, of which 95% had T2DM and approximately 8 million people or more had undiagnosed diabetes (Centers for Disease Control (CDC), 2014). The US study further reported higher prevalence of diabetes mellitus among African American women compared to white, of which 15% of African American black women aged 20 and older compared to 6.2% of white women (Go *et al.,* 2013). Another developed country, Spain, has diabetes prevalence rates of 13,8% among persons aged 18 years of age and above (Moreno *et al.*, 2019), of which 90% of the diabetes mellitus cases being T2DM (Soriguer *et al.,* 2012). Spain has the T2DM prevalence rates of 9.1% (Alonso-Morán *et al.,* 2015), particularly in the Basque country. In underdeveloped counties such as Malaysia, diabetes prevalence has increased from 8,3% in 1996 to 15,2% in 2010, among adults aged 30 years or above (Hussein *et al.,* 2015).

In Africa, an estimated 19,4 million people aged 20-79 were living with diabetes, and with a prevalence rate of 3,9% (IDF, 2019). Africa has the highest prevalence of undiagnosed diabetes, with about 60% of adults living with diabetes unaware (IDF, 2019). Type-2 Diabetes Mellitus is most common in Africa and has become a public health problem, and its prevalence is expected to increase by 110% over the next two decades (IDF, 2015), from 19.8 million individuals in 2013 to 41.5 million by 2035 (IDF, 2015). According to Pheiffer et al. (2018), the proportion of undiagnosed diabetes in Africa stands at 69,2% and that 77% of diabetes deaths occurred in individuals younger than 60 years of age, emphasising the magnitude of the diabetes epidemic. Prevalence of T2DM in Africa is reportedly at 4.4% and 7.0% in low-income and upper-middle income countries, respectively (IDF, 2015). Sub-Saharan Africa (SSA) has more cases of T2DM, estimated at 90–95% of all cases (Herman, Schmitt, Gahr *et al*.,2015), whereas 5-10% of other diabetes cases are T1DM and gestational diabetes.

The T2DM rates are anticipated to increase to 156% in SSA, from 16 million adults in 2017 to 41 million in 2045 (IDF, 2017). The overall prevalence of diabetes mellitus in SSA is between 2.7% and 17.9%, and varies widely based on the socioeconomic status of the country, area, and the gender of the individuals (Capingana *et al.,* 2013). A Northern Sudan study highlighted prevalence of diabetes is at 19% and 2.5% in urban and rural areas, respectively (Elmadhoun *et al.,* 2016). Population-based studies in both rural and urban Kenya reported diabetes prevalence rates ranging from 3.5% to 5%, with higher proportions among those in the urban areas (Ayah *et al.,* 2013; Oti et al., 2013).

In South Africa, almost 2.3 million people had diabetes in 2015, with prevalence rate of 7% amongst South Africans aged 21 to 79 years have diabetes mellitus (IDF, 2015). The magnitude of the diabetes burden in SA is further reflected in the statistics of mortality and causes, which demonstrated that diabetes has moved from being the fifth leading underlying cause of death in 2013 to being the third and second leading underlying cause of death in 2014 and 2015, respectively (Stats SA, 2015). South Africa also has a problem of people living with undiagnosed diabetes, with 5 million people with undiagnosed diabetes mellitus (IDF, 2012). In the 2000, excess body weight was considered the cause of over 87% of diabetes cases in South Africa (Pheiffer *et al.,* 2018), which raises serious concern since 38% and 69% of South African men and women were respectively considered to be overweight or obese (Ng *et al.,* 2013). Overweight or obesity due to bad eating habits and physical inactivity contribute mainly to diabetes prevalence (Ganu, Fletcher & Caleb, 2016). Western Cape is the leading province in SA with the highest prevalence of diabetes of 5.2%, while Limpopo Province is the fourth province with highest diabetes prevalence of 6.9% (Stats SA, 2014). In all districts of Limpopo Province, diabetes is amongst the 10 leading causes of death in all districts of Limpopo Province including Capricorn district were Blouberg Municipality is located (Stats SA, 2014).

2.6 CLASSIFICATION, RISK FACTORS AND COMPLICATIONS OF DIABETES

According to WHO (2016), there are main types of diabetes which is Type-1 Diabetes Mellitus (T1DM) and T2DM, however, T2DM is the most common type of diabetes (IDF, 2013). The risk factors of T2DM are determined by an interplay of genetic and metabolic factors, ethnicity, family history of diabetes, aging, and overweight and

obesity, unhealthy diet, physical inactivity and smoking to increase risk (WHO, 2016). Higher waist circumference and higher Body Mass Index (BMI) are said to be increasing risk of T2DM, though the relationship may vary in different populations (IDF, 2013). Several dietary practices are linked to unhealthy body weight and/or T2DM risk, including high intake of saturated fatty acids, high total fat intake and inadequate consumption of dietary fibre (WHO, 2015). High consumption of sugar-sweetened beverages and increased risk of T2DM (Imamura *et al.,* 2015). Early childhood nutrition affects the risk of T2DM later in life; of which factors increasing risk include poor fetal growth, low birth weight particularly if followed by rapid postnatal catch-up growth and high birth weight (Nolan *et al*., 2011; WHO, 2014). Active and passive smoking increases the risk of T2DM, with the highest risk among heavy smokers (IDF, 2013).

Diabetes complications such as cardiovascular diseases and erectile dysfunction result from unhealthy eating, lack of exercise and nonadherence to treatment. Cardiovascular Disease (CVD) is the common prevalent complication of diabetes and a major cause of death and disability among people with diabetes (IDF, 2015; IDF, 2016). The CVD affects the heart and blood vessels, causing complications such as coronary artery disease, heart attack, and strokes (van Wyk, 2015). High blood pressure, high cholesterol, high blood glucose and other risk factors contribute to increased risk of cardiovascular complications (IDF, 2015). Diabetes mellitus patients have 1.5 times higher risk of having a stroke than people who do not have diabetes (van Wyk, 2015). Erectile Dysfunction is a serious and common complication of Diabetes Mellitus (Kaya, Sikka & Gur, 2015). The prevalence of erectile dysfunction has been reported to be 1-10% in younger men below the age of 40 years, 2-9% among men aged 40-49 years, 20-40% among those aged 60-69 years, and 50-100% in men above the age of 70 years (Shiferaw, Akalu & Aynalem, 2020). The prevalence of erectile dysfunction among African men is estimated to at 71,45%, while in SA is at 77,1% (Shiferaw, Akalu & Aynalem, 2020). It has been found that erectile dysfunction is two to threefold higher in MLWD, as compared to nondiabetic men (Seid *et al.,* 2017). A South African cross-sectional study reported that 97.3% of male diabetics were suffering from erectile dysfunction (Bongongo, Ndimande & Tumbo, 2019) due to cardiovascular risk factors and penile arterial insufficiency (Maiorino, Bellastella & Esposito, 2014).

2.7 ANTHROPOMETRIC MEASUREMENTS IN DIABETES

Anthropometric measurements are used to estimate risk factors of different diseases (Bulum *et al.,* 2016), including diabetes and obesity. The prevalence of obesity has been reported through a simple weight to height index called Body Mass Index (BMI) which reflects total body fat but does not reflect patterns of fat distribution (Awasthi *et al.,* 2017). Overweight is only linked with T2DM morbidity, while obesity is linked with increased morbidity and mortality from diabetes and its complications (Awasthi *et al.,* 2017). The BMI characterization is similar between genders and ethnic groups (Bulum *et al.,* 2016). On the other side, the cut-offs for anthropometric indexes of abdominal adiposity called Waist Circumference vary by gender (Kamath, Shivaprakash & Adhikari, 2011). Various studies have linked the waist circumference with cardiovascular risk, prevalence of diabetes and incidences of hypertension (Spollett, 2013; Unnikrishnan, Anjana & Mohan, 2014). Higher waist circumference and higher Body Mass Index (BMI) are considered as risk factors for T2DM, though the relationship may differ with populations (Bulum *et al.,* 2016). Several studies have reported that central obesity which is measured through waist circumference, is an important and superior risk factor for development of T2DM, as compared to the general obesity which is measured through BMI (Marcadenti *et al.,* 2011; Spollett, 2013; Bulum *et al.,* 2016).

Other anthropometric measurements for central obesity are Waist-to-Hip Ratio (WHR) and Waist-to Height Ratio (WtHR). It has been found that the WtHR was able to predict the need of weight management, intra-abdominal fat, cardiovascular risk, and mortality (Dagan *et al.,* 2013; Jowitt, Lu & Rush, 2014). According to Awasthi et al. *(*2017), a Chinese population-based study reported that WtHR was the best anthropometric index predicting diabetes mellitus. The WHR considers that waist circumference might over or under assess dangers of different height of individuals with same waist circumference, while WtHR corrects waist circumference for height and can be used in different ethnic, age and gender for central obesity (Bulum *et al.,* 2016). A study conducted in South Asia reported lower obesity rates as per BMI and higher waist circumference and WHR indicating a greater degree of central body obesity (Unnikrishnan, Anjana & Mohan, 2014).

2.8 KNOWLEDGE RELATED TO DIABETES MANAGEMENT

Diabetes-related nutrition and exercise knowledge is one of key element which can make an individual follow a healthy lifestyle (Spronk *et al.,* 2014). Poor nutrition and exercise diabetes care knowledge contribute fundamentally to both increasing diabetes prevalence and poor diabetes control (Spronk *et al.,* 2014). It likewise adds towards complications associated with diabetes and increasing diabetes mortality rate. It likewise adds to ignorance, which contribute to increasing prevalence particularly among those with family history of diabetes, since heredity is found to significantly contributing to diabetes diagnosis (Scott *et al.,* 2013). Poor nutrition and exercise knowledge also normalizes lifestyle which immensely contributes to obesity, which is recognized as one of the main predisposing factors to diabetes (Ganu, Fletcher & Caleb, 2016). Knowledge deficits of patients about diabetes management coupled with concerns related to information overload, which patients gets from health professionals often leads to non-compliance of treatment (Raaijmakers *et al.,* 2013). The reasons for poor control of diabetes include lack of knowledge about the illness and low levels of social support from family members (Yin *et al.,* 2016). Several studies have focused on how to enhance patients' knowledge or awareness on diabetes and its management using educational interventions (Strom & Egede, 2012; Bhurji *et al.,* 2016).

According to Ajzen et al. (2011), knowledge alone is no guarantee for the adoption of healthy behaviour, much as ignorance is hugely responsible for unhealthy behaviour. Moreover, a combination of knowledge and motivation to change behaviour yield good behaviour change (Ajzen *et al.,* 2011). Knowledge enables patient to assess diabetes risk, seek proper treatment and care, and also inspire them to lead a healthy lifestyle to defeat their disease. Diabetes patients with good knowledge of the disease and its dire complications turn to take appropriate measure to control the disease (Shrivastava, Shrivastava & Ramasamy, 2013), by honouring their medical appointments. Diabetes knowledge among patients minimises chronic comorbidities, which impact significantly on the quality of life of patients. Patient who are knowledgeable about self-care practices get to achieve better diabetes control for a sustained period of time (Powers *et al.,* 2015). Adequate diabetes knowledge may pursue Type-2 Diabetes Mellitus (T2DM) patients adhere to self-management practices (Al-Sahouri, Merrell & Snelgrove, 2019), however, despite these benefits it

is worrisome that international knowledge and awareness of diabetes stays low (Breen *et al.,* 2015), hence diabetes prevalence is increasing. Global knowledge associated with diabetes management has been found to be insufficient, regardless of the fact that it is an important factor in the management of the disease Al-Sahouri, Merrell & Snelgrove, 2019). There have been few clinical based studies in Bangladesh on knowledge about diabetes among people living with or without diabetes (Farzana *et al.,* 2012). A cross-sectional South African study conducted in Vhembe district of Limpopo Province have reported poor diabetes knowledge among patients (Ralineba, Netshikweta & Shilubane, 2015).

2.9 ATTITUDES RELATED TO DIABETES MANAGEMENT

According to Muchiri, Gericke and Rheeder (2016), attitudes is considered "as the most important determinants of behaviour and behaviour change in diabetes patients". Attitudes towards diabetes and its treatment are associated with the degree of self-care, including adherence to diabetes dietary plan, exercise, and medication (Fogelman, Goldfracht & Karkabi, 2015). It has been found that diabetes patients with positive attitudes towards their diabetes are more likely to adopt an active lifestyle, change behaviour to control their diabetes as compared to patients with negative attitudes (Muchiri, Gericke & Rheeder, 2016). Although, diabetes is considered the most important determinant of behaviour change and adoption of healthy lifestyle and adherence to diabetes treatment, previous studies have reported poor attitudes regarding autonomy of patients and psychosocial impact of the disease (French, Wade & Farmer, 2013). A South African cross-sectional study which assessed attitudes among T2DM patients in the Free State reported negative attitudes towards diabetes among patients, which may contribute to morbidity and mortality (le Roux et al., 2019). However, another South African study which also assessed attitudes of T2DM in Gauteng has in contrary reported positive attitudes towards diabetes treatment and lifestyle modifications, which may contribute to better diabetes outcomes (Okonta, Ikombele & Ogunbanjo, 2014).

A Bangladesh cross-sectional study which assessed attitudes reported that positive attitude towards diabetes management and support from friends and family were associated with adequate diabetes management. Appropriate public health interventions should be designed to educate and motivate the family members to offer

greater support to the diabetes patients (Shawon *et al.,* 2016). Positive attitudes and adequate knowledge are very essential potential mediators of dietary and related health behavioural change for better diabetes outcomes; therefore, diabetes interventions should consider knowledge and attitudes to produce better outcomes and improve quality of life of patients (Muchiri, Gericke & Rheeder, 2016). A cross-sectional study which assessed both knowledge and attitudes reported positive attitudes and poor knowledge among T2DM patients towards diabetes and healthy lifestyle modifications (Okonta, Ikombele & Ogunbanjo, 2014). Another cross-sectional study which assessed both attitudes and knowledge has in contrary reported poor knowledge and attitudes towards diabetes (le Roux et al., 2019).

2.10 PRACTICES RELATED TO DIABETES MANAGEMENT

Practice related to diabetes management is critical and involves whether diabetes patients are implementing and adhering to new treatment regimen tasks and attempting to minimize distress caused by the disease (Hood *et al.,* 2015). Practices related to diabetes care includes remembering and administering medication, honouring medical appointments, adhering to diabetes self-care practices, monitoring glucose levels, and adhering to dietary treatment and physical activity (IDF, 2017). Behavioural changes and intensive lifestyle interventions are key components in the management of T2DM (le Roux *et al.,* 2019). Despite practice related to diabetes management being critical, diabetes patients are still unable to adhering to new treatment tasks (Muchiri, Gericke & Rheeder, 2016). A cross-sectional study which assessed practices of patients related to healthy lifestyle modifications in diabetes, have reported poor practice amongst T2DM patients (Okonta, Ikombele & Ogunbanjo, 2014). Another cross-sectional study conducted in Lebanon which also assessed practices related to diabetes management reported poor practice among people living with diabetes (Karaoui *et al.,* 2018). Similar findings of poor practice related to diabetes management among patients were also reported by a cross-sectional study conducted in Mpumalanga (Umeh & Nkombua, 2018), therefore there is an urgent need to employ new measure to improve practices so as to improve diabetes outcomes and quality of life.

It has been reported that adequate knowledge and positive attitudes may lead to the adoption of healthy lifestyle and overall behaviour change (Muchiri, Gericke &

Rheeder, 2016). Positive Knowledge, Attitude and Practice (KAP) are important for diabetes mellitus patients, and its elements are interrelated and dependent on each other. If the level of one element is higher, the other two factors must be positively affected. The KAP regarding diabetes vary substantially and relies on socio economic conditions, cultural beliefs and habits (Reza *et al.,* 2014). An India KAP study of diabetes patients regarding diabetes awareness and complications were good, however, practices related to abandoning alcohol and smoking were poor (Jaiswal *et al.,* 2019). A South African KAP study reported poor knowledge, negative attitude and poor practices related to diabetes management (le Roux et al., 2018). A Jordan KAP study about diabetes also reported poor knowledge, negative attitudes, and poor practice among diabetes patients (Alsous *et al.,* 2019). Therefore, there is an urgent to design diabetes intervention to improve knowledge and attitudes to improve practice for better diabetes outcomes, since knowledge and attitudes are considered as determinants of practice (Muchiri, Gericke & Rheeder, 2016).

2.11 QUALITY OF LIFE OF DIABETES MELLITUS PATIENTS

The mere existence of diabetes negatively impacts the quality of life of patients, which is worsened in the presence of complications (Trikkalinou *et al.,* 2017). The negative way the presence of diabetes impacts the patient's QoL includes the psychological impact of being chronically ill, dietary restrictions, changes in social life, symptoms of inadequate metabolic control, chronic complications and ultimately lifelong disabilities (Pichon-Riviere *et al.,* 2015; Daya, Bayat & Raal, 2016). It has been reported that diabetes patients from low-income countries can maintain a high QoL like patients when treated with insulin (Raghavendra, Viveki & Gadgade, 2017). An Argentinian study which used Audit of Diabetes Dependent Quality of Life (ADDQoL) to measure QoL of diabetes patients when evaluating diabetes programs, reported that the scores of QoL did not differ from those reported in studies that included patients from high-income countries where there is access to a high level of diabetes care (Pichon-Riviere *et al.,* 2015). An Indian observational study reported that nearly half of the diabetes patients (48.6%) had good QoL (Raghavendra, Viveki & Gadgade, 2017). An Iranian study which evaluated quality of life of diabetes patients reported that men with diabetes compared to females, non-insulin-treated patients compared with insulin-treated patients had better QoL (Mohammadi *et al.,* 2016). The study further reported

that patients with HbA1c less than 7% had better quality of life compared with those with higher HbA1c (Mohammadi *et al.,* 2016).

Various studies reported that many variables such as age, gender, socio-economic status, obesity, type of diabetes, treatment, chronic complications, health insurance, quality of care and patient education have been associated diabetes patients' Health-Related Quality of Life (HRQoL) (Pichon-Riviere *et al.,* 2015; Daya, Bayat & Raal, 2016). Studies have shown that HRQoL is associated with the duration of diabetes, age, gender, diabetic complications, comorbid diseases, and the severity of the disease itself (Pichon-Riviere *et al.,* 2015; Daya, Bayat & Raal, 2016). The South African study which assessed the HRQoL using Diabetes 39 (D-39) questionnaire reported an association between HbA1c and HRQoL, and no association was found between HRQoL and other clinical parameters such as number of insulin units used per day, exercise, BMI, lipogram and the use of OHAs (Daya, Bayat & Raal, 2016). An Indian observational study reported that the presence of diabetes had significantly affected HRQoL especially the social relationship domain (Raghavendra, Viveki & Gadgade, 2017). Diabetes patients in Botswana have been found to have relatively poor HRQoL Rwegerera *et al.,* 2018).

2.12 DEVELOPMENT AND IMPLEMENTATION OF DIABETES PROGRAMMES

Developing a diabetes intervention includes identifying and prioritising health issues and needs, choosing ways to cope with them and committing support and resources for quality health promotion activities (Muchiri *et al.,* 2013). Development process should be an inclusive and participatory process involving the community of interest in determining action (Afemikhe *et al.,* 2016). Needs is regarded "as what is essentially necessary step for the development and functionality of the people, and that the need is created by a state of disequilibrium" (Beran, 2015). In the context of health, it is regarded as the disturbance in health and well-being (Beran, 2015), therefore it is required to develop need assessment before developing or introducing diabetes intervention. The programme should take into account the literacy level, socio-cultural context and locality of programme, since lack of transport has been cited as the reason many diabetes patients with low income and low educational background failing to attend health educational programmes (ADA, 2016). A Tanzanian mixed method study which evaluated needs assessment for diabetes patients with retinopathy reported low

levels of stigma surrounding diabetes patients including low levels of self-efficacy along with high levels of anxiety and depression (Hall *et al.,* 2016).Furthermore, the study showed confusion over what constitute a healthy diet and the need for comprehensive, accessible diabetes dietary education, so as to improve diabetes control, prevents complications including retinopathy (Hall *et al.,* 2016). The findings of the needs assessment enabled the development of diabetes interventions aimed at raising community awareness, involve family and relative in the care of diabetes patients for better diabetes outcomes (Burgess *et al.,* 2013).

According to WHO (2016), diabetes interventions to implement includes dietary therapy, increased physical activity and pharmacological therapy consisting of oral hypoglycaemic drugs or insulin should only be considered in the presence of marked hyperglycaemia. Furthermore, the interventions recommends that patients and families should be empowered with skills and knowledge related to diabetes (Chrvala, Sherr & Lipman, 2016), for better outcomes and improvement of quality of life. South African Department of Health also adopted WHO guidelines in the management of diabetes (Society for Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA), 2017), however, implementation has been a challenge (Daya, Bayat & Raal, 2016). Despite efforts taken to implement diabetes interventions, behavioural changes among diabetes patients are still a problem which is associated with inaccessibility to adequate food, lack of safe places for physical activity, poorly coordinated diabetes education and lack of other essential self-management resources (Peek *et al.,* 2014). Diabetes patients live among the communities, and with family and friends, and that are from various cultural background which influences behaviour (Peek *et al.,* 2014), which influences behaviour therefore, such factors should be considered in the development and implementation of diabetes intervention for better outcomes. Behaviour change is influenced by number of factors including knowledge and attitudes which are important determinants of behaviour change (Muchiri, Gericke & Rheeder, 2016). It has been found that education programmes that contain behaviour change approaches are extra effective in changing behaviour (Long *et al.,* 2015). Behaviour change is a complex process which requires theoretical foundation during planning any behavioural intervention programme (Eric *et al.,* 2013). Theory enables greater understanding of the relationships among factors that influence behaviour change (Dombrowski, 2016).

Diabetes education programmes could be delivered using a face-to-face approach, written material, telephone and electronic methods (Michie & Johnston. 2013). Studies have reported that the face-to-face teaching method is the most typically used worldwide and has proved to be linked with better health outcomes in diabetes self-management education programmes, even among the disadvantaged populations (Michie & Johnston. 2013; McMillan *et al.,* 2016). Social support is an important element in dietary behaviour change (Michie & Johnston. 2013). Social interactions can provide good models for healthy eating and feedback that can reinforce or modify one's self-evaluation. Peers, family and professionals can provide emotional support in addition to patients' challenge, stereotype or negative expectations concerning proposed change. Social persuasion assists in improving individual's confidence and might also help diabetes individuals improve their self-care behaviours (Baig *et al.,* 2015). Interventions often brings positive outcomes. However, maintenance of the outcome remains a problem particularly among minority groups and those with low income (Michie & Johnston. 2013).

2.13 THEORETICAL FRAMEWORK

This study used the POT developed by Dickoff, James and Wiedenbach's (1968), and has six elements: Agents, Recipients, Context, Process, Resources, Dynamics and Outcomes. The use of this framework enabled the researcher to develop a diabetes intervention programme, in consideration of the findings of the situational analysis. Additionally, all components of this theory are operationalized to demonstrate how it fits in the development of the intervention. In this study, the POT directed the development of family-centred nutrition and exercise diabetes care programme based on the outcomes of phase 1.

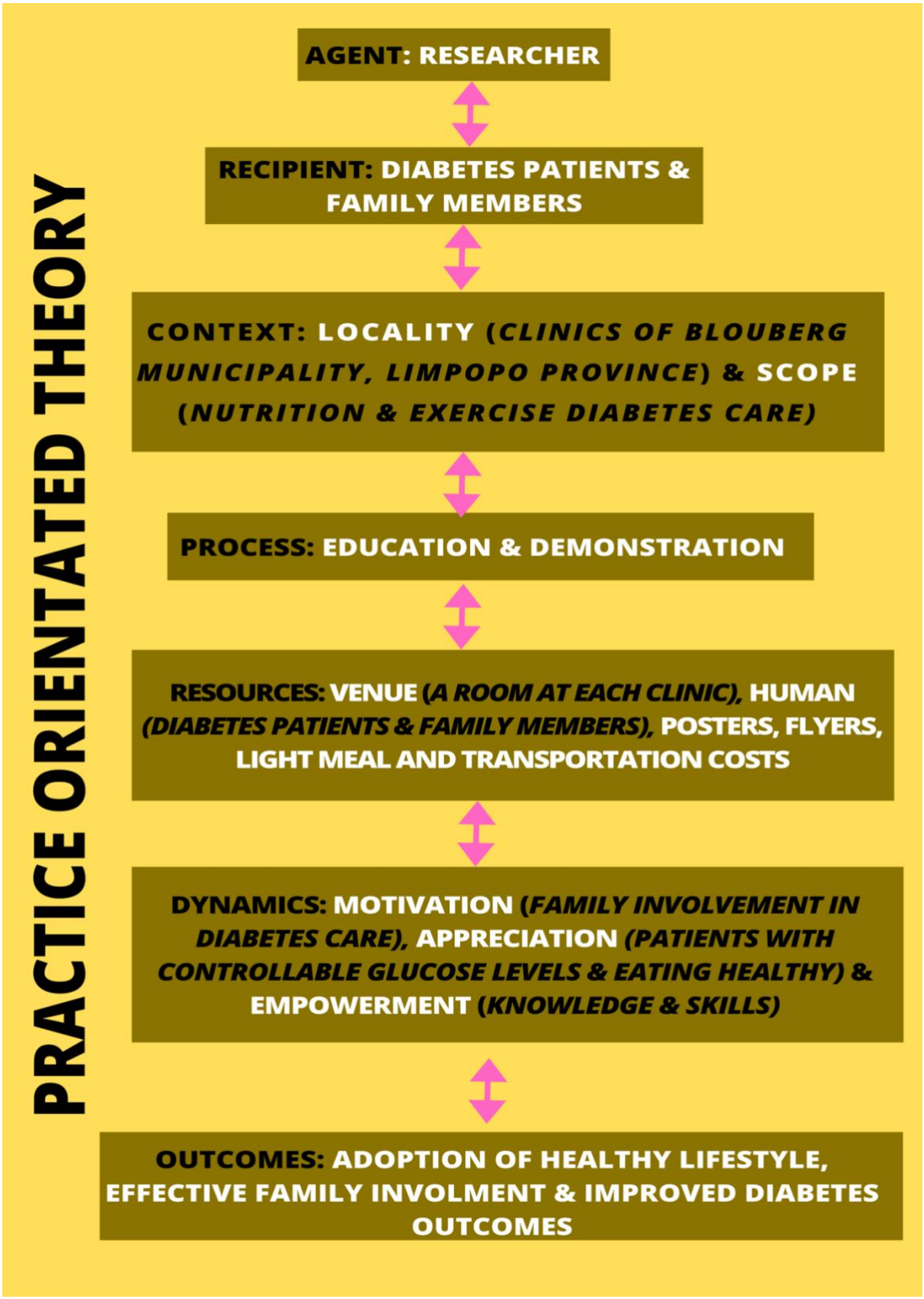


Figure 2.1: Schematic representation of the application of Practice Orientated Theory

2.13.1 Application of theoretical framework in programme development

As demonstrated by Polit and Beck (2014) theory is “the basic purpose of science since it outperforms the specifics of a particular time, place, and group of people in the relationships among variables”. In this study, Practice Orientated Theory (Dickoff, James & Wiedenbach’s, 1968) is used in the development of family-centred nutrition and exercise diabetes programme, as follows:

2.13.1.1 Agent for performing activity

The agents are individuals who offer the activity. In this study, the agents are researcher and research assistants. Researcher provides overall nutrition and exercise education and demonstration with help of physiotherapists, while research assistants support the researcher.

2.13.1.2 Recipients of the programme

The recipients of the activity receive the prescription of the activity from the agents so as to achieve desired outcomes (Dickoff *et al.,* 1968). Recipients are “the primary beneficiary of the of the intervention”. The primary recipients of this programme are diabetes patients and their family members.

Diabetes patients as recipients

Diabetes patients who get their diabetes treatment at the public clinics are the primary recipients since the programme is aimed at improving their diabetes outcomes, and quality of life.

Family members of diabetes patients as recipients

Family members of diabetes patients are also primary recipient of the programme since the programme is aimed at encouraging effective involvement of family members in diabetes care as for improved diabetes outcomes of patients.

2.13.1.3 Context

Context is defined as “an environment or setting that doesn’t just think about the physical aspects or locality, but policies governing or directing the activity at hand” (Pfadenhauer, Gerardus, Mozygemba *et al.,* 2017). All factors happening during engagement of the agent with recipient towards yielding desirable outcome could be

included as the context (Meleis, 2012). Therefore, the context for this intervention consists of the locality and scope.

Locality of the programme

The recipients of this programme are diabetes patients receiving diabetes treatment and their families at the clinics of Blouberg Municipality of Capricorn District, Limpopo Province. Therefore, the programme is implemented in the clinics of Blouberg Municipality in the Senwabarwana area.

Scope of the programme

As indicated context is “not only limited to physical location, but also directing activity at hand” (Pfadenhauer *et al.,* 2017), therefore directing activity in this instance is scope of the programme or educational guidelines as well as behavioural change process. A need assessment is required “to enable designing educational programme which deals with local needs of the target population” (Beran, 2015). The scope of the intervention or programme is based on the results of phase 1 of this study.

2.13.1.4 Process

The process emphasises the path, steps or patterns to perform activity. Meleis (2012), regards processes “as steps taken by the agent so as to realize desired goal. Programme implementation is regarded as the act of applying a programme taking into consideration resources and targeted population” (Michie & Johnston. 2013). Guidelines are considered as “essential foundations for healthcare policy, planning, delivery, evaluation and quality improvement by clinicians, managers and policy makers” (Gadliard & Alhabib, 2015). Guidelines are sought to translate the complexity of scientific research findings into recommendations that can enhance healthcare quality and outcomes (National academic press, 2013, cited in Galgliard and Alhabib (2015). Implementation guidelines for the intervention are to provide education and practical demonstration. Additional guidelines include:

- To have face to face group talk with participants.
- To use educational tool such posters and pamphlets to facilitate knowledge and behavioural change.
- Arrange with operational managers to use clinic facility or rooms.

- The program will be implemented for a day in a particular clinic and implementation schedule will be drawn and submitted to the clinic 5 days before implementation.
- To recruit diabetes patients at the clinics and requested them to bring family members on the scheduled day.

2.13.1.5 Resources needed

Resources are key in programme implementation. Resources in this context refers to "equipment's, financial or human resources which can help with intervention practically on the implementation level and those which will give political support" (Michie & Johnston. 2013). Therefore, the following resources are needed for the implementation of this programme:

- Facility at the clinic for programme to take place.
- Educational tool (Flyers and wall posters) to use during imparting of knowledge and facilitating behaviour.
- Transportation costs to get patients and family members to and from clinic.
- Light meal for the period of implementation.
- Clinic nurses to help in securing participants and venue.
- Diabetes patients and families as participants or recipient.

2.13.1.6 Dynamics

According to Dickoff *et al.* (1968), dynamics are "chemical, physical and psychological power sources driving the activity towards the attainment of a goal". In addition, dynamics are the motivating factors driving the performance of activities towards attainment of desired outcomes. Also, for the programme to achieve its intended outcomes, it requires certain power basis which are *motivation, appreciation* and *empowerment*.

Motivation which is defined as "the reason why somebody does something" (Oxford school learner dictionary 2015), serves as the energy source for family-centred diabetes care. Therefore, family members are alerted and motivated to assist diabetes patients, so as to assist themselves since the quantitative survey of the situational analysis revealed that family members are overweight, which implies they are at risk of having diabetes.

Appreciation is regarded “as pleasure that you have when you recognize and enjoy the good qualities of something” (Oxford advanced learner dictionary, 2015). The researcher, as the agent, appreciates family members who are effectively involved in diabetes care starting from consultation and have gained more knowledge, which made them reduce chances of having diabetes. also, diabetes patients who have consulted dietitians and physiotherapist and are engaged in a healthy lifestyle and are not experiencing any diabetes complications.

Empowerment is regarded “as the process by which participation of self and others to decision making” (Booyens & Bezuidenhout, 2017). Empowerment in this context involve the researcher educating and skilling patients and their families on how to change behaviour, adopt a healthy lifestyle in order to improve the quality of life, prevent complications and new diabetes incidences of family members.

2.13.1.7 Outcomes/terminus

Outcome or terminus is regarded “as the desired result of care provided by the health practitioner” (Heslop & Lu, 2014). The Oxford advanced learners dictionary (2015) consider outcome that the situation to be produced at the end of the process or activity which accomplishes a feeling of satisfaction. Moreover, terminus is the ideal outcome to be achieved through the implementation of the family-centred nutrition and exercise diabetes care. Therefore, the outcomes are as follows:

- Increased exercise behaviour.
- Improved healthy eating habits.
- Improved quality of life.
- Stabilized blood glucose levels.
- Effective family involvement in diabetes care starting with consultation with patients.

2.14 CONCLUSION

This chapter discussed literature review related to nutritional and exercise management, family-centred care, prevalence of diabetes and associated risk factors and complication. The chapter further discussed literature by the objectives of the study which included anthropometric measurements in diabetes, KAP related to diabetes care, quality of life of diabetes patients, and development and implementation

of diabetes interventions. The chapter further outlined and discussed the application of the theoretical framework used in the study. The next chapter discusses the research methodology of the study.

Chapter THREE:
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter outlined literature sources and method, and also discussed literature review and theoretical framework. This chapter discuses methodology, settings, population and overall design. The chapter discusses method, sampling and data collection method applied at each phase of the study. Furthermore, data management and analysis, including data quality, bias, and ethical considerations are discussed.

3.2 OVERALL STUDY DESIGN

The research design involves a plan, structure and strategy of the study. The overall study design for this study is intervention study design. Intervention design is explained as “study design carried out for the purpose of conceiving, creating and testing innovative human services approaches to preventing or ameliorating problems” (de Vos *et al.,* 2018). The use of intervention design enabled the researcher to develop and implement the implement family-centred nutrition and exercise diabetes care programme following baseline study which revealed the need for the intervention, as well as application of practice orientated theory. The use of intervention design was a systematic process, which was conducted in 3 phases and applied relevant study design per phase, which are as follows:

Phase 1 used convergent mixed method parallel study design, wherein both quantitative and qualitative approaches were carried at the same time. *Quantitative approach* used cross-sectional study design to determine knowledge, attitudes and practices of diabetes patient and their family members regarding nutrition and exercise diabetes care, as well as anthropometric measurements of patients. While the *qualitative approach* used phenomenological study design to explore diabetes patients’ perceived QoL post-diagnosis. Quantitative and qualitative results of patients were integrated through merging for comparison.

Phase 2 used cross-sectional developmental and validation study design, which enabled the researcher to develop family-centred nutrition and exercise diabetes care programme based on the results of phase 1.

Phase 3 used implementation design, which enabled the researcher to implement the developed programme.

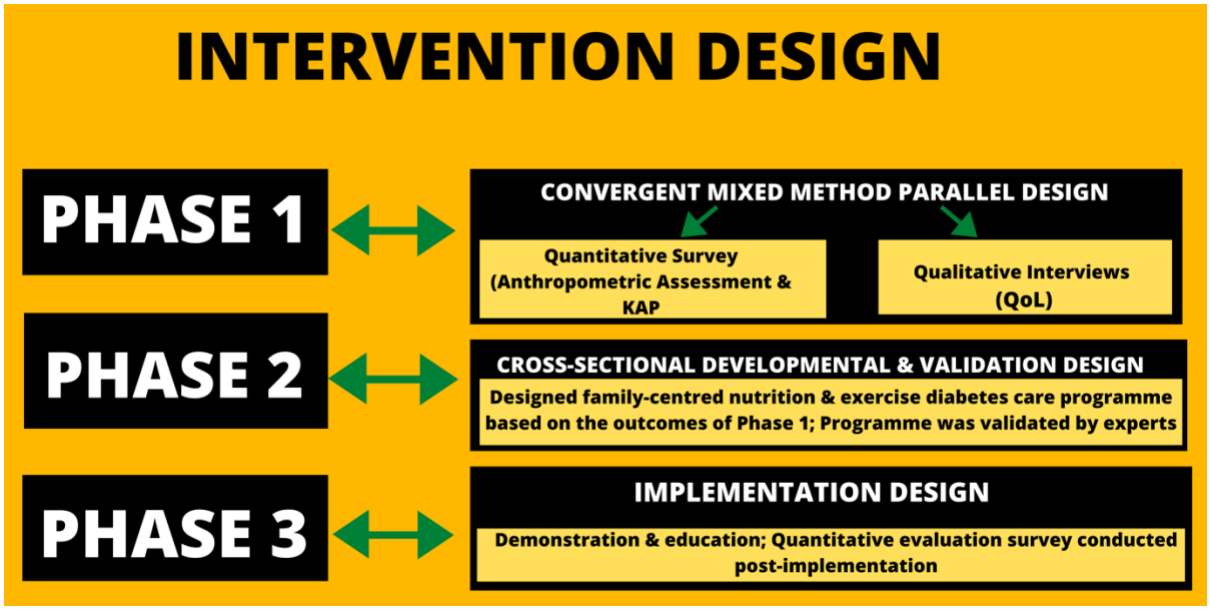


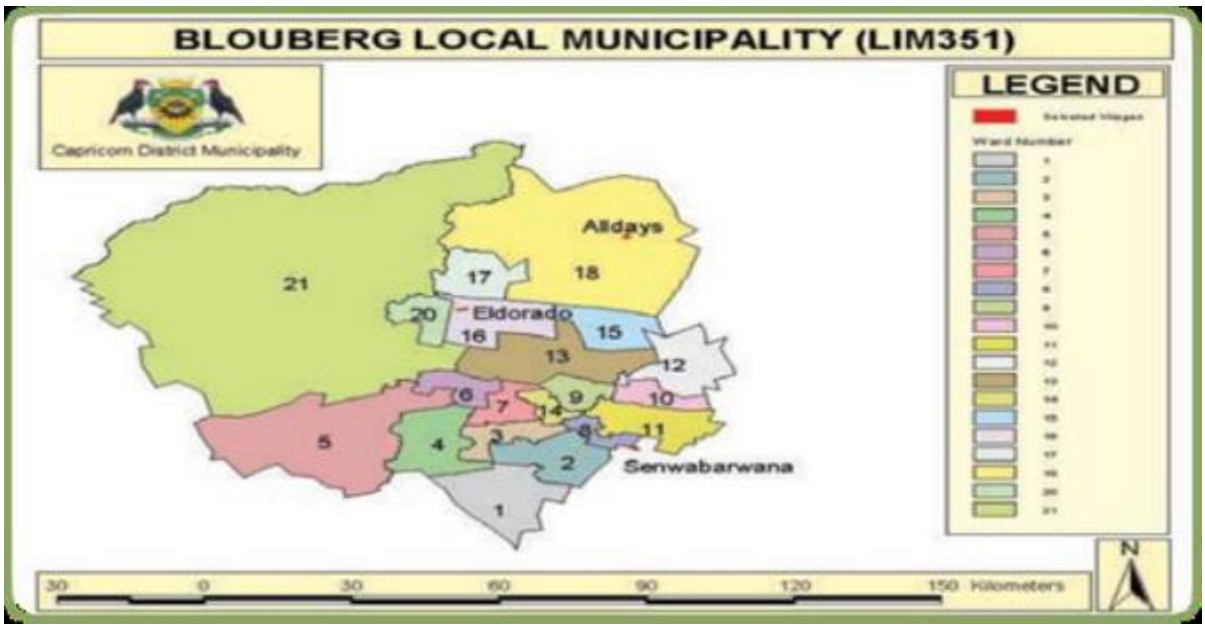
Figure 3.1: Schematic diagram for intervention study design

3.3 STUDY SITE

This study was conducted in rural-based Blouberg municipality in Senwabarwana Area of Capricorn District, Limpopo Province, which is located at the Northern Eastern corner of South Africa and shares borders with Botswana, Zimbabwe and Mozambique. Blouberg Municipality is a rural based municipality in the Limpopo Province, bordering Zimbabwe and Botswana. Blouberg Municipality has a population of 162 297 (Statistics SA, 2011). Blouberg Municipality currently is demarcated into 21 wards and a total of 22 clinics, two 2 health centres, 4 mobile clinics, and one hospital. The clinics are divided into 4 areas. However, there are wards with more than 2 clinics including health centres, while other wards have no clinics. All the clinics refer their patients to the only existing hospital in the municipality. Equally, the hospital healthcare professionals including dietitians and physiotherapists visit clinics to provide their specialist treatment through outreach programme. All the clinics in the area report to Department of Health (DOH) Capricorn District, which is under the Limpopo DOH. The study setting was chosen because of its rurality, in consideration

that rural areas in South Africa have been progressively urbanized, resulting in physical inactivity and unhealthy eating.

Schematic representation of the map of clinics of Blouberg Municipality (Senwabarwana)



(Website: Blouberg Municipality)

Figure 3.2: Map of Blouberg Municipality, Limpopo Province

3.4 POPULATION

The population is described in terms of the target population and sampling method including inclusion and exclusion criteria. Target population in this study was diabetes mellitus patients receiving treatment at clinics of Blouberg municipality, and their Family Members. According to Blouberg Sub-District Diabetes Mellitus Statistics (2017), there is an average of 406 diabetes mellitus patients seen monthly in all the Blouberg clinics. Therefore, the population for diabetes patients was 406. Population is also described according to participants per phase:

- Phase 1 involved diabetes patients and family members as participants for quantitative strand, while qualitative strand involved only diabetes patients because they are our target population, since they are diagnosed with diabetes and can relay experiences of personally living with diabetes. Family members are not diabetic, hence not included in qualitative strand.

- Phase 2 involved experts in programme development as participants for programme validation, while
- Phase 3 involved both diabetes patients and their families as participants.

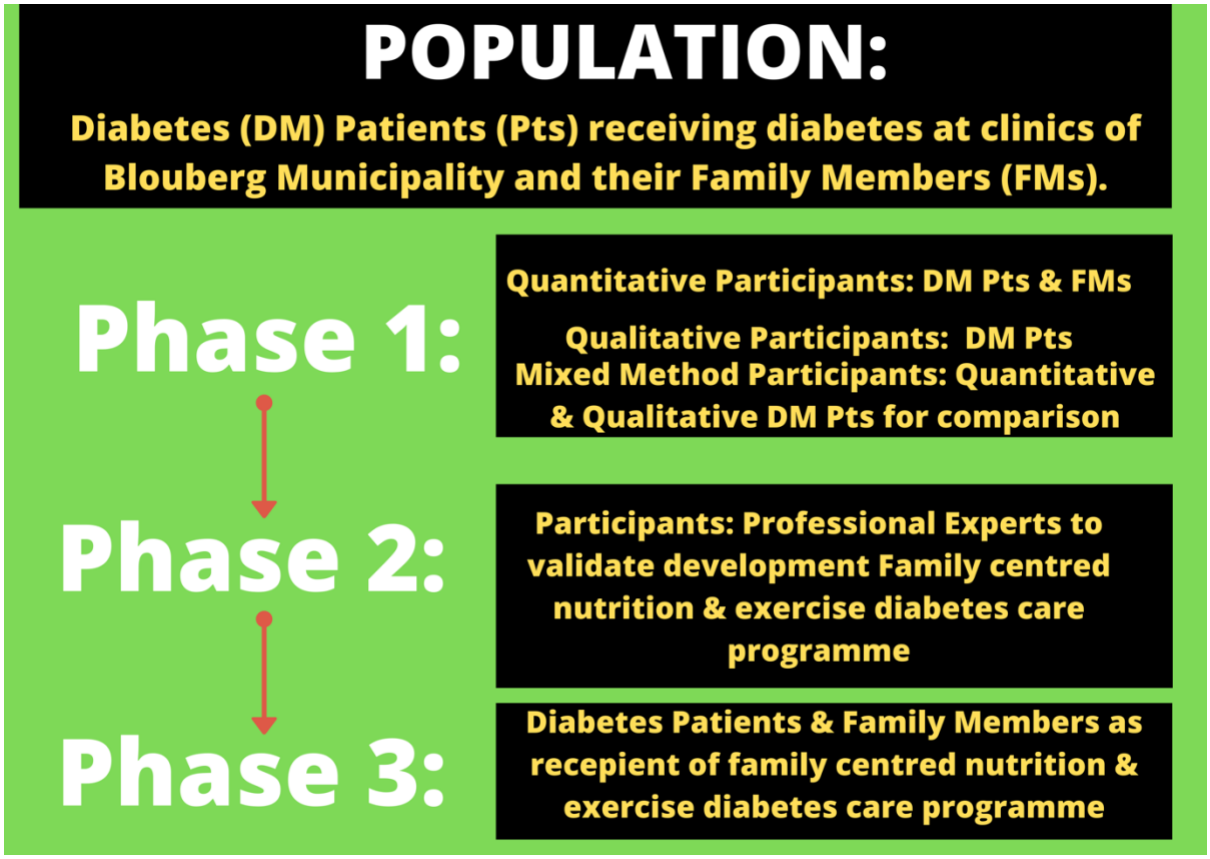
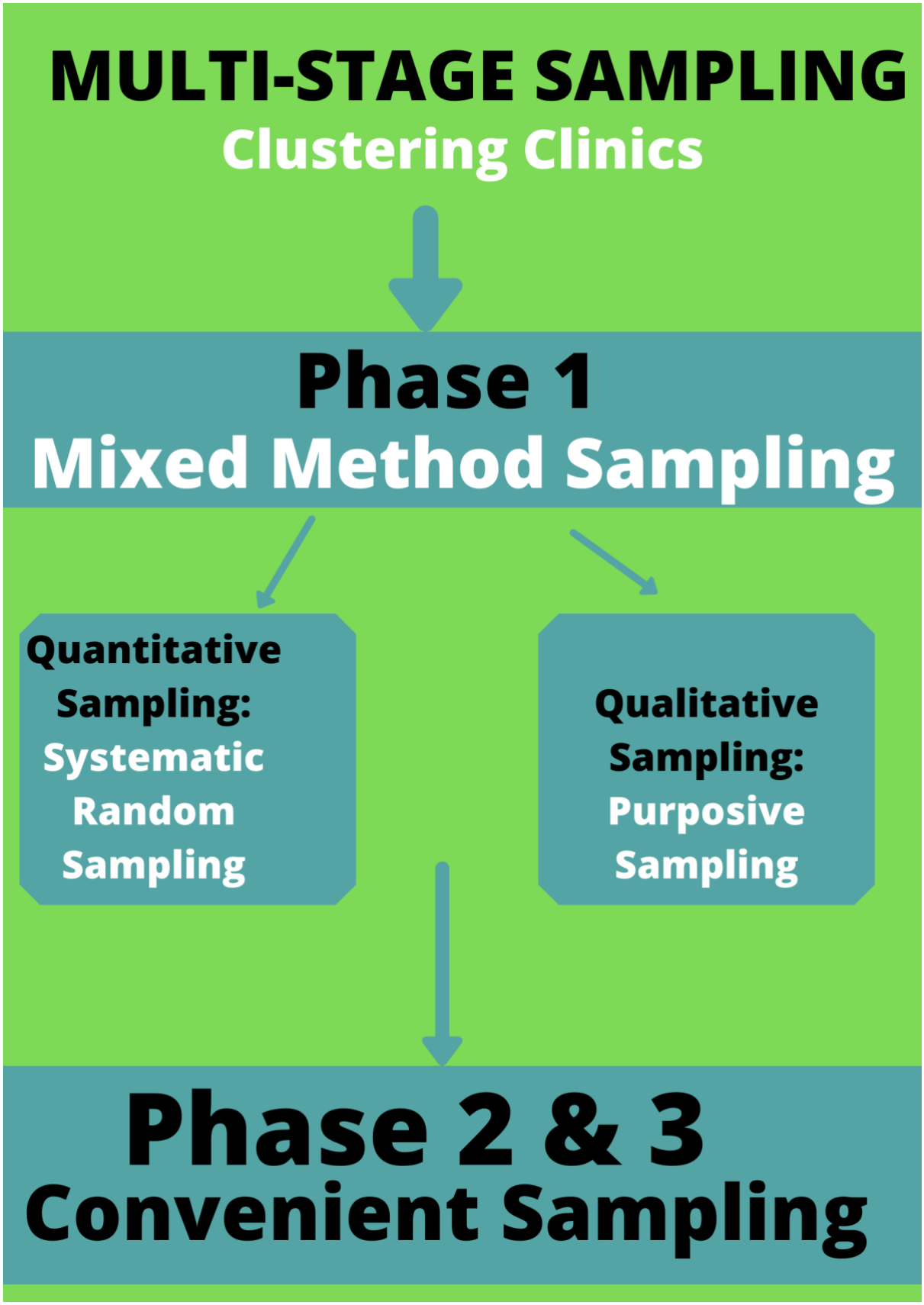


Figure 3.3: Schematic diagram showing population and participants

3.5 SAMPLING

A multi-stage sampling method was used in this study. A multi-stage sampling was relevant in this study because it enabled the clustering of participants according to their areas or clusters at which the clinics of Blouberg Municipality are clustered.

- The first stage of multi-stage sampling involved clustering of clinics into 4 areas (according to demarcations of clinics of Blouberg Municipality as discussed in the study setting). The reasons to use cluster sampling were to save money and time and also to ensure that the population is widely selected from various areas of Blouberg Municipality.
- The second stage was undertaken per phase and involved selection of participants as shown below, and the rationale for relevance of each sampling is provided in detail during explaination of methodology per sample:



Phase 1 applied mixed method sampling, while phase 2 and 3 used convenient sampling.

Figure 3.4: Schematic diagram showing sampling used per phase

3.5.1 Inclusion criteria for both quantitative and qualitative strands of the study

- Clinics with ≥20 diabetes patients getting treatment, for the likelihood of getting patients with various socio-demographic profile.
- All patients diagnosed with Diabetes Mellitus for more than 6 months; are of consenting age i.e., 18 years; are not mentally challenged and agree to participate were included in the study.
- Diabetes patients and family members who speak and understand English and Sepedi as the dominant language in the Blouberg area.
- Family members who are not diagnosed with diabetes or on any chronic disease treatment.

3.5.2 Exclusion criteria for both quantitative and qualitative strands of the study

- Clinics with ≤20 diabetes patients getting treatment, since it was unlikely to get patients with various socio-demographic profile.
- All diabetes patients who are younger than 18 years of age and those who are mentally challenged were excluded from the study.
- Any diabetes mellitus patient and family member who is mentally ill, since they too need to be taken care of.
- Family members who are not staying full-time with diabetes patients in the same household.

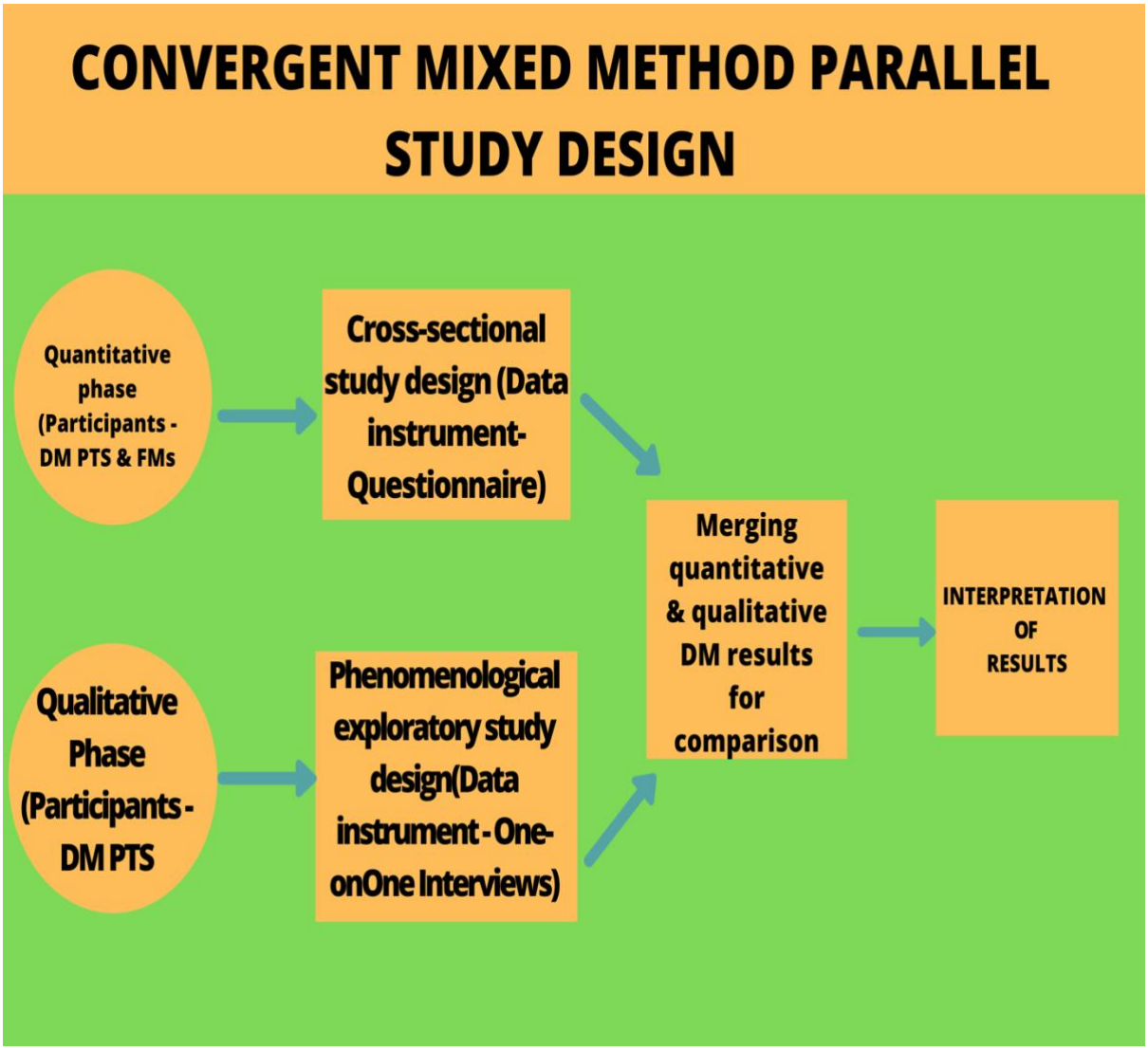
3.6 PHASE 1: SITUATIONAL ANALYSIS

The study method for the situational analysis phase is discussed as follows:

3.6.1 Study design

The research design used in this phase is convergent parallel mixed method study design. Convergent parallel mixed method study design is explained as “a study design which collect both types of data at roughly the same time; assessing information using parallel constructs for both types of data; separately analysing both types of data; and comparing results through procedures such as a side-by-side comparison in a discussion, transforming the qualitative data set into quantitative scores, or jointly displaying both forms of data” (Creswell, 2013). The use of

convergent parallel design in the collection of data for diabetes patients permitted the researcher to collect data through questionnaire and interviews, and subsequently



comparing the quantitative and qualitative data of patients with consideration of the strengths of the two methods. Quantitative strand used a cross-sectional descriptive study design, while qualitative strand used phenomenological exploratory study design.

Figure 3.5: Schematic representation of the convergent parallel design.

3.6.2 Pilot study

The pilot study was conducted at the non-participating clinics of Blouberg Municipality. The pilot study was used to pre-test or validate quantitative and qualitative data collection instruments. Permission to conduct pilot study was obtained from nursing

managers and participants also signed informed consent. For the *quantitative*, it determined average time required to complete the questionnaire which was 15-20 minutes for both questionnaires, including determining how well the questions are understood by participants. The findings of pilot study produced no changes to the questionnaires. The number of participants used for the pilot study of the quantitative strand were 10 diabetes patients and 10 family members. For the qualitative, it used to identify vagueness of the interview guide, and no modification was done. Three participants were interviewed. All participants of both quantitative and qualitative pilot study were not included in the main study.

3.6.3 Quantitative strand

Participants for the quantitative strand are both diabetes patients and their family members. The quantitative strand dealt with the following objectives in the situational analysis in phase 1:

- To determine anthropometric parameters (BMI and waist circumference) of diabetes patients in Blouberg Municipality, Limpopo Province.
- To determine knowledge of nutrition and exercise in the management of diabetes among patients and families of Blouberg Municipality, Limpopo Province.
- To determine attitude of nutrition and exercise in the management of diabetes among patients and families of Blouberg Municipality, Limpopo Province.
- To determine practice of nutrition and exercise in the management of diabetes among patients and families of Blouberg Municipality, Limpopo Province.

The rationale for determining knowledge, attitudes and practices of family members regarding nutrition and exercise in the management of diabetes was to ascertain the level of support.

3.6.3.1 Study design

Cross-sectional study design was used. It was relevant in this study because it enabled the researcher to determine anthropometric measurements as well as obtaining information about knowledge, attitude and practices of both diabetes patients and their family members regarding nutrition and exercise diabetes care.

3.6.3.2 Sample size, sampling and sampling procedure of participants

The first step in selecting a sample is to outline the population of interest. In this study, the target population was diabetes patients and their non-diabetic family members. The clinics in Blouberg Municipality are clustered, therefore, the list of clinics per cluster provided sampling frame for diabetes patients. Since clinics in Blouberg Municipality are clustered according to 4 areas, there are 6 clinics per area, clinics with more than 20 patients per month per area were purposively sampled. Participants in the quantitative strands were diabetes patients and their family members, therefore sample size and sampling is described for both patients and family members.

The sample size for diabetes mellitus patients was calculated as follows using Yamane (1967):

$n=N \div 1+N\,(e)^{2}$

n = Sample size

N = Population size

e= error margin (5%)

Therefore, the sample size was calculated at 95% confidence interval.

$n=N \div 1+N\,(e)^{2}$

$= 406 \div 1+406\,(0.05)^{2}$

$= 406 \div 1+406\,(0, 0025)$

= 203 (rounded off to 200)

An additional 10% which amounted to 20 patients were included on quantitative sample to cater for attrition and spoilt questionnaires, and finally yielded a diabetes patients' sample of 200 participants. Systematic sampling techniques was used to select diabetes patients, where every second patient in each participating clinic was selected. From each clinic, every second diabetes patient was selected to participate in the quantitative strand of the study. The family members were selected through the sampled diabetes patients who were each requested to bring a non-diabetic family

member. Moreover, family members were not in any medical treatment and stays patients with diabetes most of the time.

3.6.3.3 Data collection of the quantitative strand

The data collections tools including procedures are outlined as follows:

3.6.3.3.1 Data collection tools

Data was collected using 2 sets of self-administered close-ended questionnaires. The advantage of using a questionnaire is that the researcher can gather data from many respondents in a relatively short space of time. *First questionnaire* was for people living with diabetes mellitus (See annexure C), with five sections, *second questionnaire* was for family members (See annexure D), with four sections. *Section A* had questions about socio-demographic profile, which was developed by the researcher. *Section B* was about Anthropometric Parameters (Family members' questionnaire did not include this section). *Section C* had questions relating to knowledge of nutrition and exercise in diabetes management, which derives from a study by Muchiri, Rheeder, and Gericke (2013). *Section D* and *E* had questions relating to attitudes practice of nutrition and exercise., respectively, which derives from both Keakile and Skaal (2015), and Le Roux *et al.* (2016).

3.6.3.3.2 Data collection procedure and recruitment

The researcher and trained research assistants visited clinics for the introduction of the study, and its aims and objectives on the day chronic/diabetes patients consult. The researcher made appointments with diabetes patients who were willing to participate, at a time which was convenient for them. However, those who were immediately available to participate, consent forms were distributed to them. After signing the consent, questionnaires were given to them for completion. Selected diabetes patients not accompanied by family members meeting inclusion criteria, and staying within a walking distance to the clinic were requested to bring the family member, who is not diabetic or on any chronic disease treatment, and stays full-time with patients. Other family members who followed home to get such family member. Diabetes patients and family members were given 15 to 20 minutes to complete the questionnaire on their own, but the researcher and an assistant were available in case any clarity was required, and for those who cannot read or write they were assisted to

fill in the questionnaire (de Vos *et al.,* 2011). Also, the research assistants measured and recorded anthropometric measurements i.e., weight, height and waist circumference.

3.6.4 Qualitative strand

Participants for the qualitative strand of the situational analysis phase were only diabetes patients, as targeted participants, because they could relay lived experiences of personally being diagnosed with diabetes and how they perceive quality of life. The qualitative strand of this study dealt with the following objective of the situational analysis phase of the study:

- To explore diabetes mellitus patients' perceived quality of life post diagnosis in Blouberg Municipality, Limpopo Province

3.6.4.1 Study design

Phenomenological exploratory study design was used. Phenomenological exploratory study design was relevant since it helped in explaining quality of life of patients, including knowledge, attitude, and practices regarding nutrition and exercise diabetes care, as well as challenges of living with the disease and family support.

3.6.4.2 Sample size, and sampling and sampling procedure

Data saturation was reached at the 15th participant, but two more participants were interviewed to confirm the saturation, and added no new information, leading to discontinuation of data collection. Therefore, the sample size for the qualitative strand were 17 diabetes patients.

Purposive sampling was used to select diabetes patients from the clinics. The researcher purposively selected diabetes patients with more than six months receiving and on diabetes treatment from the clinic. The participants were chosen because of they can relay their quality of life and lived experience or challenges impacting on quality of life.

The selection of diabetes patients was done at the clinics at the same time with the quantitative study sampling. The selection was done on the days that chronic patients, including diabetes patients, receive their medication from the pharmacists from the

only hospital in the Blouberg Municipality. The selection of patients was done through assistance of clinic nurses.

3.6.5 Data collection

Informed consent was obtained from participants before the commencement of data collection. Data collection was done, until data saturation was reached. The data collection tool and procedure for diabetes mellitus patients is discussed as follows:

3.6.5.1 Data collections tools

Data were collected using semi-structured in-depth interview guide (See annexure E). There was one interview guide written in English and Sepedi. The researcher observed non-verbal communication such as gestures and facial expression from the participants and at the same time observed their attitudes in order to eventually compile notes about the quality of life of patients. The central question for the interview of people living with diabetes mellitus was: ***'Kindly describe your perception of quality of life after having been diagnosed with diabetes mellitus?'*** One-on-one interviews were conducted using voice recorders, and field notes for non-verbal cues observed which couldn't be captured by the voice recorder during interviews. Probing and clarity seeking questions were asked to obtain in-depth information.

3.6.5.2 Data collection procedure and recruitment

The researcher recruited participants from selected clinics. Those who were immediately available, interviews were conducted immediately, and follow-up appointments were arranged with those willing to participate and are not immediately available for interview. The interviews were conducted in Sepedi as a dominant language in the area, however, participants also mixed with English. Participants were informed when voice recorders were switched on and off. The interviews were done in Sepedi as the dominant language in the area. Each interview took about 20-40 minutes. A quite room conducive for interviews was used to ensure privacy and confidentiality during the interviews, however, noises from people outside were heard but never disturbed or compromised interviews. Participants were allowed to talk most with the researcher listening most of the time. Minimal remarks were made by the researcher to allow participants to tell more. Open-ended questions were asked at a time allowing participants to respond in their own way.

3.6.5.3 The role of the researcher

The researcher's role was to facilitate the interview and therefore to allow participants to move freely from questions to questions. Also, the researcher directed the interaction and the enquiry using semi-structured questions contained in the interview guide. The researcher observed non-verbal communication such as facial expressions and gestures from participants. As the interview goes, field notes were taken by jotting down any observed action. Flexibility, empathy, and objectivity were maintained by the researcher throughout the interview. Good listening by the researcher permitted participants to talk more uninterrupted. The researcher as the interviewer remained open to the experiences of participants rather than attaching own meaning to participants' discussion (Burns & Groove, 2011). The researcher used bracketing, intuiting and reflective remarks during the interviews.

Bracketing: It is explained in the qualitative data analysis "as the process of putting aside what is known about the study topic to allow the data to convey undistorted information" (Brink et al., 2012). The researcher laid aside what is known about quality of life post-diagnosis with diabetes in avoidance of preconceived ideas and beliefs. Intuition is explained as "the accumulation of attitudes including beliefs and opinions derived from experience or literature" (Brink *et al.,* 2016). The researcher adhered to the questions in the interview guide and remained naïve for the avoidance of his own views. A reflective diary was kept by the researcher throughout the study. The following communication techniques to clarify and get more details of the interviews were used as a guide to get rich data (de Vos *et al.,* 2011):

Probing: Probing was used to obtain information from patients about their quality of life. The researcher used statements such as "*may you please tell more"* or "*please let's talk more about that*" to encourage participants to give more information about their quality of life and how they maintain their QoL.

Making minimal response: It is explained as "verbal counterpart of occasional head nodding used during interviews, so as to assure participant that the research is listening" (de Vos *et al.,* 2011). The researcher used verbal cues such as "*Hmmm", "yes", "I see",* to encourage participant to tell more. At times, the researcher nodded to communicate that he understood what the participants were saying.

Paraphrasing: It is explained as “restating an author’s ideas in other words that capture the meaning” (Gray *et al.,* 2017). It also implies understanding and consequently refers to direct quotation for theoretical content that is part of a scholarly paper. The researcher stated participants’ words in another form with similar meaning, for example when a participant said “*as a result of diabetes, I’m unable to sexually satisfy my wife”*, the researcher would paraphrase it and say, “do you mean diabetes has complicated to the extent that you are unable to have sex or minimally having sex with your wife?”.

Clarifying: When the researcher needed more clarity from participants regarding quality of life of patient, used statement such as “*could you please tell me more about that….”*

Reflection: It is defined as “a process that requires integrating a wide range of perceptions to realize what is known within self; interacts with the process of response to challenge and authenticate personal knowledge” (Chin & Kramer, 2015). For this study, the researcher reflected on something interesting the participant had said, the researcher reflected on the feelings and non-verbal behaviour in order to get participants to expand more to get deeper meaning. Statements such as “*so you believe eating healthy and exercising improves your quality of life”.*

Responsive listening: It is explained as “the ability to detect change over time in a construct that has changed, commensurate with the amount of change that has occurred” (Polit & Beck, 2017). The researcher attended to verbal and non-verbal messages such as eye contact, body language, gestures, posture and underlying thoughts and feelings of the participants. The researcher listened attentively to the patients as they relayed their lived experiences and quality of life.

Silence: The researcher allowed participants to express their emotions for a particular time and the researcher remained quiet.

Reflective summarizing: It is regarded as the point at which the researcher summaries the participants’ ideas, thoughts and feelings verbalized so far to see if the participant is understood. Statements such as “*so what you are actually saying is...”* The reflective summary has a structuring function and stimulates participants to give more information. The researcher tied together several views which has been

communicated. Major cognitive and affective themes were brought together. Member checking was done with patients for the confirmation of the information gathered were what they meant.

3.7 MIXED METHOD STRAND

Mixed method strand used integration. According to Guetterman (2017), integration is "an intentional process undertaken with the sole purpose of bringing together the quantitative and qualitative results of the study for analysis and comparison". The integration in this study were presented through joint display, which is defined as a visual means to outline the integration of the quantitative and qualitative results from survey and interviews respectively, in a single matrix, table or figure. The type of integration used in this study is merging both quantitative and qualitative results from survey and interviews respectively, to relate qualitative themes to survey scores. Only diabetes patients participated in both quantitative and qualitative strands, therefore, in the mixed method strand, only results of patients' quantitative survey and qualitative interviews are integrated.

3.8 PHASE 2: DEVELOPMENT AND VALIDATION OF A FAMILY-CENTRED NUTRITION AND EXERCISE PROGRAMME

This phase addressed the following aim:

- To develop and validate family-centred nutrition and exercise programme for diabetes mellitus patients in Blouberg Municipality, Limpopo Province.

This phase applied cross-sectional developmental and validation study design. The use of cross-sectional developmental and validation design in this study enabled the research to develop the family-centred nutrition and exercise diabetes care programme which was also validated by the professional experts. This use of cross-sectional developmental study design enabled the researcher to examine in participants of different socio-demographic profile at the same point in time. Experts are "considered as excellent source of knowledge and should be exploited fully, therefore it is extremely valuable to prospective researchers to utilise these resources" (de Vos *et al.,* 2018). The convenient sampling was used to select experts. The use of convenient sampling enabled the researcher to select professional experts who were accessible to the researcher to evaluate and validate the content of the developed family-centred nutrition and exercise diabetes care programme.

3.9 PHASE 3: IMPLEMENTATION OF FAMILY-CENTRED NUTRITION AND EXERCISE PROGRAMME

This phase dealt with the seventh objective of the study which was as follows:

- To implement family-centred nutrition and exercise programme for diabetes mellitus patients in Blouberg Municipality, Limpopo Province.

3.9.1 Design

The design used in this phase of this study was an implementation study design. The use of implementation study design enabled the researcher to implement the developed family-centred nutrition and exercise diabetes care programme through education and demonstration. A total of 8 clinics, 2 per area were selected to participate in the intervention.

3.9.1.1 Sampling

A convenient sampling was used to select participants. Participants were drawn from all areas, where in 2 clinics per area were selected. In each clinic, 10 diabetes patients and their 10 family members were selected to participate in the implementation of family-centred nutrition and exercise diabetes care programme. A total of 100 participants (50 patients and 50 family members) participated in the educational programme.

3.9.1.2 Data collection

Both diabetes patients and family members were given similar questionnaire (See annexure F) post-implementation of the programme for evaluation. The questionnaire consisted of one section with seven questions.

3.10 DATA ANALYSIS OF THE STUDY

The study applied mixed method; therefore, data analysis is discussed for both quantitative and qualitative strands.

3.10.1 Data analysis for quantitative strand

Data analysis of the quantitative strand “is the reduction, organization and statistical testing of information obtained in the data collection phase” (Gray *et al.,* 2017). The researcher firstly checked for the completeness of the questionnaires and assigned identification numbers to them. The data was loaded into MS Excel and transported to

Statistical Package for the Social Science (SPSS) version 27.0 software with the assistance of supervisor for analysis. The use of SPSS version 27 enabled the researcher to gain more insights from data by providing powerful set of tools to test hypothesis and analyze data through an enriched set of statistical models. The BMI was classified according to World Health Organization (WHO) (1995), as follows: *Underweight (<18kg/m^2), normal weight (18.5-24.9kg/m^2), overweight (25.0-29.9kg/m^2) and obesity (≥30Kg/m^2).* Also Weight Circumference for *abdominal obesity* was classified as per WHO (2011) as follows: *Male(>102cm) and females (>88cm).* For the purpose of this study, knowledge was scored on an overall scale of 100% and classified into 4 categories: *poor, fair, good and excellent*. *Poor* knowledge refers to achievement of a total score of between 0-50%, *fair* knowledge 51-60%, *good* knowledge 61-74%, and *excellent* knowledge ≥75%. Attitude was scored on an overall scale of 100% and classified into 2 categories: *negative, and positive*. *Negative* attitude refers to achievement of a total score of between 0-50%, while *positive* attitudes refer to achievement of a total score of between 51-100%. Practice was scored on an overall scale of 100% and classified into 3 categories: bad, fair and good. Bad practice refers to achievement of a total score of between 0-50%, fair practice refers to achievement of a total score of between 51-69%, and good practice refers to achievement of a total score of between 70-100%.

The following statistical tests were performed:

***Descriptive statistics*:** The descriptive statistics were used to describe and analyse raw data from questionnaires. Frequency distributions were presented as tables, graphs, bar charts and histograms, including range, variance and standard deviation as measures of variability, were performed to describe how widespread values are in a distribution. Correlation coefficient and contingency table as measures of relationship was done to decide the nature and degree of the relationship between variables. The mean for age of participants were calculated.

Inferential statistics: The inferential statistics which include parametric and non-parametric tests, was done to infer from a sample to a large population in order to estimate population's parameters.

T-test: T-test as a parametric test was used to determine whether the differences between means are significant or caused by chance. The independent t-test was used

for variables having two categories as it assesses whether the means of the two groups are statistically significant. Two-tailed T-test as a parametric test was also used to determine whether the difference between means were significant or caused by chance through comparing the means of pre-test and post-test. These tests were performed at the 95% confidence level. The p-value of less than 0.05 implied that the results are statistically significant difference in means between categories.

Categorical data: The grouping of variables to describe categories of participants was used in a form of cross-tabulation to explain relationships between two or more categorical variables. Frequency tables and pie-charts are used. Pearson chi-square will be used to appraise data for independence.

Regression analysis: Univariate logistic regression was used to develop multivariate logistic regression model to establish associations.

3.10.2 Data analysis of qualitative strand

The data which were collected during individual semi-structured in-depth interviews were analysed using thematic 8 steps of Tesch's open coding qualitative data analysis method as described by Creswell (2014). A consensus meeting was set between the researcher and the independent coder in order to discuss and agree on final themes and sub-themes based on the ones which emerged when analysing independently. The 8 Steps of Tesch's inductive, descriptive open coding technique Creswell (2014) was used by following the steps below:

Step 1 – Reading through the data

The researcher got a sense of the whole by reading all the verbatim transcripts carefully. This gave ideas about the data segments and how they look like/mean. The meaning emerged during reading were written down and all ideas as they come to mind. The researcher carefully and repeatedly read the transcripts of all the participants and understood them.

An uninterrupted period of time to digest and thought about the data in totality was created. The researcher engaged in data analysis and wrote notes and impressions as they come to mind.

Step 2 – Reduction of the collected

The researcher scaled-down the data collected to codes based on the existence or frequency of concepts used in the verbatim transcriptions. The researcher then listed all topics that emerged during the scaling down. The researcher grouped similar topics together, and those that did not have association were clustered separately. Notes were written on margins and the researcher started recording thoughts about the data on the margins of the paper where the verbatim transcripts appear.

Step 3 – Asking questions about the meaning of the collected data

The researcher read through the transcriptions again and analyse them. This time the researcher asked herself questions about the transcriptions of the interview, based on the codes (mental picture codes when reading through) which existed from the frequency of the concepts. The questions were “Which words describe it?” “What is this about?” and “What is the underlying meaning?”

Step 4 – Abbreviation of topics to codes

The researcher started to abbreviate the topics that have emerged as codes. These codes need to be written next to the appropriate segments of the transcription. Differentiation of the codes by including all meaningful instances of a specific code’s data were done. All these codes were written on the margins of the paper against the data they represent with a different pen colour as to the one in Step 3.

Step 5 – Development of themes and sub-themes

The researcher developed themes and sub-themes from coded data and the associated texts and reduced the total list by grouping topics that relate to one another to create meaning of the themes and sub-themes.

Step 6 – Compare the codes, topics, and themes for duplication

The researcher in this step reworks from the beginning to check the work for duplication and to refined codes, topics and themes where necessary. Using the list of all codes she checked for duplication. The researcher grouped similar codes and recoded others that were necessary so that they fit in the description.

Step 7 – Initial grouping of all themes and sub-themes

The data belonging to each theme were assembled in one column and preliminary analysis was performed, which was followed by the meeting between the researcher and co-coder to reach consensus on themes and sub-themes that each one has come up with independently.

Step 8 – Recoding if necessary

A necessity to recode emerged as some of the themes reached independently were merged. Notes were jotted down to record ideas as they came to mind. The audio-recorded data were transcribed verbatim, and the researcher and the independent-coder completed independent analysis and then held a consensus meeting to clarify discrepancies and identification of similar findings.

3.10.3 Research data management

Research Data Management (RDM) is explained as “the organization of data from its entry to the research cycle through to the dissemination and archiving of valuable results” (Chigwada, Chiparausa & Kasiroori, 2017). The RDM in this study was ensured through keeping of the participants’ voice records in a safe cabinet, which is locked. The discs which were copied was locked in the cabinet together with the notes taken by the researcher. The information downloaded to the researcher’s laptop was saved as the researcher does not share the laptop with anyone and a password is installed to limit unauthorised access to the laptop. The data will be kept and saved for at least a period of five years, thereafter the data will be destroyed using shredding machine among others.

3.10.4 Data quality

Data quality is explained as “the degree to which data, including research process such as data collection and statistical accuracy, meet the needs of the users” (Vale, 2010). Among the critical aspects to consider when assessing data quality are relevance, validity, reliability, objectivity, integrity, completeness and generalizability (Radhakrishma *et al.,* 2012). This was a mixed method study with quantitative and qualitative, therefore measures of rigour for both quantitative and qualitative data is outlined.

3.10.4.1 Data quality for quantitative research

The rigor of quantitative research involves a consideration of validity and reliability. The validity and reliability of the study are important determinants of the quality of a study and are detailed below.

3.10.4.1.1 Validity

Validity of the questionnaire is discussed according to the following elements: Face, Content, Construct and Criterion-related validity.

Face validity: Face validity is “the quality of an indicator that simplify the quantification of a variable” (Babbie, 2013) and the researcher ensured this by getting some of the colleagues in research and the supervisors to trial all the instruments to check whether the questions appear to be relevant, clear and unambiguous.

Content validity: A content validity looks at whether the tool competently covers all the content that it must as for the variable. In other words, does the tool cover the entire domain related to the variable, or construct it was designed to measure? Content validity was ensured through the using pre-validated questionnaires and literature review and by giving the questionnaires to the supervisor, co-supervisor, and biostatistician to check if the instrument will cover all aspects under study.

Construct validity: Construct validity was guaranteed by ensuring that different kinds of meanings are relevant to the participants in their natural environment and by grounding the measures in a wide literature search that outlines meanings of the construct and its elements.

Criterion-related validity**:** Criterion-related validity guaranteed through adhering to the inclusion criteria.

3.10.4.1.2 Reliability

The researcher ensured reliability of the questionnaires through pilot study to test consistency and dependability. Questions in the questionnaires were divided into sections, and the researcher ensured internal consistency by submitting the questionnaire to the experts including statistician and supervisors to ensure that it is evaluated to measure what it intends to. A guideline was developed for the training of the research assistants to ensure that they ask questions in the same way. They were

trained on the completion of the questionnaire prior to the pilot study. The researcher and trained assistants took measurements with the same equipment, which were calibrated. Measurements were taken thrice to improve reliability of anthropometric measurements. The research assistants were trained on taking anthropometric measurements prior to the pilot study.

3.10.4.2 Data quality for qualitative

The rigor of qualitative is ensured through trustworthiness. Trustworthiness is “the process of ensuring credibility, transferability, confirmability, and dependability of the research findings” (Gunawan, 2015). The stated criteria will be ensured as follows:

3.10.4.2.1 Credibility

In this study, credibility was ensured as follows:

Prolonged engagement: The researcher familiarized himself with the study site before the interviews are conducted and by staying in the field for a prolonged period during data collection.

Persistent observation: The researcher or assistants will look for multiple influences through a process of continual and tentative analysis, and also determine what counts and what does not.

Triangulation: It is explained as “the use of multiple methods to collect and interpret data about a phenomenon, so as to converge on an accurate representation of reality” (Polit & Beck, 2017). It was ensured through asking questions differently and using different methods to collect data. The method used to collect data was in-depth interview and observations.

Member checks: After data was analyzed, the emerging findings of the study were taken back to the participants for confirmation of the adequacy of the data and its conclusion.

Peer review/Evaluation: The researcher used peer review wherein he looked for support from other professionals willing to provide scholarly guidance. The researcher engaged expert colleagues in programme validation. The peers were able to review the programme content and gave feedback.

Adoption of research established methods: Specific procedures employed such as line of questioning pursued in data collection sessions and methods of data analysis were derived from methods which were successfully utilized in previous comparable studies.

Iterative questioning: This was done through probing to elicit detailed data and iterative questioning in which the researcher will rephrase questions to matters which were previously raised by the participants.

Tactics to help ensure honesty in informants: The researcher encouraged the participants to give honest answers by indicating that there are no right or wrong answers to the questions to be asked. The researcher also emphasized independence to allay fears.

Researcher's reflective commentary: In addition to scrutiny by academics in the Department of Public Health, the researcher continuously evaluated the project as it develops, particularly as regards the effectiveness of the techniques used.

Negative case analysis: Hypothesis was developed based on extensive fieldwork. Hypothesis was continuously refined by including cases which appear to disconfirm the hypothesis or until all cases are accounted for without exception.

Background, qualifications, and experience of the researcher: The researcher has published an article with one of the Departmental Professors. The researcher has two qualifications i.e., Bachelor of Nutrition and Master of Public Health. The researcher has more than six years of working experience and adheres to ethical professional principles.

Referral adequacy: This was ensured through determining that all the necessary materials available to document findings.

Examination of previous research findings: The researcher related the findings to an existing body of knowledge during the discussions of the findings.

3.10.4.2.2 Transferability

It refers to the ability to apply the findings in different other contexts or to other participants (Brink *et al.,* 2018). It was ensured as follows:

Thick description: It was ensured through probing and encouraging participants to give a sufficient and detailed description about their quality of life with diabetes.

Purposive sampling: It was used to include participants, and that the study participants will not be generalised to all the clinics of Limpopo Province but only be limited to clinics of Blouberg municipality.

Data saturation: It refers to a point during enquiry, additional participants are no longer providing new information, and when emerging themes become repetitive.

3.10.4.2.3 Confirmability

It was ensured by involving an independent coder. Written field notes and use of voice recording were also produced to confirm the data.

3.10.4.2.4 Dependability

The researcher depended on the experience of established researchers, voice recorders, and thick descriptions of methodology for the success of this study. Dependability was further ensured as follows:

Stepwise replications: It was ensured through clear description of research methods to enhance the possibility of repeating the study by another researcher.

Inquiry audit: It was ensured thran independent auditor reviewed all the activities undertaken by the researcher including field notes, audios or tape recorders to see how well the activities and the techniques for meeting credibility and transferability have been followed.

3.11 BIAS

Researcher bias which can occur when the researcher influences the responses of the participants by making gestures and imposing opinions, was minimised through the addition of research assistants during data collection. *Selection bias* which is could have occurred during sampling was minimized by using systematic random sampling to select diabetes patients to participate in the quantitative study and selection of qualitative participants from various widely spread clinics. Sampling bias, that may arise throughout selection of participants, was also minimised by adhering to systematic random sampling method in clinics with many diabetic patients.

Systematic bias which is regarded “as a type of bias of a measurement system or estimate method, which leads to systematic errors, namely produces readings or results which are consistently too high or too low, relative to a given actual value of the measured or estimated variable”. Therefore, this bias was minimized through calibration of weighing scale each day before and after weighing patients and also taking measurements thrice. *Translation bias* which could have resulted during the translation of English questionnaire to Sepedi, was minimized through the use of a language translator.

Triangulation, wherein couple of resources, which include in-depth interviews and observations of information, was used to counterbalance biases and also offered opportunity to identify biases if they occur. This was ensured by bracketing of the researchers’ own ideas was done before entering the study field to avoid using pre-conceived ideas to prevent any influence that can distort the results and the validity of the study.

3.12 ETHICAL CONSIDERATIONS

The ethical considerations are discussed as follows:

3.12.1 Seeking permission

According to de Vos et al. (2011), a study involving human participants requires written approval before the commencement of the study. In this study, ethical approval and permission were obtained from the following authorities:

- Ethical clearance to conduct the study was obtained from Turfloop Research and Ethical Committee (TREC) (Appendix A).
- Permission to conduct the study was obtained from Department of Health (DOH) Limpopo Province (Appendix B)

In addition to written approval, the Operational Nursing Managers at each clinic of Blouberg Municipality also gave verbal approval.

3.12.2 Ethical standards

The study adhered to the following ethical standards that guide research that deals with human participants (Maree, 2012):

3.12.2.1 Informed consent

Permission to participate in the study was obtained from the potential participants. The researcher explained to the participants the study purpose and objectives prior to voluntarily consenting to participate in the study by signing a consent form. The participants were made aware of the significance, aims and objectives of the study, including that they can terminate their participation when they feel their rights are being violated.

3.12.2.2 Confidentiality, privacy and anonymity

Confidentiality was ensured through availing the information obtained from the participants only to people who are involved in the study that is the researcher, supervisor, co-supervisor and independent coder. No names of participants were divulged or recorded on the data. The audio recorded data also did not have names of participants, but codes were used as participants number 1 to 17. In addition, the questionnaires were coded, and the participants were not required to write their names on the questionnaires. However, names of the participants were written on the consent forms, which were separated from the questionnaires so as to make it difficult to link the questionnaires with personal identifiers.

Privacy of the participants was maintained by interviewing patients in private consulting rooms of the clinics. No interviews were done on the street or public places.

Anonymity was ensured through guaranteeing that the participants are not being identified with their names. The researcher used alphabets as participants' identification in order that their response could not be traced to them, thus protecting the participants' identity. However, the researcher had a separate book where is able to link participants with the questionnaires to enable reverting to the participants in the event of need. However, the book was kept to the researcher. The participants' names did not appear anywhere in the study.

3.12.3 Ethical principles

The study adhered to the following ethical principles that guide research that deals with human participants (Maree, 2012):

3.12.3.1 Principle of non-maleficence

In this study, the principle of non-maleficence was ensured through ensuring that the participants are settled down in a safe environment and participants who have to take medications and/or food before the data collection sessions were allowed to do so. The principle of non-maleficence was ensured by considering that no practice oppose the welfare of any participant intentionally, through lack of knowledge or negligence. The participants were attended to in a way that avoids any possible physically and emotionally harm, through the consistent use of process consent questions e.g. *I am going to ask a sensitive question, can I continue?*

3.12.3.2 Principle of beneficence

Principle of beneficence is explained as "involving the performance of some of good and the protection of participants from physical and psychological harm and exploitation" (Polit & Beck, 2017). The researcher anticipated minimal harm in the form of psychological distress. The psychological distress could result during probing of lived experiences post-diagnosis of diabetes in the qualitative strands of the situational phase of this study. This was circumvented by observing participants' expressions through their facial expression and voice tone changes and avoiding very sensitive questions and continually during probing and very sensitive questions were avoided.

3.12.3.3 Principle of autonomy

Principle of autonomy in this study was ensured through the following:

- Participants were informed about the objectives of the study.
- Participants were informed that participation is voluntary, and no penalty was to be imposed on refusal to participate.
- Participants were also informed of their rights to withdraw from the study at any time
- Also informed consent, confidentiality and anonymity was ensured.

3.12.3.4 Principle of justice

The principle of justice was adhered to through fair selection of participants is because the eligibility criteria were strictly followed, and no discriminatory selection occurred. Those who declined or withdrew at any time were not victimized.

3.13 CONCLUSION

This chapter discussed the intervention design which guided the overall study. The study was conducted in 3 phases. Phase 1 of this study applied convergent mixed parallel design. The quantitative strand of this phase applied cross-sectional descriptive study design whereas the qualitative strand used phenomenological exploratory study design. Phase 2 used professional experts to validate the developed family-centred nutrition and exercise diabetes care programme based, while phase 3 applied implementation design. The chapter further discussed data analysis, management, and quality for both quantitative and qualitative approaches, as well as bias, and ethical considerations. The next chapter outlines, interpret and discusses the results of the phase 1.

CHAPTER FOUR:
PRESENTATION, INTERPRETATION AND DISCUSSIONS OF RESULTS OF SITUATIONAL ANALYSIS

4.1 INTRODUCTION

The previous chapter discussed the research methodology for the study. This chapter presents, interpret, and discusses results of data analysis for both diabetes patients and family members. Diabetes patients took part in both quantitative and qualitative strands, while family members only participated in the quantitative strand. Furthermore, the findings are presented in accordance with the objectives of the study. The results presented using Figures abbreviated as (Fig) and Tables. Furthermore, results are interpretated and discussed using existing literature.

4.2 DATA ANALYSIS AND MANAGEMENT

The results emerged from quantitative surveys and qualitative interviews. The quantitative data from questionnaires was analysed using Statistical Package for the Social Science (SPSS) software version 27. The researcher firstly checked for the completeness of the questionnaires and assigned identification numbers to them, entered data into the SPSS and submitted to supervisor for data analysis. Descriptive and inferential statistics were calculated, where p-value of 0.05 and less was considered statistically significant.

The qualitative data from interviews were analysed using 8 steps of Tesch's open coding qualitative data analysis method as described by Creswell (2014). Data was also submitted to an independent coder who also used 8 steps of Tesch's open coding method of qualitative data analysis as described by Creswell (2014). A consensus meeting was set between the researcher and the independent coder in order to discuss and agree on final themes and sub-themes based on the ones which emerged when analysing independently.

Data management was ensured through keeping of the participants' questionnaires and voice records in a safe and locked cabinet. The data will be kept for a minimum of five years.

4.3 RESULTS OF DIABETES PATIENTS

Diabetes patients took part in both quantitative and qualitative strands; therefore, the results are presented accordingly, including mixed method results which involved the integration of both quantitative and qualitative patients results through merging using joint display for comparison.

4.3.1 Quantitative results and discussion of diabetes patients

The quantitative results of diabetes patients are presented according to subsection of the questionnaire which are (1) Socio-demographic profile, (2) Anthropometric measurements, (3) Knowledge, (4) Attitudes and (5) Practices related to nutrition and exercise diabetes care. Therefore, results of diabetes patients are as follows:

4.3.2 Socio-demographic profile of diabetes patients

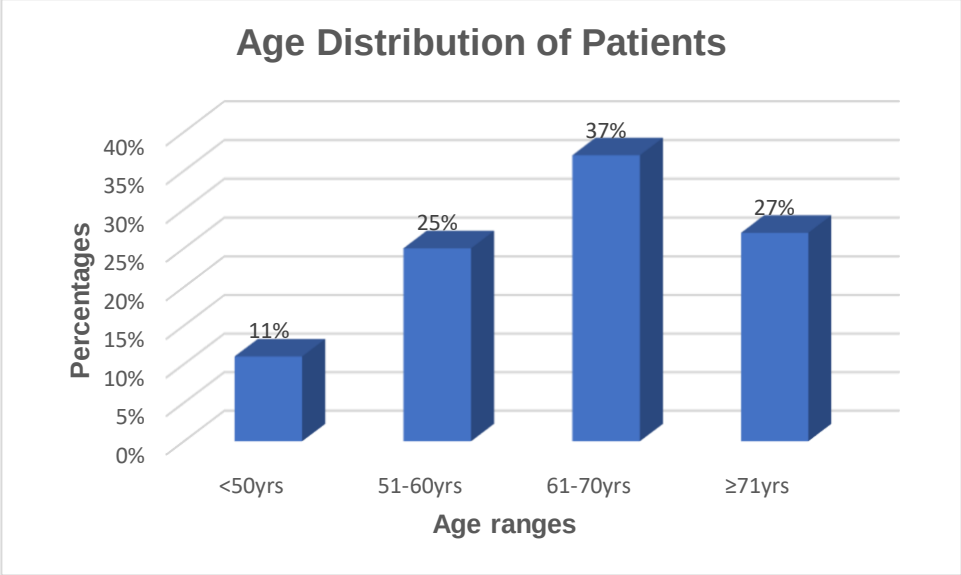


Figure 4.1: Age groups of patients

Figure 4.1 shows that over a third (37%) of the participants were between the age of 61 and 70 years, followed by those above the age of 70 years (27%), and the least of the participants were those below the age of 50 years (11%).

Type-2 Diabetes Mellitus (T2DM) is most prevalent type of Diabetes Mellitus worldwide and affect mostly older people (International Diabetes Federation (IDF), 2014). This study shows that close to two-third of diabetes patients (65%) were of the age of 60 years and above, which confirms that diabetes mellitus is most prevalence among the elderly (Herman, Schmitt, Gahr *et al*., 2015).

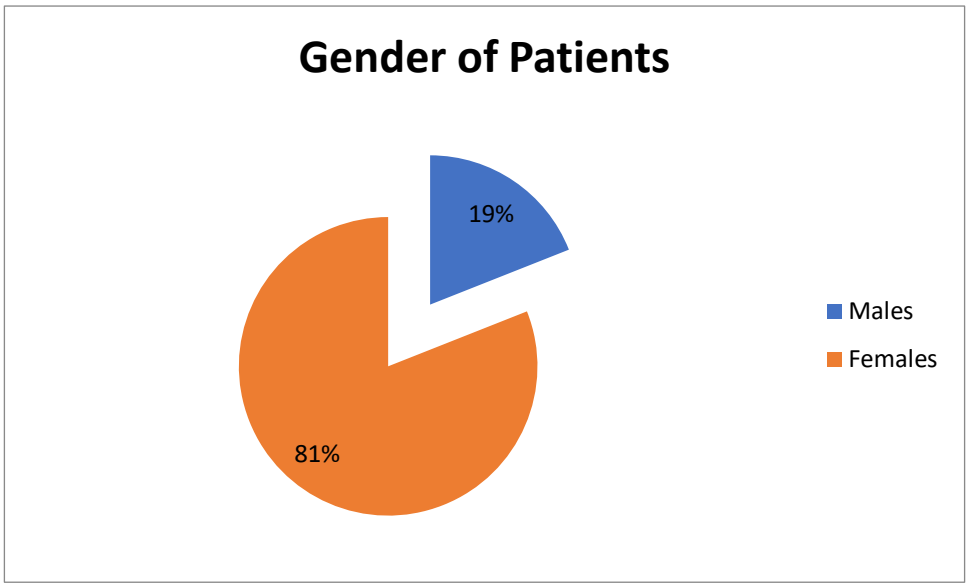


Figure 4.2: Gender of the patients

Figure 4.2 shows that an overwhelming majority of participants were females (81%) and only 19% were males.

This study surpassed a Tanzanian study regarding prevalence of diabetes which showed that 61.4% of participants were females (Chiwanga *et al.,* 2016). Moreover, this study findings are also similar to a study which showed higher prevalence of diabetes mellitus amongst females than males which could be due to a high rate of physical inactivity and bad eating habits amongst females (Azimi-Nezhad, *et al.,* 2008).

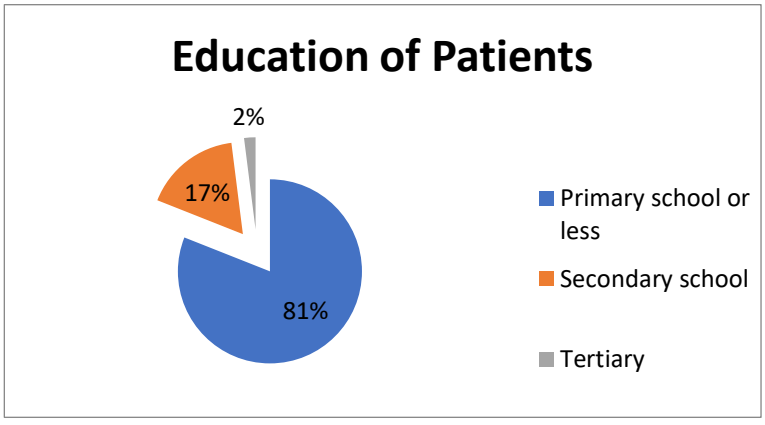


Figure 4.3: Education of patients

Figure 4.3 shows that an overwhelming majority of participants had primary or no schooling (81%), followed by those who had secondary schooling (17%) and only 1% had tertiary education.

This study surpassed Statistics South Africa (Stats SA) (2013) report which indicated that highest percentages of adults with no formal schooling among African women and men at 14,8% and 10,8%, respectively. This could additionally be ascribed to the fact that most of the participants were over the age of 60 years, who could have had no access to education during apartheid South Africa (SA).

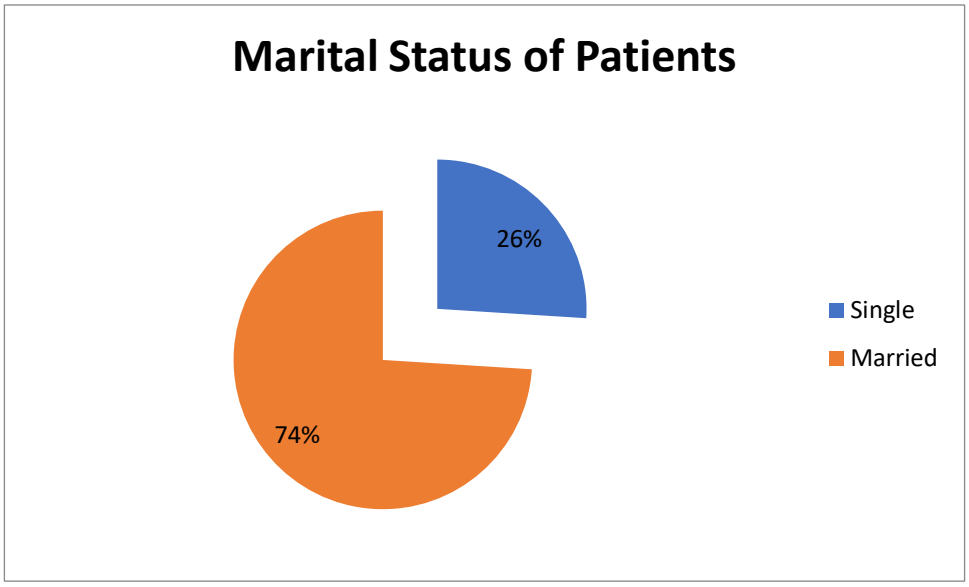


Figure 4.4: Marital status of patients

Figure 4.4 shows that most of the participants were married (74%), and only 26% were single.

This study affirms Stats SA (2013), that only smaller proportions of persons aged 30–59 years are married compared to the older persons. Spousal support has been found to positively influence diabetes outcomes (Baig *et al.,* 2015), implying that patients in this study would benefit from spousal support.

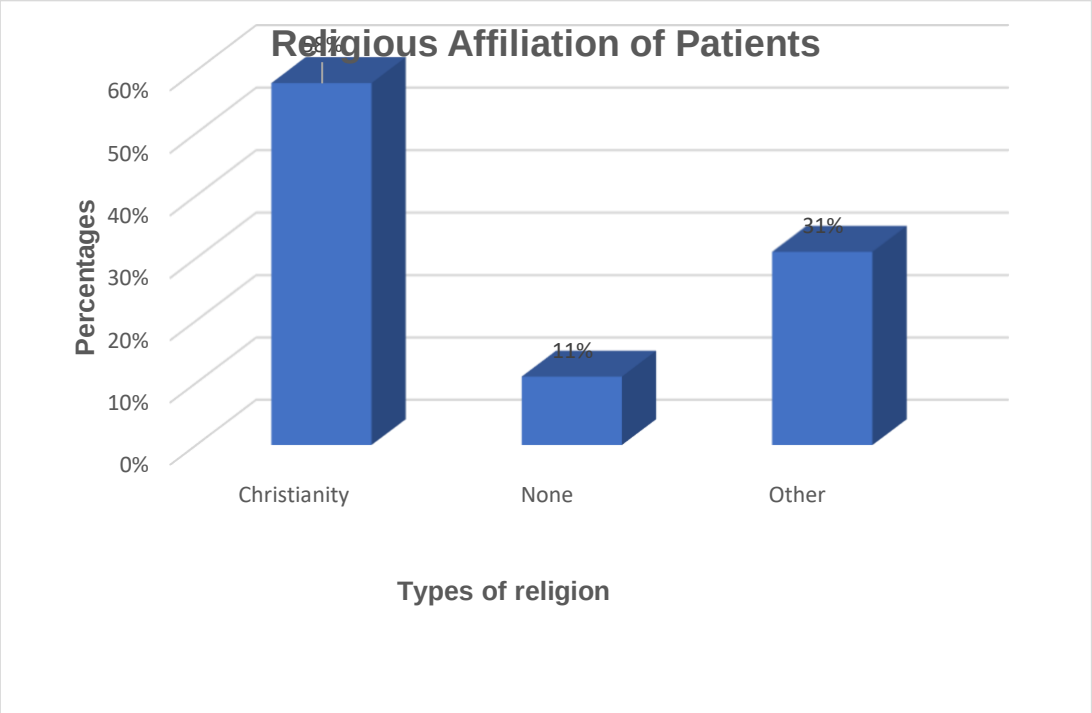


Figure 4.5: Religious affiliation of patients

Figure 4.5 shows that over half of the participants were Christians (58%), followed by those who affiliate to other religions (31%) such as traditional African religion, Hinduism, etc and least were none affiliated (11%).

This study is in accordance with the 2001 census data on religion which reported that almost 80% of South Africa's are Christians (Erasmus & Hendriks, 2005).

Table 4.1: Income of patients

Income of patients		**Frequency (n=200)**	**Percentages (100%)**
Income	No income	48	24%
	≤R1000	11	5,5%
	>R1000	141	70,5%

Other person with income in the family	Yes	107	53,5%
	No	93	46,5%
Number of family members with income	None	93	46,5%
	1-2	98	49%
	3-4	9	4,5%
Number of family members at home	2-6	154	77%
	7-12	46	23%

Table 4.1 shows that most of the participants have a monthly income of over R1000 (70,5%), over half of the participants have other family members with income (53,5%), and close to half of the participants have between one and two family members with income (49%). Also, most of participants stays with a family size of between two and six individuals (77%).

According to Stats SA (2013) more African women than men are receiving old-age social grants, which is above R1000. Therefore, this study is in accordance with a report highlighting that most of the females are beneficiaries of old-age social grant. Over half of the participants had other family members with income, which was expected since most participants were elderly, female and married, which could mean their partners are also above the age of 60 years and also earning old-age social grant. Close to half of the participants had between 1 and 2 of other family members with income, it could also imply that the participants had children who are either working, engaged in market-activities or having children with kids receiving child support grant, which is provided by South African government (Department of Social Development (DSD), 2012).

Various studies detailed that men strongly influence couples' childbearing behaviour (Ezeh, 1993; Speizer, 1999). Another study additionally detailed that African men's

ideal number of children tends to be higher than women's (Gebreselassie, 2008). Most of the participants stays with a family of between two to six people, which could be attributed to males' influence of bigger family sizes. Likewise, it could be ascribed to the fact that the majority of the participants in this study were elderly with children, who could have given participants grandchildren. Research by Brody Kogan, Murry, Chen, and Brown (2008) has shown that self-care is compromised when individuals live alone without people to provide emotional or physical support. Participants in this study have a support base since the majority live with family members.

Table 4.2: Family prevalence, knowledge of status and support in diabetes care of patients

Family prevalence, knowledge of status and support in diabetes care of patients		**Frequency (n=200)**	**Percentages (100%)**
Does your family know you have diabetes?	Yes	192	96%
	No	8	4%
Do you have any family member with diabetes	Yes	39	19,5%
	No	161	81%
Other family member with diabetes	None	161	80,5%
	1	37	18,5%
	2	2	1%
Did a family member accompany you to consult dietitian in the past 6 months?	Yes	12	6%
	No	188	94%

Did a family member accompany you to consult physiotherapist in the past 6 months?	Yes	7	3,5%
	No	193	96,5%

Table 4.2 shows that an overwhelming majority of participants reported that they families know about their diabetes diagnosis (96%); only 19,5% of participants have other family members with diabetes, and most of the participants have 1 family member with diabetes (18,5%). An overwhelming majority of participants were not accompanied to both dietitian (94%) and physiotherapist (96,5%) in the past 6 months respectively.

This study concurs with cross-sectional study which indicated that families of diabetes patients know about their diagnosis and are being supported and cared for by their families (Shilubane & Potgieter, 2007). An Indian study by Anjana *et al. (*2011), reported that around 60% diabetes mellitus patients had family members suffering from diabetes affirming heredity as an important risk factor of developing Diabetes Mellitus. This study showed only few diabetes patients had family members with diabetes, of which the majority of them had 1 family member with the disease. Therefore, this study differs with the Indian study reporting 60% of diabetes patients having family members with diabetes but does not differ on heredity being important risk factor. Also, most of the participants pointed that their families never accompanied them to either consult dietitian or physiotherapists in the past 6 months. Family is underutilized resource for continuous support and often battle on best support (Kovacs, Burns, Nicolucci, *et al.,* 2013). Therefore, this study confirms that indeed family remains underutilized resources by healthcare and patients to help in providing continuous support to patients.

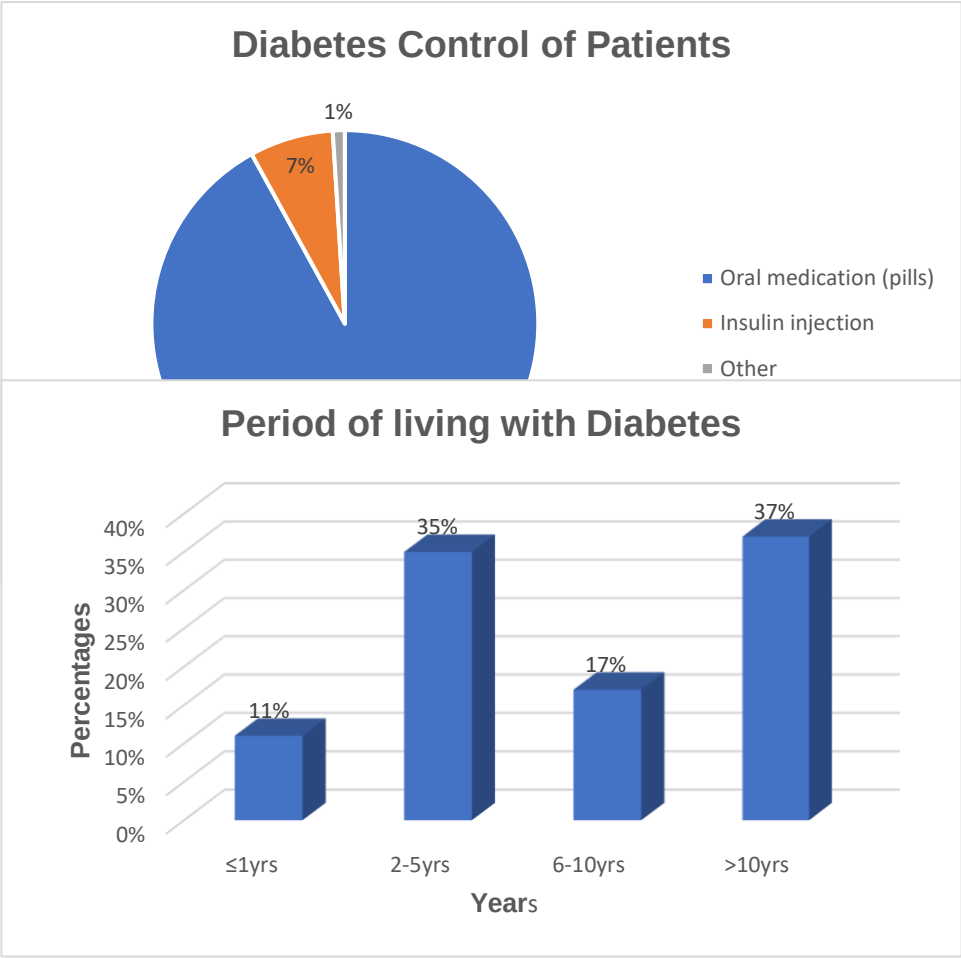


Figure 4.6: Diabetes control of participants

Figure 4.6 shows that an overwhelming majority of participants control their diabetes through oral medication (92%), followed by those using insulin injection (7%), and least being those who use other forms (1%).

This study showed that an overwhelming majority of participants controls diabetes through oral medication (92,5%), which confirms that T2DM is most prevalent among the elderly and that it is mostly controlled through medication (Herman *et al*., 2015).

Figure 4.7: Period at which participants lived with diabetes

Figure 4.7 shows that over a third of participants lived with diabetes for over 10 years (37%), followed by those with 2-5 years (35%), and least being those with 1 years or less (11%).

According to Shilubane, Netshikweta and Ralineba (2016), the prevalence of diabetes among South Africans aged 30 years or more has expanded by half since 2009,

therefore, it is not surprising that over a third of participants lived with diabetes for more than 10 years, since they could have had diabetes at their early ages considering also that most participants are above 60 years.

Table 4.3: Co-morbidities of diabetes patients

Co-morbidities of diabetes patients			**Frequency(n=200)**	**Percentage (100%)**
Do you suffer from any other diseases besides diabetes?	Yes		151	75,5%
	No		49	24,5%
How many additional diseases do you have?	None		48	24%
	1		126	63%
	2		24	12%
	3		2	1%
Types of additional diseases	Hypertension (n=200)	Yes	135	67,5%
		No	65	32,5%
	Arthritis (n=200)	Yes	27	13,5%
		No	173	86,5%
	Heart (n=200)	Yes	4	2%
		No	196	98%
	Asthma (n=200)	Yes	2	1%
		No	198	99%

	HIV (n=200)	Yes	4	2%
		No	196	98%
	Cancer (n=200)	Yes	2	1%
		No	198	99%

Table 4.3 shows that most of the participants suffer from additional diseases besides diabetes (75,5%), of which close to two-third had 1 additional disease (63%), and over two-third of the participants besides diabetes had hypertension (67,5%).

Presence of comorbid conditions influences health and Quality of Life (QoL) of patients (Nguyen, Tran & Nguyen, 2019). The results of this study indicated infers that diabetes mellitus patients are in danger of health deterioration, diseases and death, if measures are not taken to improve their self-care practices. Moreover, over two-third of the participants had hypertension as a leading comorbid condition, which is not surprising since diabetes patients are often obese, of which obesity has been linked with rates of hypertension among diabetes patients (Gus *et al.,* 2009). Comorbidity is common and connected with unfavorable clinical outcomes and higher healthcare costs, contrasted with single chronic disease (Parekh, Goodman, Gordon *et al.,* 2011). Therefore, the results of this study place a risk to the Department of Health (DOH) 's budget considering the cost burden of managing diabetes worsens in the presence of comorbidity condition.

4.3.1.2 Anthropometric assessment for diabetes patients

Objective 1: *To determine anthropometric measurements i.e., Body Mass Index & Waist Circumference.*

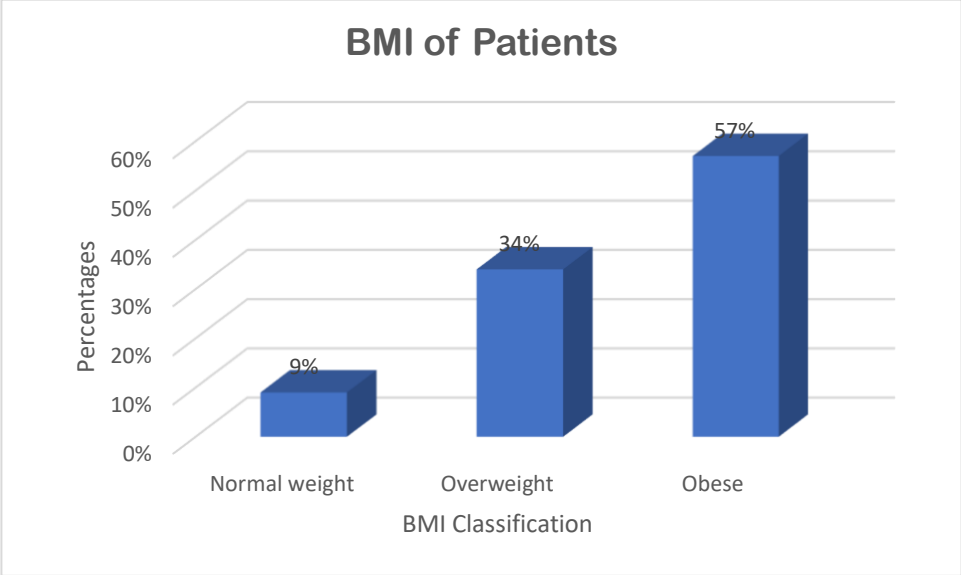


Figure 4.8: BMI of patients

Figure 4.8 shows that over half of participants are obese (57%), followed by over a third of overweight (34%) and least having normal weight (9%).

This study differs with Tanzanian study which detailed that less than half of the diabetes patients in rural areas were either overweight or obese (Chiwanga *et al.,* 2016). Obesity increases chances of poor diabetes outcomes by disturbing diabetes control (James, Rigby & Leach, 2004). Likewise, poor diabetes control leads to diabetes complications and expands the dangers of diabetes associated health problems (James *et al.,* 2004). Again, prevalence of obesity among over half of the participants in this study could be responsible for prevalence of comorbid condition among participants, thereby confirming that obesity increases chances of poor diabetes control and complications.

Table 4.4: BMI patients by sociodemographic profile

BMI of patients by socio-demographic profile		BMI			P-values
		Normal weight	Overweight	Obesity	
Age	≤50yrs	1	4	16	X^2 = 3.527 P = 0.171
	>50yrs	17	64	98	
Gender	Male	6	18	13	*X^2 = 9.300** *P = 0.010*
	Female	12	50	101	
Education	Primary or less	17	55	90	X^2 = 2.427 P = 0.297
	Secondary or more	1	13	24	
Marriage	Single	6	10	35	*X^2 = 6.376** *P = 0.041*
	Marriage	12	58	79	

**signifies statistical significance @ 95% CI*

Table 4.4 shows that there was no significant association between BMI and age (p-value=0.171), and also education (p-value=0.297) respectively. However, there was significant association between BMI and gender (p-value=0.010), and also marriage (p-value=0.041).

United States (US) study involving school children discovered that an individual socio-demographic characteristic such as age, and gender were associated with obesity among participants (Rundle *et al.,* 2012). Similar results were highlighted by the

Nigerian study involving school children which also found out that gender, age and socio-economic factors influences abnormal BMI among the participants (Akinsola *et al.,* 2018). This study found no significant association between Body Mass Index (BMI) and age, yet there was significant association between BMI and gender. Therefore, this study differs with the studies on the significant association between BMI and age, however, concurs on significant association between BMI and gender.

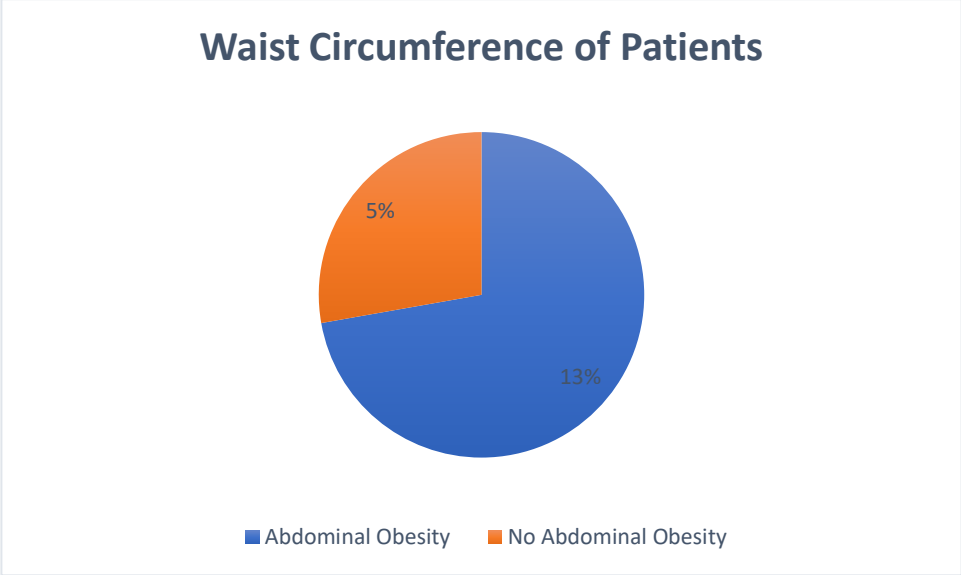


Figure 4.9: Waist circumference of patients

Figure 4.9 shows that most of the participants had abdominal obesity (75%) and only 25% does not have abdominal obesity.

This study further differs with Tanzanian study which revealed that only 20,6% of diabetes patients had abdominal obesity in rural areas (Chiwanga *et al.,* 2016). Abdominal obesity has been associated with hypertension (Gus *et al.,* 2009). Therefore, this study also confirms association between abdominal obesity and hypertension, since most participants had hypertension as the most prevalent comorbidity.

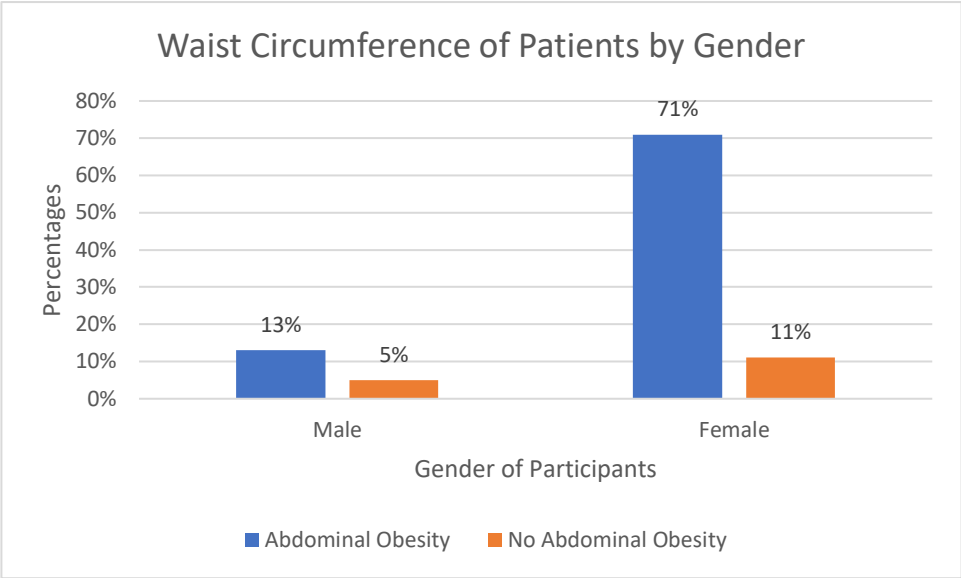


Figure 4.10: Waist circumference of patients by gender

Figure 4.10 shows that most of participants with abdominal obesity are females (71%) and compared to 5% of males.

An Iranian population cohort study detailed that abdominal obesity was most prevalent among male diabetic patients as compared to females (Haghighatdoos *et al.,* 2017), which differs with the findings of this study which in contrast showed prevalent of abdominal obesity among females.

4.3.1.3 Knowledge of diabetes patients

Objective 2: *To determine knowledge regarding nutrition and exercise in the management of diabetes.*

Overall knowledge of diabetes patients regarding nutrition and exercise in diabetes management

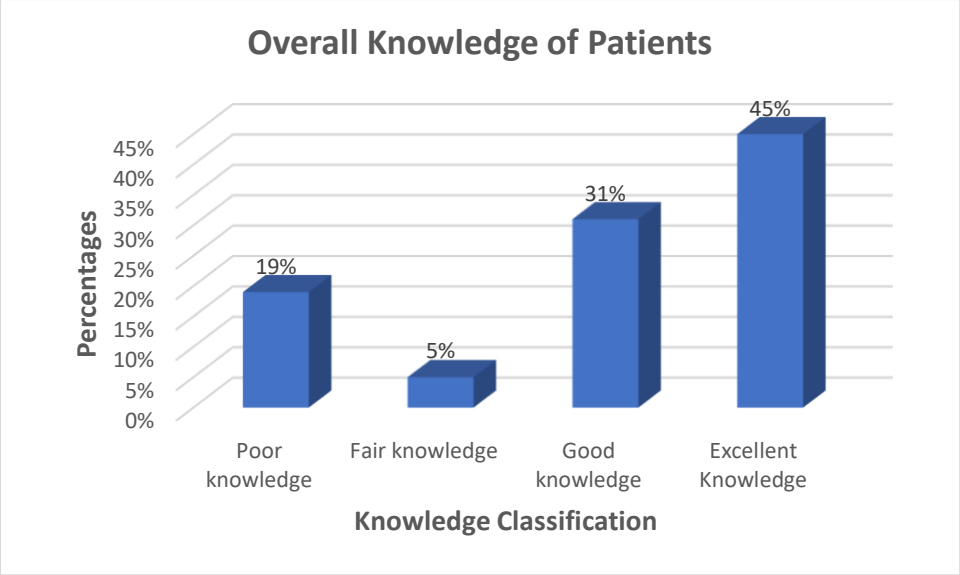


Figure 4.11: Overall knowledge of patients regarding diabetes care through nutrition and exercise

Figure 4.11 shows that close to half of the participants had excellent knowledge (45%), followed by about a third with good knowledge (31%), and the least were those with fair knowledge (5%).

This study affirms various studies which indicated that patients are found deficit with diabetes knowledge (Breen *et al.,* 2015; Fitzgerald, Damio, Segura-Pérez & Pérez-Escamilla, 2008), notwithstanding growing diabetes prevalence (IDF, 2015). Adequate knowledge of diabetes can prevent chronic comorbidities and other complications of diabetes, which has significant impact on the quality of life (Nagar, Prasad, Mitra, Kale, Yadav & Shukla, 2018). Most of the participants in this study had comorbid conditions which could be attributed to lack or inadequate knowledge of participants. Therefore, in a way this study confirms that adequate knowledge prevents against comorbidity.

Table 4.5: Overall knowledge of patients by socio-demographic profile

Knowledge of patients by socio-demographic profile		Overall knowledge				P-values
		Poor knowledge	Fair knowledge	Good knowledge	Excellent knowledge	
Age	≤50yrs	3	2	4	12	X^2 = 7.223 P = 0.614
	51-60yrs	9	1	13	26	
	61-70yrs	16	5	27	27	
	>70yrs	9	3	18	25	
Gender	Male	10	2	12	13	X^2= 2.797 P = 0.424
	Female	27	9	50	77	
Education	Primary or less	31	11	54	66	X^2= 8.943 P = 0.177
	Secondary or less	6	0	8	20	
Marriage	Single	6	4	16	25	X^2 = 2.611 P = 0.456
	Married	31	7	46	65	

Table 4.5 shows that there is no significant association between levels of knowledge and sociodemographic profile i.e., Age (p-value =0.614), gender (p-value =0.424), education (p-value= 0.177), and marriage (p-value= 0.546) respectively.

A Zimbabwean cross-sectional study highlighted that low diabetes knowledge was associated with female gender and could be a risk factor for the development of diabetes-related complications (Mufunda *et al.,* 2012). An overwhelming majority of participants in this study were females and only about a third of participants had excellent diabetes nutrition and exercise knowledge, therefore, lack of significant association between overall knowledge and sociodemographic profile in this study affirm the association of inadequate knowledge with females. A study by Malathy *et al.,* (2011) reported that “educated diabetes patients lacked knowledge on how to manage their disease because of their ignorance and laziness to seek information regarding how exercises improve their condition”. This is supported by (Okonta, 2014) who also “reported that low levels of education led to poor knowledge on benefits of exercises on lowering blood glucose level.”

Knowledge of diabetes patients regarding nutrition in diabetes management

Table 4. 6: Knowledge of patients regarding diabetes care through nutrition, % in rows; n=200

Knowledge of patients regarding diabetes care through nutrition	**Yes**	**Not sure**	**No**
Nutrition plays an important part in diabetes management.	162(81%)	3(1,5%)	35(17,5%)
Fruits and vegetables must be eaten because they are good in managing blood sugar.	177(88,5%)	1(0,5%)	22(11%)
It is good to eat small, frequent meals regularly to manage blood sugar.	165(82,5%)	5(2,5%)	30(15%)
Whole-grains high in fibre are recommended as a healthy source of carbohydrate.	159(79,5%)	2(1%)	39(19,5%)
When overweight and diabetes, it is good to skip meals to lose weight.	*134(76%)*	*11(5,5%)*	*55(27,5%)*
When preparing meat, it is recommended to remove visible fats from red meat, and also to eat chicken without skin.	174(87%)	6(3%)	20(10%)
Eating a large portion size of food at once may lead to increased blood sugar.	163(81,5%)	6(3%)	31(15,5%)
High fat dairy products including high animal proteins must be avoided.	163(81,5%)	4(2%)	33(16,5%)
It is good to cut back on salty food including high sodium food such as processed food.	172(86%)	2(1%)	26(13%)
It is good to cut back on sugary food including avoiding added sugar in drinks and food.	177(88,5%)	5(2,5%)	18(9%)
Fried food and other food high in fats must be avoided.	168(84%)	5(2,5%)	27(13,5%)

Table 4.6 shows that an overwhelming majority of participants know that nutrition plays important part in diabetes care (81%); fruits and vegetables must be eaten because they are good in managing blood sugar (88,5%); eating small frequent meals is recommended (82,5%), including eating whole grains high in fibre (79,5%), as well as removing visible fats from red meat and eating skinless chicken (87%). Less than a third of the participants believe overweight diabetes patients should skip meals to lose weight (27,5%). Also, an overwhelming majority of participants reported that eating large portion sizes at once will increase blood sugar (81,5%); it is good to cut back on both salty food (86%), and sugary food (88,5%), including avoiding high fat dairy products (81,5%) and fried food (84%).

The findings of the study impressively revealed that an overwhelming majority of participants know that nutrition is important in diabetes care, and that fruits and vegetables, whole-grains high in fibre should be eaten. This gives hope that diabetes patients will begin to eat healthy diet which includes consumption of vegetables and fruits and whole-grains, leading to improved glycaemic control (Ronquest-Ross, Vink & Sigge, 2015). “This is because knowledge can lead individuals pursue healthy eating (Spronk, Kullen, Burdon, & O’Connor, 2014), anyway this is not an assurance that diabetes patients will consume healthy diet, since there are factors such as food availability and affordability which determine or affect intake (Campbell, King-Shier, Hemmelgarn *et al.,* 2014).”

“Food preparation and serving are important in diabetes care, since diabetes patients should not be eating large portion sizes since it may prompt increased glucose levels” (Mahan & Escott-Stump, 2008). An overwhelming majority of participants indicated that it is important to eat small frequent meals and that visible fats in red meat including chicken skin should be removed during preparation. Also, the results impressively show that an overwhelming majority of participants know that it is good to cut back on both salty and sugary food, including avoiding high fat dairy products and fried food. This gives hope that diabetes patients will use healthy food preparation method and consume healthy food in small portion for good diabetes control. However, it is assumed that the majority of diabetes patients do not cook or prepare food for themselves, their food is often prepared by their families who may not know these food preparations and serving of small portion sizes and continue to serve patients large portion sizes. Therefore, this study affirms view that it is imperative to assess

knowledge of family members regarding self-care and support to diabetes patients for effective FCC interventions (Carman *et al.,* 2013), considering that diabetes patients consume meals prepared by family members.

Moreover, results worryingly reveals that close to a third of participants stated that overweight diabetes patients should skip meals to lose weight. “Skipping of meals may lead to hypoglycaemia” (Mahan and Escott-Stump, 2008), which is reported to be leading factor in diabetes death.

Knowledge of diabetes patients regarding exercise in diabetes management

Table 4.7 Knowledge of patients regarding diabetes care through exercise, % in rows; n=200

Knowledge of patients regarding diabetes care through exercise	Yes	Not sure	No
Exercise is important in diabetes management and help control blood sugar	168(84%)	4(2%)	28(14%)
Blood sugar, blood pressure and cholesterol levels stay on track with exercise.	159(79,5%)	2(1%)	39(19,5%)
Exercising can reduce diabetes-related health problems or complications.	164(82%)	3(1,5%)	33(16,5%)
It is good to stop exercising, in the event of feeling dizziness, shortness of breath and pains	160(80%)	5(2,5%)	35(17,5%)
When engaging in prolonged exercise, it is encouraged to eat before and after exercise, including drinking fast acting carbohydrate drinks during exercise.	152(76%)	2(1%)	46(23%)
It is recommended to check blood sugar before and after exercise.	151(75,5%)	5(2,5%)	44(22%)
People with diabetes who are on insulin should measure blood sugar before, and after exercise.	142(71%)	3(1,5%)	55(27,5%)
I should wait till my blood sugar becomes normal when I discover that my blood sugar is high just before exercise.	139(69,5%)	3(1,5%)	58(29%)
30 minutes, 3 days is recommended minimum amount of exercise that a person with diabetes should get in a week.	*13(6,5%)*	*10(5%)*	*177(88,5%)*
A diabetes patient on insulin and does running exercises, should not inject themselves on thighs.	*3(1,5%)*	*10(5%)*	*187(93,5%)*
The amount of insulin in the body decreases during exercise.	*54(27%)*	*15(7,5%)*	*131(65,5%)*
The acceptable blood glucose levels of a diabetes patients is a range of 4-8mmol/L.	*37(19%)*	*10(5%)*	*153(76%)*

Table 4.7 shows that an overwhelming majority of participants know that exercise plays important part in diabetes care (84%); blood sugar, pressure and cholesterol levels stay on track with exercise (79,5%); exercising reduces complications (82%); and that it is good to stop exercising when feeling dizziness and shortness of breath (80%). Most of the participants reported that when engaging in prolonged exercise, it is good to eat before and after exercise including drinking fast acting carbohydrate drinks during exercise (76%); it is good to check glucose before and after exercise (75,5%); those on insulin should also measure blood sugar before and after exercise (71%); and that a diabetes patient should wait till blood sugar is normal after discovering that it is high before exercise (69,5%). An overwhelming majority of participants do not know exercise prescription (88,5%), and also do not that a diabetes patient on insulin and does running exercises should know inject themselves on the thighs (93,5%). Less than a third of the participants know that insulin decreases during exercise (27%) and that also only 19% know the acceptable blood glucose ranges.

Benefits of regular Physical Activity includes: (1) improved blood glucose control, (2) lipids, (3) blood pressure and (4) QoL including prevention of T2DM and its complications. It also reduces mortality and cardiovascular diseases among diabetes mellitus patients (Qui, Sun, Cai, Liu & Yang, 2012). Our results show that an overwhelming majority of participants know these benefits of exercise, however, this is not guarantee that they will exercise, since exercise at the rural areas is also affected by urbanization (Levitt, Steyn, Lambert, Reagan, Lombard, Fourie, Rossouw & Hoffman, 1999). Knowledge about the importance of exercise maybe affected by urbanization, prompting diabetes patients driving an inactive lifestyle. An Indian study highlighted that “only 40% of diabetes patients regards regular exercise and weight control as possible treatment options” (Benjamin *et al*. 2017). Therefore, this study differs from the Indian study since participants overwhelmingly regarded exercise as key in diabetes care. Engaging in regular aerobic physical activity such as brisk walking at least 30 minutes per day, most days of the week, minimum of 150 minutes/week (Sigal, Kenny, Boulé *et al.,* 2007), decreases insulin resistance and therefore aid in both prevention and management of diabetes (Rippe, 2013). The results of this study showed that an overwhelming majority of participants did not have a clue about exercise prescription which could be assumed that they will not exercise properly. During exercise, “blood glucose falls prompting decreased secretion of

insulin" (Yurkewicz, Michael, Zellers & Sweger, 2017), however, in this study only less than a third of participants knew that insulin levels lower with exercise which could be attributed to inadequate overall knowledge levels.

A study by Yurkewicz *et al.* (2017) reported that most studies "recommended checking of blood glucose before and after exercise including every 30 minutes during exercise", which is consistent with this study which found that most participants know that it is important for patients to measure blood glucose before and after exercise. Although this is impressive, it's sadly doesn't guarantee that patients will be able to check glucose before and after exercise because of lack of affordability (Campbell *et al.,* 2014) of glucometers. In simplest terms, being unable to afford glucometers implies that, patients in the majority may not own glucometers, affecting their capacity to measure glucose before and after exercise. Simultaneously, the results shockingly shows that only 19% of participants know glucose readings, which implies that even if they had glucometers, they would proceed with exercise regardless of glucose readings and dangers involved of exercising when glucose is at its lowest or highest (Paul *et al.,* 2012).

4.3.1.4 Attitude of patients regarding diabetes care through nutrition and exercise

Objective 3: *To determine attitude regarding nutrition and exercise in the management of diabetes.*

Overall attitude of diabetes patients regarding nutrition and exercise in diabetes management.

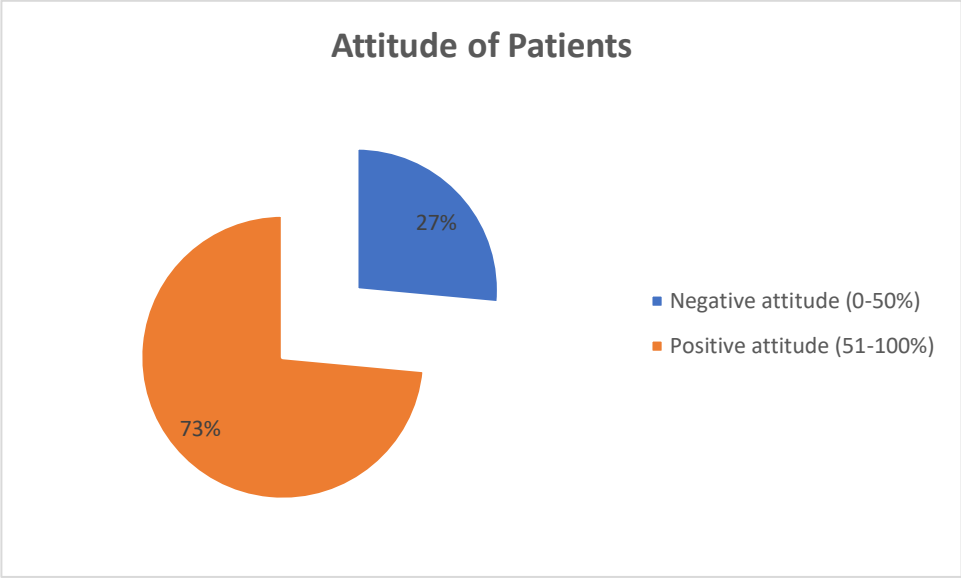


Figure 4.12: Overall attitude of patients regarding diabetes care

Figure 4.12 shows that most of participants have positive attitude (73%) and only 27% had negative attitude.

According to Muchiri, Gericke and Rheeder (2016), “beliefs and attitudes are viewed as important determinants of behaviour and behaviour change in people with diabetes” (McCord & Brandenburg, 1995). “Attitudes towards diabetes and treatment thereof are associated with the degree of self-care, including compliance with meal plans” (Cox *et al.,* 2004) and glycaemic control (Masaki, 1990). There is proof that patients with positive attitudes towards managing diabetes are bound to change their behaviour in order to keep their condition under control compared with those with negative attitudes (Anderson *et al.,* 1993). Most of the participants had positive attitude related to nutrition and exercise in diabetes management, which promises that they will take action to lead an active lifestyle. This study is in concurrence with cross-sectional study on Knowledge, Attitude and Practices (KAP) conducted in Mamelodi hospital which also reported positive attitude among diabetes patients towards healthy lifestyle modifications (Okonta *et al.,* 2014). At the same time the study differs with an Indian cross-sectional KAP study which reported negative attitude among patients about diabetes (Nagar *et al.,* 2018). This study is also similar to those of Mukhopadhyay *et al.* (2010), in which the majority of respondents 82.8% had positive attitude towards lifestyle modifications.

Table 4.8: Overall attitude of patients by socio-demographic profile

Attitude of patients vs socio-demographic profile		Overall attitude		P-values
		Negative attitude	Positive attitude	
Age	≤50yrs	6	15	$X^2 = 3.592$
	51-60yrs	10	39	P = 0.309
	61-70yrs	19	56	
	>70yrs	20	35	
Gender	Male	11	26	$X^2 = 0.113$
	Female	44	119	P = 0.737
Education	Primary or less	50	112	*$X^2 = 6.921$**
	Secondary or less	5	33	*P = 0.031*
Marriage	Single	15	36	$X^2 = 0.125$
	Married	40	109	P = 0.723

**signifies statistical significance @ 95% CI*

Table 4.8 shows that there is no significant association between levels of attitudes and socio-demographic data i.e., age (p-value = 0.309), gender (p-value=0.737), and marriage (p-value =0.723). however, there was significant association between levels of attitude and education (p-value = 0.031).

A Bangladesh study found “significant association between levels of attitudes and gender and age and found insignificant association between levels of attitudes and education” (Fatema, Hossain, Natasha, Chowdhury, Akter, Khan & Ali, 2017). This study differs with Bangladesh study, since there was no association between levels of attitudes and gender, and age, however, there was significant association between levels of attitudes and education.

Attitude of diabetes patients regarding nutrition in diabetes management

Table 4.9: Attitude of patients regarding diabetes management through nutrition, % in rows; n=200

Attitude of patients regarding diabetes management through nutrition	Agree	Neutral	Disagree
I can see a dietitian for nutrition diabetes education at least once every 6 months.	188(94%)	2(1%)	10(5%)
I can control my diabetes so that it does not interfere with the things I want to do.	188(94%)	2(1%)	10(5%)
I can follow my recommended diet even when I have to share food with other people who do not have diabetes.	191(95,5%)	5(2,5%)	4(2%)
I am willing to avoid food that a dietitian or healthcare worker advises you to avoid.	189(94,5%)	6(3%)	5(2,5%)
I can eat all my meals as per the time intervals recommended by my dietitian or healthcare worker.	186(93%)	10(5%)	4(2%)
I'm too old to change how I eat.	112(56%)	3(1,5%)	85(42,5%)
It is too late for me to start checking what to eat and not to eat.	112(56%)	4(2%)	84(42%)

Table 4.9 shows that an overwhelming majority of participants reported that they can go to consult dietitian every 6 months (94%); can control diabetes (94%); willing to follow recommended diet plan (95,5%); are willing to avoid food when advised (94,5%); and at time intervals as recommended (93%). Over half of the participants indicated that they are too old to change how they eat (56%), and also that it is too late for them to start checking what to eat and not to eat (56%).

Multidisciplinary team approach is mostly recommended diabetes health service delivery mode (American Diabetes Association (ADA), 2012). "Multidisciplinary treatment of patients with diabetes and hypertension has shown significant improvements in clinical and laboratory parameters, despite ageing of the population evaluated" (Jardim, Inuzuka, Galvão *et al.,* 2018). This study impressively revealed that an overwhelming majority of participants reported that they can consult dietitian

every 6 months, to control diabetes better, including following recommended dietary plan. Therefore, this study differs with study which indicated that the needs of patients to require multidisciplinary team care might evolve with duration of disease (Wiley *et al.,* 2013), considering that the majority of participants in this study lived with diabetes for over 10 years. The willingness of patients to consult dietitian doesn't give assurance that patients will gain more and more knowledge regarding nutrition and diabetes care, since factors like communication affect the patient's ability to recall and implement advice. "Good communication helps the patient to recall information and comply with treatment instructions thereby improving patient satisfaction" (Maguire & Pitceathly, 2002). Healthcare practitioner and patient relationship is central to the delivery of high-quality medical care (Al-Zahrani *et al.,* 2015).

Table 4.10: Attitude regarding diabetes management through nutrition by gender and age group; n=200% in rows

		Attitude					
		I'm too old to change how I eat.			It is too late for me to start checking what to eat and not to eat.		
		Agree	Neutral	Disagree	Agree	Neutral	Disagree
Gender	Male	25 (12,5%)	0	12 (6%)	25(12,5%)	0	12(6%)
	Female	87(43,5%)	3(1,5%)	73(36,5%)	87(43,5%)	4(2%)	72(36%)
Age	<50yrs	15(7,5%)	1(0,5%)	5(2,5%)	14(7%)	1(0,5%)	6(3%)
	51-60yrs	28(14%)	0	21(10,5%)	28(14%)	0	21(10,5%)
	61-70yrs	43(21,5%)	0	32(16%)	42(21%)	1(0.5%)	32(16%)
	>70yrs	26(13%)	2(1%)	27(13,5%)	28(14%)	2(1%)	25(12,5%)

Table 4.10 shows that the majority of female patients agree that they are too old to change how they eat (43,5%), and most are between the ages of 61 and 70 years (21,5%). Also, the majority of females agree that it is too late for them to start checking what to eat and not to eat (43,5%), and most are between the ages of 61 and 70 years (21%).

The majority of females in this study indicated that they are too old to change how they eat and that it is too late for them to start checking what to eat and not to eat. Most of these females are between the ages of 61 and 70. These results are in line with higher prevalence of diabetes among females due to bad eating habits amongst females (Azimi-Nezhad, *et al.,* 2008), therefore, it may imply that female participants may require a bit of motivation to lead a healthy lifestyle.

Attitude of diabetes patients regarding exercise in diabetes management

Table 4.11 Attitude of patients regarding diabetes management through exercise, % in rows; n=200

Attitude of patients regarding diabetes management through exercise	**Agree**	**Neutral**	**Disagree**
I can lead a normal life if I take appropriate measures for diabetes.	189(94,5%)	6(3%)	5(2,5%)
I am willing to do regular exercise to prevent further complication due to diabetes.	182(91%)	13(6,5%)	5(2,5%)
I am willing to do specially prescribed exercises as given by my physiotherapist or healthcare worker.	187(93,5%)	7(3,5%)	6(3%)
I will/wear footwear as recommended by my physiotherapist when I go to exercise.	184(92%)	7(3,5%)	9(4,5%)
I can see a physiotherapist for exercise diabetes education at least once every 6 months.	181(90,5%)	3(1,5%)	16(8%)
I'm too old to exercise	*47(23,5%)*	*13(6,5%)*	*140(70%)*
I'm too sick to exercise	*43(21,5%)*	*10(5%)*	*147(73,5%)*
I'm too fat to exercise	*43(21,5%)*	*8(4%)*	*149(74,5%)*
My diabetes prevents me from exercising	*39(19,5%)*	*8(4%)*	*153(76,5%)*
I'm too busy to exercise	*38(20%)*	*9(4,5%)*	*153(76,5%)*
It is too late for me to exercise	*37(18,5%)*	*7(3,5%)*	*156(78%)*
My culture does not allow me to exercise	*50(25%)*	*4(2%)*	*146(73%)*

Table 4.11 shows that an overwhelming majority of participants reported that they can lead a normal life if they take measures to control diabetes (94,5%); willing to do regular exercises (91%), specialized exercises (93,5%), and can wear appropriate footwear (92%); including consulting a physiotherapist every 6 months (90,5%). Less than a third of participants indicated that they are too old (23,5%), too sick (21,5%), too fat (21,5%) and too busy (20%) to exercise. Also, less than a third of participants highlighted that diabetes (18,5%) and culture (25%) prevent them from exercising, while only 19% of participants indicated that it is too late for them to exercise.

The results of this study are in line with the results of Kheir *et al.* (2011) who found that the majority of patients had positive attitudes towards exercise. In contrast, Al-Adsani, et al., (2009) found that respondents scored poorly in attitude and only 35% had positive attitude towards exercise in their study. Exercise plays a major role in the prevention and control of diabetes complications, improve insulin action, assist with the management of blood glucose, pressure, lipids, cardiovascular risk, mortality, and QoL. However, "an individual must exercise regularly to ripe the benefits of exercise" (Escott-Stump, 2015). The results also indicated that most of the participants pointed out that they are not too old, sick, fat, busy, late to start exercising, and that their diabetes and culture doesn't prevent them from exercising. This is impressive and gives hope that participants will exercise regularly to ripe benefits of exercise.

4.3.1.5 Practice of patients regarding diabetes care through nutrition and exercise

Objective 4: *To determine practice regarding nutrition and exercise in the management of diabetes.*

Overall practice of diabetes patients regarding nutrition and exercise in diabetes management

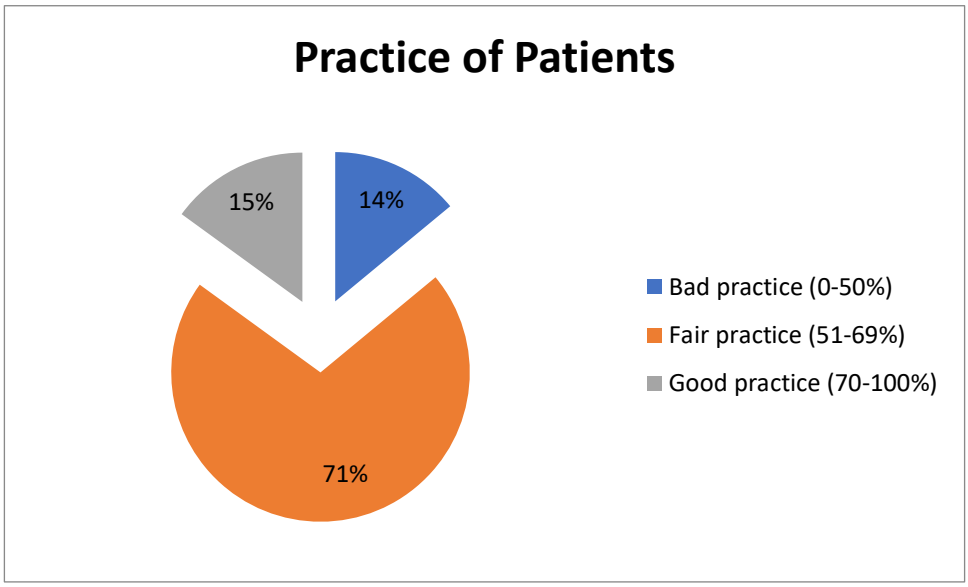


Figure 4.13: Overall practice of patients

Figure 4.13 shows that most of the participant had fair practice (71%), followed by 15% with good practice and least being 14% with bad practice.

Overall practice of participants in this study is not satisfactory since most had fair practice related to nutrition and exercise in diabetes management. Therefore, the study affirms results of cross-sectional KAP study conducted in Mamelodi hospital which reported poor practice among diabetes patients towards healthy lifestyle modifications (Okonta, Ikombele & Ogunbanjo, 2014). It also in agreement with an Indian cross-sectional KAP study which reported negative practice among patients about diabetes (Nagar *et al.,* 2018).

Table 4.12: Overall practice by socio-demographic profile

Practice of patients by socio-demographic profile		**Overall Practice**			**P-values**
		Bad practice	**Fair practice**	**Good practice**	
Age	≤50yrs	1	18	2	$X^2 = 4.442$
	>50yrs	27	123	29	P = 0.617
Gender	Male	2	27	8	$X^2 = 3.532$
	Female	26	114	23	P = 0.171
Education	Primary or less	22	116	24	$X^2 = 0.623$
	Secondary or more	6	25	7	P = 0.961
Marriage	Single	8	37	6	$X^2 = 0.796$
	Married	20	104	25	P = 0.672

Table 4.12 shows that there was no significant association between levels of practice and socio-demographic profile i.e., age (p-value= 0.617), gender (p-value=0.171), education (p-value=0.961) and marriage (p-value=0.672).

A Bangladesh study found significant association between levels of practice and gender, age, and education (Fatema *et al.,* 2017). Therefore, this study differs with Bangladesh study since the results of this study found no significant association between levels of overall practice and socio-demographic profile i.e., age, gender, education, and marriage.

Table 4.13: Overall practice by BMI, knowledge and attitude

Practice of patients by BMI, knowledge & attitude		**Practice**			**P-values**
		Bad practice	**Fair practice**	**Good practice**	
BMI	Normal weight	5	12	1	*X^2 = 10.973** *P = 0.027*
	Overweight	9	54	5	
	Obesity	14	75	25	
Knowledge	Poor knowledge	3	25	9	X^2 = 4.208 P = 0.649
	Fair knowledge	1	8	2	
	Good knowledge	9	44	9	
	Excellent knowledge	15	64	11	
Attitude	Negative attitude (<50%)	7	43	5	X^2 = 2.733 P = 0.255
	Positive attitude (51-100%)	21	98	26	

**signifies statistical significance @ 95% CI*

Table 4.13 shows a significant association between levels of practice and BMI (p-value=0.027), however there was no significant association between levels of practice, and knowledge (p-value=0.649) and attitude (p-value=0.255).

A Bangladesh study found no significant association between levels of practice and BMI of patients but also found significant association between levels of practice and knowledge, and attitude (Fatema *et al.,* 2017). Therefore, this study contradicts the Bangladesh study, because in the present study, there was significant association between levels of practice and BMI and insignificant association between levels of practice and knowledge, and attitudes. This could be attributed to inadequate knowledge of patients since less than of patients had excellent knowledge, which affirms that sufficient knowledge lead to good practice (Spronk *et al.,* 2014). Absence of significant association between levels of practice and attitude affirms cross-sectional study which reported poor practice among diabetes patients, despite them having positive attitude (Okonta, Ikombele & Ogunbanjo*,* 2014).

Practice of diabetes patients regarding nutrition in diabetes management

Table 4.14: Practice of patients regarding diabetes management through nutrition, % in rows; n=200

Practice of patients regarding diabetes management through nutrition	**Regularly (4 times or more a week)**	**Sometimes (1-3 times a week)**	**Never**
In the past week, how often did you eat breakfast?	*57(28,5%)*	*136(68%)*	*7(3,5%)*
In the past week, how often did you eat lunch and supper?	110(55%)	89(44,5%)	1(0,5%)
How often do you eat fried and fatty food?	8(4%)	61(30,5%)	131(65,5%)
How often do you eat sugary food and sugary drinks?	5(2,5%)	79(39,5%)	116(58%)
How often do you take alcoholic drinks	6(3%)	38(19%)	156(78%)
How often do you eat vegetables?	*84(42%)*	*101(50,5%)*	*15(7,5%)*
How often do you eat fruits?	*70(35%)*	*121(60,5%)*	*9(4,5%)*
How often do you eat meat, chicken, fish, mopani-worms, eggs and milk	*53(26,5%)*	*132(66%)*	*15(7,5%)*
How often eat high fibre food such as beans, lentils, legumes and wholegrain foods among others?	*72(36%)*	*123(61,5%)*	*5(2,5%)*
How often do you eat starchy food such as pap, rice, samp and bread?	191(95,5%)	9(4,5%)	0(0%)
How often do you eat salty food such as processed food like polony or added salt?	19(9,5%)	66(33%)	115(57,5%)
Statement		**Yes**	**No**
Did the person preparing food, accompany you to see a dietitian?		*25(12,5%)*	*175(87,5%)*

Table 4.14 shows that less than a third of participants eat breakfast regularly (29%), over half of participants eat lunch and supper regularly (55%). About a third of participants eat fried and fatty food sometimes (31%), while over a third eat sugary food sometimes (39%). Less than a third of participants takes alcoholic drinks sometimes (19%), while over half of the participants eat vegetables (51%) and two-third eat fruits (66%) sometimes. Over a third of participants eat high fibre food (36%) regularly, while an overwhelming majority of participants eat starchy food (96%) regularly. Also, a third of participants eat salty food sometimes (33%). An overwhelming majority of participants reported that were never accompanied by family member who prepares food to consult dietitian (87%).

“Breakfast is most important meal of the day, and research has reaffirmed its nutritional benefits, as well as other positive outcomes, including feelings of well-being immediately after consumption” (Dwyer, 2014). There is also intriguing, but less conclusive, evidence of improved weight management, reduced risk of cardiovascular disease and T2DM, and better cognitive performance (O’Neil *et al.,* 2014). However, despite benefits accompanying intake of breakfast, it is frequently skipped, and the and its composition is poorly defined (Dwyer, 2014). Results of this present study showed that over two-third of participants indicated that they do eat breakfast but not regularly, thereby confirming that breakfast is frequently skipped. However, this is worrisome and raises concern of medication adherence, since diabetes patients are supposed to take diabetes medication daily in the morning with food. Only over half of the diabetes patients indicated that they eat both lunch and supper regularly, which could be attributed to family culture of reducing meal routines due to availability and affordability of food (Kearney, 2010).

South Africa’s Food Based Dietary Guidelines (FBDG)s recommend eating fats, sugar and salt sparingly (Vorster, Love & Browne*,* 2001). Studies indicated increase in fats and oils consumption in SA and other developing countries (Popkin, 2004). However, results of this study contradicted these studies since close to two-third of participants indicated that they never ate fried or fatty food, however, it is still worrying that over 35% of diabetes are either eating fats regularly or sometimes. There has been global increase of intake of processed food because of their convenience (Ronquest-Ross *et al.,* 2015). These has been confirmed by this present study since close to half of participants are either regularly or sometimes eating processed food which contains

salt. The intake of raw sugar and sweeteners like honey in SA has decreased, yet there is increase of intake of sugar and sweeteners through processed food and soft drinks (Ronquest-Ross *et al.,* 2015). These findings are also confirmed by this present study since close to half of participants indicated that they consume sugary food and drinks regularly or sometimes.

Studies from low- and middle-income countries reported high alcohol problem drinking among older adults (Castro-Costa *et al.,* 2008; Negin, Cumming, de Ramirez, Abimbola & Sachs*,* 2011). Diabetes patients who participated in this study were aged 61 years and older, therefore, this study differs with high alcohol problem among adults, yet confirmed study which reported moderate drinking among South Africans aged 60 years and older (Peltzer & Phaswana-Mafuya, 2013).

"Fruit and vegetable consumption play a vital role in providing a micronutrient dense diet" **(**Lombard, Labuschagne & Goosen*,* 2011**)** and South Africa's Food Based Dietary Guidelines recommend eating plenty of fruits and vegetables every day and dry beans, peas, lentils and soya regularly (Vorster *et al.,* 2001). Inadequate fruit and vegetable consumption are a problem worldwide **(**Kearney, 2010) as well as in South Africa **(**Lombard *et al.,* 2011**). T**he results of this study also affirmed this since only less than half and over a third of participants eat vegetables and fruits regularly, respectively.

Meat has always been an important part of the human diet and remains central to most meals in developed countries (Kearney, 2010). The South African Food Based Dietary (FDG) Guidelines recommend that either chicken, fish, meat, milk or eggs should be eaten daily (Vorster *et al.,* 2001). Only 27% of the participants in this study indicated that they do eat meat, chicken, fish, mopani-worms, eggs and milk daily and followed by over two-third who eat such sometimes. Therefore, participants in this study are not eating from these food groups according to South African FBD guidelines, and this could be attributed to affordability and availability (Kearney, 2010). Also, an overwhelming majority of diabetes patients indicated that they regularly consume starchy food like porridge, rice, samp and bread, confirms that maize is the mostly eaten food among south African adults (Ronquest-Ross *et al.,* 2015).

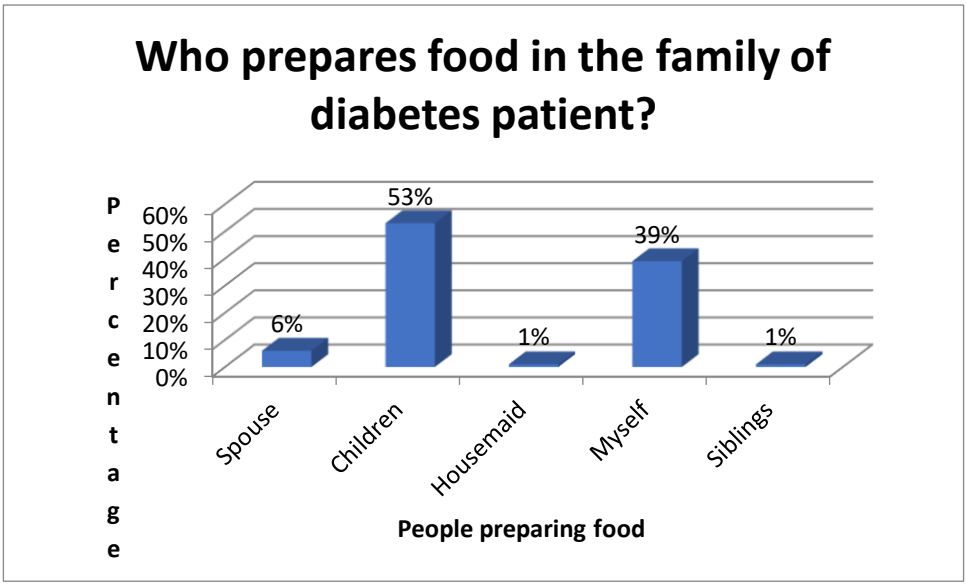


Figure 4.14: Preparation of food in the family.

Figure 4.14 shows that over half of participants' food are prepared by their children (53%), followed by participants cooking family food (39%), and the least of participants' food being prepared by housemaids (1%) and siblings (1%) respectively.

Family support in diabetes care is important and may include preparation of food (Baig *et al.,* 2015). Over half of the participants indicated that their meals are mostly prepared by their children, confirming the importance of family in diabetes care with regard to diet.

Practice of diabetes patients regarding exercise in diabetes management

Table 4.15: Exercise Practice 1: Exercising types, frequency; % in rows; n=200

Exercising and frequency		**Yes**	**No**
Do you exercise?		166(83%)	34(17%)
During the past week, did you spend at least 30 minutes, 3 days per week doing stretching or muscle strengthening exercises such as lifting weights, including home chores such as washing clothes and cleaning?		*96(48%)*	*104(52%)*
During the past week, did you spend at least 30 minutes, 3 days per week doing any of the following exercises: walking, running, riding bicycle, swimming, climbing stairs, or any other aerobic exercises?		*99(49,5%)*	*101(50,5%)*
In the past month, have you exercised for at least 30 minutes/ 3 days per week?		*83(41,5%)*	*117(58,5%)*
Frequency, and footwear when exercising	**Always (4 or more times a week)**	**Sometimes (1-3 times a week)**	**Never**
In the past month, how often a week did you exercise for at least 30 minutes/ 3 days?	*8(4%)*	*115(57,5%)*	*77(8,59%)*
When you exercise, how often do you wear the type of shoes recommended by your health provider?	*4(2%)*	*33(16,5%)*	*163(81,5%)*

Table 4.15 shows that an overwhelming majority of participants exercise (83%), and close to half of the participants have exercised by stretching and muscle strengthening (48%), and close to half have exercised by walking, running, riding bicycle, swimming, climbing stairs and aerobics (49,5%) for at least 30 minutes, 3 days in the past week respectively. The majority of participants did not exercise for about 30 minutes, 3 days a week (58,5%). Also, only 4% and 2% of participants always exercised and wearing footwear recommended by heath provider, respectively.

“Obesity levels among participants raises concern of the amount and frequency of the exercises, including its adherence. This is because obesity and physical inactivity are also leading factor in the increase of the burden of diabetes (Qi *et al.,* 2008; Yang *et al.,* 2010). A study by Goldberg et al. (2010), reported that most American adults with T2DM or at highest risk for developing diabetes mellitus do not take part in regular physical activity; their pace of participation is significantly below national norms (Morrato *et al.,* 2007), which additionally confirmed by this study since only 4% always participated in exercise. Studies have also indicated that overweight is associated with diabetes morbidity, while obesity is associated with high risk of both diabetes associated morbidity and mortality among patients (Colditz *et al.,* 1995). Overweight and obesity results inactive lifestyle (Mahan & Escott-Stump, 2008). Furthermore, numerous South Africans typically idealise larger, more voluptuous body types in women (Puoane, Fourie, Shapiro, Rosling, Tshaka & Oelofse*,* 2005). Most of the participants in this study were women, who never participated in more intensity exercise which could be ascribed to the culture of idealizing bigger women. Along these lines, it is imperative to assess factor hindering physical activity among older citizens in order to bring about exercise modification programme which addresses such barriers for effective implementation and adherence.”

A Western Cape study reported that individuals aged between 45-64 years participated predominately in light intensity activities (58%) and only a small proportion engaged in strenuous physical activity (2.8%) (Sparling *et al.,* 2002). About half of the participants had indicated that they had exercised 30 minutes, 3 days a week through stretching or muscle strengthening and also through walking, running, riding bicycle etc, which is impressive since it shows that the participants are engaged in a variety of exercises. Therefore, results of this study are differing to the findings of Charlton, Lambert and Kreft (1997), which used the Yale Physical Activity Survey for Older

Adults (YPAS) to describe patterns of weekly activity of older South African adults from historically disadvantaged backgrounds, where it was reported that most spent in housework, gardening, and yard work, caregiving, exercise, and recreation (Charlton, Lambert & Kreft, 1997). Moreover, this study confirms that older citizens are engaged in light exercise because the majority of the participants were above 60 years.

“Exercise has been shown to be an important strategy for diabetes patients to control glucose levels (ADA, 2006). Over half of the participants in this study indicated that they did not exercise for at least 30 minutes, 3 days a week. Also, those who exercised for 30 minutes, 3 days a week pointed out that they did so sometimes and not regularly implying none-adherence. Therefore, affirming doubts of exercise non-adherence considering that most of the participants were obese and overweight. The result is consistent with a study by Mohamed (2015), who found that a third of diabetic patients adhered to their physical exercise regime in their study. Furthermore, the results agree with a study by Murata, Shah, Adam, Wendel, Bokhari, Solvas, Hoffman NS Duckworth (2003), who found that the majority of patients with diabetes or at the highest risk of developing type 2 diabetes do not engage in regular physical activity, with a rare significantly below national norm.”

Moreover, an overwhelming majority reported that they don’t wear footwear recommended by healthcare professional, which was expected since an overwhelming majority of participants never consulted physiotherapists. Therefore, this is also ascribed to lack knowledge of the type of footwear to wear for exercising, since lack of knowledge can be responsible for poor practices (Ajzen *et al.,* 2011).

Table 4.16: Exercise Practice 2: Glucometers and checking of glucose when exercising, % in rows; n=200

Owning of glucometers			**Yes**	**No**
Do you have a machine to measure your blood sugar?			*22(11%)*	*178(89%)*
Checking of glucose when exercising	**Always (4 or more times a week)**	**Sometimes (1-3 times a week)**	**Never**	
In the past month, how often have you check your blood sugar level before you exercise?	*6(3%)*	*91(45,5%)*	*103(51,5%)*	
In the past month, how often have you checked your blood sugar level after you exercise?	*7(3,5%)*	*94(47%)*	*99(49,5%)*	

Table 4.16 shows that the vast majority of patients do not have glucometers (89%). Also, only 3% and 3,5% of participants always checked blood sugar before and after exercise, respectively.

A study by Yurkewicz *et al.* (2017) reported that most studies recommended checking of glucose before and after exercise including every 30 minutes during exercise. This study findings indicated that the majority of participants indicated that they do not own glucometers, therefore making it impossible for participants to check blood glucose as prescribed. It is not surprising that only 3% and 3,5% of participants in this study reported that they checked their blood glucose regularly before and after exercise respectively, which is accounted to not having glucometers. This means these participants are at risk of complications which may results from unknowingly engaging in exercise when glucose it at its lowest or highest (Mahan & Escott-Stump, 2008). As

a results, participants should be encouraged to exercise for shorter period and eat frequently before and after exercise in order to prevent complications which may results from exercising without knowing blood glucose levels.

Use of traditional medication to control diabetes

Table 4.17: Use of traditional medicine to control diabetes, % in rows; n=200

Use of traditional medicine to control diabetes	**Yes**	**No**
Do you use traditional medicine to control diabetes? n=200	8 (4%)	**192(96%)**
Do you sometimes replace diabetes medicine with traditional medicine? n=8	**7(87,5%)**	1(12,5%)

Table 4,17 shows that the overwhelming majority of participants do not use traditional medicine to control diabetes (96%), while only 4% of participants does. Also, the 87,5% of participants using traditional medicine do replace diabetes medicine with traditional medicine to control diabetes.

Therefore, this study contradicts a Ugandan study which investigated the use of traditional medicine to manage diabetes and found that many patients seek help from traditional healers when health care fails to manage the disease or diabetes-related complications (HJjelm & Atwine, 2011).

Table 4,18: Usage of traditional medicine by socio-demographic profile

		Do you use traditional medicine to control diabetes? n=8; % in column	p-values
Age	**≤50yrs**	2 (25%)	$X^2 = 5.081$
	>50yrs	6 (75%)	$P = 0.166$
Gender	**Male**	1 (12,5%)	$X^2 = 0.199$
	Female	7(87,5%)	$P = 0.656$
Education	**Primary or less**	8(100%)	$X^2 = 1.955$
	Secondary or higher	0(0%)	$P = 0.376$
Marital Status	**Single**	1 (12,5%)	$X^2 = 0.741$
	Married	7(87,5%)	$P = 0.389$

**signifies statistical significance @ 95% CI*

Table 4.18 shows no significant association between usage and replacing of diabetes medicine with traditional medicine with socio-demographic profile.

This study confirms Ugandan study which showed no significant association between usage of traditional medicine to control diabetes with socio-demographic profile.

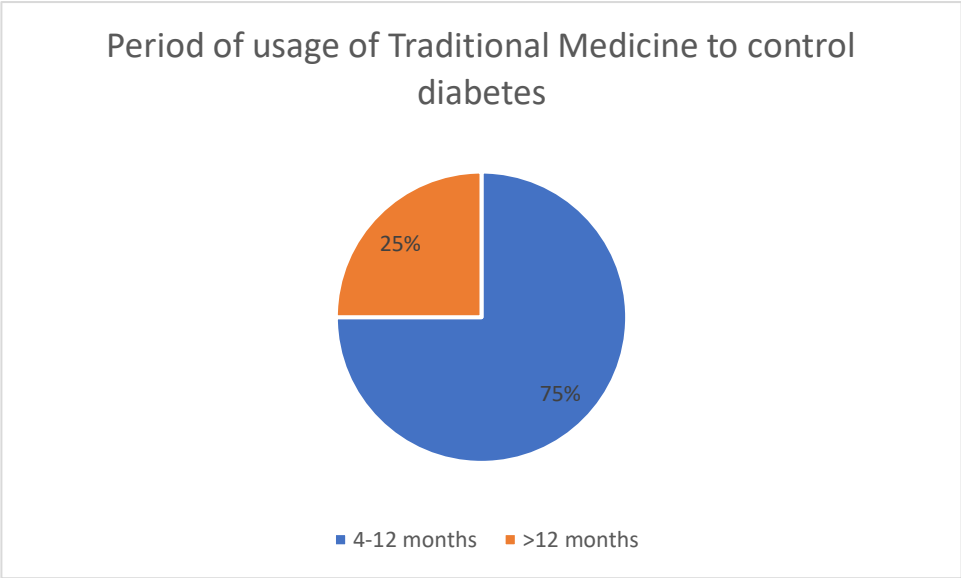


Figure 4,15: Period of usage of traditional medicines

Figure 4,15 shows that 75% of patients using traditional medicine to manage diabetes have done so for a period of 4 – 12 months.

Despite high rates of usage of traditional medicines to control diabetes, an Ethiopian cross-sectional study reported that there are very low rates of disclosure of the usage of traditional medicine to control diabetes to the healthcare providers (Mekuria *et al.,* 2018). Therefore, the is higher need for health professional to develop skill to probe the usage period of traditional medicine to control diabetes. Moreover, this study recommends the incorporation of the usage of traditional medicines within the South African medical model and allow patients to choose the type of intervention needed.

4.3.2 Qualitative results of diabetes patients

Diabetes patients also took part in qualitative strand, which used one-on-one interviews using voice recorder to collect data. The results also include observations which were recorded using field notes for non-verbal cues observed which couldn't be captured by the voice recorder during interviews. The central question for the interview, which was asked to all participants in the same way was: "***Kindly describe your perception of quality of life after having been diagnosed with diabetes mellitus?"*** Based on the responses, further probing and clarity seeking questions were asked to obtain in-depth information. The presentation of the qualitative results includes socio-demographic profile and themes which emerged from the data

analysis. Literature support is used for interpretation and discussion of results. The qualitative results were used to address the following objective of the study:

- To explore and describe diabetes mellitus patients' perceived quality of life post diagnosis in Blouberg Municipality, Limpopo Province.

Demographic profile of the qualitative participants

Table 4.19: Demographic profile of diabetes patients

Participant no.	Age	Gender	Years living with diabetes	Economic status
1	60	M	Over 5 years	Pensioner
2	63	F	Over 2 years	Pensioner
3	65	M	Over 5 years	Pensioner
4	63	M	Over 10 years	Pensioner
5	64	M	5-6 years	Pensioner
6	56	F	4 years	Unemployed
7	58	M	22 years	Unemployed
8	47	M	2 years	Unemployed
9	69	M	23 years	Pensioner
10	56	F	8 months	Unemployed
11	54	F	5 years	Unemployed
12	91	F	9 months	Pensioner
13	52	F	Over 3 years	Unemployed
14	73	M	5 years	Pensioner
15	80	M	18 years	Pensioner
16	61	F	14 years	Pensioner
17	84	M	Since 90s	Pensioner

Table 4.19 shows that 10 of the participants were males, 11 were 60 years of age and that they had more than 5 years living with diabetes.

This study showed that 11 out of 17 participants were above the age of 60 years, which confirms studies which reported that diabetes is mostly prevalent amongst the elderly (IDF, 2014; Herman *et al.,* 2015).

Aging and duration of diabetes is reportedly contributing significantly to the development and severity of diabetes complications (Shiferaw, Akalu & Aynalem, 2020), which affects quality of life. This study shows that 11 out of 17 participants were aged 60 years and older, and had lived with diabetes for 5 years, implying that the quality of life of the participants could be compromised and having existing comorbid conditions (Nguyen *et al.,* 2019).

Table 4.20: Themes and sub-themes reflecting the perception of what quality of life entails when diagnosed with diabetes mellitus

Themes	Sub-themes
1. Description of existing knowledge related to the dos and don'ts when diagnosed with Diabetes Mellitus	1.1 Knowledge existence on the type of food diabetic person has to or not to eat, time to eat and reasons thereof provided 1.2 Knowledge exists on how to prepare a diabetic meal and required portions to serve including reasons thereof outlined 1.3 Existence of knowledge on the importance of exercises and consequences of not exercising for diabetes persons outlined 1.4 Existence of knowledge on the importance of diabetic persons to consult multidisciplinary health professionals 1.5 Knowledge existence of diabetic medications and the importance of adherence to medication instructions outlined 1.6 Knowledge existence of food when taking diabetic medications outlined 1.7 Existing knowledge that diabetes may lead to death is worrying to females not males diabetic persons

2. Description of existing challenges by people living with diabetes mellitus	2.1 Difficulties experienced related to maintenance of quality of life due to societal and family expectation outlined (Scared to tell anyone that you have diabetes ending up eating wrong food) 2.2 Existing feelings of shame related to diabetic diagnosis resulting in lack of disclosure to family and others outlined 2.3 Existing challenges of lack or minimal sex drive for men with diabetes resulting in stress and fear of losing wives explained 2.4 Commencement of health seeking following diagnosis of diabetes outlined (going to traditional healers, churches hoping to get cure) 2.5 An outline that diabetic diagnosis causes fear, stress and depression which is unbearable 2.6 An outline that development of co-morbidities when having diabetes viewed as problematic 2.7 Loss of income and jobs due to diabetes lead to family misunderstanding after diabetes diagnosis
3. **Description of the experiences of being diagnosed with diabetes mellitus**	3.1 Ability of performing household chores after diagnosis as compared to prior diagnosis with diabetes outlined 3.2 Acceptance versus denial experienced after diagnosis with diabetes outlined 3.3 Acceptance of diabetes diagnosis viewed as a difficult issue and taking time which is influenced by several factors

	3.4 An explanation that disclosure of diabetes diagnosis to family members is difficult 3.5 Psychological and physical signs and symptoms experienced by people living with diabetes mellitus outlined
4. Description of existing support for people living with diabetes mellitus	4.1 Existence versus lack of support by family members for people living with diabetes outlined (which include food, exercise, collection of medication etc.) 4.2 Description of support experienced from wives of men who lost sexual drive 4.3 Description of support experienced from husband of women diagnosed with diabetes 4.4 Description of support experienced from children of diabetes patients with regard to meal preparation and serving 4.5 Existence of support from family support groups which lead to maintenance normal glucose levels, relieve from fear and stress

Theme 1: Description of existing knowledge related to the does and don'ts when diagnosed with diabetes.

Adequate knowledge on self-management is crucial for better diabetes outcomes. Participants in this study showed knowledge of does and don'ts when living with diabetes as evident in the following sub-themes that have emerged from this theme:

Sub-theme 1.1: Knowledge existence on the type of food diabetic person has to or not to eat, time to eat and reasons thereof provided

Dietary knowledge on the food to eat and not to eat is crucial for improved outcomes. Participants in this study pointed out that knowledge of food to eat or not to eat, as well as time to eat as supported by the following statements:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*I know that I don't have to eat sugary and fried food, and that I'm supposed to eat vegetables"*

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): "*Sugar and sugary food such as cakes should be avoided. As a result, I also avoid drinking tea, however, ironically, I sometimes takes raw sugar alone without adding it to the tea and still feel good"*

Participant 5 (64 years old, Male, Diabetic for 5-6 years, Pensioner): "*I know that we diabetes patients should not eat salt, sugar, and also to eat skinless chicken. I do eat white meat only, including vegetables."*

Participant 16 (61 years old, Female, Diabetic for 14 years, Pensioner): "*I know I'm not supposed to eat sugary food; I eat more of porridge and vegetables, I don't eat red meat, however I eat chicken sometimes"*

Adequate knowledge of the food to eat may persuade diabetic patients to adopt healthy eating (Spronk *et al.,* 2014). Participants in this study showed knowledge of the food to eat, implying that they will eat healthy diet for better diabetes outcomes. The food commonly eaten by participants are shown in Table 5.21:

Table 4.21: Food commonly eaten by participants

Food group	Names
Vegetables and fruits	Cabbage, spinach, carrots, beetroot and traditional vegetables. Oranges, guavas and apples
Meat, chicken, milk, eggs, fish	Low-fat milk, chicken, fish, eggs, mopani worms and wild animal meat
Beans	Brown and white beans
Starches	Porridge and bread
Drinks	Coke, Tab, juice and warm water

Healthy eating consists of the consumption of variety of food from different food groups (Estump, 2015), therefore participants in this study are to benefit from nutritional content of eating a variety of foods.

Medical nutrition therapy is an integral component of diabetes management (IDF, 2017), and that knowledge of the importance of nutrition is fundamental for better outcomes. Participants in this study reported knowledge of the importance of nutrition as supported by the following claims:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): *"I never got admitted to the hospital because of diabetes and this is all because my wife makes sure that I eat healthy"*

Participant 9 (69 years old, Male, Diabetic for 23 years, Pensioner): "*I am able to do some of the work I used to do before diagnosis because of the healthy food I eat"*

Participant 11 (54 years old, Female, Diabetic for 5 years, Unemployed): "*I live like a person who is not well and this is because I eat as coached by healthcare professionals"*

Healthy eating and its adherence are crucial to better diabetes outcomes, minimizing the complications and also improving the quality of life of patients (IDF, 2015). Therefore, this study confirms that healthy food intake is key for better diabetes outcomes and improvement of quality of life.

Participants also indicated that they eat breakfast in the morning so as to take medication. Below are some of the statements by the participants in emphasizing the importance, time and reasons of consuming or avoiding certain food:

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): "Sugary food such as cakes should be avoided since they increase blood sugar."

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): "I eat in order to take medication, since I can't take medication without food, I eat breakfast, lunch and supper"

Participant 11 (**54 years old, Female, Diabetic for 5 years, Unemployed)** proudly further commented *"I never experienced pains or any other side effects; all this is because I eat nice and also play football"*.

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*I eat porridge with vegetables, in fact I eat vegetables more regularly. I do eat beans and nuts during its season, but vegetables I eat a lot. Chicken I eat it after a very while, unlike before where I used to eat it sometimes."*

"Breakfast is most important meal of the day (Dwyer, 2014); and is beneficial because it improves feelings of well-being after consumption and also reduces risk of cardiovascular diseases (O'Neil, Byrd-Bredbenner, Hayes, Jana, Klinger & Stephenson-Martin, 2014). Participants indicated knowledge of importance of eating breakfast daily and are doing so to take medication. Therefore, this affirms research by Spronk *et al.* (2014), which highlighted that knowledge could pursue individual to adopt a healthy eating habit. At the same time, the study contradicts a study by Dwyer (2014), which indicated that breakfast is frequently skipped. "

In addition to consumption of breakfast, participants in this study reported that they also eat lunch and supper. However, other participants indicated that despite knowing that they should be eating breakfast, lunch and supper, they eat once or twice or when hungry which have attributed that to family culture. Therefore, confirms report that due to high food costs which impact on availability and affordability, many families have opted to changing their daily eating routine to eating few meals daily (Kearney, 2010). Knowledge alone do not always translate into improved self-care practices in people living with Type-2 Diabetes Mellitus (T2DM) and warrants assessment of the factors

that contribute to suboptimal self-management for improved diabetes outcomes, especially at the primary-care level (Formosa & Muscat, 2016). Also, this study affirms a need to assess factors affecting food intake among patients with excellent diabetes-associated nutrition knowledge.

A Netherlands study detailed that most respondents had general knowledge about foods to avoid or restrict in case of diabetes like carbohydrate rich products or fats (Jager, van der Sande, Essink-Bot & van den Muijsenbergh, 2016), therefore this study affirms knowledge of diabetes mellitus patients about food to avoid or reduce. Similarly, participants indicated that they eat porridge mainly as a source of starch and that they eat so in order to improve quality of life. Diet has been reported as important in diabetes management with very low compliance among patients (Peyrot, Rubin, Lauritzen, Snoek, Matthews & Skovlund, 2005), however this study agrees since participants had indicated that they eat according to their knowledge. Furthermore, participants indicated that their desire to eat according to their knowledge is often affected by family misunderstanding, attendance of ceremonies or parties adding to factors which were found to influence intake such as availability, affordability and choice among others (Kearney, 2010). Again, this also affirms need for the assessment of factors affecting dietary intake among patients. Therefore, results of this study contradict cross-sectional studies which reported low adherence to the dietary recommendations for macronutrient intake and fruit and vegetable consumption (Thanopoulou *et al.,* 2004; Virtanen *et al.,* 2000), since participants in this study indicated that they eat vegetables frequently including fruits while waiting for main meals.

Sub-theme 1.2: Knowledge exists on how to prepare a diabetic meal and required portions to serve including reasons thereof outlined

The quality and quantity of food consumed by diabetes patients are essential for glycaemic control. Participants showed knowledge on how to prepare diabetic meal, and portion sizes to eat. Below are some of the statements made by the participants regarding preparation of diabetic meal and required portions:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): “I add 2 teaspoons of sugar in the tea and also reduce to one in the event I feel the taste is still

too much and to completely add no sugar in the tea if I feel it is still sweeter. I use small cup to drink tea"

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): "*I eat 2 slices of bread at a time, since I'm not supposed to eat too much food at once"*

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): "I sometime cook using cooking oil, but I don't add too much of it.

Participant 11 (54 years old, Female, Diabetic for 5 years, Unemployed): "I'm the one cooking and I make sure I don't eat salty food including sugary ones. I also don't eat fatty food. I use olive oil. When I want to spread my bread, I use lite margarine to avoid too much fat."

Participants in this study indicated that they reduce portion sizes and choose low fat food including preparing food without adding oil or frying, which explains that participants know the importance of the portion and type of food to eat, thereby confirming study by Asif (2011), which indicated that the amount and type of food consumed mainly serve as determinant of human health. This study is in line with a study by Jager et al. (2016), which reported knowledge of preparation of diabetic food or meals.

"Portion sizes control is a challenge in this study since participants reported that they eat until they are satisfied, which is similar to a Netherland's study which pointed out that nearly all participants stressed that they eat until are satisfied, which is attributed to culture" (Jager *et al.,* 2016). However, this study differs with Jager *et al.* (2016). study on the basis that some of the participants in this study indicated that they reduce portion sizes.

In preparing fat-free diabetic meal, participants indicated that they should not fry food, including not using spread on bread and using less cooking oil and removing chicken skin. Also eating low fat products. Therefore, this affirmed literature report removal of visible fats, chicken skin, not frying food and using low-fat products to reduce fats as well as using other food preparation methods such as braai, steaming and grilling (Tarrago-Trani *et al.,* 2006).

Sub-theme 1.3: Existence of knowledge on the importance of exercises and consequences of not exercising for diabetes persons outlined

Exercise is one of the critical elements in the management of diabetes through maintenance of weight management. This sub-theme outlines knowledge of participants on the importance of exercise, and consequences of diabetes patients not exercising. Below are some of the quotations by the participants in support of the sub-theme:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "Exercise is important since it prevents the development of other diseases which may be associated with diabetes."

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner) confidently further notes that *"I started riding bicycle while I was still having problems with my legs till, I got healed and I'm still riding it even now. I enjoy it a lot. I sleep well".*

Participant 5 (64 years old, Male, Diabetic for 5-6 years, Pensioner): "I don't like sitting for longer, I work and drive bicycle to keep myself fit and healthy since I feel good after working or riding bicycle, if I take 3 days without riding bicycle I get sick."

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): *"It is through exercise that I am able to perform household chores and other activities which requires energy"*

Various studies demonstrated that exercise is important in preventing and/or reducing risk of diabetes associated health problems and complications (Williams, Pollack & Dibonaventura, 2011). This is also confirmed in this study with participant 1 having indicated that exercise is important to diabetes patients since it prevents against the development of other diseases which may be associated with diabetes. "Exercise is also important in improving well-being and quality of life of diabetes patients" (Williams, Pollack & Dibonaventura, 2011), this is also confirmed in this study since participant 5, 10 and 11 reported that it is through exercising and eating healthy that they are able to perform all the duties/work they used to do prior diagnosis without exception.

Studies have also reported boosting of self-efficacy and mood as one of the benefits of exercise (Williams, Pollack & Dibonaventura, 2011; IDF, 2015). Participants in this

study also affirmed this benefit of exercise by indicating that it boosts their mood and that they feel good when exercising. At the same time, participants indicated that they feel sick and unwell in the event they take days off exercise which implies that participants know the dangers of not exercising. Therefore, this study also affirms study which indicated that physical inactivity may increase burden of diabetes (Yang *et al.,* 2010).

Sub-theme 1.4: Existence of knowledge on the importance of diabetic persons to consult multidisciplinary health professionals

Diabetes management requires that people living with diabetes consult multidisciplinary team for better outcomes. This sub-theme highlight knowledge on the importance of diabetes patients to consult multidisciplinary team. Participants alluded that it is important to consult multi-disciplinary team in order to gain more knowledge on how to best manage their disease, and further went on to say, they can bring their family members who looks after them for consultation. Below are some of the statements made by the participants in support:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): *"I can see dietitian and physiotherapist every 6 months to get nutritional and exercise education, respectively, because they will advise me better on how to control my diabetes better through food and exercise in addition to the medication I'm currently taking."*

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner): *"My current health challenges is the eyesight but I'm also getting eye treatment from the local clinic though waiting to be transferred to another hospital for treatment."*

Participant 4 (63 years old, Male, Diabetic for over 10 years, Pensioner): "*I was told not to eat salty, sugary and fatty food. I was even given a paper of food to eat and not to eat, while I was still in Gauteng, unfortunately I lost it. I was also encouraged to bring my wife for dietetics consultation, unfortunately such could not happen since my wife works during the week and the dietetics department don't work over weekend, however, I can still bring my wife for consultation since is the one who cooks".*

Participant 5 (64 years old, Male, Diabetic for 5-6 years, Pensioner): "I'm a Christian, I believe a lot. When health professionals tell me not to eat certain food, I

stop eating them. I was told to stop drinking coke drink, including liquor which I stopped. Also, if I can be told to see certain specialist, I will"

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): *"I can consult multidisciplinary team, so that I manage my diabetes better. If health professionals can tell me to leave certain food, I will stop since I will be told by knowledgeable people."*

The multidisciplinary health care team promotes self-care, emphasizes the development of abilities and skills, encourages social participation and proactive decision-making, expands social networks, and is sensitized in the effective promotion of health and empowerment (Blanco-Cornejo *et al.,* 2017). Participants had lived with diabetes for a minimum period of six months and emphasis that they can see multi-disciplinary team, therefore our results differ with the study which reported the needs of patients to require multidisciplinary team care changes with duration of disease (Wiley *et al.,* 2013).

Sub-theme 1.5: Knowledge existence of diabetic medications and the importance of adherence to medication instructions outlined

Medication and its adherence are important for better outcomes (IDF, 2015). This sub-theme highlights knowledge of diabetes patients to take their medications and importance of adherence to medication as prescribed. Participants emphasized the knowledge by also outlining personal benefits deriving from intake of medications as shown in below direct quotes from participants:

Participant 5 (64 years old, Male, Diabetic for 5-6 years, Pensioner): "*Medication helped me, I get tired like any other person, like I used to before diagnosis with diabetes. I sleep well at night without any interruptions."*

Participant 8 (47 years old, Male, Diabetic for 2 years, Unemployed): "*Diabetes medication helped me a lot with regard to dizziness, though I'm still experiencing it but it is no longer that frequent compared to previously. The only consistently health challenge is eyesight; I don't see well; I hope I will get better if I continue the treatment"*

Participant 11 (54 years old, Female, Diabetic for 5 years, Unemployed): "*I live like a person who is not sick or having diabetes because of diabetes treatment including medications and I always honour my appointments"*

Participant 13 (52 years old, Female, Diabetic for over 3 years, Unemployed): *"I started taking medication 3 times a day, one doctor changed to two daily, then I got sick and admitted in hospital, I quickly explained to the doctor that I was taking medication 3 times without any problem, and that the problems started when I was changed to two times daily; I was returned to 3 times and I'm got well."*

"An Indian study indicated that almost all of the patients said that oral antidiabetic drugs and insulin form an important part of the treatment of diabetes (Benjamin *et al*. 2017). This study revealed that participants understand or know that diabetic medication is important in achieving improved wellbeing, therefore, this study agrees that diabetes medication and insulin are important in managing the disease. Non-adherence to treatment is a problem, which leads to bad consequences at both patients and healthcare system levels (Clark, 2004). Generally previous studies found that adherence to diabetes treatment was suboptimal (Kalyango *et al.,* 2008; Al Taee, 2009). Participants in this study further indicated that since they started medication, they have adhered to it, therefore contradicts studies which reported lack of absolute adherence to medication. Moreover, participants in this study indicated that they are adhering to medication in order to live longer for their children and grandchildren, therefore this study adds to factors which influence adherence of medications. Previous studies reported the following as factors affecting adherence to diabetes medication: information about medications, their experience with medication and associated complications with use, social support for medication behaviour and routines in medication behaviour, female gender, level of education, urban population, irregularity of the follow-up, non-adherence to exercise regimen and type of treatment" (Khan *et al.,* 2012; Borgsteede *et al,* 2011).

Sub-theme 1.6: Knowledge existence of food when taking diabetic medications outlined

Dietary and medication intake are crucial for diabetes treatment (IDF, 2013). Participants indicated that it is important to eat in order to take medications, and that the reason they eat breakfast is mainly to take medication. They further said each time

they take medication they have to eat. They went on to say, the reason why they eat when taking medication is to avoid collapsing. Below are some of the statements made in support:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*I eat breakfast so that I can drink medication, I never miss eating breakfast, since I never miss taking my medication."*

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): *"I eat 3 times a day i.e., breakfast, lunch and supper in order to take medication, since I can't take medication without food"*

Participant 15 (80 years old, Male, Diabetic for 18 years, Pensioner): "*I eat soft porridge in the morning. I firstly inject insulin then wait for half an hour before eating soft porridge, however, I eat something while working since I work for longer."*

Hypoglycemia is about low blood glucose levels and can result from lack of intake of food, delayed or missed meals or snacks, alcohol intake without food or taking medication without food (Mahan & Escott-Stump, 2008). Therefore, this study shows that participants understand and know the importance of food when taking medication since participants indicated that they are eating in order to avoid collapsing. Dizziness, collapsing and death are some of the symptoms of hypoglycemia.

Sub-theme 1.7: Existing knowledge that diabetes may lead to death is worrying to females not males diabetic persons

Diabetes may lead to poor complications and subsequently to death, particularly in the presence of inadequate knowledge (IDF, 2015). This sub-theme outlines female diabetes are worried that their diabetes may lead them to death as compared to males. Below are some of the statements in support of the sub-theme:

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner) who is female says *"I know one can die of diabetes, particularly when stressing about it, so I'm avoiding stress so as to avoid premature death due to diabetes"*

Participant 4 (63 years old, Male, Diabetic for over 10 years, Pensioner) who is male said "*I don't worry about dying because of diabetes. I only worry about one thing, i.e., inability to have sex and this is what will kill me and not the disease"*

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed) who is also female said "*This disease can kill you. I'm not sleeping at night because I don't know who will take care of the little one if I die of diabetes, since his mother has long passed on."*

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed) who is male said, "*I don't worry about dying of diabetes because I know we will all die in this world."*

"As per Mathew and Gucciardi (2012), men are more concerned that diabetes restricting their lifestyles and affecting their provider role (Jonsson *et al.,* 2000), yet still believe diabetes can be controlled (Brown *et al.,* 2000). This was also confirmed in this study whereby despite men experiencing complications such as erectile dysfunction, they still believe their diabetes can be controlled. On the other hand, women in this study feared to die from diabetes, since they still want to live longer to raise their children and grandchildren. Therefore, this agrees with studies which reported that women are worried that the disease will hinder their familial responsibilities, general wellbeing, fearing loss of health, diabetes-related morbidity, and early mortality compared to men" (Dietrich, 1996; Mathew and Gucciardi, 2012).

This study agrees with a study by Sriram *et al.* (2005) conducted on 226 diabetes patients, of which 143 were males and 83 females, which found that, about the psychosocial correlation female diabetes patients had a slightly higher score on anxiety. In contrast male were significantly more satisfied, had lesser social worries, lesser stress due to the illness, higher score on positive well-being and rated their health as being better. Male coped far better than females (Siddiqui, Khan & Carline, 2013). Some women's poor health protective behaviour may be explained by research on the fact that women often put other people's needs before their own (Detzer *et al.,* 1995); this is also evident in this study since women indicated that they worry a lot on who to take care of their grandchildren if they pass on.

Theme 2: Description of existing challenges by people living with diabetes mellitus

Living with diabetes brings along health challenges related to maintenance of quality of life and challenges related to self-care practices which influence diabetes outcomes. Participants reported life challenges they are experiencing as a result of living with

diabetes. This was evident in the following sub-themes that have emerged from this theme:

Sub-theme 2.1: Difficulties experienced related to maintenance of quality of life due to societal and family expectation outlined (Scared to tell anyone that you have diabetes ending up eating wrong food)

Consumption of unhealthy meals or food threatens the quality of life of patient which is already compromised by the presence of the disease. Diabetes patients should adhere to dietary modifications. However, participants indicated that they sometimes find themselves having to eat food which they aren't supposed to due to societal and family expectations. Below are some of the claims, participants made:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*I don't eat beef, though I'm sometimes forced to eat it at church events or other people's ceremonies, since I cannot go around telling people what I eat and what I don't eat."*

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): *"My family knows very well that I am having diabetes and I'm currently living with my son at home who also know that I'm having diabetes. Though, he sometimes out of love try to get me to eat nice fatty and sugary thing he bought for me from nearby shopping complex."*

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner): "*My wife constantly serves me chicken intestines knowing very well that I'm not supposed to eat them, and when I refuse to eat them and cook something else, we fight; so for the sake of peace at home, I just eat whatever I'm given to eat."*

Participants in this study highlighted that they turn to eat food which they know are not supposed to eat at the ceremonies, parties and other people' houses or events. They do so because they believe their disease is their secret and therefore, they cannot go around disclosing their diabetes for the fear of discrimination and stigmatization (Crandall & Moriarty, 1995), yet they have to conform to established trend or tradition of eating at other people's places, events, ceremonies and parties. Participants further conceded that they experience signs and symptoms of uncontrolled diabetes after eating these foods which they aren't supposed to, which compromise and threaten their quality of life.

Sub-theme 2.2 Existing feelings of shame related to diabetic diagnosis resulting in lack of disclosure to family and others outlined

Participants indicated that their diagnosis is their secret and are mainly comfortable in disclosing to immediate family they reside within the same household. Diabetes is often associated with complications such as erectile function, which -is a source of shame for many men with the condition. Participants in this study also pointed out that the reason to keep their diagnosis secret is to avoid being shamed and stigmatized. Below are some of the statement's participants had made:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "I cannot go around telling people about my disease diagnosis, it is my secret and that of my family."

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner): *"I also experience erectile dysfunction. Fortunately, my wife supported me through and through, remained loyal and never told people about my condition. Had she told people I would have died since that's what I was largely worried about."*

The results of this study showed that participants are only disclosing their diabetes diagnosis to the immediate family they reside with at the same household and finding it difficult to disclose to other family and other people. This could be that they fear being stigmatized, discriminated against, shamed, and people feeling sorry for them. This study affirms a Netherlands study among Surinamese community which investigated factors affecting disclosure of diabetes and demonstrated that diabetes patients only chose to disclose their diagnosis to those they live with and to some very close family members, but rarely to other people in their wider social networks or at work (Kohinor, Stronks & Haafkens, 2011). The reasons which limited the disclosure of diabetes to people outside their homes was the perception that talking about a disease in public is a taboo in the Surinamese community that may lead to gossip among community members, shame, and most importantly disgrace for the patient and their family, including fear of job discrimination (Kohinor *et al.,* 2011).

Sub-theme 2.3: Existing challenges of lack or minimal sex drive for men with diabetes resulting in stress and fear of losing wives explained

“Erectile Dysfunction is a serious complication of Diabetes Mellitus” (Kaya, Sikka & Gur, 2015), which is common among diabetes patients and worsens quality of life. Participants reported existence of erectile dysfunction which impact on their mental health and also bring along fear of losing their wives. Below are some of the statements made:

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner): *“I nearly died because of erectile problem and inability to have sex with the woman I married. I couldn’t do any other work because of the stress brought by erectile problems. Though I and my wife are done having kids, we were doing sex for fun. However, nowadays I’m a bit better and able to sex her even if is not that satisfactory.”*

Participant 4 (63 years old, Male, Diabetic for over 10 years, Pensioner) sadly remarked that “*Diabetes took away my happiness. I no longer have sex. I am married, but I can go for a month without sex. I only do it once a month, but it is also poor. What stresses me a lot is that my wife is younger, I’m afraid she may decide to have sex out of wedlock since she is not getting satisfaction from her husband. I’m also still young, as you can see me. I still have to have sex. This thing of not having sex, I’m afraid may worsen my diabetes and also kill me.”*

Participant 15 (80 years old, Male, Diabetic for 18 years, Pensioner): *“I’m having erectile dysfunction and no longer having sex with my wife, I had to request the doctor to invite my wife and explain my condition to her so that she doesn’t think I have concubines. I had to this through doctor so that I don’t lose my wife.”*

Erectile Dysfunction is a common complication of diabetes with prevalence rate ranging from 35 to 70% (Chew *et al.,* 2000). A study by de Berardis *et al. (*2002), also reported that erectile dysfunction is a very common problem, affecting one third of patients with T2DM. Almost all men who participated in the qualitative study reported erectile dysfunction, therefore this confirms erectile dysfunction as common diabetes complication. The presence of a normal sexual desire and the inability to physically act on that desire can affect patients’ lives in different ways, including disorders in interpersonal relationships, interference with sexual life, problems with partners, and increase in mental stress, making erectile dysfunction a major QoL issue (National Health Institute, 1993). Participants in this study reported that they are having sleepless night because of inability to act on the sexual desire and satisfy their wives.

Participants further indicated that they fear losing their wives to other men because of lack of sexual dissatisfaction. Sexual function is a major concern for men with diabetes, and it is confirmed in this study since men reported having sleepless nights and fear of losing their wives. This study confirms that women turn to please their husbands even at the expense of their health or wellbeing (Johnson & Elliott, 1997), since married men with erectile dysfunction reported that their wives have been supportive through and through.

Sub-theme 2.4: Commencement of health seeking following diagnosis of diabetes outlined (going to traditional healers, churches hoping to get cure)

Starting diabetes treatment early may help preventing complications and improve quality of life. However, participants in this study reported delayed start of treatment due to seeing alternative health options, as evident in below statements participants made

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*At first, I didn't understand when they told me I have diabetes, even when nurses said so, I did not take them serious, until I accepted when I noticed that my manhood is no longer working and cannot have sex. I went to traditional doctors and churches for the treatment of my manhood, it remained not working, then I started diabetes treatment, though even now I cannot have sex since it is totally not working."*

Participant 8 (47 years old, Male, Diabetic for 2 years, Unemployed): "When I was diagnosed with diabetes, I went to church to get opinion, at church, they told me that I can heal if I stop eating red meat and continue coming to church since this diabetes is not real one but witchcraft, and I believes them, since I'm no longer experiencing frequent dizziness after I stopped eating red meat".

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*I was diagnosed with diabetes at the age of 90 years, and I couldn't understand why I can be diagnosed of chronic disease at this age."*

Diabetes diagnoses bring about shock, emotions and anger including denial (da Silva *et al.,* 2018). Emotions and its burden trigger complications of diabetes and makes it difficult for acceptance and denial (Ferreira, Daher, Texeira & Rocha, 2013). Therefore, delaying commencement of diabetes treatment since individuals begin to

seek alternative health treatment. This study also affirms diabetes bringing about shock, emotions, and denial.

Sub-theme 2.5: An outline that diabetic diagnosis causes fear, stress and depression which is unbearable

Diabetes is an emotional and sensitive condition, which may trigger associated complications and compromise mental health. This sub-theme outlines views of participants regarding diabetes diagnosis causing fear, stress and depression and supported by below quotes:

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): "*I refuse to eat fatty, sugary and salty food my son buys them for me, for the fear of complication and death, because I still want to live longer for him."*

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed): "*I no longer attends other people's events and ceremonies for the fear of complicating in front of people, since I have to wait for about half an hour before I eat after injecting insulin and I sometimes forget to eat and get reminded when I feel signs and symptoms such as shakiness and dizziness and then eat, so when I'm home I can immediately eat when I experience this symptoms but at other people's ceremonies, you will have to wait for lunch time…..I also sleep having prepared a mixture of water and sugar so that if I complicate, my grandchild can give me to drink and then eat."*

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): *"I sleep with a flask of warm water so that when he experiences signs of high sugar, I can drink water to cool down and this I do usually after eating cakes and sugary food at other family event."*

Participant 16 (61 years old, Female, Diabetic for 14 years, Pensioner): "*I love eating sweet and salty food, but nowadays I try not to though difficult. Life before diabetes diagnosis was nicer because I would eat anything without restriction e.g. chocolate, cooldrinks, sweets, etc. I stay alone since the passing of my aunt, so I have to force to avoid these foods like for the fear of diabetes complications."*

Participant 1 who has erectile dysfunction and hypertension says, with a sad face that "*Life is very difficult to me. I don't sleep at night due to stress which result from inability to have sex; I also have hypertension".*

Diabetes is emotionally and cognitively demanding diseases that place patients at risk of variety of psychological conditions (de Groot, Golden & Wagner, 2016). These include depression (Ghosh & Chatterjee, 2013), poor-eating habits (Peveler *et al.*, 2005), and fear of hypoglycemia (Gold *et al.,* 1997). Therefore, there is a need to prioritize the psychological well-being of patients by also involving family to provide diabetes self-management support which is fundamental in improving psychological wellbeing. Women also report significantly more depressive symptoms (Gucciardi *et al.,* 2008).

Sub-theme 2.6: An outline that development of co-morbidities when having diabetes viewed as problematic

Diabetes often exists with other comorbid conditions, particularly when it is poorly managed and brings along an additional burden. This sub-theme shows that the presence of co-morbid conditions is problematic as demonstrated in below quote:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*I also developed hypertension, and diabetes-associated erectile dysfunction, this stresses me and make me have sleepless nights even though as a man I'm too fighting back by adhering to health advises from healthcare professionals"*

This study agrees with the view that comorbidity disrupts and complicate the usual diabetes management, since it adds more burden and require additional care in terms of medication, dietary and exercise (Nguyen *et al.,* 2019). Comorbidity is common and linked with adverse clinical outcomes and higher healthcare costs, compared with presence of one chronic disease (Parekh *et al.,* 2011). Therefore, there is a need for lifestyle modification among this participant in order to prevent further comorbid condition and to achieve better glucose control.

Sub-theme 2.7: Loss of income and jobs due to diabetes lead to family misunderstanding after diabetes diagnosis

Participants in this study generally consult at healthcare alone, however, the relay health advises to their partners or families. However, participants who lost jobs or income claimed as follows:

Participant 3 (65 years old, Male, Diabetic for over 5 years, Pensioner): "*When I tell my wife that the food, she me to eat will kill me, the wife will instead reply by saying if you die, you die. This treatment started when I was no longer employed, though I built her a house. This used to stress me. Nowadays I eat anything my wife gives me to eat to avoid stress. I even stopped cooking suitable food for myself, because that too led to fights".*

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): "*At my family, my wife sometimes gives me chicken feets while she knows very well that I'm not supposed to eat fats. When I complain, we fight, so to avoid fights, I just keep quiet and eat".*

Improved patients' quality of life is linked to better income, social support, education and exercises without any complications (Clark 2008). This study confirms linkage of better QoL with better income, since family care better for patients with income. There is a need to community awareness campaigns to encourage the families to practice the African philosophy of *botho* (Tshoose, 2009) and treat all with respect and equally for better diabetes outcomes.

Theme 3: Description of the experiences of being diagnosed with diabetes mellitus

Participants pointed out their experiences of being diagnosed with diabetes mellitus. This was evident in the following sub-themes that have emerged from this theme:

Sub-theme 3.1: Ability of performing household chores after diagnosis as compared to prior diagnosis with diabetes outlined

Of all the participants, only participant 5, and 11 reported that they are able to perform all the duties/work they used to do prior diagnosis without exception. Participant 11 notes that she lives like any other person who is not sick or living with diabetes and that in addition to house chores, she does play football, and in the days where she doesn't play football, she goes jogging at the football ground closer to her house.

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): *"I'm no longer able to do heavy house chores but only manages to do light house chores such as cleaning the house, washing dishes and clothes".*

Participant 8 (47 years old, Male, Diabetic for 2 years, Unemployed): "*I am unable to do hard labour because of body weakness and dizziness, which I used to do before diagnosis; I used to work at the farms doing hard labour before diagnosis."*

Participant 9 (69 years old, Male, Diabetic for 23 years, Pensioner): *"I own a liquor supplier store so I'm able to carry and load cases of beers for delivery in additions to the house chores. However, the only work I cannot do is having sex with my wife."*

Participant 10 (56 years old, Female, Diabetic for 8 months, Unemployed): "*I look after the kids of my children as a result I daily cleans the house, cook and wash dishes and weekly wash clothes. However, I no longer manage to do heavy duties like carrying water tanks."*

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*Before diagnosis with diabetes, I used to walk to my friend's place in the village, however, nowadays I no longer able to. I only walk within my yard. I am able to sweep the floor like before though my daughter whom I stay with and grandchildren, will stop me from sweeping if they feel I swept for long. Since physically, I'm not well".*

World Health Organization (WHO) regards QoL as "an estimation of well-being as well as the measurement of health and the effects of health care" (WHO, 1998). In this study, quality of life is considered as the ability to do the work an individual was able to do prior diagnosis with diabetes without exception. Quality of life is about "how good or bad a person regards their life to be, and not what other people necessarily imagine it to be" (Raghavendra *et al.,* 2017).

Nutrition, exercise, and medication are extremely important in diabetes care and improves the quality of life (IDF, 2015). Participants attributed their ability to perform work they used to before diagnosis without or with limitations, had attributed their ability to nutrition, exercise and medication. Therefore, this contradicts studies which indicated diabetes patients are always find wanting with diabetes knowledge (Breen *et al.,* 2015; Fitzgerald *et al.,* 2008).

The results of this study are similar to the findings of Charlton, Lambert and Kreft (1997), which described patterns of weekly activity of older South African adults from historically disadvantaged backgrounds, where it was reported that most spent in housework, gardening, and yard work, caregiving, exercise, and recreation (Charlton, Lambert & Kreft, 1997).

Sub-theme 3.2: Acceptance versus denial experienced after diagnosis with diabetes outlined

The road of participants to acceptance of diabetes diagnosis was not an easy one, as they reported that it included getting views of others and consulting traditional healers and churches. Below are statements made in regarding acceptance or denial:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): *"At first, I didn't understand when they told me I have diabetes, even when nurses said so, I did not take them seriously, until I accepted when I noticed that my manhood is no longer working, and I cannot have sex."*

Participant 2 (63 years old, Female, Diabetic for over 2 years, Pensioner): *"I accepted the diabetes diagnosis very well since it wasn't the first disease; I started with hypertension."*

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*I had difficulty in accepting diabetes diagnosis, since I lived for 90 years without any chronic disease."*

A Brazilian participatory qualitative study on diagnosis of diabetes and living with chronic disease reported that the impact of diagnosis is met with a mixture of feelings including preoccupation, panic, and even anger and consequently denial of the condition (da Silva *et al.,* 2018). The emotional impact generated by diagnosis and its entire burden triggers the complications of diabetes and makes it difficult for acceptance to occur, leading to prolonged denial (Ferreira *et al.,* 2013). This was also evident in this study where participants took time to accept diagnosis, which meant anger, panic and denial.

Sub-theme 3.3: Acceptance of diabetes diagnosis viewed as a difficult issue and taking time which is influenced by several factors

This sub-theme outlines demonstrate that participants consider diabetes diagnosis as a difficult issue and taking time which is influenced by several factors as captured in the below statements:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): *"At first, I didn't understand when they told me I have diabetes, even when nurses said so, I did not take them seriously, until I accepted when I noticed that my manhood is no longer working, and I cannot have sex."*

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*It was difficult for me to understand why I'm diagnosed with diabetes at 90 years, and not in the early days of elderly."*

Studies indicated that the impact of diabetes diagnosis resembles the stages of mourning which are denial, anger, bargaining, depression, and acceptance as described by Kubler-Ross (1989). These stages of mourning affect the self-image and self-esteem (Beltrame *et al.*, 2012; Silva 2014). This was also evident in this study since participants indicated that acceptance is difficult and influenced by onset of complications, denial and most importantly desire to live longer and fear of death from diabetes.

Sub-theme 3.4: An explanation that disclosure of diabetes diagnosis to family members is difficult

Generally, participants indicated that they were able to disclose their diagnosis of diabetes to the immediate family, they reside within the same house than to extended family.

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): *"I cannot go around telling people that I have diabetes, it is my own secret and those of my family, though I sometimes eat food which I'm not supposed due to not disclosing to others."*

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed): *"I resorted to not attending family events because of difficulty to disclose my diagnosis and also for the fear of experiencing signs and symptoms of wanting to eat, because I will not*

be easily given food immediately to eat without disclosing that my diagnosis or being suspected of living with diabetes mellitus."

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): "*I find it difficult to disclose to family outside my household, and as a result I end up eating sugary food like cake at family celebrations which I'm not supposed to eat. As a result, I experience signs and symptoms of high diabetes such as shaking and pains after eating cakes but I will then drink lot of warm water to cool down."*

Stigma is defined "as a deeply discrediting attribute" (Goffman 2006). Moreover, Crandall and Moriarty (1995) reported that stigma linked to chronic illness leads to social rejection and can lead to prejudice and discrimination. It is of great importance for health professionals to understand the power of stigma and to help people reduce feelings of stigmatization (Audulv *et al.,* 2009). The results of this study showed that diabetes patients find it difficult to disclose to family, which could be ascribed to the fear of being stigmatized.

Sub-theme 3.5: Psychological and physical signs and symptoms experienced by people living with diabetes mellitus outlined

This sub-theme outlines psychological and physical signs and symptoms experienced by diabetes patients. The following statements by participants explain the experiences:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*I'm experiencing sexual dysfunction, and as a result I'm unable to have sex with the woman I married. This gives me sleepless nights; I am always worried."*

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed): "*When I feel not well and shaky it means I should grab something to eat since I'm using insulin to control diabetes and after injecting, I should wait for about 30 minutes before I eat, of which I sometimes forget due to stress."*

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): *"I have been living with diabetes since 1997. I can now feel when diabetes is not controlled. I sometimes eat cake and sugary things during celebrations, when I experience shaking*

and pains, it will mean my sugar level is uncontrolled/high then I will drink lot and lot of warm water to cool it down. When I go to sleep, I put water in a flask".

Participant 8 (47 years old, Male, Diabetic for 2 years, Unemployed): *"I have been living with diabetes for long now. This disease sometimes overpowers medication. When it overpowers medication, I get ill, dizzy, and painful. Though I'm currently getting better, I'm no longer experiencing dizziness that frequently compared to previously".* He further said the only consistently health challenge he is experiencing is eyesight.

Diabetes patients often find it difficult to accept taking medication for lifetime, including in dietary modification resulting in poor treatment adherence and diabetes self-management (Kaira, Sridhar, Balhara *et al.,* 2013). Diabetes is "emotionally and cognitively demanding diseases that place patients at risk for a variety of psychological conditions" (de Groot *et al.,* 2016). These include depression (Ghosh & Chatterjee, 2013), poor-eating habits (Peveler *et al.*, 2005), and fear of hypoglycemia. (Also, the burden of depression and other psychological conditions increases globally, with the increase of diabetes prevalence (de Groot *et al.,* 2016). The symptoms of psychological disorders include inability to sleep at night. The results of this study confirmed the burden of psychological symptoms which often accompany diabetes since participants reported that they are unable to sleep at night and are worried because of the complications brought by the disease and fear of death. The existence of psychological disorders among diabetes patients impacts on glycaemic control, self-care behaviour, and quality of life (Kalra, Jena & Yeravdekar, 2018). Therefore, there is a need to prioritize the psychological well-being of patients by also involving family to provide diabetes self-management support which is fundamental in improving psychological wellbeing.

A study by Hilliard *et al. (*2013) reported a strong correlation between poor diabetes management and depressive symptoms. Non-ketonic hyperosmolar coma is a "condition exclusive to older people with diabetes and is characterized by extreme hyperglycaemia and hyperosmolarity. People with these symptoms exhibit mental status changes, dehydration, and hypotension" (Selvin *et al.,* 2006). Participants in this study reported shakiness, sleepless nights, dizziness, and pains which are physical signs of uncontrolled diabetes. Fatigue is also a "main issue for people with

diabetes; they report it twice as often as nondiabetics" (Kelleher, 1988). Other common signs and symptoms of poor glucose control include, but are not limited to, polyuria, polydipsia, polyphagia, weight loss, visual disturbances, and/or ketosis (Bytomski & Moorman, 2010). These symptoms were also reported by participants in this present study.

Theme 4: Description of existing support for people living with diabetes mellitus

Participants pointed out the support they get from family members in the management of diabetes mellitus. This was evident in the following sub-themes that have emerged from this theme:

Sub-theme 4.1: Existence versus lack of support by family members for people living with diabetes outlined (which include food, exercise, collection of medication etc.)

This sub-theme outlines existence versus lack of support diabetes patients get from their family members with regard to collection of medication, food and exercise. The following are some of the claims made by the participants:

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed): "*I stay with my grandchild at home, so I sometimes forget to eat after waiting period of injecting insulin, and my grandchild could not notice and too fail to remind me, however, I sleep having prepared mixture of sugar and water, and put it closely. So that in the event that I get unwell, the grandchild could give me to drink, and he knows that."*

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*My family knows that I'm diabetic and are supportive. They cook for her. They let me exercise by sweeping the floor since I'm in my 90s but supervise me to ensure that I don't overwork myself."*

Participant 14 (73 years old, Male, Diabetic for 5 years, Pensioner): "*The family knows that I have diabetes and are supportive, when I leave the house, I let them know where I'm going, and they encourage me to come get my medication."*

Participant 15 (80 years old, Male, Diabetic for 18 years, Pensioner): "*The family knows my diagnosis, and they know food which I'm supposed to eat and not to eat and are giving me accordingly."*

Caring for each other among Africans comes naturally and influenced by African philosophy of *ubuntu or botho* (Tshoose, 2009), which translate to humanity. *Botho* is "crucial to African culture and expresses the primary values of intense humanness, caring, sharing, respect, compassion and associated values, thus ensuring a happy and quality community life in the spirit of family" (Tshoose, 2009; de Beer & Brysiewicz, 2017). Participants in this study reported that they get support from their family members in the form of collection of medication, and preparation and serving of food or meals. This could be attributed to the prevalence of *botho* among the families of the participants. At the same time, participants mentioned no support with regards to exercise care, this is despite exercise being regarded as the cornerstone in diabetes care (IDF, 2013). Therefore, there is a need to educate family members of diabetes patients on diabetes care for better support and diabetes outcomes of patients. It is important to assess FMs' diabetes-related nutrition and exercise knowledge for effective family-centred diabetes care (Carman *et al.,* 2013).

Diabetes Self-Management Support (DSMS) refers "to the support that is required for implementing and sustaining coping skills and behaviours needed to self-manage on an ongoing basis" (Powers *et al.,* 2016). DSMS is provided by the family since most of the care takes place where the patient resides. Family members are an underutilized resource for ongoing support and often struggle with how to best provide this help (Kovacs *et al.,* 2013). Including family members in the DSME/S process on at least an annual basis can help to facilitate their positive involvement (Vaccaro *et al.,* 2014). Family-centred care begins with consultation and assures good quality of life (Baig *et al.,* 2015). Therefore, the training of family members on how best to provide and modify support they provide to patients, will lead to improved diabetes outcomes and saves the government costs which result from complications (Mutyambizi *et al.,* 2018). A study by Jager et al. (2016) indicated that all participants highlighted that hospitality is a very important social concept for all respondents, which they linked to their culture. This is also confirmed in this study in which participants 12 who is over 90 years reported that her family no longer allows her to work for longer which may impact on the quality of her life. Social support has also been associated with greater

levels of PA (Mier, Medina & Ory, 2007), in this study participants reported lack of family support in exercise activities which could be accounted to lack of adequate knowledge and obesity levels among the participants.

Sub-theme 4.2: Description of support experienced from wives of men who lost sexual drive

Participants 1, 3, 4, 9, 14, 15 and 17 indicated that they experience erectile dysfunction and as a result cannot have sex and/or sexually satisfy their wives. However, despite their inability to have sex, their wives still support them through cooking for them and being there for them. The following are some of the statements made by the participants:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*My wife still cooks for me, and she makes sure I eat food which diabetes patients are supposed to eat such as less or no fats, sugar and salt. "*

Participant 4 (63 years old, Male, Diabetic for over 10 years, Pensioner): "*Although I never consulted dietitian with my wife, she was always willing to go consult with me, but her work schedule prevented her; however, I relayed what I was advised to eat including the document highlighting food to eat. She always makes sure that I eat accordingly."*

Participant 17 (84 years old, Male, Diabetic for 14 years, Pensioner): "*I live with my wife. She cooks for me. When she is happy, I get happy with her. When she is emotional, I just avoid her so I can avoid stress. I have erectile dysfunction and the wife understands. She is also too old, she no longer desires sex that much like before."*

Women outpace men in their responsiveness to their partner's need for support (Neff & Karney, 2005; Bodemann et al., 2007). Male participants who lost sexual drive and are unable to sexually satisfy their wives, they still get support from the wives through collection of medication and preparation and serving of food. Therefore, this study also confirms that women are skilled in identifying times at which their husbands need absolute support and thereby providing it.

Sub-theme 4.3: Existence versus lack of support by husbands for women diagnosed with diabetes

Married female participants staying with their husbands indicated that their husbands are aware of their diabetes diagnosis including knowledge of food to eat and/or not to eat. Below are some of the claims made by the participants:

Participants 10 (56 years old, Female, Diabetic for 8 months, Unemployed): "*The presence of my husband at home gives me assurance that in the event I complicate, I will be helped quickly since he will know what to do; and this relieves stress".*

Participant 11 (54 years old, Female, Diabetic for 5 years, Unemployed): "*My family knows that I'm having diabetes, I stay with my husband and grandchild who is in primary school; my husband has since joined me in eating food without salt and fats."*

Participant 13 (52 years old, Female, Diabetic for over 3 years, Unemployed): "*My family knows I have diabetes and gives support, however my husband was being difficult and not supportive, when I first got diagnosed with hypertension and then diabetes I was pregnant, and I was trying to prepare family meals without salt, but my husband always insulted and tortured me as if I'm the one who chose to have the disease and I got stressed and admitted. He didn't think I was telling the truth that I'm sick. God is great; now he is recently diagnosed with hypertension and diabetes, because he is a coward, he is afraid and act supportive and encourages children not to add salt to our food."*

This study differs with a study by Van Boemel *et al.* (1999), which pointed out that husbands of women diagnosed with diabetes were prepared and willing to modify their dietary behaviours to accommodate the needs of their diabetic wives.

Sub-theme 4.4: Existence versus lack of support by children of diabetes patients with regard to food and exercise

This sub-theme outlines the support children of diabetes patients offers in the management of the disease. Below are some of the statements made by the participants:

Participant 6 (56 years old, Female, Diabetic for 4 years, Unemployed): "*I stay with my grandchild at home, so I sometimes forget to eat after waiting period of injecting insulin, and my grandchild could not notice and too fail to remind me.*

However, I sleep having prepared mixture of sugar and water, and put it close. So that in the event that I get unwell, the grandchild could give me to drink, and he knows that."

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): "*The only person who understand me at home is my daughter who is married; she gives me food I'm supposed to eat and on time."*

Participant 16 (61 years old, Female, Diabetic for 14 years, Pensioner): "*My children when they cook, they don't add salt right away, but dish for me and their father who is also diabetic, and thereafter add salt to their food."*

Studies *have shown competing demands between patient and family members as barriers to self*-management (Gallant, 2007; Siddiqui, Khan & Carline, 2013). For example, family members may not want to eat the same foods as a diabetic patient who is trying to maintain a healthier diet. Therefore, this study in contrast showed no competing demands, since children of diabetes patients do not add salt to patients' food but add salt to their food after dishing out to parents.

Sub-theme 4.5: Existence of support from family support groups which lead to maintenance of normal glucose levels, relieve from fear and stress

This sub-theme describes family support to diabetes patients which improves glycaemic control, relieve fear and stress. The following statements contains such descriptions:

Participant 1 (60 years, Male, Diabetic for over 5 years, Pensioner): "*My wife used to come and collect my diabetes medication at the local clinic, when I was not around."*

Participant 7 (58 years old, Male, Diabetic for 22 years, Unemployed): "*The only person who understand me at home is my daughter who is married; she gives me food I'm supposed to eat and on time."*

Participants 10 (56 years old, Female, Diabetic for 8 months, Unemployed): "*The presence of my husband at home, gives me assurance that in the event I complicate, I will be helped quickly since he will know what to do; and this relieves stress".*

Participant 11 (54 years old, Female, Diabetic for 5 years, Unemployed): "*My family knows that I'm having diabetes, I stay with my husband and grandchild who is in primary school; my husband has since joined me in eating food without salt and fats."*

Participant 12 (91 years old, Female, Diabetic for 9 months, Pensioner): "*My family knows that I have diabetes and they are supportive. They cook for me. In addition to cooking, they make sure I exercise by sweeping the floor but at the same time, they act as my supervisors so as to make sure that I don't overwork myself since I'm old"*

Research by Brody *et al.* (2008) has shown that self-care is compromised when individuals live alone in a rural setting with lack of family, friends, community, and neighbours who could provide emotional or physical support. Therefore, participants in this study have good support base which could lead to maintenance of glucose levels. Nutrition and diabetes medication play important part in diabetes management and its outcomes (IDF, 2013) leading to stabilization of glucose levels. Therefore, the provision of support by families through preparation and serving of meals, including collection of medication lays good foundation for maintenance of normal glucose levels. However, provision of support by families through food preparation and serving is not in itself an assurance for a better foundation of glucose stabilization. Behaviours of family members may also be unfavourable through preparing unhealthy meals and promoting inactive lifestyle (Mayberry *et al.,* 2014), particularly with inadequate knowledge. This is because inadequate diabetes-related nutrition and exercise knowledge may be liable for poor diabetes outcomes (Ajzen *et al.,* 2011). The amount, type and how food are prepared and served matters a lot for stabilization of glucose. Therefore, there is a need to assess knowledge of families related to nutrition diabetes care for effective family-centred care.

Also, participants in this study indicated that the presence of an elder person in the family looking after the patient helps in relieving fear and stress, since participants are assured that they will get the help they require in the event of complications. Stress impact negatively the glycaemic control of diabetes patients and ultimately quality of life (Kalra, Jena & Yeravdekar, 2018). Although, participants in this study reported that the presence of elder person is sufficient to relieve stress and fear, there is a need to

educate the elder family members will good self-care practices, so that he/she can provide appropriate care when needed.

Friends and families can promote good health by influencing a person's daily behaviour, and the loss or reduction of such support can have negative health effects (Black, Maitland, Hilbers, & Orinuela, 2016).

4.5 INTEGRATED MIXED METHODS RESULTS OF DIABETES PATIENTS

Integration was done with intent to bring together the quantitative and qualitative results of the diabetes patients for comparison. The integration in this study were presented through joint display in a table format. The type of integration used in this study is merging both quantitative and qualitative results from survey and interviews respectively, to relate qualitative themes to survey scores. The integration of the results addressed the following mixed method objective of the study:

Table 4.22: Mixed method results for diabetes patients

Joint display for merging quantitative and qualitative results		
Quantitative	**Qualitative**	**Comment**
Nutrition diabetes care		
81% of participants indicated that nutrition plays an important part in diabetes management.	All participants indicated that they are able to do house chores because of the food they eat. Participant 11 emphasized that her diabetes is controlled because of how she eats.	The results correspond and demonstrate that diabetes patients understand importance of nutrition in diabetes care.
89% of participants know that they should eat fruits and vegetables. Only 35% and 42% eat fruits and vegetables regularly.	All participants indicated that they eat fruits and vegetables almost daily, although consumption in determined by availability. Only one participant who sells fruits indicated consistent daily consumption.	The results correspond on the knowledge of eating fruits and vegetables, and the less than 50% of those eating fruits and vegetables regularly could be attributed to intake being affected by f availability as mentioned by qualitative participants.

86%, 89% and 84% of participants indicated that it is good to reduce or avoid salty, sugary, and fried food respectively. On the other hand, 57%, 58% and 68% never ate salty, sugary and fried food respectively.	All participants highlighted knowledge of the avoidance or reduction of intake of sugary, salty and fatty food. However, 4 participants indicated that they sometimes eat these foods which they know they aren't supposed to eat due to various factors. Participant 2 indicated that she doesn't eat sugary food but take raw sugar alone.	The results correspond on knowledge of the avoidance or reduction of intake of salty, sugary and fried food. Also, over half of the participants from quantitative strand never ate salty, sugary or fried food which could be correlated with views of participants from qualitative strand who indicated that they sometimes find themselves eating food which they aren't supposed to eat.
83% of participants know that they should eat small frequent meals and that eating large portion sizes should be avoided.	Only 8 of the 17 participants know that they should eat small frequent meals, even though they indicated that they mostly eat large portion sizes, and only 3 eat small portion sizes.	The results don't correspond on the knowledge on intake of small frequent meals. Therefore, there is a need to educate on the importance of eating small frequent meals.
96% of participants indicated that they eat starchy food regularly 96%.	All participants indicated that they daily consume starchy food, of which porridge is the mainly consumed starch.	Results correspond on the intake of starchy food.

Only 29% of participants eat breakfast regularly	All participants indicated that they eat breakfast daily in order to take medication. The time of consumption of breakfast varies greatly.	Less quantitative participants eat breakfast as compared to qualitative participants.
Exercise diabetes care		
84% of participants know the importance of exercise in diabetes care. 83% are exercising, of which 45% exercise by doing household chores.	All participants know the importance of exercise and are exercising daily by doing household chores.	Both quantitative and qualitative participants know importance of exercise and exercising. However less than half of quantitative participants exercise by doing household chores.
82% of participants know that exercise prevents against complications (82%).	4 of the 17 participants indicated that exercise is important because it help them in preventing against diseases.	More quantitative participants indicated knowledge of exercise preventing complications.
Only 7% of participants know that 30 minutes, 3 days is recommended	None of the participants indicated knowledge of exercise prescription.	There is a poor understanding or knowledge of exercise prescription in both quantitative and qualitative participants.

minimum amount of exercise that they should get in a week.		
Multidisciplinary team		
94% and 90% of participants showed willingness to consult dietitian and physiotherapists.	All participants indicated that they are willing to consult dietitians and physiotherapists in future.	The willingness to consult both dietitian and physiotherapist is the same in both quantitative and qualitative participants.
95% and 93% of participants are willing to follow dietary and exercise prescription.	All participants showed good attitudes and their willingness to follow dietary and exercise prescriptions from the healthcare workers, including wearing of appropriate shoes.	Both quantitative and qualitative participants demonstrate good attitudes towards dietary and exercise prescription.
Family		
96% of participants indicated that their families know about their diabetes diagnosis.	All participants indicated that their families particularly their partners and children know about their diabetes diagnosis.	Both quantitative and qualitative participants have disclosed their diagnosis to the families.

53% of participants eat food prepared by their children.	All participants indicated that they eat food prepared by their children, although 8 of the participants highlighted that they most eat food eaten by themselves.	All qualitative participants eat food prepared by their children as compared to just over a half of quantitative participants.
Glucometers		
Only 11% has glucometers.	Only two participants own glucometers.	Personal ownership of glucometers is a challenge and unable patients to check their glucose regularly.
Self-care practices		
76% of participants know that they should eat before and after exercise, including drinking fast acting carbohydrate drinks when engaging in prolonged exercise.	All participants showed knowledge of eating before exercising. However, further alluded that they sometimes find themselves exercising before eating for various factors.	Both quantitative and qualitative participants know importance of eating before and after exercise even though qualitative participants further indicated lack of adherence.

Only 19% of participants know the glucose readings.	None of the participants know glucose readings including those owning glucometers. Participants indicated that their ability to perform household chores implies that their glucose is fine.	There is generally poor knowledge of glucose readings.
3% and 4% checked blood glucose before and after exercise regularly.	None of the participants checked glucose levels before and after exercise.	Lack of knowledge of glucose readings and none-ownership of glucometers could be reason why glucose is not being checked before and after exercise.
Traditional medication		
Only 4% uses traditional medicine to control diabetes.	Only participant 1 and 8 indicated consultation of traditional healers and religious healers to control diabetes.	The quantitative and qualitative results correspond and shows that the province does fairly well in defeating control of diabetes using traditional medication.

4.6 RESULTS OF FAMILY MEMBERS

Family members only participated in the quantitative strand; therefore, the results are presented accordingly, and in line with subsection of the questionnaire which are (1) Socio-demographic profile, (2) Knowledge, (3) Attitudes and (4) Practices related to nutrition and exercise diabetes care. Therefore, results of family members are as follows:

4.6.1.1 Socio-demographic data of family members of diabetes patients

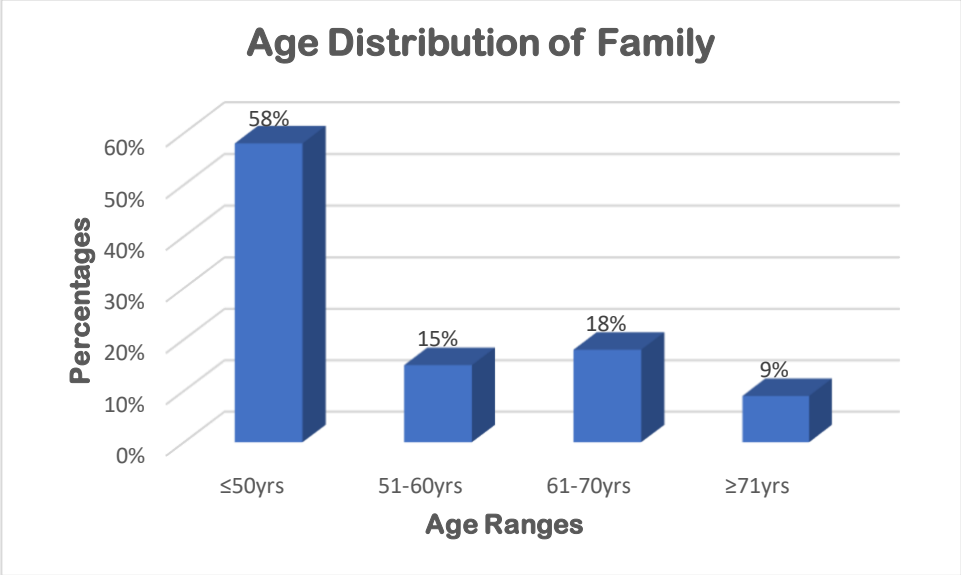


Figure 4.16: Age groups of family members

Figure 4.16 shows that over half of the participants were of the age 50 years and below (58%), followed by those above between the age 61 and 70 years (19%), and the least of the participants were those above the age of 70 years (9%).

This could be attributed to high population rate of young people and those between the age 35 years and 50 years as compared to older people above 50 years (Stats SA, 2013).

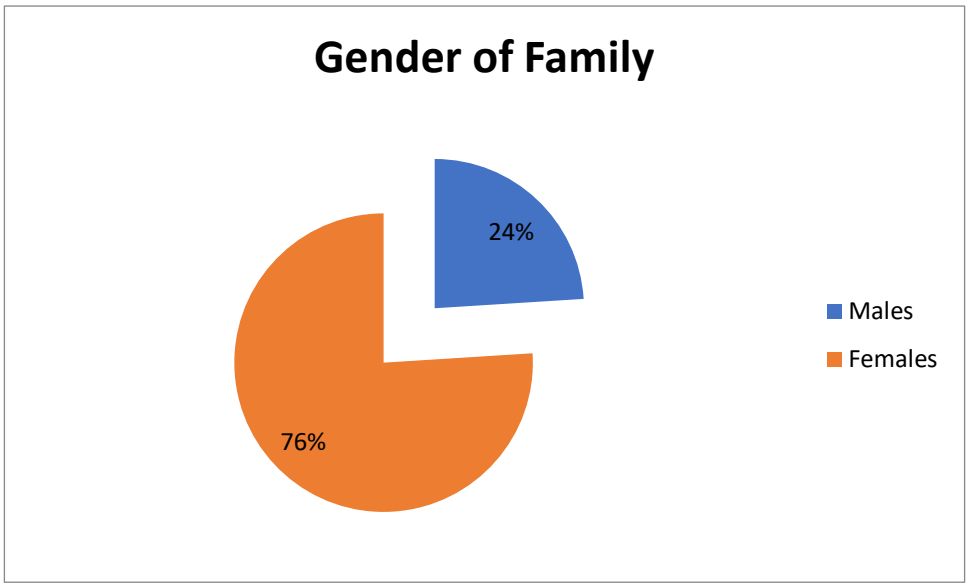


Figure 4.17: Gender of family members

Figure 4.17 shows that most of the participants were females (76%), and only 24% are males.

This study confirms report by Stats SA (2013), that despite low unemployment rates among Africans, women were less engaged in market activities compared to men (Stats SA, 2013).

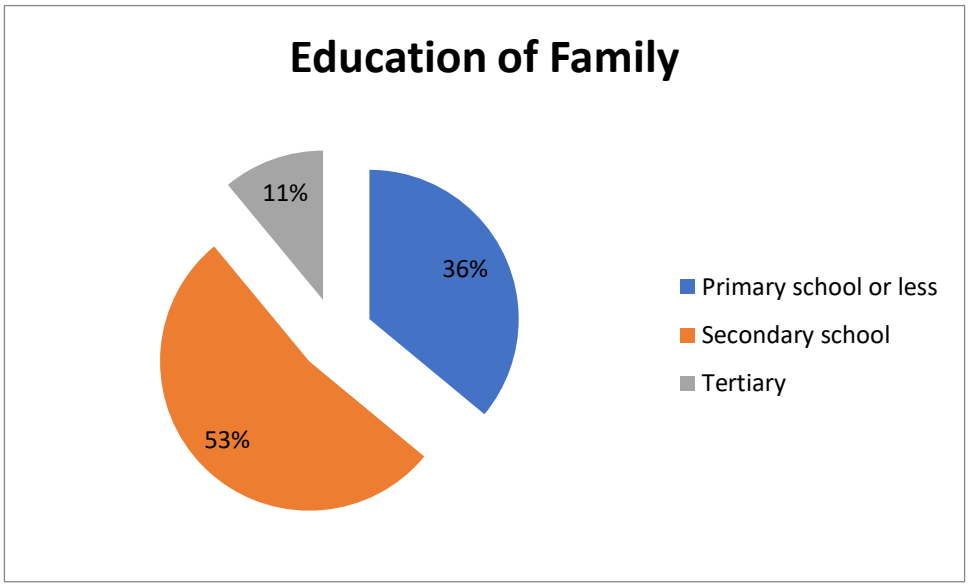


Figure 4.18: Education of family members

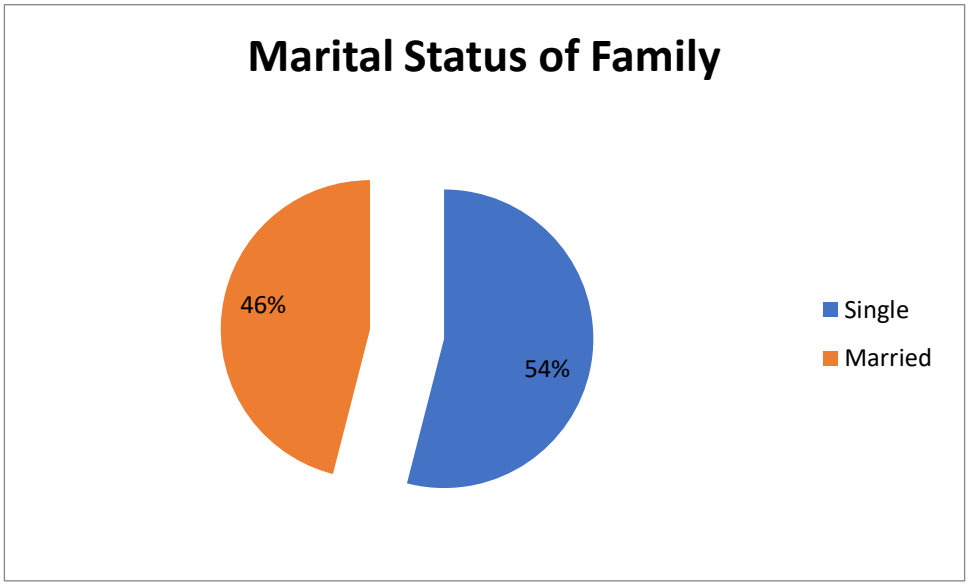
Figure 4.18 shows that over half of the participants had secondary education (53%), followed by those with primary education or less (36%), and only 11% had tertiary education.

Only 11% of family members had tertiary education, which confirms the Stats SA (2013) report which indicated that only less than 10% of indigenous African women and men have a qualification higher than Grade 12.

Figure 4.19: Marital status of family members

Figure 4.19 shows that over half of the participants are married (54%) and only 46% are single.

Marriage patterns among indigenous South Africans have declined, which is mainly attributed to economic reasons (Moore & Govender, 2013). This study also indicated that just over half of the family members who were mainly less than 50 years of age were married, compared to most of diabetes patients who were mainly older than 60 years of age. Therefore, this study confirms that marriage in South Africa has declined.



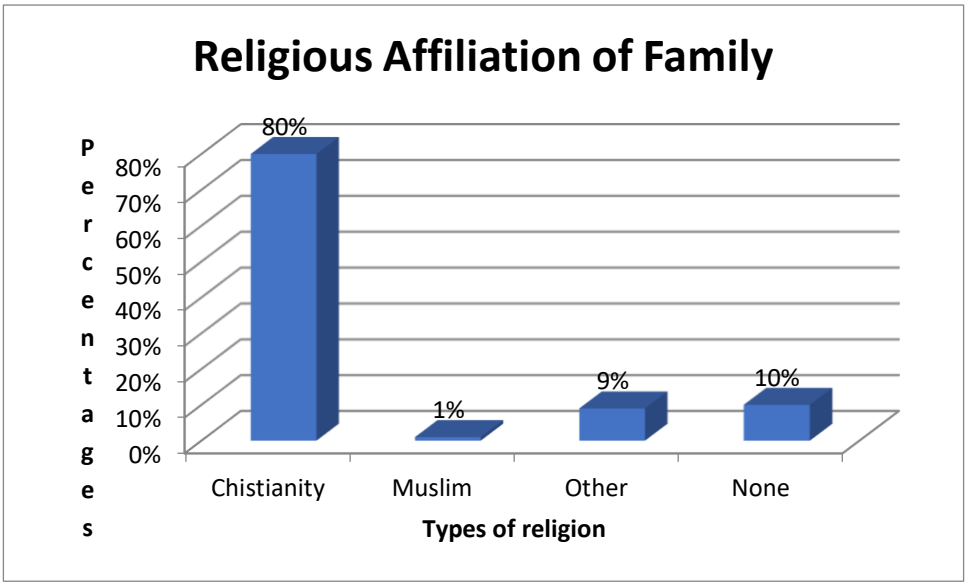


Figure 4.20: Religious affiliation of family members

Figure 4.20 shows that an overwhelming majority of participants are Christians (80%), followed by those who do not affiliate (10%), and least being Muslims (1%).

An overwhelming majority of participants were Christians, which confirms that Christianity is the dominant religion in South Africa. A general trend of the 2001 census data on religion showed that almost 80% of South Africa's population follows the Christian faith (Erasmus & Hendriks, 2005).

Table 4.23: Socio-demographic profile of family members

Socio-demographic profile of family members		**Frequency(n=200)**	**Percentages (100%)**
Income	No income	67	33,5%
	≤R1000	63	31,5%
	>R1000	70	35%
	Yes	178	89%

Other person with income in the family	No	22	11%
Number of family members with income	None	23	11,5%
	1-2	157	78,5%
	3-4	20	10%
Number of family members at home	2-6	156	78%
	7-12	44	22%
Did you accompany family member with diabetes to consult dietitian in the past 6 months?	Yes	13	6,5%
	No	187	93,5%
Did you accompany family member with diabetes to consult physiotherapist in the past 6 months?	Yes	7	3,5%
	No	193	96,5%

Table 4.23 shows that the majority of the participants had an income above R1000 (35%), and an overwhelming majority had other family members with income (89%). Most participants had between one and two family members with income (78,5%). Also, most of the participants stay with between two and six family members (78%). An overwhelming majority of the participants never accompanied their family members with diabetes to consult a dietitian (93,5%) and physiotherapist (96,5%), in the past six months.

The study also indicated that most participants had an income of over R1000. Considering that most of the participants were women below the age of fifty, this could mean that most of the participants had more than three children and benefited from

child support grants. Each child gets an amount of R350 (DSD, 2019). Equally, an overwhelming majority indicated that there are other family members with income, which was expected as these are families of diabetes patients who were mainly elderly and receiving social grant money. Also, they reported that they had one or two other family members with income, which could be the elderly diabetes patients, and any other person in the family who could either be employed or too having children and dependent on child support grants. An overwhelming majority of participants indicated that they never accompanied family members with diabetes to consult either dietitians or physiotherapists in the past six months, which was also expected considering that diabetes patients overwhelmingly reported that they never consulted either dietitians or physiotherapists in the past 6 months. Therefore, this confirms the findings of a study which reported that family members rely more on what the patient tells them on how to care/support them (Baig *et al.,* 2015), as a result of not consulting together.

4.6.1.3 Knowledge of family members of diabetes patients

Objective 2: *To determine knowledge regarding nutrition and exercise in the management of diabetes.*

Overall knowledge of family members regarding nutrition and exercise in diabetes management

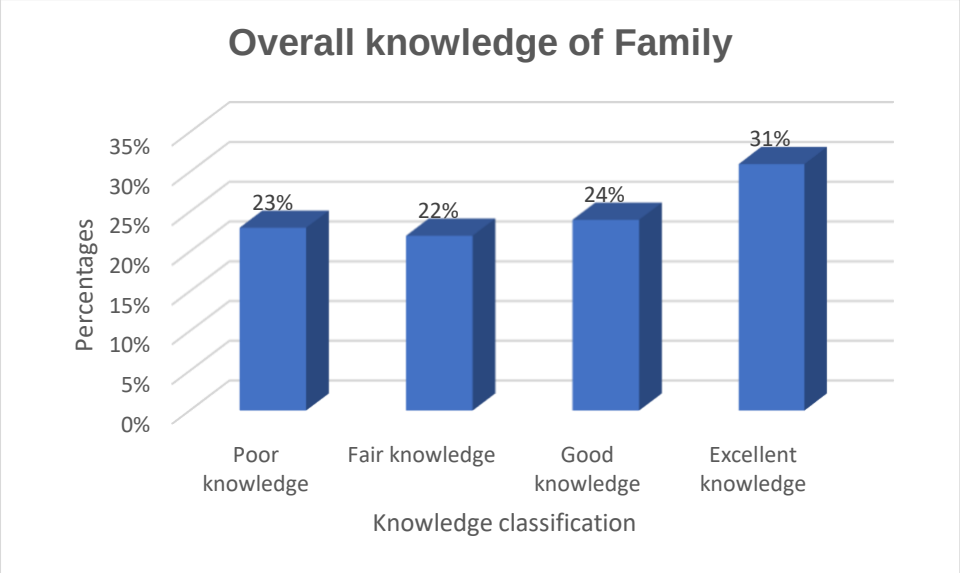


Figure 4.24: Overall knowledge of family members

Figure 4.24 shows that the majority of participants had excellent knowledge (31%), followed by those with good knowledge (24%) and least are those with fair knowledge (22%).

It is important to assess FMs' diabetes-related nutrition and exercise knowledge for effective family-centred diabetes care (Carman *et al.,* 2013), since their support is influences diabetes outcomes of patients (Baig *et al.,* 2015). The study revealed that only 31% of family members had excellent knowledge about overall knowledge regarding nutrition and exercise diabetes care, which makes family members suspect to poor diabetes outcomes (Mayberry *et al.,* 2014). This is because knowledge is important in persuading people to adopt a healthy lifestyle and absence of excellent knowledge or ignorance accounts for por diabetes outcomes (Spronk *et al.,* 2014).

Table 4.25: Overall knowledge of family members by socio-demographic profile

Knowledge of family by socio-demographic profile		Overall knowledge				P-values
		Poor knowledge	Fair knowledge	Good knowledge	Excellent knowledge	
Age	≤50yrs	26	26	28	35	X^2 = 0.044 P = 0.998
	>50yrs	19	19	20	27	
Gender	Male	14	5	17	11	*X^2= 10.227 * P = 0.017*
	Female	31	40	31	51	
Education	Primary or less	19	17	15	22	X^2 = 1.460 P = 0.692
	Secondary or less	25	29	33	40	
Marriage	Single	29	22	29	27	X^2 = 5.942 P = 0.114
	Married	16	23	19	35	

**signifies statistical significance @ 95% CI*

Table 4.25 shows there is no significant association between levels of knowledge and age (p-value=0.998), education (p-value=0.692), and marriage (p-value=0.114). However, there is a significant association between levels of knowledge and gender (p-value=0.017).

A study among the Oman non-diabetes persons highlighted that knowledge of participants about diabetes was directly influenced by their level of education and family history of diabetes, which perhaps increased their awareness (Al Shafaee et al., 2008). A Ghanian study on non-diabetes students indicated that demographic

variables such as level of education, age, and sex have been associated with diabetes knowledge (Amankwah-Poku, 2019). However, the present study differs with the studies on age and education influencing levels of knowledge, since there was no significant association, however, there was significant association between levels of knowledge and gender, thereby confirming influence of gender on knowledge.

Knowledge of family members regarding nutrition in diabetes management

Table 4.26: Knowledge of family members regarding diabetes care through nutrition, % in rows; n=200

Knowledge of family members regarding diabetes care through nutrition	**Yes**	**Not sure**	**No**
Nutrition plays an important part in diabetes management.	181(90,5%)	1(0,5%)	18(9%)
Fruits and vegetables must be eaten because they are good in managing blood sugar.	177(88,5%)	4(2%)	19(9,5%)
Diabetes patients should eat small, frequent meals regularly to manage blood sugar.	162(81%)	4(2%)	34(17%)
Whole-grains high in fibre are recommended as a healthy source of carbohydrate for diabetes patients.	153(76,5%)	5(2,5%)	42(21%)
It is recommended that diabetes patient who is overweight should skip meals to lose weight.	*106(53%)*	*10(5%)*	*84(42%)*
When preparing meat for diabetes patients, it is recommended to remove visible fats from red meat, and also to eat chicken without skin.	128(64%)	2(1%)	70(35%)
If a diabetes patient eat large portion size of food at once may lead to increased blood sugar.	129(64,5%)	3(1,5%)	68(34%)
Diabetes patients should avoid high fat dairy products including high animal proteins must be avoided.	118(59%)	5(2,5%)	77(38,5%)
It is good for diabetes patients to cut back on salty food including high sodium food such as processed food.	140(70%)	4(2%)	56(28%)
It is good for diabetes patients to cut back on sugary food including avoiding added sugar in drinks and food.	143(71,5%)	6(3%)	51(25,5%)
Diabetes patients should avoid fried food and other food high in fats.	147(73,5%)	3(1,5%)	50(25%)

Table 4.26 shows that an overwhelming majority of participants know that nutrition plays important part in diabetes management (90,5%), fruits and vegetables must be eaten because they are good in managing blood sugar (88,5%) and eating small frequent meals is recommended for diabetes patients (81%). Most of the participants reported that whole-grain high in fibre should be eaten (76,5%), while over half of the participants said overweight diabetes patients should skip meals to lose weight (58%). Close to two-third of participants indicated that it is good to remove visible fats from red meat and eating skinless chicken (64%), and that eating high portion at once may increase blood sugar (64,5%). Over half of the participants said high fat dairy food (59%) and mostly said fried food should be avoided (73,5%). Also, most indicated that it is good to cut back on both salty food (70%), and sugary food (71,5%).

Result impressively showed that an overwhelming majority of participants know that nutrition is essential in diabetes management. However, it is worrisome that over a third of participants do not know that it is not good for diabetes patients to eat large portion sizes, close to half do not know that high fat dairy products should be avoided, and that over half said overweight diabetes patients should skip meals to lose weight. This point to the need for intensified nutrition awareness campaigns to correct misconception family members have. If this is not attended, it may lead humanly efforts of family members caring for diabetes patients becoming harmful (Mayberry *et al.,* 2014) and increasing diabetes-associated morbidity and mortality (Moodley & Rambiritch, 2007).

Moreover, the results shows that a close to two-thirds majority of the participants indicated that visible fats from red meat and chicken skin should be removed, including avoiding high fat dairy products, salty, sugary and fried food. This gives hope that they will not prepare food that has more fats, sugar and fat, however, if family members don’t know healthy cooking methods including portioning small sizes, they will unintentionally or intentionally serve fatty, sugary and salty food in large portions even though themselves could consider that small. Therefore, this strength calls for nutrition awareness campaigns and family-centred nutrition care to empower family members with knowledge relating to diabetes nutrition care.

Knowledge of family members regarding exercise in diabetes management

Table 4.27: Knowledge of family members regarding diabetes care through exercise, % in rows; n=200

Knowledge of family regarding diabetes care through exercise	Yes	Not sure	No
Exercise is important in diabetes management and help control blood sugar	170(85%)	3(1,5%)	27(13,5%)
When a diabetes patient exercises blood sugar, blood pressure and cholesterol levels stay on track.	167(83,5%)	2(1%)	31(15,5%)
Exercising can help diabetes patients to prevent and/or reduce diabetes-related health problems or complications.	162(81%)	6(3%)	32(16%)
It is recommended that a diabetes patient should stop exercising, in the event of feeling dizziness, shortness of breath and pains	148(74%)	5(2,5%)	47(23,5%)
When a diabetes patient engages in prolonged exercise, it is encouraged to eat before and after exercise, including drinking fast acting carbohydrate drinks during exercise.	151(75,5%)	3(1,5%)	46(23%)
It is recommended for diabetes patient to check blood sugar before and after exercise.	150(75%)	4(2%)	46(23%)
A diabetes patient should wait until blood sugar becomes normal when he/she discovers that his/her blood sugar is high just before exercise.	135(67,5%)	10(5%)	55(27,5%)
It is recommended that a diabetes patient should at least exercise for a minimum amount of 30 minutes, 3 days in a week.	*7(3,5%)*	*14(7%)*	*179(89,5%)*
When a diabetes patient who is on insulin and does running exercises, should not inject themselves on thighs.	*6(3%)*	*10(5%)*	*184(92%)*
The amount of insulin in the body decreases during exercise.	*48(24%)*	*13(6,5%)*	*139(69,5%)*
The acceptable blood glucose levels of a diabetes patients is a range of 4-8mmol/L.	*38(19%)*	*11(5,5%)*	*151(75,5%)*

Table 4.27 shows that an overwhelming majority of participants know that exercise is important in diabetes management (85%), blood sugar, pressure and cholesterol levels stay on track with exercise (83,5%); and that exercising reduces complications (81%). Most of participants know that it is good to stop exercising when feeling dizziness and shortness of breath (74%); and that a person should wait till blood sugar is normal after discovering that it is high before exercise (67,5%). Also, most of the participants know that it is good to check glucose before and after exercise (74,5%). Most of the participants do not know exercise prescription (89,5%), and acceptable blood glucose ranges (75,5%).

These results provide hope that family members will be able to encourage their family members with diabetes to exercise in order to achieve stabilized glucose levels and reduce diabetes associated complications. However, this is not assurance that family members will encourage diabetes patients to exercise, since knowledge alone is not sufficient for adoption of a active lifestyle (Ajzen *et al.*, 2011). Factors such as urbanization were found to impact on physical activity (Leviatt *et al.,* 1999) in rural areas, therefore there is a need for behavioural change which should be preceded by assessing of other factors which may impact physical activity.

Also, most of the participants know that it is good for diabetes patients to check glucose before and after exercise. Sadly, most of the participants do not know prescribed minimum exercise a week including glucose readings. Therefore, this could be ascribed to lack of consultation with diabetes patients. Family members “are an underutilized resource for ongoing support and often struggle with how to best provide this help” (Kovacs *et al.,* 2013). Therefore, there is a need for family-centred diabetes exercise care which begins with family consultation of physiotherapists or other multidisciplinary team with patients.

4.6.1.3 Attitude of family members of diabetes patients regarding diabetes care through nutrition and exercise

Objective 3: *To determine attitude regarding nutrition and exercise in the management of diabetes.*

Overall attitude of family members regarding nutrition and exercise in diabetes management.

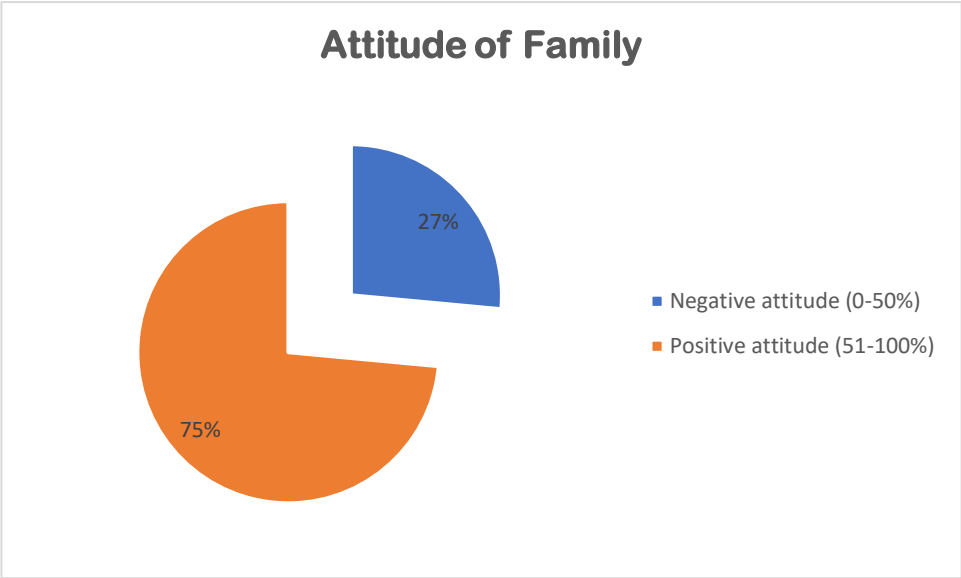


Figure 4.25: Overall attitude of family members

Figure 4.25 shows that most of the participants had negative attitude (75%), and only 25% had positive attitude.

The KAP elements are interrelated and depend on each other (Reza *et al.,* 2014). Results of this present showed most participants had negative attitudes, which could be ascribed to inadequate knowledge of participants (Reza *et al.,* 2014). Moreover, this study confirms that adequate knowledge leads to positive attitude (Fatema *et al.,* 2017), considering that participants in this study had insufficient knowledge and negative attitude. A Bangladesh study among non-diabetes patients showed positive attitudes towards the importance of diabetes care among participants (Fatema *et al.,* 2017). Therefore, this study differs with the Bangladesh study findings.

Table 4.28: Overall attitude of family members by socio-demographic profile

Attitude of family by sociodemographic profile		Attitude		P-values
		Negative attitude (<50%)	Positive attitude (51-100%)	
Age	≤50yrs	88	27	$X^2 = 0.334$
	>50yrs	62	23	P = 0.563
Gender	Male	45	2	*$X^2 = 14.101$**
	Female	105	48	*P = 0.000*
Education	Primary or less	49	24	$X^2 = 2.788$
	Secondary or less	100	27	P = 0.095
Marriage	Single	81	26	$X^2 = 0.060$
	Married	69	24	P = 0.806

**signifies statistical significance @ 95% CI*

Table 4.28 shows there was no significant association between levels of attitude and age (p-value=0.563) and marriage (p-value=0.806). However, there is a significant association between levels of attitude and gender (p-value=0.000) and education (p-value= 0.095).

Regarding the association of levels of attitudes and gender, the present study agrees with a study by Fatema *et al.* (2017), found significant association between levels of attitudes with gender, and differs on association of age and levels of attitude, since this study found no significant association between levels of attitudes and age, while Fatema *et al.* study found significant association. Moreover, this study differs with Fatema *et al.* study on significant association between levels of attitudes and education, since this study found significant attitudes, whereas Fatema *et al.,* study, did not.

Attitude of family members regarding nutrition in diabetes management.

Table 4.29: Attitude of family members regarding diabetes management through nutrition, % in rows; n=200

Attitude of family regarding diabetes care through nutrition	Agree	Neutral	Disagree
I can go with a family member with diabetes to consult a dietitian for nutrition diabetes education at least once every 6 months.	148(74%)	8(4%)	44(22%)
I can help family member with diabetes control his/her diabetes so that it does not interfere with the things he/she want to do.	178(89%)	4(2%)	18(9%)
I can follow diet plan recommended for a family member with diabetes.	187(93,5%)	6(3%)	7(3,5%)
I am willing to avoid food that a dietitian or healthcare worker advises you to avoid me to avoid in support of family member with diabetes.	189(94,5%)	3(1,5%)	8(4%)
I can eat all my meals as per the time intervals a family member with diabetes does as recommended by dietitian or healthcare worker.	191(95,5%)	1(0,5%)	8(4%)
My family member with diabetes is too old to change how he/she eat.	122(61%)	2(1%)	76(38%)
It is too late for my family member with diabetes to start checking what to eat and not to eat.	101(50,5%)	5(2,5%)	94(47%)

Table 4.29 shows that an overwhelming majority of participants are agreeing that they can help family member with diabetes control it (89%), follow diet plan recommended for family member with diabetes (93,5%), are willing to avoid food which they can be advised to avoid (94,5%), and are also willing to eat at the time intervals family member with diabetes (95,5%) does as by dietitian. Over two-third of participants are willing to go with family member with diabetes to consult dietitian (74%). Close to two-third of participants believe their family member with diabetes is too old to change how he/she eat (61%), while half of the participants believe it is too late for their family member with diabetes to start checking what to eat and not to eat (50,5%).

The results of the study showed that most of participants indicated that they could go with diabetes patients to consult a dietitian for nutrition diabetes care advice, which lays a good foundation for effective family-centred nutrition diabetes care. Family-centred care begin with consultation (Carman *et al.,* 2013). Willingness of family members to consult with diabetes patients gives hope that misinformation regarding nutrition diabetes care will be cleared during consultation which will also improve knowledge and attitude of participants.

Also, the results impressively reveal that an overwhelming majority of participants are willing to follow prescribed patients' diet plan, including avoiding food and eating at the time intervals that patients eat. This will also assist in clearing out any diabetes sigma in the family and help boost the confidence of the patients in adhering to diabetes nutrition treatment. Family support has been found to be "vital and boosting patient' confidence and adherence to diabetes treatment" (Gunggu, Thon & Lian 2016). Sadly, close to two-third of participants indicated that their family member with diabetes were too old to change how to eat, while half of the participants said that it is too late for family member with diabetes to start checking what to eat and not to eat. Therefore, this could be attributed to inadequate knowledge among participants, as a result there is need to improve knowledge of diabetes nutrition and exercise care.

Attitude of family members regarding exercise in diabetes management.

Table 4.30: Attitude of family members regarding diabetes management through exercise, % in rows; n=200

Attitude of family regarding diabetes care through exercise	Agree	Neutral	Disagree
A diabetes patient can lead a normal life if he/she take appropriate measures for diabetes.	197(98,5%)	2(1%)	1(0,5%)
I am willing to join family member with diabetes in doing regular exercise to prevent further complication due to diabetes.	178(89%)	5(2,5%)	17(8,5%)
I am willing to join family member with diabetes in doing specially prescribed exercises as given by my physiotherapist or healthcare worker.	175(87,5%)	7(3,5%)	18(9%)
I will/wear footwear as recommended by physiotherapist when I go to exercise.	167(83,5%)	7(3,5%)	26(13%)
I can go with a family member with diabetes to consult a physiotherapist for exercise diabetes education at least once every 6 months.	161(80,5%)	11(5,5%)	28(14%)
My family member with diabetes is too old to exercise	114(57%)	9(4,5%)	77(38,5%)
My family member with diabetes is too sick to exercise	*91(45,5%)*	*10(5%)*	*99(49,5%)*
My family member with diabetes is too fat to exercise	*36(18%)*	*5(2,5%)*	*159(79,5%)*
Diabetes is the type of disease which can prevent a person living with it from exercising.	*23(11,5%)*	*8(4%)*	*169(84,5%)*
My family member with diabetes is too busy to exercise	*36(18%)*	*4(2%)*	*160(80%)*
It is too late for my family member with diabetes to exercise	*40(20%)*	*5(2,5%)*	*155(77,5%)*
Our family culture does not allow us to exercise	*45(22,5%)*	*8(4%)*	*147(73,5%)*

Table 4.30 shows that an overwhelming majority of participants agree that a diabetes patient can lead a normal life if he/she take appropriate measures (98,5%), are willing to join family member with diabetes in doing regular exercises (89%), specialized exercises (87,5%) and wearing recommended footwear (84%), including consulting

physiotherapist every 6 months (80,5%). Over half of the participants believe their family member with diabetes is too old to exercise (57%), while close to half of the participants believe their family member with diabetes is too sick to exercise (45,5%). Less than a third of the participants agree that their family culture does not allow them to exercise (22,5%). An overwhelming majority of participants disagree that their family member with diabetes is too fat (84,5%), too busy (80%) and that it is too late (77,5%) to exercise.

The results shows that an overwhelming majority of participants agree that a diabetes patient can lead a normal life if he/she take appropriate measures, are willing to join family member with diabetes in doing regular exercises, specialized exercises and wearing recommended footwear, including consulting physiotherapist every 6 months. These lays a good foundation for patients' adherence to diabetes exercise treatment, since it is reported that family plays a vital role for patients' diabetes treatment (Gunggu, Thon & Lian 2016). Also, the willingness of the family members can be attributed to the African philosophy of *ubuntu* (Tshoose, 2009), which translate to humanity. *Ubuntu* is "crucial to African culture and express primary values of intense humanness, caring, sharing, respect, compassion and associated values, thus ensuring a happy and quality community life in the spirit of family" (Tshoose, 2009; de Beer & Brysiewicz, 2017).

Over half of the participants believe their family member with diabetes are too old to exercise, while close to half of the participants believe their family member with diabetes are too sick to exercise. Less than a third of the participants agree that their family culture does not allow them to exercise. An overwhelming majority of participants disagree that their family member with diabetes are too fat, too busy and that it is too late to exercise. Exercise when undertaken regularly by an individual at higher risk of diabetes plays a major role in the prevention and control of insulin resistance, all types of diabetes including prediabetes and gestational diabetes mellitus (Escott-Stump, 2015). Therefore, the willingness of family members who are at risk of diabetes because of their overweight and obese status, to join diabetes patients in exercise implies that they too shall ripe benefits of exercise and reduce their chances of diabetes.

4.6.1.4 Practice of family members regarding diabetes care through nutrition and exercise

Objective 4: *To determine practice regarding nutrition and exercise in the management of diabetes.*

Overall practice of family members regarding nutrition and exercise in diabetes management

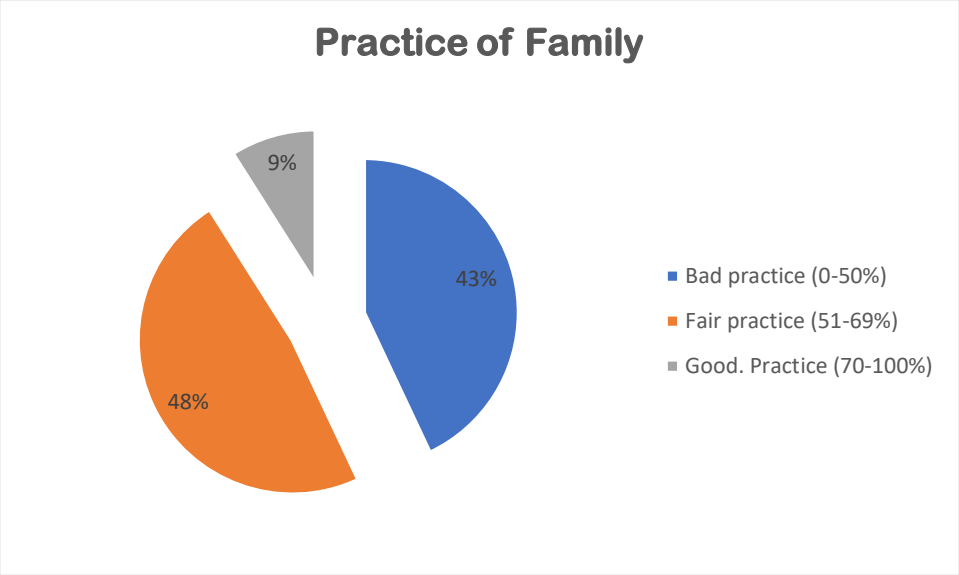


Figure 4. 26: Overall practice of family members

Figure 4.26 shows that close to half of the participants had fair practice (48%), followed by 43% of participants with bad practice and only 9% of participants had good practice.

This study differs with Bangladesh study which found average practice of none-diabetes patients related to diabetes care (Fatema *et al.,* 2017). Nonetheless, this study agrees with recommendations of the Bangladesh study regarding the urgent need for coordinated education campaigns to improve practice for better diabetes outcomes of patients. Also, the practice of the participants in this study could have been influenced by lack of adequate knowledge regarding link between abnormal BMI and diabetes, since it has been indicated by another study that the majority of overweight or obese individuals are unaware of the link between weight and diabetes, and not considering themselves to be at risk of T2DM (Puoane *et al.,* 2007), hence unsatisfactory practice regarding nutrition and exercise.

The results of this study show that there was significant association between levels of overall practice and age. Also, that there was no significant association between gender, education and marriage. Food consumption is affected by food availability, accessibility, and choice (Kearney, 2010). Food intake choices “are influenced by factors such as geography, season, education, demography, urbanization, social networks, time, and the consumer” (Kearney, 2010; Wenhold *et al.,* 2012). However, there existence or none-existence of significance cannot be concluded that this study contradicts report that socio-demographic profile influence food intake, since there are other factors such as traditional use of medication and exercise practices which were included in the score of levels of overall practice.

A Bangladesh study found no significant association between levels of practice and BMI of patients but also found significant association between levels of practice and knowledge, and attitude (Fatema *et al.,* 2017). Therefore, this study agrees with Bangladesh study on insignificant association between levels of practice and BMI, including significant association between levels of practice and knowledge, since this study found no significant association between levels of practice and BMI, attitudes, and significant association between levels of practice and knowledge. Moreover, this study disagrees with Bangladesh study on significant association between levels of practice and attitudes.

Table 4.31: Overall practice of family members by socio-demographic profile

Practice of family vs socio-demographic profile, BMI, knowledge & attitude		**Practice**			**P-values**
		Bad practice	**Fair practice**	**Good practice**	
Age	≤50yrs	53	57	5	*X^2 = 7.389**
	>50yrs	32	40	13	*P = 0.025*
Gender	Male	22	23	2	X^2 = 1.808
	Female	63	74	16	P = 0.405
Education	Primary or less	31	33	8	X^2= 0.671
	Secondary or more	54	63	10	P = 0.715
Marriage	Single	47	51	9	X^2= 0.232
	Married	38	46	9	P = 0.891

**signifies statistical significance @ 95% CI*

Table 4.31 shows above shows significant association between levels of practice and age (p-value =0.025). Also, there was no significant association gender (p-value =0.405), education (p-value =0.715) and marriage (p-value =0.891).

A Bangladesh study found significant association between overall levels of practice and age, levels of practice and gender, levels of practice and education on non-diabetes patients (Fatema *et al.,* 2017). Therefore, this study agrees with Bangladesh study on significant association between levels of practice and age; and disagrees on levels of practice and gender, and education.

Table 4.32: Overall practice of family members by BMI, knowledge and attitude

Practice of family by BMI, knowledge & attitude		**Practice**			**P-values**
		Bad practice	**Fair practice**	**Good practice**	
BMI	Underweight	0	3	1	$X^2 = 12.693$
	Normal weight	20	16	4	P = 0.241
	Overweight	35	36	8	
	Obesity	30	42	5	
Knowledge	Poor knowledge	17	23	5	*X^2 = 13.247**
	Fair knowledge	28	12	5	*P = 0.039*
	Good knowledge	17	29	2	
	Excellent knowledge	23	33	6	
Attitude	Negative attitude	68	72	10	X^2= 4.794
	Positive attitude	17	25	8	P = 0.091

**signifies statistical significance @ 95% CI*

Table 4.32 shows that there was no significant association between levels of practice and BMI (p-value = 0.241), and levels of practice and attitude (p-value=0.091). However, there is significant association between levels of practice and knowledge (p-value =0.039).

A Bangladesh study found significant association between levels of practice and BMI of patients, levels of practice and knowledge, and levels of practice and attitude on non-diabetes patients (Fatema *et al.,* 2017). Therefore, this study disagrees with Bangladesh study on significant of levels of practice with BMI and attitude but agrees on significant of levels of practice and knowledge.

Practice of family members regarding nutrition in diabetes management

Table 4.33: Practice of family members regarding diabetes management through nutrition, % in rows; n=200

Practice of family regarding diabetes care through nutrition	Regularly (4 or more times a week)	Sometimes (1-3 times a week)	Never
In the past week, how often did you eat breakfast?	71(35,5%)	119(59,5%)	10(5%)
In the past week, how often did you eat lunch and supper?	138(69%)	62(31%)	0(0%)
How often do you eat fried and fatty food?	16(8%)	127(63,5%)	57(28,5%)
How often do you eat sugary food and sugary drinks?	10(5%)	129(64,5%)	61(30,5%)
How often do you take alcoholic drinks	2(1%)	50(25%)	148(74%)
How often do you eat vegetables?	36(18%)	155(77,5%)	9(4,5%)
How often do you eat fruits?	34(17%)	160(80%)	6(3%)
How often do you eat meat, chicken, fish, mopani-worms, eggs and milk	77(38,5%)	115(57,5%)	8(4%)
How often eat high fibre food such as beans, lentils, legumes and wholegrain foods among others?	58(29%)	136(68%)	6(3%)
How often do you eat starchy food such as porridge, rice, samp and bread?	188(94%)	12(6%)	0(0%)
How often do you eat salty food such as processed food like polony or added salt?	17(8,5%)	120(60%)	63(31,5%)

Table 4.33 shows that over a third of participants eat breakfast (35,5%) and also eat meat, chicken, fish, mopani-worms, eggs, and milk (38,5%) regularly. Over two-third of participants eat lunch and supper regularly (69%). An overwhelming majority of participants eat starchy food regularly (94%). Close to a third of participants takes alcoholic drinks sometimes (25%), while the majority of participants eat vegetables (77,5%), fruits (80%), high fibre food (68%), and salty food (60%) sometimes.

Breakfast is “the first meal of the day that breaks the fast after the longest period of sleep and is consumed within 2 to 3 hours of waking; it is comprised of food or beverage from at least one food group and may be consumed at any location” (O’Neil *et al.,* 2014). The study revealed that over a third of participants eat breakfast regularly, implying that most of the participants do not eat breakfast regularly or they skip it, as

indicated that breakfast is frequently skipped (Dwyer, 2014). Therefore, there is a need for community health awareness campaigns to educate on the importance of eating breakfast, because if families aren't adopting culture of eating breakfast their family members with diabetes will too not eat it and thereby increasing risk of hypoglycemia and poor diabetes outcomes. This is because family plays important part in diabetes control and that their behaviour can also be harmful.

Over two-third of family members indicated that they eat both lunch and supper regularly as compared to over half of diabetes patients in this study. These eating habits contradict various studies which reported that individuals do not eat both lunch and supper which is mainly influenced by affordability (Kearney, 2010). The consumption of fatty, sugary or salty foods among family members in this study is much higher than the consumption among diabetes patients. Most of the participants reported that they consume fried or fatty food regularly or sometimes, and that over two-third of participants are consuming sugary and salty food regularly or sometimes. Therefore, this could be attributed to families regarding themselves as low-risk for diabetes and therefore not limited to use less fats, sugar and salt. Also, this could be attributed to insufficient knowledge, whereby family members not knowing that they are too at risk of developing diabetes. Lack of knowledge could be liable for poor dietary habits (Ajzen *et al.,* 2011). This study also confirms various studies which reported increase in fats and oils consumption in South African and other developing countries (Popkin, 2004).

The amount that South African alcohol drinkers consume is exorbitantly high (WHO, 2011). Most of the families in this study also indicated that they never take alcohol, which also contradict the high consumption of alcohol among South Africans.

Few of the family members in this study reported the consumption of fruits and vegetables regularly as compared to diabetes patients in this study. This could also be attributed to affordability (Kearney, 2010), to purchase adequate fruits and vegetables for the whole family, therefore opting to let family members with diabetes to consume more of fruits and vegetables in the family. This is based on the fact that an overwhelming majority of participants in this study reported that patients should eat fruits and vegetables because they are good in maintenance of blood glucose. Also, the consumption of whole-grains rich in fibre is not regular, which could affirm reports

that women, who are largely doing grocery shopping in the family, consider ease of preparation (Ronquest-Ross *et al.,* 2015).

The consumption of meat, chicken, fish, mopani-worms, eggs and milk among family members is higher as compared to consumption by diabetes patients, although still inadequate since only over a third of family members consume regularly. This could be attributed to family arrangement that patients consume more vegetables and fruits as available in the family because of their benefits to glucose control. Above all, this also confirms that affordability does influence intake (Kearney, 2010).

Also, an overwhelming majority of family members indicated that they regularly consume starchy food like porridge, rice, samp and bread, which is similar to the consumption of diabetes patients. Therefore, this also confirms that maize is the mostly eaten food among south African adults (Ronquest-Ross *et al.,* 2015).

Practice of family members regarding exercise in diabetes management

Table 4.34: Practice of family members regarding diabetes management through exercise, % in rows; n=200

Practice of family regarding diabetes care through exercise		**Yes**	**No**
Do you exercise?		174(87%)	26(13%)
During the past week, did you spend at least 30 minutes, 3 days per week doing stretching or muscle strengthening exercises such as lifting weights, including home chores such as washing clothes and cleaning?		78(39%)	122(61%)
During the past week, did you spend at least 30 minutes, 3 days per week doing any of the following exercises: walking, running, riding bicycle, swimming, climbing stairs, or any other aerobic exercises?		77(38,5%)	123(61,5%)
In the past month, have you exercised for at least 30 minutes/ 3 days per week?		64(32%)	136(68%)
	Always (4 or more times a week)	**Sometimes (1-3 times a week)**	**Never**
In the past month, how often a week do you exercise for at least 30 minutes/ 3 days?	9(4,5%)	119(59,5%)	72(36%)
When you exercise, how often do you wear the type of shoes recommended by your health provider?	5(2,5%)	41(20,5%)	154(77%)

Table 4.34 shows that an overwhelming majority of participants exercise (87%); only over a third of participants spend at least 30 minutes, 3 days a week doing stretching or muscle strengthening exercise (39%); and about a third also spend at least 30 minutes, 3 days a week doing exercises such as walking, running, riding bicycle, swimming, climbing stairs and/or aerobic exercises (38,5%). Also in the past month,

about a third of participants exercised for about 30 minutes, 3 days a week (32%). Also, only 2,5% of participants wear footwear recommended by health provider when exercising.

The results shows that an overwhelming majority of participants exercise, which confirms study that physical activity among South Africans levels decreases with increasing age, considering that the majority of family members were less than 50 years and overwhelmingly indicated that they exercise (Steyn, Fourie & Temple, 2006). Although, the amount, adherence and intensity of the exercise participants embarks upon is questionable considering that most were overweight and obese. A Western Cape study reported that indicated that the least active persons were those between the ages of 25-34 years compared to those who were 35-44 years and 45-64 years (54% vs. 61%) (Sparling *et al.,* 2002). Those aged between 45-64 years participated predominately in light intensity activities (58%) and only a small proportion engaged in strenuous physical activity (2.8%) (Sparling *et al.,* 2002). In this study, the majority of participants were those aged less than 50 years of which only over a third of participants spend at least 30 minutes, 3 days a week doing stretching or muscle strengthening exercise; and about a third also spend at least 30 minutes, 3 days a week doing exercises such as walking, running, riding bicycle, swimming, climbing stairs and/or aerobic exercises, which confirms the Western Cape study which reported least physically active were youthful generation. Furthermore, the results agree with a study which reported that individuals at highest risk for developing T2DM do not engage in regular physical activity, with a rare significantly below national norm (Murata *et al.,* 2003).

Other studies reported that community members consider overweight women as attractive, since being overweight is linked with dignity, respect, confidence, and high self-esteem (Fourie & Shapiro, 2005; Puoane *et al.,* 2005). Most of the participants in this study were women, of which the study reported that in the past month, only about a third of them exercised for about 30 minutes, 3 days a week. This could be attributed to the linkage of overweight women to dignity and high self-esteem which affects exercise or adherence to exercise. Other factors which were found to affect exercise include high crime, lack of security, time constraints, the inability to afford exercise equipment, and lack of green areas and recreational facilities hinder individuals' ability to participate in physical activities (Puoane *et al.,* 2007). Therefore, exercise

modification programme should mediate on these factors which were found to be barrier for exercise for the effective implementation and adherence.

Also, only 3% of participants wear footwear recommended by health provider when exercising. These results aren't surprising since these participants did not consult physiotherapists with patients implying that they might lack knowledge of the type of footwear to wear for exercising, since lack of knowledge can be responsible for poor practices (Ajzen *et al.,* 2011).

4.7 OVERVIEW OF RESEARCH FINDINGS

This study results revealed that close to two-third of diabetes patients were over the age of 60 years and the majority of patients were females compared to males. Over a third of patients lived with diabetes for over over 10 years (37%), an overwhelming majority controlled the disease with medication (92%), only 3,5% used traditional medicine to control diabetes, and the majority had comorbidity (75,5%) and married (74%), implying that they can positively benefit from spousal support and subsequently better minimizes chance of complications.

Over half of patients (57%) were obese, and 75% had abdominal obesity. There was significant association between BMI and gender of patients(p=0,010).

Close to half of patients had excellent knowledge (45%), positive attitude (73%) and fair practice (71%), compared with family members who had excellent knowledge (31%), negative attitude (75%) and fair practice (48%). There was significant association between levels of knowledge and sociodemographic profile of patients, compared with existence of knowledge and gender (p-value=0.017) of family members. There was existence of significant association between levels of attitudes and education (p = 0.031) of patients, compared to no existence of significant association between levels of attitudes and education (p= 0.095) of family members.

There was no significant association between levels of practices and socio-demographic profile of patients, compared to existence of significant association between levels of practice and age (p =0.025) of family members.

The qualitative results of diabetes patients describe existing knowledge related to the does and don'ts when diagnosed with diabetes mellitus, challenges by people living

with diabetes mellitus, experiences of being diagnosed with diabetes mellitus, and existing support for people living with diabetes mellitus as reported by participants.

The mixed method results of patients' correspondence of existence of family support, demonstration of importance of nutrition and exercise in diabetes care. The results correspond on the knowledge of eating fruits and vegetables, and the less than 50% of those eating fruits and vegetables regularly could be attributed to intake being affected by availability as mentioned by qualitative participants.

4.8 CONCLUSION

This chapter presented and discussed the results of the situational analysis phase. The quantitative, qualitative and mixed method results of diabetes patients were discussed. Integration through merging of quantitative and qualitative results was done and results presented through joint display. Also, the quantitative results of family members were presented and discussed. Literature was used to support discussions. The results of situational analysis phase as presented and discussed, will be used together with the application of practice orientated theory to develop and implement the educational programme. The following chapter discusses the development and description of family-centred nutrition and exercise diabetes care programme, including the outlining of the programme.

CHAPTER FIVE:
DEVELOPMENT AND VALIDATION OF THE FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

5.1 INTRODUCTION

The previous chapter discussed the results of the situational analysis phase. This chapter discusses development and validation of the family-centred nutrition and exercise diabetes care. The learning outcomes for the programme which Findings of the situational phase provided base and scope of the educational family-centred nutrition and exercise diabetes care programme. The Practice Orientated Theory (POT) also provided guidance in the development of the programme. The chapter further discusses the validation of the programme using professional experts.

5.2 DESCRIPTION OF THE DEVELOPMENT OF FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

The programme development processes was based on the results of the situational analysis, application of theoretical framework, and programme validation. The programme development was based on the results of the phase 1 of this study, and its structure is based on the POT as articulated by Dickoff, James and Wiedenbach's (1968) as described in chapter 3 of this study.

5.2.1 Needs assessment

Need assessment is "a prerequisite to programme development; in this study, the findings of situational analysis phase informed the development of family-centred nutrition and exercise programme for diabetes care". Inadequate and knowledge deficiency/gaps which were identified and informed the need for educational intervention included: Importance of nutrition and exercise in diabetes care; Portion control; Food preparation; Food intake and exercise; Food and medication intake; Exercise prescription; and Exercise and glucose readings or monitoring. In addition, unhealthy practices such as consumption of large portions, lack of intake of breakfast and unhealthy meals, none-adherence to physical activity, including the high prevalence of overweight and obesity influenced the combination of educational talks with behaviour change. On the other hand, the diabetes patients in the qualitative strand of the situational analysis phase indicated family culture of eating large portion

sizes, once a day including lack of physical activity influenced the need for the family-centred care and behaviour change.

5.2.1.1 Knowledge

Educational talks which were aimed at improving knowledge were provided to participants. The knowledge deficiencies and gaps highlighted in the needs assessment constituted the scope or learning outcomes of the educational talks. In addition to educational talks, educational tools such as flyers and posters were also used to improve knowledge. Demonstrations were also provided to participants to improve both knowledge and skills. The implementation of the intervention is explained in detail in chapter 6 of this study.

5.2.1.2 Behaviour change

The findings of the situational analysis indicated the need for behaviour change as indicated in the needs assessment above. Models of behaviour change which is regarded “as representations of how people think and act in a manner which can be changed, used to help predict and explain behaviour” (Davies & Macdowall, 2006), was applied. Social Cognitive Theory (SCT) was applied as a model for behavioural change. The SCT is defined as model which describes gaining knowledge as reciprocal interaction between an individual’s cognitive process, environment and behaviour (reciprocal determinism) (Baranowski *et al.,* 2002). The SCT is applied as shown in Table 5.1.

Table 5.1: Application of Social Cognitive Theory for behavioural change.

Concept	Definition	Application
Reciprocal determinism	Behaviour changes result from interaction between person and environment; change is bidirectional.	Involving diabetes patients and their families for changing how they eat and exercise.
Behavioural capability	Knowledge and skills to influence behaviour.	Educating and implementing programme through practical demonstrations, thereby skilling participants to influence behavioural change.
Expectations	Beliefs about likely results of action.	Improved diabetes-related knowledge and behavioural change, leading to improved quality of life.
Self-efficacy	Confidence in ability to take action and persist in action.	Taking control over the disease by eating a healthy diet and engaging in physical activity, and preventing complications as a result.
Observational learning	Beliefs based on observing others like self-and/or visible physical results.	Self-confession of diabetes patient who has since adopted healthy eating and active lifestyle, and has improved well-being; no longer experiences dizziness, improved erectile dysfunction or no longer urinate frequently.
Reinforcement	Responses to a person's behaviour that increase or decrease the chances of recurrence.	Reinforcement will be done through family-involvement in exercise and eating healthy diet. Also, through establishment of diabetes support groups or its strengthening where in existence.

5.3 DRAFT FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

The researcher drafted family-centred nutrition and exercise diabetes care programme with the help of 2 dietitians and physiotherapists from public hospitals. The draft family-centred nutrition and exercise diabetes care programme is presented in Table 6.2.

Table 5.2: Draft programme "*family-centred nutrition and exercise programme*".

FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME
1. Consultation
• Family members should consult multidisciplinary team with diabetes patients. • Patients should also consult medical healthcare team for exercise clearance. • In the event, patients' experiences stress which impact on quality of life, they should consult psychologists through the clinic referral. Comments:

2. Clinic

- Clinic healthcare staff should encourage patients to bring along their families when coming to consult and make environment conducive for family-centred care.
- Clinic healthcare staff must work together in offering medical clearance for exercise purpose.
- There should be proper referral systems for those needing specialized intervention such as dietetics, physiotherapy and psychology among others.
- Make the environment conducive for diabetes support groups to operate.

Comments:

3. Diabetes support groups

- Establishment and/or strengthening of diabetes support groups.
- Incorporate family members into diabetes support groups.
- During days of diabetes consultations at the clinics, an hour should be dedicated for exercises and also sharing experiences of how to cope with diabetes.

Comments:

4. Family involvement

- Being involved in diabetes care starting with consultation with patients.
- Understanding that they too are at risk of diabetes because of weight and heredity.
- Able to help patients, so as to help themselves.
- Treating and caring for diabetes patients with humanly love even the patients has lost income or employment.
- In the event, there is family misunderstanding which can impact on the quality of life of patients, they should seek help as a family.

Comments:

5. Self-care practices

- Sharing responsibilities by distributing household activities.
- Able to manage diabetes as family and dealing with its side effects.
- Understanding glucose readings.
- Setting time reminders using watches or phones, for medication and food intake, as well as schedule exercises.

Comments:

6. Nutrition care

- Must be able to know and adopt healthy food preparation methods.
- Must also understand nutrition labels and what to look for when purchasing grocery or food.
- Be able to adhere to eating patterns and portion sizes even at the parties.
- Knowing food to eat and not to eat, including the amount of portion sizes.
- Knowing the frequency and quantity of meals to consume daily, and for adherence.
- How to use less fats during food preparation.
- How to use less sugar during food preparations.
- Understanding good fats to include or eat.
- Maintenance of hygiene during food preparation.
- Understanding the importance of eating variety of food.
- Using usual foods they consume and preparing them differently and safely.
- The importance of use of local traditional foods.
- How to lose and/or maintain weight using food.
- Eating of breakfast regularly or daily.
- Eating before exercising.

Comments:

7. Exercise care

- Understanding types of exercises and their importance.
- Be able to choose costless exercises, which they will enjoy.
- Ability to listen to their bodies when exercising, so as to stop when feeling dizziness, shortness of breath, pains, etc.
- Use of time to record the exercise done as prescribed.
- Understanding how to practically achieve the exercise prescription of 30 minutes, 3 days weekly by scheduling exercise for at least 10-15 minutes daily and engaging more on household chores.
- Checking of blood glucose before and after exercise.
- Since many patients have no glucometers, they should schedule exercise for shorter period like 10-15 minutes and also by eating before and after exercises.
- How to make exercise part of daily life.
- Scheduling exercise to suit family members so that the entire family adopt active lifestyle.
- Choosing low risk exercises to avoid injuries.
- How to lose or maintain weight using exercise.

Comments:

8. Distribution of activities

- Patients and family members must all of them engage in household chores daily, e.g., when one washes dishes, the other cleans the house; equally if one cooks, the other chops vegetables.
- If culture does not allow males to do certain household chores such as cooking and cleaning in the presence of females, then they should do gardening and other activities permissible daily.
- Co-planning of activities together and distributing according so that all, i.e., patients and families, enjoy benefits of exercise.
- Have weekly plan of activities, so that if possible, everyone can do all types of household chores.

Comments:

9. Documents

- Documents highlighting importance of exercises and the exercises to do and how often should be provided.
- The document should also highlight the importance of food and healthy food preparation and safe methods including portion sizes.
- The document must also encourage follow-ups.
- These documents should be translated in home languages and provided to patients and families.

Comments:

10. Indicators of successful family-centred nutrition and exercise diabetes care programme

- Patients must be able to eat appropriate food and portion sizes at the parties.
- Eating of breakfast regularly or daily.
- Eating before and after exercise.
- Patients and families must understand nutrition labels.
- Understanding of healthy food preparation and safe methods.
- Understanding of serving small portion sizes.
- Understanding of how to lose and maintain weight using food and exercise.
- Patients must have medical clearance for exercise.
- Patients must be able to do exercises independently.
- Families must be able to join patients in exercising.
- Wearing of appropriate footwear when exercising.
- Families consulting with patients.
- Physically challenged individuals must be able to do exercises according to their abilities.
- Improved quality of life, stabilization of glucose and prevention or reduction of complications.

Comments:

5.4 PROGRAMME VALIDATION

Validation is “the process that draws on the traditional methods of science to substantiate the accuracy of conceptual meanings in terms of empiric evidence” (Chinn & Kramer, 2015). According to Polit and Beck (2017), a “programme can be peer reviewed by one or more experts, who make recommendations as to its worth to the professional discipline”. The draft family-centred nutrition and exercise diabetes care programme was then validated by experts (with PHD) from nutrition and physiotherapy from other universities in South Africa. The experts provided comments and recommendations to the draft programme, which were effected and submitted back to the experts for final approval and validation. A consensus meeting was arranged with the experts for the finalization and approval of the final programme.

5.4.1 Purpose of validation

The purpose of validation in this study was to verify the applicability and content of the developed draft programme in addressing the identified barriers from the results of this study in promoting effective implementation of the family-centred nutrition and exercise diabetes care programme for better diabetes control.

5.4.2 Objectives of the validation

The aim of validation of the draft programme was to validate the family-centred nutrition and exercise diabetes care programme for its relevance. The validation was carried for the following aspects as per Chinn and Kramer (2015): (1) clarity of concepts, (2) scope of the programme, (3) extent of programme use and (4) logical development of the programme.

5.5 FINAL FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE

The final family-centred nutrition and exercise diabetes care emerged after validation by the experts. Therefore, the final programme is herein presented in Table 6.3.

Table 5.3: Final Family-centred nutrition and exercise diabetes care programme

FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME	
Definition of terms for the purpose of programme:	
Multidisciplinary team: For the purpose of this programme, multidisciplinary team refers to dietitians, physiotherapists, medical practitioners, nurses, psychologists and social workers. **Intensity:** For the purpose of the programme, intensity refers to the amount of exercise done.	
1. Clinic and consultation	
Assembling of diabetes team	Medical doctor
	Nurse
	Dietitian
	Physiotherapist
	Psychologist
	Social worker
	Patient
	Family member of diabetes patient.

Consultation and referral	Newly diagnosed diabetes patients should upon diagnosis be referred to dietitian and physiotherapists for nutrition and exercise prescription.
	Known diabetes patients should as well be referred to dietitian and physiotherapists.
	Medical doctor and nurse should do referrals.
	Patients should be referred to psychologists and social worker when need arises.
	Medical doctor should request patients to bring along family members for dietetics and physiotherapy consultation upon referral.
	Dietitian and physiotherapists should as well request patient who came without family members to bring one in next appointment.
Role of family members during consultation	Advocate for patients by expressing additional health challenges which the patients has omitted.
	Ask questions to multidisciplinary team to ensure that the patient understand medication and its usage, nutrition and exercise care prescriptions.
	Provides emotional support to the patient.
	Be the voice of the elderly or children who may not express themselves properly to the multidisciplinary team.
Screening	Physiotherapists should screen patients for level of physical activity.
	Dietitian should screen patients for nutrition status.
	Patients should also be screened for psychological problems, so they can be referred or helped to prevent impact of stress on adherence to nutrition and exercise prescription.

2. Diabetes support groups	
Assembling of diabetes support group team	At least one nurse from clinic.
	Patient
	Family member of diabetes patient
Members of support groups	**Roles of members of support groups**
Nurse	Be the facilitator of support group.
	Create timetables for meetings and special days such as international diabetes day.
	Initiate and organize multidisciplinary team for planning and execution of diabetes awareness campaigns.
	Give health talks on diabetes self-care practices.
	Develop yearly scheduled for dietitians and physiotherapists to engage support groups.
	Schedule educational talks by other multidisciplinary team such as psychologists, social worker and medical doctor.
	Screen patients needing specialist care and attention and refer them.
	Identify family members not coping with loved one's disease and refer them.
	Encourage patients and family to seek health together.
Patient	Be leader of support groups.
	Share experiences and challenges of living with diabetes.
	Share benefits of involving family during consultation and care.
	Encourage each other to involve family.
	Engage in support group activities at the clinic.

	Ask questions to fellow support group members, and multidisciplinary team present at support group gatherings.
Family member	Share experiences of caring for patient through nutrition and exercise with other support groups members.
	Share frustrations and challenges they encounter in the care of diabetes patients with other support group members.
	Ask questions to fellow support group members, and multidisciplinary team present at support group gathering for improved care.
	Participate in the special diabetes events such as Diabetes Day.
	Engage in activities with patient during support group gatherings.
	Engage in exercise activities at the clinic with patients.
Schedule and meeting venue	Meeting once a month during chronic day or collection of medication.
	They meet for an hour and 30 minutes per session, which is distributed as follows: 30 minutes – for vital taking and distribution of medication by nurse who is also member of support group. 30 minutes – for educational talks and sharing 30 minutes – for activities
	They meet at the clinics.
Dressing	Tracksuits Older women must wear tracksuits inside skirts for cultural sensitivity Soft shoes

3. Self-care practices	
Vitals signs	Educating on glucose readings or levels.
	Educating on importance of checking blood glucose levels before and after exercise, including demonstrating how to check glucose.
	Educating on importance of checking blood pressure before and exercise, including demonstration of how to measure.
	Educating on the disadvantages of not exercising when blood glucose is higher or lower.
	Educating on glucose readings warranting health seeking or consultation.
Exercising	Educating on importance of setting time reminders with family involvement for scheduled exercises, and also demonstrating how to set time reminders.
	Educating on importance of exercising with family.
	Educating on exercise prescription, including importance of adherence.
	Educating on advantages of wearing soft shoes and demonstrating the types of soft shoes.
	Educating on importance of eating 30 minutes before and after exercise.
	Educating on advantages of exercise before sunrise or before 10am and after 5pm when it is cool.
	Educating on the importance of stretching before and after exercise.
	Educating on importance of carrying and drinking of water during exercising.
	Educating on the importance of using sunscreen protection such as calamine lotion during exercise.
	Educating on the importance of patients and family members sharing household chores.
	Educating on the variety of exercise such as walking, running, cycling, and household chores to permit patients and family members to choose preferred exercises.

	Educating on contraindications of exercise such as low blood sugar levels.
	Educating on the advantages of doing exercise repeatedly and challenging self for intensity e.g., recording distance walked at how long and plan to improve by increasing distance and reducing time or same distance reduced time.
	Educating on the importance of listening to the body while exercising, so as to stop when feeling pains, dizziness, shortness of breath, etc.
Nutrition	Educating on the importance of eating low fat food and dairy products.
	Educating on the importance of avoidance of fried, sugary and salty food.
	Educating on healthy food preparation method like steaming, grilling, roasting.
	Educating on the use of plate system for portion sizes, including demonstration it, as well as the use of small plates.
	Eating intervals and adherence to eating times.
	Educating on the importance of the use of time reminders for mealtimes, including demonstration.
	Educating on the importance of eating of breakfast, before engaging in exercise.
	Educating on importance of also lunch and supper including snacking with fruits or any other food while waiting for meals.
	Educating on importance of buying seasonal fruits and vegetable including importance of having fruits and vegetable gardens at home.
	Educating on the advantages of bulk purchasing and price comparison when purchasing.
	Educating on the type of food to avoid or reduce including food to consume.
	Educating on food based dietary guidelines e.g., eating variety of food.

	Educating on food preparation e.g., remove fats, chicken skin, avoidance of frying and instead use of steaming, roasting, etc
	Educating of food hygiene e.g., the importance of washing hands regularly
	Educating on importance of food nutrition labels and what to consider during purchasing.
Emergency situations	Educating on the uncontrolled signs and symptoms of diabetes.
	Educating on importance of healthcare seeking when frequently experiencing signs of uncontrolled diabetes.
	Educating on the importance of stopping exercising when feeling pains, shortness of breath, nausea, etc
	Educating on the importance of first aid measures like giving a mixture of sugar and water when one collapses due to low sugar.
Medication	Educating on the importance of setting time reminders for medication or insulin injection.
	Educating on the importance of taking medication with food, including setting time reminders for spacing of intake of medication and food intake.
	Educating on the adherence on taking medication or insulin as prescribed and adhering.
Follow-up appointments	Educating on the importance of patients honouring follow up appointments.
	Educating on the importance of family accompanying patients for follow-ups.
4. Disclosure	
Educating diabetes patients on the advantages of disclosing diabetes diagnosis to the family.	
5. Educational materials or pamphlets	
Development	The educational materials or pamphlets are developed by the research for the purpose of educating.
	The developed educational pamphlets are attached.
Language	The educational materials are developed using English as language.

	Also, the material is also translated into Sepedi language which is the home-language of the participants
Scope	The scope of the educational materials includes the following: • Glucose readings and checking of blood glucose. • Blood pressure levels. • Contraindications of exercise. • Exercise prescription. • Use of sunscreen protection for exercise. • Types of exercises. • Appropriate wear. • Portion control. • Food preparation. • Cooking methods. • Food labelling. • Food purchasing. • Food hygiene. • Food based dietary guidelines. • Food to avoid and those to increase intake. • Medication intake. • Disclosure and family involvement.

6. Indicators of successful programme	
Patient	Improved quality of life.
	Improved glycaemic control.
	Reduction of diabetes complications and health problems.
	Reduction of diabetes mortality.
	Eating small portion sizes.
	Increase in the intake of breakfast.
	Knowledge of glucose readings and checking of blood glucose.
	Improved self-care practices such as use of time reminders for medication, exercise and dietary intake.
	Engaging in household activities and exercise.
	Use of sun protection for exercise.
	Doing learned exercises alone at home.
	Knowledge of healthy food preparation methods.
	Increase intake of fruits and vegetables.
	Engaging in exercises early in the morning before 10 and in the afternoon around 17h00 when sun has cooled down.
	Participation in diabetes support groups.
Family	Consulting with patients.
	Sharing household activities with patients.
	Doing exercises together with patients.
	Using of healthy cooking methods to prepare food.

	Usage of no or reduced fats, sugar and salt during preparation.
	Also, eating small portion sizes including intake of breakfast.
	Increase of fruits and vegetable intake.
	Doing learned exercises together with patients at home.
	Forming part of diabetes support groups.
	Adoption of a healthy lifestyle.
Clinic or healthcare facility	Adoption of preventative care or promotion of active lifestyle.
	Clinic nurses forming part of diabetes support groups.
	Diabetes patients and families engaging in exercise activities at the clinic during diabetes days.
	Reduction of new diabetes diagnosis.
	Diabetes support groups at each clinic.
	Awareness campaigns.
Educational materials or pamphlets.	Usage of educational materials to educate patients and families.
	Educational materials on the walls or notices of each clinic.
	Distribution of educational materials to members of support groups.
N.B: Educational materials are attached (see annexure I)	

5.6 SUMMARY

The chapter highlighted how the development of the family-centred nutrition and exercise diabetes care programme were based on the outcomes of phase 1 and POT. The results of phase 1 which informed programme development highlighted the need for improving knowledge and behaviour change. Knowledge shall be improved through education using flyers and pamphlets, as well as demonstrations, while behaviour change shall be done through application of SCT. The programme was developed with the help of dietitians and physiotherapists from public hospitals and was further validated by academics from universities. The chapter further outlined the final family-centred nutrition and exercise diabetes care programme. The next chapter discusses the implementation of the family-centred nutrition and exercise diabetes care programme.

CHAPTER SIX:
IMPLEMENTATION OF FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

6.1 INTRODUCTION

The previous chapter discussed the development and validation of the family-centred nutrition and exercise diabetes care programme. The programme was validated by experts from institutions of higher learning. This chapter discusses how family-centred nutrition and exercise diabetes care programme was implemented. Furthermore, the impact evaluation of family-centred nutrition and exercise diabetes care intervention was undertaken. Therefore, this chapter outlines and discusses the findings of the impact evaluation.

6.2 IMPLEMENTATION OF THE FAMILY-CENTRED NUTRITION AND EXERCISE DIABETES CARE PROGRAMME

The family-centred nutrition and exercise diabetes care programme was educational and implemented in 5 clinics of Blouberg Municipality in Senwabarwana, through focus groups. Each focus group consisted of 10 persons (5 diabetes patients and 5 of their family members), resulting in a total of 100 participants (50 patients and 50 family). The intervention was implemented for a period of 2 months; at each clinic the implementation was done during the scheduled chronic days when the patients were coming for reviews and collections of medication. The recruitment of participants for intervention phase was drawn from the list of those who participated in the situational analysis phase of the study. The potential participants were contacted telephonically, requesting patients together with their family members. Participants who had challenges with transportation were assisted with transportation costs. The implementation was through face-to-face educational talks, using different methods of verbally and the use of visuals, demonstrations, flyers, and posters. The venue for programme implemented was pre-arranged with operational managers at each clinic. The programme at each clinic was implemented in private rooms where only beneficiaries (patients and family members were in attendance, and each session lasted for 60 minutes). The educational intervention was implemented by the researcher and physiotherapist.

6.3 EDUCATIONAL MATERIALS

The content of the educational tools was informed by the knowledge gaps which were identified in the findings from data analysis of the situational phase. The educational tools i.e., flyers and posters are annexed (see annexure I). The flyers and posters were translated into Sepedi. The educational tools were translated into Sepedi by the researcher who is also speaks Sepedi. However, the translated information was offered to Sepedi translator for verification, thereafter a consensus meeting was convened, and agreement reached on the final translation. Visuals used were in the form of pictures as captured in the flyers and/or posters. The pictures used in the educational materials were taken from the internet. The posters were displayed in the private rooms where education was offered, additionally, others were displayed in the clinics' boards for the attention of other patients. The flyers were given to the participants at the end educational talks session and were distributed by research assistants. In addition, at the end of each session, the flyers were given to the clinics for distribution particularly to other diabetes patients and or their families, who did not participate in the intervention study.

6.4 EVALUATION OF THE IMPLEMENTATION OF THE EDUCATIONAL PROGRAMME

Following the implementation of the educational programme, participants were provided with questionnaire to complete for the evaluation on their own. The evaluation of the implementation of the educational programme was aimed at reviewing and critiquing how the programme was implemented for its feasibility. However, the evaluation of the implementation of the programme did not include the impact evaluation. It is recommended that further studies should be conducted for impact evaluation of the programme. All aspects of the intervention were evaluated including how the events were organized, the educational tools, presentations and demonstrations. Participants who did not complete questionnaires properly were telephonically contacted for completion of missing information; such was done in consideration of the COVID-19 regulations.

6.4.1 **Presentation of results and discussions of the impact evaluations of family-centred nutrition and exercise diabetes care programme**

The results and discussions of the evaluation quantitative survey are as follows:

6.4.1.1 Organization and demonstration during interventions

Table 6.1: Evaluation of the organizational and demonstration part of the educational intervention, (% in rows, n=100).

Statement related to the evaluation of the organization and demonstrations part of the educational intervention		**Participants N (100)**	**Yes**	**Not sure**	**No**
Organization of educational intervention	Commendable	Patients (n=50)	42 (84%)	7 (14%)	1 (2%)
		Family (n=50)	50 (100%)	0	0
	Needs improvement	Patients (n=50)	7 (14%)	9 (18%)	34 (68%)
		Family (n=50)	3 (6%)	11 (22%)	36 (72%)
	Goals of the intervention well met	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
Demonstrations	Commendable	Patients (n=50)	42 (84%)	8 (16%)	0
		Family (n=50)	45 (90%)	5 (10%)	0
	Needs improvement	Patients (n=50)	4 (8%)	11 (22%)	35 (70%)
		Family (n=50)	5 (10%)	17 (34%)	28 (56%)
	Stimulate interests	Patients (n=50)	50 (100%)	0	0

		Family (n=50)	50 (100%)	0	0
	Respond well to questions	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Very helpful to my learning	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0

Table 6.1 shows that the majority of both patients (84%) and family members (100%), indicated that the organization of the educational intervention was commendable. Fewer patients (8%) and family (10%) respectively indicated that the demonstrations done during implementation of the educational intervention needed improvement.

Diabetes education is important in assisting patients to manage the disease, promote good lifestyle behaviours and prevent/delay onset of Type-2 Diabetes Mellitus (T2DM) (Mukona, 2020). Diabetes education is also important in transferring knowledge to assist in adopting lifestyle which minimizes diabetes new cases or prevalence (Mukona, 2020). Most of the diabetes patients (84%) that the organization of the educational intervention was commendable compared with all family members. Although, it is not abnormal in South Africa for family members accompanying family members to the healthcare, it is however, rare to find patients and family members consulting together, hence all family members found the organization of the educational intervention which permits their participation to be commendable. Family members are the providers of care at home and often depends on patients to inform them how to care for them. Family involvement in diabetes care reduces psychological distress resulting from not knowing how best to take care of the loved ones (Carman et al., 2013). It is possible that the family members found the organization of the education intervention commendable since it will empower them and minimize the psychological distress which may result from inadequate knowledge of how best to care for family members.

On the other hand, about 16% of the diabetes patients found the organization of the educational intervention not commendable. Learning environment and duration of the sessions are key for the success of health education (Kosti & Kanakari, 2012). Most of the clinics in Senwabrwana area has infrastructural challenges which prohibit total avoidance of distraction, hence the 16% of patients who indicated that the organization was not commendable could be attributed to minimal distractions which occurred. It has been reported that for education to be effective, the learning environment should be quiet without distraction, the group of participants should not exceed 10 and the session must also not exceed 60 minutes (Polikandrioti & Ntokou, 2011). In this study the education was offered to a group of 10 participants (5 patients and 5 family members) and that each session did not exceed 60 minutes. However, there were minimal distractions in the clinic facilities which were mainly caused by infrastructural challenges.

According to Kosti and Kanakari (2012), there are individual and group education teaching methods. The individual teaching method is predominantly used since patients usually consult individually. Group education is reportedly the “most effective teaching method and enables communication with other patients experiencing similar health problems, thereby enhancing learning” (Kosti & Kanakari, 2012). Group education has been found to be more effective and has demonstrated good glycaemic control among diabetes patients (Filho *et al.,* 2016). A clinical controlled trial study conducted in Greece has shown that diabetes education offered to patients in groups was more effective with 1.4% and 0.5% reduction of Haemoglobin A1C (HbA1C) in the intervention and control groups, respectively, than when education was offered to individual patient (Merakou *et al.,* 2015). The participants in this study were given nutrition and exercise diabetes care education in groups. Communication among patients, their family members and healthcare providers on diabetes management plays an important role and may enhance learning (Duke, Colagiuri & Colagiuri, 2009). Group-based education approach has been found to result in improvements in clinical, lifestyle and psychosocial outcomes (Steinsbekk et al., 2012).

The traditional way of delivering diabetes education has been one where the health professional is imparting knowledge about management to the diabetes patient (Rashed *et al.,* 2016). According to Ajzen *et al.* (2011), knowledge alone is no guarantee for the adoption of healthy behaviour, much as ignorance is hugely

responsible for unhealthy behaviour. Moreover, a combination of knowledge and motivation to change behaviour yield good behaviour change (Ajzen *et al.,* 2011). The educational intervention in this study was coupled with demonstrations to empower both patients and their family members with skills related to nutrition and exercise diabetes care so as to ensure adoption of healthy lifestyle necessary for good diabetes outcomes.

It has been recently recognized that diabetes education interventions are more effective when coupled with behavioural change to enable patients taking charge of self-care activities and decision-making (Dube *et al.,* 2015). Diabetes Self-Management Education (DSME) is intended "to provide the patient with the necessary knowledge and skills for effective management and to promote lifestyle behaviours which will lead to good diabetes outcomes" (Muchiri, Gericke & Rheeder, 2016). Nutrition and exercise are key in diabetes management (IDF, 2016), therefore, empowering patients and their family members with knowledge and skills related to nutrition and exercise diabetes care will improve adherence to treatment. Several studies examined effectiveness of diabetes education in improving glycaemic control, knowledge, and adoption and adherence of healthy self-management behaviours (Dube *et al.,* 2015; Muchiri, Gericke & Rheeder, 2016; Tawfik, 2017).

6.4.1.2 Presentation of the educational intervention

Table 6.2: Evaluation of the presentation part of the educational intervention, % in rows.

Statement relation to the evaluation of the presentation part of the educational intervention	Participants	Yes	Not sure	No
Commendable	Patients (n=50)	49 (98%)	1 (2%)	0
	Family (n=50)	50 (100%)	0	0
Needs improvement	Patients (n=50)	0	13 (26%)	37 (74%)
	Family (n=50)	1 (2%)	27 (54%)	22 (44%)
Excellent explanations	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	49 (98%)	0	1 (2%)
Stimulate interests	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	50 (100%)	0	0

Dynamic, engaging style	Patients (n=50)	48 (96%)	1 (2%)	1 (2%)
	Family (n=50)	47(94%)	2 (4%)	1 (2%)
Good use of visual aids	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	50 (100%)	0	0
Effective examples	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	50 (100%)	0	0
Good summaries provided	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	48 (96%)	1 (2%)	1 (2%)
Respond well to questions	Patients (n=50)	48 (96%)	2 (4%)	0
	Family (n=50)	50 (100%)	0	0
Very helpful to my learning	Patients (n=50)	50 (100%)	0	0
	Family (n=50)	50 (100%)	0	0

Table 6.2 shows that the majority of patients (98%) and family members (100%) respectively indicated that the presentation made during implementation of the educational intervention were commendable. All patients (100%) and 98% of family members respectively indicated that excellent explanations were provided. All patients (100%) and 96% of family members respectively indicated that good summaries were provided. All patients (100%) and family members (100%) indicated that the presentations stimulated their interest and were very helpful to their learning.

According to Maslakpak, Razmara and Niazkhani (2017), education of patients and their families is the cornerstone of effective diabetes care. Education interventions can be delivered in different ways, including face to face, written material, telephone and technologically (Maslakpak, Razmara & Niazkhani, 2017). The face-to-face teaching method “is the most typically used in the healthcare system throughout the world” (Knight *et al.,* 2006). The face-to-face diabetes education is linked with better health outcomes in diabetes self-management education programmes (Ellis *et al.,* 2004), and enables participants to ask questions or discuss their health concerns with healthcare provider (Maslakpak, Razmara & Niazkhani, 2017). The presentations to the patients and family members in this study were done face-to-face by dietitian and physiotherapist. Health care providers delivering diabetes or health education may strongly influence on how patients perceive their disease and follow the recommended treatment (Maslakpak, Razmara & Niazkhani, 2017). Almost all patients (98%) and all family members (100%) in this study indicated that the presentation by the healthcare providers was commendable. Furthermore, all patients (100%) and family members

(100%) indicated that the presentation made by dietitian and physiotherapist were stimulating interests and helpful to their learning, respectively. A Brazilian study reported that the patient's motivation and attitude towards diabetes treatment is stimulated by healthcare providers (Filho et al., 2016). Healthcare providers are recognized as the cornerstone or the drivers of healthcare interventions, therefore, it becomes important to do in-service training of the healthcare providers so as to empower them with recent skills and competencies (Nicol, Turawa & Bonsu, 2019), so as to positively influence how patients and family members perceive the disease and its treatment for better diabetes outcomes.

Health literacy is regarded "as the comprehension required to make well-informed decisions regarding own health" (Pratt & Searles, 2017). Visuals such as pictures, drawings, charts, graphs and diagrams, can be effective tools for communicating health information and also to make the presentation of complex information easily understood by the participants (van Beusekom et al., 2015). However, a Texas study reported that not all visuals used during the health education are effective (Park & Zuniga, 2016), however, visuals should be designed so that they match the preferences and needs of their target group. Visuals were used to facilitate education in this study. All patients (100%) and family members (100%) indicated that the presenters applied good use of visuals to facilitate nutrition and exercise diabetes care education. Well-designed visuals reinforce written or spoken health messages and also increases understanding and recall, as well as intentions and behaviours toward adherence (van Beusekom *et al.,* 2015).

According to Funnel *et al.* (2011), the health education curriculum should be dynamic, and based on recent literature. Almost all patients (96%) and family members (94%) in this study indicated that the session was dynamic and engaging in style. The content of the curriculum was based on nutrition and exercise diabetes care and also included a demonstration on how to prepare healthy meals, small portion sizes and type of exercises, as well as how to inject insulin. It has been found that diabetes patients discussing treatment goals and disease management strategies with healthcare providers have good glycaemic outcomes compared with those who fear to discuss with healthcare providers (Seung-Hyun et al., 2012). Participants in this study discussed with the healthcare providers and almost all patients (96%) and all family members (100%) indicated that the healthcare providers or investigators responded

well to questions asked and that they gave effective examples which enhances their learning.

6.4.1.3 Educational tools (flyers and posters)

Table 6.3: Evaluation of the flyers and posters used in the implementation of the educational intervention, % in rows.

Statement related to the evaluation of the flyers and posters used in the implementation of educational intervention		**Participants**	**Yes**	**Not sure**	**No**
Flyers	Did you see flyers?	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Are/were they informative?	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Did you take a copy with you	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Need improvement	Patients (n=50)	0	0	50 (100%)
		Family (n=50)	1 (2%)	2 (4%)	47 (94%)
Posters	Did you see posters?	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Are/were they informative?	Patients (n=50)	50 (100%)	0	0
		Family (n=50)	50 (100%)	0	0
	Need improvement	Patients (n=50)	0	0	50 (100%)
		Family (n=50)	4 (8%)	19 (38%)	27 (54%)
	Good coverage of material	Patients (n=50)	46 (92%)	2 (4%)	1 (2%)
		Family (n=50)	47(94%)	3 (6%)	0
	Right length for the amount of time given	Patients (n=50)	40 (80%)	2(4%)	8 (16%)
		Family (n=50)	43 (86%)	7 (14%)	0

Table 6.3 shows that all patients (100%) and family members (100%) saw both flyers and posters used during the intervention; and that they were informative. Fewer patients (2%) and family members (8%) respectively indicated that posters were in need improvement.

In primary health care facilities, health education is common and the cornerstone. The provision of health education to patients helps improve knowledge, compliance to treatment and self-care of the disease (Eckman *et al.,* 2012; Jahan *et al.,* 2014).

Healthcare providers usually educate patients verbally on diabetes management educate, however, patients tend to forget the verbal information delivered to them (Hoffmann & Ladner, 2012). Written materials such as flyers and posters are used to supplement and reinforce verbal health education to maximize the effectiveness of the health education (Al-Khashan *et al.,* 2012). Flyers and posters were used to supplement verbal education in this study. All participants (patients and family members) indicated that they have seen both the flyers and posters. Various studies have highlighted that people living with diseases like diabetes appreciate the usefulness of written materials (McKenna *et al.,* 2003; Al-Khashan *et al.,* 2012).

The benefits of the use of written materials include consistency, readily available information, and ability to share information (Jahan *et al.,* 2014). However, it is important to design written materials suitable to target population so as to enforce adoption of healthy lifestyle and adherence to treatment which includes nutrition and exercise (Gill *et al.,* 2012). All patients (100%) and family members (100%) indicated that they were given copies of the flyers, implying that they would be able to remind themselves at home in case they had forgotten the verbal education. Despite the benefits of written materials, the era of acquiring health education is gradually advancing technologically, particularly at this era of Fourth Industrial Revolution (4IR), as such people rely more on the internet for health education (Jahan *et al.,* 2014). Almost all patients (98%), compared with all family members reported that both flyers commendable and that all participants (patients and family members) reported that posters are commendable. Therefore, in this era of 4IR, it becomes necessary that the written materials (flyers and posters) which were found to be commendable be shared using social networks platforms such as WhatsApp, etc. In rural areas such as Senwabwarwana, connectivity to internet or network is poorer, therefore the issuing of written materials remains essential.

Participants in this study indicated that none of the written materials requires improvement. Despite the benefits of adequate knowledge on diabetes care, it is a concern that international knowledge on diabetes is poor (Spronk *et al.,* 2014). Lack or insufficient knowledge on nutrition and exercise diabetes care may be the reason why both patients and family members indicated that the written materials does not need to be improved. Therefore, it may be necessary to strengthen nutrition and exercise diabetes care awareness campaigns so as to capacitate both patients and

family members. It is assumed that the capacitation of both patients and family members would enable them to know what to excepted from written materials and evaluate them better, since knowledge is power.

6.5 SUMMARY

This chapter outlined the how the family-centred nutrition and exercise diabetes care programme was implemented. It further outlined how the participants in the implementation phase were recruited, including describing the educational materials. The questionnaires were provided after implementation of the intervention, for purpose of reviewing or critiquing how the programme was implemented, therefore its results were presented and discussed.

The next chapter discusses the conclusion, summary, limitations and recommendations of the study.

CHAPTER SEVEN:
CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

7.1 INTRODUCTION

The previous chapter described the development and validation of the family-centred nutrition and exercise diabetes care programme, as well as the results of the quantitative process evaluation. This chapter outline the summary of research method and findings, contribution to the body of knowledge overall conclusion, limitations and recommendations of the study.

7.2 RESEARCH DESIGN AND METHOD

The overall study design applied in this study is intervention design, which enabled the researcher to develop and implement family-centred nutrition and exercise diabetes care programme. The study was conducted in 3 phases and applied relevant study design per phase. Phase 1 used convergent mixed method parallel study design, wherein both quantitative and qualitative approaches were carried at the same time. Quantitative approach used cross-sectional study design to determine knowledge, attitudes and practices of both diabetes patient and their family members regarding nutrition and exercise diabetes care, as well as anthropometric parameters of patients. The rationale for determining knowledge, attitudes and practices of family members was to ascertain the level of support to patients. Data collection for quantitative strand was done through the use of two closed-ended questionnaires (for patients and family members). The qualitative approach used phenomenological exploratory study design to explore diabetes patients' perceived QoL post-diagnosis. The family members were excluded from qualitative strand because they were not diagnosed with diabetes. The qualitative data was collected through unstructured interviews using voice recorders, and field notes for non-verbal cues observed which couldn't be captured by the voice recorder during interviews. Based on the responses, further probing and clarity seeking questions were asked to obtain in-depth information.

Phase 2 used cross-sectional developmental and validation study design, which enabled the researcher to develop and validate family-centred nutrition and exercise diabetes care programme based on the results of phase 1. Experts from other

institutions of higher learning were used to validate the family-centred nutrition and exercise diabetes care programme.

Phase 3 used implementation study design, which enabled the researcher to implement the developed family-centred nutrition and exercise diabetes care programme. Quantitative survey was conducted post the implementation of the intervention using closed-ended questionnaire for both patients and family members. The quantitative data was analysed using Statistical Package for the Social Science (SPSS) software version27, while qualitative data analysed using 8 steps of Tesch's open coding qualitative data analysis method as described by Creswell (2014).

7.3 SUMMARY OF RESEARCH FINDINGS

A total of 400 subjects (200 diabetes mellitus patients and 200 nondiabetic family members) participated in the quantitative strand of phase 1 in this study. The results showed that that close to two-third of diabetes patients were over the age of 60 years and the majority of patients were females. Over a third of patients lived with diabetes for over 10 years (37%), an overwhelming majority controlled the disease with medication (92%), only 3,5% used traditional medicine to control diabetes, and the majority had comorbidities (75,5%) and were married (74%). Over half of patients (57%) were obese, and 75% had abdominal obesity. Close to half of patients (45%) had overall excellent nutrition and exercise diabetes care knowledge compared with less than a third of family members (31%). The majority of patients (73%) had overall positive attitudes towards nutrition and exercise diabetes care compared with 25% of family members. Only 15% of diabetes patients had overall good practice related to nutrition and exercise diabetes care compared with 9% of family members.

Seventeen participants participated in the qualitative strand of this study of which 10 were males, 11 were 60 years of age and that they had more than 5 years living with diabetes. The qualitative results of diabetes patients showed existence of knowledge of food to eat and not to eat when living with diabetes. It also indicates the existence of knowledge of the importance of nutrition and exercise in diabetes care. The study also indicated challenges of living with diabetes including little to no sex, feelings of shame resulting with lack of disclosure which subsequently leading to consumption of inappropriate food which affects their Quality of Life (QoL). An outline that diabetes diagnosis causes fear, stress and depression which also affect their QoL. Loss of

income which lead to family misunderstanding resulting in poor QoL, and that acceptance of the condition is difficult and influenced by number of factors such as onset of complications. Diabetes patients indicated that they are unable to perform some of the work, they used to perform before diagnosis, and that they experience psychological and physical signs and symptoms of living with diabetes. Patients including those who lost sexual desire reported the existence of family support which is helpful to their QoL.

Phase 2 of this study involved the development of family-centred nutrition and exercise diabetes care programme, which was submitted to experts at institutions of higher learning for validation. Experts provided comments on the draft programme which were implemented, submitted back to the experts which finally yielded final family-centred nutrition and exercise diabetes care programme.

Phase 3 involved the implementation of the family-centred nutrition and exercise diabetes care educational intervention. The intervention was implemented through focus group consisted of 10 persons (5 diabetes patients and 5 of their family members), resulting in 100 participants (50 patients and 50 family members). Each session of the intervention lasted for about 60 minutes. The educational intervention was implemented by the researcher who is a dietitian including physiotherapist colleague. The facilitation of knowledge was done using different methods face-to-face educational talks to focus groups, demonstrations, and visual use (educational materials).

Quantitative evaluation survey to review or critique the implementation of the educational programme was conducted on 100 participants (50 patients and family members). The results of the survey indicated that the majority of patients (84%) and family members (100%) respectively indicated that the organization of the educational intervention was commendable. Only 8% of patients and 10% of family members respectively indicated that the demonstrations done during implementation of the educational intervention need improvement. The majority of patients (98%) and 100% family members respectively indicated that the presentation was commendable. All patients (100%) and 98% family members respectively indicated that excellent explanations were provided. All patients (100%) and 96% of family members respectively indicated that good summaries were provided. All patients (100%) and

family members (100%) saw both flyers and posters used during the intervention; and that they were informative. None of patients said flyers and posters need improvement, while only fewer family members indicated that flyers (2%) and posters (8%) need improvement.

7.4 CONCLUSION OF THE STUDY

The results of Phase 1 indicated the need to improve knowledge, and food and exercise behaviour among diabetes patients and their non-diabetic family members. Based on the outcomes of Phase 1, a family-centred nutrition and exercise diabetes care programme was developed and validated by experts. Subsequently, the programme was implemented through the use of different methods i.e., educational talks, visuals and demonstrations. Educational talks were provided by researcher and physiotherapist to empower and improve knowledge of patients and their families. Demonstrations were done to empower patients and their family members with necessary skills.

The Phase 1 results have shown that family culture of eating and physical inactivity influences diabetes outcomes among patients, pointing to the need for behaviour change. As a result, the Social Cognitive Theory was employed to influence among behaviour change among patients and family members for adoption of culture f healthy eating and physical activity. However, the study did not assess the impact thereof.

Post-implementation of the family-centred nutrition and exercise diabetes care programme, a quantitative evaluation survey to review or critique how the programme was implemented was conducted. Diabetes patients and their non-diabetic patients alluded that the implementation of the family-centred nutrition and exercise diabetes care programme was commendable. Therefore, there is a need to conduct the study on the impact of the gained knowledge, on the adoption of healthy eating and physical activity, and consequently on the quality of life of patients.

The study also highlighted the need for diabetes support groups, including their constitution and further defined the roles of each role players. Therefore, there is a need for clinics to establish the diabetes support groups and constituted accordingly. Furthermore, based on the fact that patients and their family members indicated that

the implementation of the intervention was success, it is recommended that the programme implementation in the area should be adopted for better diabetes outcomes. In addition, the study can be conducted in a different setting to explore its adoption and implementation.

7.5 RECOMMENDATIONS

The following recommendations are made based on the outcomes of this study for successful family-centred nutrition and exercise diabetes care practices in the Blouberg Municipality of Limpopo Province, South Africa:

Provincial Department of Health

- There is an urgent need for the adoption of family-centred nutrition and exercise diabetes care.
- Train healthcare professionals on the family-centred nutrition and exercise diabetes care.
- A family-centred nutrition and exercise diabetes care programmes such as the one in this study should be given more attention for the roll-out in the province.
- Ensure availability of educational materials and pamphlets on family-centred nutrition and exercise diabetes care.

Clinics

- There is an urgent need for diabetes support groups in each clinic.
- Ensure that nurses assist and direct diabetes support groups at the clinics.
- Conduct diabetes awareness campaigns.
- Organizes a room and place within the clinics for educational and demonstration of nutrition and exercise diabetes care.
- Mounting of educational materials on the walls.
- Diabetes patients and family members
- Adoption of health eating and active lifestyle.
- Form part of the support groups at the clinics.
- Family members active and effective participation in diabetes care.

Research

- A qualitative study to explore lived experiences of family members of caring for patients should be conducted.
- A large scale implementation study should be conducted to assess impact of the family-centred nutrition and exercise diabetes care programme on the behaviour of patients and their families in the clinics of Blouberg Municipality, Limpopo Province, as part of post-doctoral studies.
- Replicate by implementing in other centres, within rural areas.

7.6 CONTRIBUTIONS OF THE STUDY

The original contribution of this thesis is that it highlights that teamwork is the best way to manage diabetes. The study outlined the diabetes team and constituted the diabetes support groups at the clinic settings, including highlighting their roles and responsibilities. The study further acknowledges that family members are already at risk of developing diabetes due to family history of diabetes, and therefore, there is a need to involve families in the care of the family members with diabetes, starting with consulting together with patients. This study also encourages diabetes patients to disclose their condition to their family members so as to enable the implementation of the family-centred nutrition and exercise diabetes care, since family members cannot be involved in the care without consent of patients. This study also pinpoints the need for the active involvement of multidisciplinary team in the management of diabetes outpatients and not getting involved in the event of critically care to minimize and prevent complications. This study further outlines the referral procedures for the from one healthcare provider to the other so as to ensure that patients and family members benefit from the service of the multidisciplinary team. The clinics should improve the way they deliver diabetes education by supplementing the verbal way with written materials using simple, understandable and home language.

7.7 DISSEMINATION OF INFORMATION

The researcher will communicate the outcomes of the study to the nursing managers of the clinics of Blouberg Municipality in Senwabarwana, where the study was conducted. The researcher will train the nurses at the clinics on how to implement the family-centred nutrition and exercise diabetes care programme. In addition, a copy of the findings of this study will be submitted to Limpopo Department of Health, and summary of the study findings shall as well be communicated to the department. The

researcher will further enrol for post-doctoral studies to assess or explore provincial adoption and implementation of the family-centred nutrition and exercise diabetes care programme for better diabetes outcomes and minimizing new cases. The researcher has already published one article and book chapter this study with Department of Higher Education and Training accredited journal and others are submitted for review. Two more articles are approved for publication by accredited journal, while two more were submitted for review.

7.8 LIMITATIONS OF THE STUDY

The limitations of the study include the following:

- The study only focused on diabetes patients and their family members, and it might have been valuable if nurses at the clinic levels were involved so as to understand their views on family-centred nutrition and exercise programmes at the facility level. A further study has been recommended to that effect.
- The study did not explore the experiences of non-diabetic family members of caring for diabetes patients, since patients were targeted.
- Due to COVID pandemic, community members were not involved, it would have been valuable to involve them so as to understand cultural views particularly with regards to the exercise in the area.
- The study was conducted only in selected clinics of the Blouberg Municipality, which is rural areas in one province in South Africa.

7.9 SUMMARY

This chapter briefly outlined the research method of the study and also provided the summary of the findings of this study. Furthermore, the chapter highlighted overall conclusion, recommendations and contribution the study had to the body of knowledge. Limitations of the study were also discussed.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE LETTER

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: 06 March 2019

PROJECT NUMBER: TREC/35/2019: PG

PROJECT:

Title: Development and Implementation of a Family-Centred Nutrition and Exercise Programme for Diabetes Mellitus Patients of Blouberg Municipality, Limpopo Province.

Researcher: MH Mphasha
Supervisor: Prof. L Skaal
Co-Supervisor/s: Prof. TM Mothiba
School: Health Care Sciences
Degree: PhD in Public Health

PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

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APPENDIX B: LETTER SEEKING CONSENT FROM DEPARTMENT OF HEALTH: LIMPOPO

University of Limpopo
School of Health Care sciences
Department of Public Health
Private Bag X1106
Sovenga
0727

24 April 2019

Limpopo Department of Health
Research Unit
Office D36 Old Building
Polokwane
0700

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT THE CLINICS OF BLOUBERG MUNICIPALITY

Dear Sir/Madam

1. Above subject refers.
2. I am a Ph.D. in Public Health student at the University of Limpopo with the following details:

   Name: Mphasha Mabitsela Hezekiel

   Student No.: 200309198

   Identity No.: 8511155856089

   Cell No.: 076 619 9310

   Email: pitso85@gmail.com

3. I have been granted ethical clearance by the University and the topic is as follows:

“Development and Implementation of Family-centred Nutrition and Exercise Programme in Blouberg Municipality of Capricorn District, Limpopo Province”.

4. The following documents are attached to this letter:
   4.1 The ethical clearance from the University.
   4.2 Full research proposal which has the following essential documents attached to it:
      4.2.1 A consent form on page 64.
      4.2.2 Instruments for data collection from page 40.
   4.3 I therefore take this rare opportunity to request permission to conduct the study in the clinics in the Blouberg Municipality of Capricorn District, Limpopo Province.

Thanking you in advance

Regards

_____

Mphasha MH

APPENDIX C: APPROVAL LETTER TO CONDUCT STUDY

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH

Ref: LP 201903_007
Enquiries: Stander SS
Tel: 015 293 6650
Email: research.limpopo@gmail.com

Mphasha M.H

University of Limpopo
Private bag x 1106
Sovenga
0727

Greetings,

RE: DEVELOPMENT AND IMPLEMENTATION OF A FAMILY-CENTRED NUTRITION AND EXERCISE PROGRAMME FOR DIABETES MELLITUS PATIENTS OF BLOUBERG MUNICIPALITY, LIMPOPO

Permission to conduct the above mentioned study is hereby granted.

1. Kindly be informed that:-
   - Research must be loaded on the NHRD site (http://nhrd.hst.org.za) by the researcher.
   - Further arrangement should be made with the targeted institutions, after consultation with the District Executive Manager.
   - In the course of your study there should be no action that disrupts the services, or incur any cost on the Department.
   - After completion of the study, it is mandatory that the findings should be submitted to the Department to serve as a resource.
   - The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.
   - The above approval is valid for a 1 year period.
   - If the proposal has been amended, a new approval should be sought from the Department of Health.
   - Kindly note, that the Department can withdraw the approval at any time.

Your cooperation will be highly appreciated.

Head of Department

22/04/2019
Date

Private Bag X9302 Polokwane
Fidel Castro Ruz House. 18 College Street. Polokwane 0700. Tel: 015 293 6000/12. Fax: 015 293 6211.

The heartland of Southern Africa – Development is about people!

APPENDIX D: LETTERS REQUESTING PERMISSION TO CONDUCT RESEARCH

University of Limpopo
School of Health Care sciences
Department of Public Health
Private Bag X1106
Sovenga
0727

…… 2018

The Nursing Managers
Blouberg Clinics
Blouberg Municipality
Bochum
0790

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT THE CLINICS OF BLOUBERG MUNICIPALITY.

Dear Sir/Madam

I, Mphasha Mabitsela Hezekiel, a PhD student in Public Health at University of Limpopo hereby request to be granted a permission to collect research information on the following topic: Development and implementation of family-centred nutrition and exercise programme in Blouberg Municipality of Capricorn district, Limpopo Province. Information will be collected from patients with diabetes mellitus. The study will involve family members who will be recruited at the clinics and some at their homes with the assistance of diabetes patient.

The study has been approved by the University of Limpopo and the Department of Health Limpopo province. The study may contribute towards to improved glycaemic control and reduction of diabetes complications resulting from poor glycaemic control.

Researcher's Signature:……..… Date:….....……..…2017

Cell number: 076 619 9310

APPENDIX E: CONSENT FORM

UNIVERSITY OF LIMPOPO

Statement concerning participation in a Research Project

Name of Study: Development and implementation of a Family-centred Nutritional and Exercise Programme in Clinics of Blouberg Municipality, Limpopo Province

Information box:

Thank you for agreeing to participate in this study. My name is **Mabitsela Hezekiel 'Pitso' Mphasha**.I am a researcher from the University of Limpopo. The aim of this study is to develop and implement a family-centred nutritional and exercise programme for diabetes patients in clinics of Blouberg Municipality, Limpopo Province. The study is non-invasive. Voice recorder and questionnaires will be used to collect data.

Participation in this study is voluntary and that you may withdraw from it at any time and without giving reasons. This will have no influence on the diabetes treatment you or your family member is receiving at the clinic.

Should you have any queries kindly contact:

M.H. Mphasha (076 619 9310)

I have heard the aims and objectives of the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurised to participate in any way.

I understand that participation in this study is completely voluntary and that I may withdraw from it at any time and without giving reasons. This will have no influence on the diabetes treatment I or a family member is receiving at the clinics.

I know that this study has been approved by the Turfloop Research and Ethics (TCREC) Committee at the University of Limpopo. I am fully aware that the results of this study will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I hereby give consent to participate in this study.

.....	…….....
Name of volunteer	Signature of volunteer

.....	.....	.....
Place	Date	Witness

DATA COLLECTION TOOLS

APPENDIX F: QUESTIONAIRE FOR DIABETES PATIENT (ENGLISH VERSION)

Section A: Socio-demographic profile

Instructions: Please tick once or write your answer in provided space

1.	Age				
2.	Gender	**Male**		**Female**	
3.	Highest level of education	**Never been to school**	**Primary School**	**Secondary school**	**Tertiary education (Certificates, Diploma, Degree, Postgraduate qualifications)**
4.	Marriage	Single	Cohabitated	Married	Divorced
5.	Religion	Christianity	Muslim	Other	None
6.	Income	**No income**	**Less than R1000**	**R1001 to R5000**	**R5001 & more**
6.1	Is there any other person in your household with income?	**Yes**		**No**	
6.1.1	If yes, how many in your household have income? (Please specify)				
7	Number of family members at home				
8.	Does your family know you have diabetes?	**Yes**		**No**	
9.	Do you have any family member with diabetes?	**Yes**		**No**	

9.1	If yes, please specify the number of people with diabetes in your family						
10.	How do you control your blood sugar?	**Oral medications (pills)**	**Insulin injections**	**Other (Please specify)**			
11.	How long have you been living with diabetes?	**Less than one year**	**2 to 5 years**	**6 to 10 years**	**More than 10 years**		
12.	Do you suffer from any other disease besides diabetes?	**Yes**		**No**			
12.1	If yes, (please specify additional diseases)						
13.	Did a family member accompany you to consult a dietitian in the past 6 months for nutritional advice?	**Yes**		**No**			
14.	Did a family member accompany you to consult physiotherapist in the past 6 months for exercise advise?	**Yes**		**No**			

Section B: Anthropometric assessment

1.	Weight	
2.	Height	
3.	Body Mass Index	
4.	Waist Circumference	

Section C: Knowledge of nutrition and exercise in diabetes management

No.	Statement Instructions: Please tick or write your answer in the provided space	Yes	Not sure	No
Knowledge of nutrition in diabetes management				
1.	Nutrition plays an important part in diabetes management.			
2.	Fruits and vegetables must be eaten because they are good in managing blood sugar.			
3.	It is good to eat small, frequent meals regularly to manage blood sugar.			
4.	Whole-grains high in fibre are recommended as a healthy source of carbohydrate.			
5.	When overweight and diabetes, it is good to skip meals to lose weight.			
6.	When preparing meat, it is recommended to remove visible fats from red meat, and also to eat chicken without skin.			
7.	Eating a large portion size of food at once may lead to increased blood sugar.			
8.	High fat dairy products including high animal proteins must be avoided.			
9.	It is good to cut back on salty food including high sodium food such as processed food.			
10.	It is good to cut back on sugary food including avoiding added sugar in drinks and food.			
11.	Fried food and other food high in fats must be avoided.			
Knowledge about exercise in diabetes management				
1.	Exercise is important in diabetes management and help control blood sugar			

2.	Blood sugar, blood pressure and cholesterol levels stay on track with exercise.			
3.	Exercising can reduce diabetes-related health problems or complications.			
4.	It is good to stop exercising, in the event of feeling dizziness, shortness of breath and pains			
5.	When engaging in prolonged exercise, it is encouraged to eat before and after exercise, including drinking fast acting carbohydrate drinks during exercise.			
6.	It is recommended to check blood sugar before and after exercise.			
7.	People with diabetes who are on insulin should measure blood sugar before, during, and after exercise.			

Please tick only once

8.	What must you do if you discover that your blood sugar is high just before exercise?	**Don't exercise**	**Go ahead and exercise**	**Wait till it becomes normal**	**Don't know**

9.	What is the recommended minimum amount of exercise that a person with diabetes should get in a week?	**30 minutes 2 days**	**20 minutes 2 days**	**30 minutes 3 days**	**20 minutes 3 days**	**Don't know**

10.	When a person who is on insulin and does running exercises, where should they not inject themselves?	**Arms**	**Abdomen**	**Thighs**	**Don't know**

11.	During exercise what happens to the amount of insulin in the body?	**Increases**	**Stays the same**	**Decreases**	**Don't know**

Knowledge about glucose (sugar) levels (please answer appropriately)

1.	Do you know the normal acceptable range for blood sugar for a diabetes patient?	**Yes**		**No**	
1.1	If the answer is yes, please indicate the range.				

Section D: attitudes towards diabetes management through nutrition and exercise

No.	**Statement** **Instructions: Please tick or write your answer in the provided space**	**Agree**	**Neutral**	**Disagree**
1.	I can lead a normal life if I take appropriate measures for diabetes.			
2.	I am willing to do regular exercise to prevent further complication due to diabetes.			
3.	I am willing to do specially prescribed exercises as given by my physiotherapist or healthcare worker.			
4.	I will/wear footwear as recommended by my physiotherapist when I go to exercise.			
5.	I can see a physiotherapist for exercise diabetes education at least once every 6 months.			
6.	I'm too old to exercise			
7.	I'm too sick to exercise			
8.	I'm too fat to exercise			
9.	My diabetes prevents me from exercising			
10.	I'm too busy to exercise			
11.	It is too late for me to exercise			
12.	My culture does not allow me to exercise			

13.	I can see a dietitian for nutrition diabetes education at least once every 6 months.			
14.	I can control my diabetes so that it does not interfere with the things I want to do.			
15.	I can follow my recommended diet even when I have to share food with other people who do not have diabetes.			
16.	I am willing to avoid food that a dietitian or healthcare worker advises you to avoid.			
17.	I can eat all my meals as per the time intervals recommended by my dietitian or healthcare worker.			
18.	I'm too old to change how I eat.			
19.	It is too late for me to start checking what to eat and not to eat.			

Section E: practices related to diabetes management through nutrition and exercise

No.	**Statement** **Instructions: Please tick or write your answer in the provided space**	**REGULARLY (4 OR MORE TIMES A WEEK)**	**SOMETIMES (1-3 TIMES A WEEK)**	**NEVER**
Practices related to diabetes management through nutrition				
1.	In the past week, how often did you eat breakfast?			
2.	In the past week, how often did you eat lunch and supper?			
3.	How often do you eat fried and fatty food?			
4.	How often do you eat sugary food and sugary drinks?			

5.	How often do you take alcoholic drinks			
6.	How often do you eat vegetables?			
7.	How often do you eat fruits?			
8.	How often do you eat meat, chicken, fish, mopani-worms, eggs and milk			
9.	How often do you eat high fibre food such as beans, lentils, legumes and wholegrain foods among others?			
10.	How often do you eat starchy food such as pap, rice, samp and bread?			
11.	How often do you eat salty food such as processed food like polony or added salt?			

Please tick appropriately in the following questions.

12.	Who prepares food in your family?	**Spouse**	**Children**	**Housemaids**	**Other (Please specify)**

13.	Did the person who prepares food, accompany you to see a dietitian?	**Yes**		**No**	

Practices related to diabetes management through exercise

1.	Do you exercise?	**Yes**		**No**	
2.	During the past week, did you spend at least 30 minutes, 3 days per week doing stretching or muscle strengthening exercises such as lifting weights, including home chores such as washing clothes and cleaning?				
3.	During the past week, did you spend at least 30 minutes, 3 days per week doing any of the following exercises: walking, running, riding bicycle, swimming, climbing stairs, or any other aerobic exercises?				

4.	In the past month, have you exercised for at least 30 minutes/ 3 days per week?				
5.	Do you have a machine to measure your blood sugar (glucose) level?				

	Please tick only once	**Always (4 or more times a week)**	**Sometimes (1-3 times a week)**	**Never**
6.	In the past month, how often a week do you exercise for at least 30 minutes/ 3 days?			
7.	In the past month, how often have you check your blood sugar level before you exercise?			
8.	In the past month, how often have you checked your blood sugar level after you exercise?			
9.	When you exercise, how often do you wear the type of shoes recommended by your health provider?			

Use of traditional medicine (Please tick appropriately)

1.	Do you use traditional medicine to control your diabetes?	**Yes**		**No**	
1.1.	If yes, for how long have you been using traditional medicine.	**Years**		**Months**	
2.	Do you sometimes replace diabetes medicines with traditional medicine?	**Yes**		**No**	

Thank you

APPENDIX F1: QUESTIONAIRE FOR DIABETES PATIENT (SEPEDI VERSION)

KGAOLO A: SEEMO

1.	Megwaga						
2.	Bong	**Monna**		**Mosadi**			
3.	Tsa Sekolo	**A san ka ka tsena sekolo**	**Sekolo sa fasana**	**Sekolo sa godingwana**		**Sekolo sa godimo (dipoloma, setifikarata, kgerata, dithuto tsa postgraduate)**	
4.	Lenyalo	**Ga sa nka ka nyalwa**	**Ke no dula le motho**	**Ke nyetswe**		**Ke hladile**	
5.	Tsa sedumedi	**Mokheresete**	**Mo muslim**	**Sedumedi se sengwe (ngwala gore o dumela kae)**		**Ga ke tsene tsa sedumedi**	
6.	Letseno	**A go na letseno**	**Ka fase ga R1000**	**R1001 -R5000**		**R5001 go ya godimo**	
6.1.	O na le o mongwe ka mo lapeng wa go ba le letseno?			**Ee**		**Aowa**	
6.1.1	Ge karabo e le aowa, bolela gore ke ba ba kae?						
87	Le ba ba kae ka mo gae						
8.	Ba le lapa ba tseba gore o na le bolwetsi ba sukiri			**Ee**		**Aowa**	
9.	Ka mo lapeng go na le o mongwe yo a nago le bolwetsi bja sikiri?			**Ee**		**Aowa**	
9.1.	Ge e le gore o na le wa go ba le bolwetsi bja sukiri, ke ba ba kae?						

10	O laola bolwetsi bja gago bja sukiri, ka mokgwa o fe?		**Ka dihlare**		**Go ihlaba ka insulini**		**Other (Hlalosa)**
11.	Ke lebaka le lekakang o phela ka bolwetsi bja sukiri?	**Ka fase ga ngwaga**	**Megwaga ye 2-5**		**Megwaga ye 6-10**		**Megwaga ya go feta 10**
12.	O na le bolwetsi bjo bongwe ka ntle le sukiri?		**Ee**		**Aowa**		
12.1	Ge karabo e leng ee, hlalosa bolwetsi bjouwe.						
13.	O na le motho wa le lapa yo sa le a go felesetsa go yo bona ngaka ya dijo/phepo o hwetsa hlahlo ka tsa dijo mo kgweding tse 6 tse di fetileng?		**Ee**		**Aowa**		
14.	O na le motho wa le lapa yo sa le a go felesetsa go yo bona ngaka ya marapo o hwetsa hlahlo ka tsa boitshudullo mo kgweding tse 6 tse di fetileng?		**Ee**		**Aowa**		

KAROLO YA B: TSHEKATSHEKO YA MMELE

1.	Boima	
2.	Botelele	
3.	Boima bja mmele	
4.	Seemo sa matheka	

KAROLO C: TSEBO YA PHEPO LE BOITSHUDULLO MO HLOKOMELONG YA BOLWETSI BJA SUKIRI

No.	**Lefoko**	**Nnete**	**Ga ke tsebe**	**Aowa**
Tsebo mabapi le tsa phepo mo taolong ya bolwetsi bja sukiri				
1.	Dijo di raloka karolo e kgolo mo taolong ya sukiri			

2.	Dienywa le merogo e bohlokwa taolong tya sukiri			
3.	O ja gannyane kgafetsakgafetsa, ka nako tsa mehleng o loketse taolo ya sukiri			
4.	Dijo tsa di whole-grains tseo dinang le fiber e kgolo di tseiwa bjalo ka tseo dinang le carbohydrate ye botse			
5.	Ge o na le mmele o mo ntshi ebile o na le bolwetsi bja sukiri, o lokile gore o ka fela o sa je go thusha go fokotsa mmele			
6.	O lokile gore motho a ka apea le go ja kgogo ntle le letlalo, le o tlosa makhura a a bonalago mo nameng ye hwidibidu.			
7.	Go ja dijo tse dintshi ka nako e tee, o ka isha sukiri godimo			
8.	Dijo tsa go tswa maswing go akaretsa le nama ya e hwibidu le kgogo di swanetse go fokotsiwa			
9.	O gabotse o fokotsa letswai le dijo tsa matswai, o akaretsa le dijo tseo re reng ke di processed			
10.	O gabotse o fokotsa dijo tsa sukiri, o akaretsa le dino tsa go ba le sukiri yeo e okeditswego			
11.	Dijo tsa go foraiwa le tsa makhura a mantshi di swanetse go fokotsiwa			
Tsebo ya bohlokwa bja go itshudulla mo taolong ya sukiri				
1.	Boitshudullo bo bohlokwa ka kudu mo taolong ya sukiri ebile e thusha o laola sukiri mo mading.			
2.	Sukiri mo mading le madi a magolo a ba taolong, ebile le makhura a fokotsega ka baka la go itshudulla			
3.	Boitshudullo bo ka fokotsa ditlamorago tsa bolwetsi bja sukiri ge bo sa laolege.			
4.	O lokile gore nka emixa go itshudulla ge ke e kwa go lapa, go se heme botse le dihlabi			

5.	Ge ke eya go itshudulla nako ye telele, ke swanetse go ja pele le ka morago, le go nwa dino sa go ba le carbohydrate ge ke ntse ke itshudulla					
6.	Ke gabotse go lekola sukiri pele le ka morago ga boitshudullo.					
7.	Balwetsi ba sukiri bao ba e laolang ka go ihlabela insulin, ba swanetse go lekola sukiri ya bona pele, ka nako le ka morago ga boitshudullo.					
Dira kgetho e tee ka kgopelo						
8.	Ke swanetse go dirang ka morago ga o lemoga gore sukiri e godimo pele ga boitshudullo	**Emixa go itshudulla**		**Tswelepale go ye o itshudulla**	**Ema go fihlela e boela mo e swanetsego go ba gona**	**Ga ke tsebe**
9.	Motho wa sukiri o swanetse o itshudulla nako ye kakang mo bekeng.	**Metsotso ye 30, matsatsi a 2**	**Metsotso ye 20, matsatsi a 2**	**Metsotso ye 30, matsatsi a 3**	**Metsotso ye 20, matsatsi a 3**	**Ga ke tsebe**
10.	Motho wa go laola sukiri ka go hlabela insulin, ga swanela go ihlabela mo kae?		**Letsogo**	**Mpeng**	**Serope**	**Ga ke tsebe**
11.	Ge motho a itshudulla, go diregalang ka insulin mo mmele?		**Ye ya oketsega**	**E no ema seeming seo**	**E ya fokotsega**	**A ke tsebe**
Tsebo ya go laola sukiri (araba dipotsisho tse di latelago ka kgopelo)						
1.	O tseba gore sukiri e swanetse go ba dinomoro tse dife gore ba re e ya laolega.			**Ee**	**Aowa**	
1.1	Ge karabo e le ee, bontsha gore e swanetse go ba mo go kae.					

KAROLO D: MAIKUTLO GO TAOLONG YA BOLWETSI BJA SUKIRI KA DIJO LE BOITSHUDULLO

No.	Lefoko	Ke ya dumela	Ke a dumela; a ke dumele ke	A ke dumele
1.	Nka phela bjalo ka motho wa go se lwale ge nka ihlokomela?			
2.	ke ikemisheditse o itshudulla ka mehla le mehla go fokotsa ditlamorago tsa bolwetsi bja sukiri?			
3.	Ke ikemisheditse go dira boitshudullo bjo ngaka ya marapo goba moshomi wa tsa maphelo a eleditsego gore ke di dire.			
4.	Nka apara dieta tseo di swanetsego boitsudullo go ya le ka keletso ya ngaka ya boitshudullo goba ya marapo.			
5.	Nka bona ngaka ya marapo goba ya boitshudullo ka morago a kgwedi tse tshela mehla le mehla o hwetsa hlahlo ka tsa sukiri le boitshudullo.			
6.	Ke yo mogolo ka kudu go ka itshudulla.			
7.	Ke lwala ka kudu go ka itshudulla.			
8.	Ke na le mmele o mo ntshi go ka itshudulla.			
9.	Bolwetsi bja ka bja sukiri bo nshitisha go itshudulla.			
10.	Ga ke na nako ya go itshudulla, ka gore ke phela ke emaema.			
11.	Go llata go nna gore nka itshudulla.			
12.	Setso sa gesho ga se ntumelele gore nka itshudulla.			
13.	Nka bona ngaka ya dijo goba ya phepo ka morago a kgwedi tse tshela mehla le mehla o hwetsa hlahlo ka tsa sukiri le dijo.			
14.	Nka laola sukiri ya ka gore e ska ntshitixa go dira meshomo ya mehleng.			

15.	Nka latela ka mokgwa o ke swanetsego go ja ka gona le ge ke swanetse go ja le batho bao ba senago sukiri.			
16.	Nka tlogela dijo tseo ngaka ya dijo goba moshomi wa tsa maphelo a ka nkeletsago gore ke ditlogele.			
17.	Nka ja dijo ka di nako tseo ngaka ya dijo e eleditsego gore ke je ka tsona.			
18.	Ke yo mogolo o ka tlogela ka mokgwa yo ke hlwaetseng go ja ka tsona.			
19.	Go llata go nna o ka laodixa dijo tseo ke swanetseng go di ja le tseo ke swanetsego go di tlogela.			

KAROLO E: DITIRO MABAPI LE GO LAOLA BOLWETSI BJA SUKIRI KA DIJO LE BOITSHUDULLO

No.	**Lefoko** **(Araba a tee fela mo potsishong ye nngwe le ye nngwe)**	**KA MEHLA (4 LE GO FETA MO BEKENG**	**NAKO TSE DINGWE (GA 1-3 MO BEKENG)**	**LE GANNY ANE**
DITIRO MABAPI LE DIJO TAOLONG YA SUKIRI				
1.	Mo bekeng ye e fetileng, o jele dijo ga kae ge boesa?			
2.	Mo bekeng ye e fetileng, o jele dijo tsa mosegare le bosego ga kae?			
3.	O ja dijo tsa go apeiwa ka makhura goba tsa go fraiwa a kae?			
4.	O ja dijo tsa go ba le sukiri go swana le malekere, di khoukhu le di juice a kae?			
5.	O nwa mabjalwa a kae?			
6.	O ja merogo a kae?			
7.	O ja dienywa a kae?			

8.	O jele dijo tsa legorong la bo di nama, kgogo, hlapi, mashotja, makgopa, mae le maswi a kae.				
9.	Ke ga kae go eja dijo tsa go ba le fiber go swana le di beans, lentils, legumes le tse dingwe tsa go whole grain?				
10.	Ke ga kae go eja dijo tsa go ba le starch sa go shidiwa ka kudu go swana le borotho bjo boswego le di kuku?				
11.	Ke ga kae o eja dijo tsa letswai go swana le di poloni goba o shomisa stock cubes ge o apea?				
Ngwala Karabo gabotse go dipotsishong tse dilatelago					
12.	Ke mang yo apeang ko gae?	**Molekani**	**Bana**	**Moshomedi**	**Yo mongwe (Hlalosa)**
13.	Motho yo a apeyang sa le a ya go bona ngaka ya dijo le wena?		**Ee**	**Aowa**	
Ditiro mabapi le taolo ya sukiri ka go tshudulla					
1.	O wa itshudulla?		**Ee**	**Aowa**	
2.	Mo bekeng, o fela go tsea nako ya metsotso ye 30 gararo mo bekeng o dira tse di latelago: o ikotlolla, goba go tshidulla di nama tsa mmele ka go kuka ditshipiana tsa go se imele ka kudu, o akaretsa le mebereko ya ka gae go swana le go hlatswa diaparo, dibjana le go fiela?				
3.	Mo bekeng, o fela o tsea nako ya metsotso ye 30 gararo mo bekeng o dira tse di latelago: o sepela, o kitima, o reila paesekela, oswima, o fofafofa, o namela disteps le go dira di aerobics?				
4.	Mo kgweding ye e fetilego, o itshudulutse ya tekano labaka la metsotso ye 30 gararo mo bekeng?				
5.	O na le motshene wa go lekola sukiri?				

Ka kgopelo, araba a tee		Ka mehla (4 le go fetsa mo bekeng)	Nako tse dingwe (1-3 mo bekeng)	Le gannya ne
6.	Mo kgweding ye e fetilego, o itshudulutse a kae tekano ya labaka la metsotso ye 30 gararo mo bekeng?			
7.	Mo kgweding, ke ga kae o lekola sukiri ya gago pele ga boitshudullo?			
8.	Mo kgweding, ke a kae o lekola sukiri ya gago ka morago ga boitshudullo?			
9.	Ge o itshudulla, ke ga kae mo o aparang dieta tseo o eleditsego ke ngaka ya marapo le boitshudullo gore o di apare?			
Tshomisho ya dihlare tsa Sesotho mo taolong ya sukiri (ka kgopelo araba tse dilatelago)				
1.	O shomisha dihlare tsa Sesotho go laola sukiri?	**Ee**	**Aowa**	
1.1	Ge Karabo e le ee, ke nako e kakang, o di shomisha?	**Ngwaga**	**Dikgwedi**	
2.	O fela o beela dihlare tsa sepetlela ko thoko, o shomisha tsa Sesotho legatong la tsona?	**Ee**	**Aowa**	

Re a leboga…..

APPENDIX G: QUESTIONAIRE FOR FAMILY MEMBERS (ENGLISH VERSION)

SECTION A: SOCIO-DEMOGRAPHIC PROFILE

Instructions: Please tick once or write your answer in provided space

1.	Age						
2.	Gender	**Male**		**Female**			
3.	Highest level of education	**Never been to school**	**Primary School**	**Secondary school**	**Tertiary education (Certificates, Diploma, Degree, Postgraduate qualifications)**		
4.	Marriage	Single	Cohabitated	Married	Divorced		
5.	Religion	Christianity	Muslim	Other	None		
6.	Income	**No income**	**Less than R1000**	**R1001 to R5000**	**R5001 & more**		
6.1	Is there any other person in your household with income?	**Yes**		**No**			
6.1.1	If yes, how many in your household have income? (Please specify)						
7.	Number of family members at home						
8.	Did you accompany family member with diabetes to consult a dietitian in the past 6 months for nutritional advice?	**Yes**		**No**			
9.	Did you accompany family member with diabetes to consult physiotherapist in the past 6 months for exercise advise?	**Yes**		**No**			

SECTION B: KNOWLEDGE OF NUTRITION AND EXERCISE IN DIABETES MANAGEMENT

No.	Statement **Instructions: Please tick or write your answer in the provided space**	Yes	Not sure	No
Knowledge of nutrition in diabetes management				
1.	Nutrition plays an important part in diabetes management.			
2.	Fruits and vegetables must be eaten by diabetes patient, because they are good in managing blood sugar.			
3.	Diabetes patients should eat small, frequent meals regularly to manage blood sugar.			
4.	Whole-grains high in fibre are recommended as a healthy source of carbohydrate for diabetes patients.			
5.	It is recommended that diabetes patients who are overweight should skip meals to lose weight.			
6.	When preparing protein to be eaten by diabetes patients, it is recommended to remove visible fats from red meat and also removing chicken skin before cooking.			
7.	If a diabetes patient eat large portion size of food at once may lead to increased blood sugar.			
8.	Diabetes patients should avoid high fat dairy products including high animal proteins.			
9.	It is good for diabetes patients to cut back on salty food including high sodium food such as processed food.			
10.	It is good for diabetes patients to cut back on sugary food including avoiding added sugar in drinks and food.			
11.	Diabetes patients should avoid fried food and other food high in fats.			
Knowledge about exercise in diabetes management				

1.	Exercise is important in diabetes management.			
2.	When a diabetes patient exercises blood sugar, blood pressure and cholesterol levels stay on track with exercise.			
3.	Exercising can help diabetes patients to prevent and/or reduce diabetes-related health problems or complications.			
4.	It is recommended that a diabetes patient should stop exercising, in the event of feeling dizziness, shortness of breath and pains			
5.	When a diabetes patient engages in prolonged exercise, it is encouraged to eat before and after exercise, including drinking fast acting carbohydrate drinks during exercise.			
6.	It is recommended for diabetes patient to check blood sugar before and after exercise.			

Please tick only once

7.	What must a diabetes patient do if he/she discover that his/her blood sugar is high just before exercise?	**Don't exercise**	**Go ahead and exercise**	**Wait till it becomes normal**	**Don't know**

8.	What is the recommended minimum amount of exercise that a person with diabetes should get in a week?	**30 minutes 2 days**	**20 minutes 2 days**	**30 minutes 3 days**	**20 minutes 3 days**	**Don't know**

9.	When a diabetes patient who is on insulin and does running exercises, where should they not inject themselves?	**Arms**	**Abdomen**	**Thighs**	**Don't know**
10.	When a diabetes patient exercises, what happens to the amount of insulin required by the body?	**Increases**	**Stays the same**	**Decreases**	**Don't know**

Knowledge about glucose (sugar) levels (please answer appropriately)

1.	Do you know the normal acceptable range for blood sugar for a diabetes patient?	**Yes**		**No**	
1.1	If the answer is yes, please indicate the range.				

SECTION C: ATTITUDES TOWARDS DIABETES MANAGEMENT THROUGH NUTRITION AND EXERCISE

No.	**Statement** **Instructions: Please tick or write your answer in the provided space**	**Agree**	**Neutral**	**Disagree**
1.	A diabetes patient can lead a normal life if he/she take appropriate measures for diabetes.			
2.	I am willing to join family member with diabetes in doing regular exercise to assist family member to prevent further complication due to diabetes.			
3.	I am willing to join family member with diabetes do specially prescribed exercises as given by physiotherapist or healthcare worker.			
4.	I will wear footwear as recommended by physiotherapist when I go to exercise.			
5.	I can go with family member with diabetes to see a physiotherapist for exercise diabetes education at least once every 6 months.			
6.	My family member with diabetes is too old to exercise			
7.	My family member with diabetes is too sick to exercise			
8.	My family member with diabetes is too fat to exercise			
9	Diabetes is the type of disease which can prevent a person living with it from exercising.			
10.	My family member with diabetes is too busy to exercise			
11	It is too late for a family member with diabetes to start exercising.			

12.	Our family culture does not allow us to exercise			
13.	I can go with family member with diabetes to see a dietitian for nutrition diabetes education at least once every 6 months.			
14.	I can help family member with diabetes to control diabetes so that it does not interfere with the things he/she want to do.			
15.	I can follow diet recommended for my family member with diabetes.			
16.	I am willing to avoid food that a dietitian or healthcare worker advises me to avoid in support of family member living with diabetes.			
17.	I can eat all my meals at per the time intervals a family member with diabetes does as recommended by my dietitian or healthcare worker.			
18.	My family member with diabetes is too old to change how I eat.			
19.	It is too late for a family member with diabetes to start checking what to eat and not to eat.			

SECTION D: PRACTICES RELATED TO DIABETES MANAGEMENT THROUGH NUTRITION AND EXERCISE

No.	**Statement** **Instructions: Please tick or write your answer in the provided space**	**REGULARLY (4 OR MORE TIMES A WEEK)**	**SOMETIMES** **(1-3 TIMES A WEEK)**	**NEVER**
Practices related to diabetes management through nutrition				
1.	In the past week, how often did you eat breakfast?			
2.	In the past week, how often did you eat lunch and supper?			
3.	How often do you eat fried and fatty food?			

4.	How often do you eat sugary food and sugary drinks?			
5.	How often do you take alcoholic drinks			
6.	How often do you eat vegetables?			
7.	How often do you eat fruits?			
8.	How often do you eat meat, chicken, fish, mopani-worms, eggs and milk			
9.	How often eat high fibre food such as beans, lentils, legumes and wholegrain foods among others?			
10.	How often do you eat starchy food such as pap, rice, samp and bread?			
11.	How often do you eat salty food such as processed food like polony?			

Please tick appropriately in the following questions.

12.	Who prepares food in your family?	**Myself**	**Spouse**	**Children**	**Housemaid**	**Other (Please specify)**

Practices related to diabetes management through exercise (Tick only once)

1.	Do you exercise?	**Yes**		**No**	
2.	During the past week, did you spend at least 30 minutes, 3 days per week doing stretching or muscle strengthening exercises such as lifting weights, including home chores such as washing clothes and cleaning?				
3.	During the past week, did you spend at least 30 minutes, 3 days per week doing any of the following exercises: walking, running, riding bicycle,	**Yes**		**No**	

	swimming, climbing stairs, or any other aerobic exercises?				
4.	In the past month, have you exercised for at least 30 minutes/ 3 days per week?	**Yes**		**No**	

	Please tick only once	**Always** **(4 or more times a week)**	**Sometimes** **(1-3 times a week)**	**Never**
5.	In the past month, have you exercised for at least 30 minutes/ 3 days per week?			
6.	When you exercise do you wear the type of shoes recommended by your health provider?			

Thank you

APPENDIX G1: QUESTIONAIRE FOR FAMILY MEMBERS (SEPEDI VERSION)

KGAOLO A: SEEMO

1.	Megwaga						
2.	Bong	**Monna**		**Mosadi**			
3.	Tsa Sekolo	**A san ka tsena sekolo**	**Sekolo sa fasana**	**Sekolo sa godingwana**		**Sekolo sa godimo (dipoloma, setifikarata, kgerata, dithuto tsa postgraduate)**	
4.	Lenyalo	**Ga sa nka ka nyalwa**	**Ke no dula le motho**	**Ke nyetswe**		**Ke hladile**	
5.	Tsa sedumedi	**Mokheresete**	**Mo muslim**	**Sedumedi se sengwe (ngwala gore o dumela kae)**		**Ga ke tsene tsa sedumedi**	
6.	Letseno	**A go na letseno**	**Ka fase ga R1000**	**R1001 -R5000**		**R5001 go ya godimo**	
6.1	O na le yo mongwe ka lapeng wa go ba le letseno?			**Ee**		**Aowa**	
6.1.1	Ge karabo e le ee, bolela gore ke ba kae?						
7.	Le ba kae ka mo gae						
8.	Sa le wa felesetsa wa lelapa wa go ba le bolwetsi bja sukiri go yo bona ngaka ya dijo/phepo o hwetsa hlahlo ka tsa dijo mo kgweding tse 6 tse di fetileng?			**Ee**		**Aowa**	
9.	Sa le wa felesetsa wa le lapa wa go ba le bolwetsi bja sukiri go yo bona ngaka ya marapo o hwetsa hlahlo ka tsa boitshudullo mo kgweding tse 6 tse di fetileng?			**Ee**		**Aowa**	

KAROLO B: TSEBO YA PHEPO LE BOITSHUDULLO MO HLOKOMELONG YA BOLWETSI BJA SUKIRI

No.	Lefoko	Nnete	Ga ke tsebe	Aowa
Tsebo mabapi le tsa phepo mo taolong ya bolwetsi bja sukiri				
1.	Dijo di raloka karolo e kgolo mo taolong ya sukiri			
2.	Molwetsi wa sukiri o swanetse go ja dienywa le merogo ka ge e le bohlokwa bja gona taolong ya sukiri			
3.	Motho wa bolwetsi bja sukiri o swanetse go ja gannyane kgafetsakgafetsa, ka nako tsa mehleng o laola sukiri gabotse.			
4.	Dijo tsa di whole-grains tseo dinang le fiber e kgolo di tseiwa bjalo ka tseo dinang le carbohydrate ye botse yeo e nyakago ke batlwetsi bja sukiri.			
5.	Ge o na le mmele o mo ntshi ebile o na le bolwetsi bja sukiri, o lokile gore o ka fela o sa je go thusha go fokotsa mmele			
6.	O lokile gore motho wa bolwetsi bja sukiri a ka apea le go ja kgogo ntle le letlalo, le o tlosa makhura a a bonalago mo nameng ye hwidibidu.			
7.	Go ja dijo tse dintshi ka nako e tee, o ka dira gore sukiri ya molwetsi wa sukiri e ye godimo.			
8.	Dijo tsa go tswa maswing go akaretsa le nama e hwibidu le kgogo di swanetse go fokotsiwa ke molwetsi wa sukiri			
9.	O gabotse gore molwetsi wa sukiri a fokotse letswai le dijo tsa matswai, o akaretsa le dijo tseo re reng ke di processed			
10.	O gabotse gore molwetsi wa sukiri a fokotsa dijo tsa sukiri, o akaretsa le dino tsa go ba le sukiri yeo e okeditswego			
11.	Dijo tsa go foraiwa le tsa makhura a mantshi di swanetse go fokotsiwa ke motho wa go phela ka sukiri.			

Tsebo ya bohlokwa bja go itshudulla mo taolong ya sukiri					
1.	Boitshudullo bo bohlokwa ka kudu mo taolong ya sukiri ebile bo dira gore sukiri e laolege mo mading.				
2.	Ge motho wa bolwetsi bja sukiri ge a itshudulla, sukiri le madi a magolo a ba taolong ebile le makhura a fokotsega.				
3.	Ge motho wa go phela ka sukiri a itshudulla, o ka thuxa o fokotsa ditlamorago tsa bolwetsi bja sukiri ge bo sa laolege.				
4.	O lokile gore molwetsi wa sukiri a emixe go itshudulla ge a e kwa go lapa, go se heme botse le dihlabi				
5.	Ge motho wa sukiri a eya go itshudulla nako ye telele, o swanetse go ja pele le ka morago, le go nwa dino tsa go ba le carbohydrate ge a ntse a itshudulla				
6.	Ke gabotse gore motho wa sukiri a lekole sukiri pele le ka morago ga boitshudullo.				
Dira kgetho e tee ka kgopelo					
7.	Motho wa sukiri, o swanetse go dirang ka morago ga o lemoga gore sukiri e godimo pele ga boitshudullo	**Emixa go itshudulla**	**Tswelepale go ye o itshudulla**	**Ema go fihlela e boela mo e swanetsego go ba gona**	**Ga ke tsebe**
8.	Motho wa sukiri o swanetse o itshudulla nako ye kakang mo bekeng.	**Metsotso ye 30, matsatsi a 2** / **Metsotso ye 20, matsatsi a 2**	**Metsotso ye 30, matsatsi a 3**	**Metsotso ye 20, matsatsi a 3**	**Ga ke tsebe**
9.		**Letsogo**	**Mpeng**	**Serope**	**Ga ke tsebe**

	Motho wa go laola sukiri ka go hlabela insulin, ga swanela go ihlabela mo kae?				
10.	Ge motho wa sukiri a itshudulla, go diregalang ka insulin yeo mmele o e nyakago?	**Ye ya oketsega**	**E no ema seeming seo**	**E ya fokotsega**	**A ke tsebe**
Tsebo ya go laola sukiri (araba dipotsisho tse di latelago ka kgopelo)					
1.	O tseba gore sukiri ya motho wa bolwetsi bja sukiri e swanetse go ba dinomoro tse dife gore ba re e ya laolega.	**Ee**		**Aowa**	
1.1	Ge karabo e le ee, bontsha gore e swanetse go ba mo kae.				

KAROLO C: MAIKUTLO GO TAOLONG YA BOLWETSI BJA SUKIRI KA DIJO LE BOITSHUDULLO

No.	**Lefoko**	**Ke ya dumela**	**Ke a dumela; a ke dumele ke**	**A ke dumele**
1.	Motho wa bolwetsi bja sukiri a ka phela bjalo ka motho wa go se lwale ge a ka ihlokomela?			
2.	ke ikemisheditse o itshudulla le motho wa ka mo lapeng wa go phela ka sukiri ka mehla le mehla go fokotsa ditlamorago tsa bolwetsi bja sukiri?			
3.	Ke ikemisheditse go dira le molwetsi wa sukiri boitshudullo bjo ngaka ya marapo goba moshomi wa tsa maphelo a eleditsego gore re dire.			
4.	Nka apara dieta tseo di swanetsego boitsudullo go ya le ka keletso ya ngaka ya boitshudullo goba ya marapo.			
5.	Nka thushana le motho wa ka lapeng wa go ba le sukiri o bona ngaka ya marapo goba ya boitshudullo ka morago a kgwedi tse tshela mehla le mehla o hwetsa hlahlo ka tsa sukiri le boitshudullo.			
6.	Motho yo wa ka gae wa go phela ka sukiri ke yo mogolo ka kudu go ka itshudulla.			

7.	Motho wa ka mo lapeng wa go phela ka sukiri o lwala ka kudu go ka itshudulla.			
8.	Motho wa ka lapeng wa go phela ka bolwetsi bja sukiri o na le mmele o mo ntshi go ka itshudulla.			
9	Bolwetsi bja sukiri bo ka shithixa molwetsi go itshudulla.			
10.	Motho wa ka mo lapeng wa go phela ka bolwetsi bja sukiri ga na nako ya go itshudulla			
11.	Setso sa ga bo rena ga se re dumelele gore re ka itshudulla.			
12	Go llata go motho wa ka mo lapeng wa sukiri o ka gore a ka itshudulla			
13.	Nka bona ngaka ya dijo le motho wa ka lapeng wa go phela ka sukiri goba ya phepo ka morago a kgwedi tse tshela mehla le mehla o hwetsa hlahlo ka tsa sukiri le dijo.			
14.	Motho wa ka lapeng a ka laola sukiri gore e ska mo shithisha go dira meshomo ya mehleng.			
15.	Nka latela ka mokgwa yo motho wa ka lapeng wa bolwetsi bja sukiri a swanetse o ja ka gona.			
16.	Nka tlogela dijo tseo ngaka ya dijo gore moshomi wa tsa maphelo a ka eletsago gore motho wa sukiri a di tlogele.			
17.	Nka ja dijo ka di nako tseo ngaka ya dijo e eleditsego gore motho wa ka mo lapeng wa go phela ka bolwetsi bja sukiri a je ka gona.			
18.	Ke yo mogolo o ka tlogela ka mokgwa yo ke hlwaetseng go ja ka tsona.			
19.	Go llata go motho wa ka mo lapeng wa sukiri o ka laodixa dijo tseo a swanetseng go di ja le tseo a swanetsego go ditlogela.			

KAROLO D: DITIRO MABAPI LE GO LAOLA BOLWETSI BJA SUKIRI KA DIJO LE BOITSHUDULLO

No.	Lefoko (Araba a tee fela mo potsishong ye nngwe le ye nngwe)	KA MEHLA (4 LE GO FETA MO BEKENG	NAKO TSE DINGWE (GA 1-3 MO BEKENG)	LE GANNYANE
DITIRO MABAPI LE DIJO TAOLONG YA SUKIRI				
1.	Mo bekeng ye e fetileng, o jele dijo tsa mesong ga kae?			
2.	Mo bekeng ye e fetileng, o jele dijo tsa mosegare le bosego ga kae?			
3.	O ja dijo tsa go apeiwa ka makhura goba tsa go fraiwa a kae?			
4.	O ja dijo tsa go ba le sukiri go swana le malekere, di khoukhu le di juice a kae?			
5.	O nwa bjalwa a kae?			
6.	O ja merogo a kae?			
7.	O ja dienywa a kae?			
8.	O jele dijo tsa legorong la bo di nama, kgogo, hlapi, mashotja, makgopa, mae le maswi.a kae			
9.	Ke ga kae go eja dijo tsa go ba le fiber go swana le di beans, lentils, legumes le tse dingwe tsa go whole grain?			
10.	Ke ga kae go eja dijo tsa go ba le starch sa go shidiwa ka kudu go swana le borotho bjo boswego le di kuku?			
11.	Ke ga kae o eja dijo tsa letswai go swana le di poloni goba o shomisa stock cubes ge o apea?			
Ngwala Karabo gabotse go dipotsishong tse dilatelago				
12.	Ke mang yo apeang ko gae?	**Nna**	**Molekani**	**Bana**	**Moshomedi**	**Yo mongwe**

						(Hlalosa)
Ditiro mabapi le taolo ya sukiri ka go tshudulla						
1.	O wa itshudulla?	**Ee**		**Aowa**		
2.	Mo bekeng, o fela go tsea nako ya metsotso ye 30 gararo mo bekeng o dira tse di latelago: o ikotlolla, goba go tshidulla di nama tsa mmele ka go kuka ditshipiana tsa go se imele ka kudu, o akaretsa le mebereko ya ka gae go swana le go hlatswa diaparo, dibjana le go fiela?					
3.	Mo bekeng, o fela o tsea nako ya metsotso ye 30 gararo mo bekeng o dira tse di latelago: o sepela, o kitima, o reila paesekela, oswima, o fofafofa, o namela disteps le go dira di aerobics?					
4.	Mo kgweding ye e fetilego, o itshudulutse ya tekano labaka la metsotso ye 30 gararo mo bekeng?					
Ka kgopelo, araba a tee		**Ka mehla (4 le go fetsa mo bekeng)**	**Nako tse dingwe (1-3 mo bekeng)**		**Le gannyane**	
5.	Mo kgweding ye e fetilego, o itshudulutse a kae tekano ya labaka la metsotso ye 30 gararo mo bekeng?					
6.	Ge o itshudulla, ke ga kae mo o aparang dieta tseo o eleditsego ke ngaka ya marapo le boitshudullo gore o di apare?					

Re a leboga…..

APPENDIX H: INTERVIEW GUIDE (ENGLISH VERSION)

Central question

Kindly describe your perception of quality of life after having been diagnosed with diabetes?'

Probing questions

a. Health status

1. Please share with us your overall health in general with regard to your ability to perform duties you used to perform before being diagnosed with diabetes.
2. Do you sometimes get worried about passing out?
3. What health challenges do you encounter?

b. Knowledge of nutrition and exercise in diabetes management.

4. How satisfied are you with your nutrition and exercise knowledge in the management of your diabetes?
5. How many times do you find yourself eating what you are not supposed to eat?
6. Do you get worried if you don't exercise?
7. Do you think what you eat or what you do influences your health?

c. Family involvement

8. We want to develop a family-centred nutrition and exercise programme for diabetes patients. Do you think encouraging your family to get involved in your diabetes management will improve your health?
9. Are you staying with family?
10. Does your family know that you are living with diabetes?

APPENDIX H1: INTERVIEW GUIDE (SEPEDI VERSION)

Potsishokgolo

Ka kgopelo hlalosa ka mokgwa yo o bonang seemo sa bophelo bja gago ka morago ga gore o lekolwe gore o na le bolwetsi bja sukiri?

Potsisho tsa tsekatseko

a. Seemo sa bo phelo

1. Ka kgopelo hlalosa seemo sag ago sa bophelo gore o kgona o dira mebereko yeo ne o e dira pele ga bolwetsi bjo bja sukiri?
2. O fela o belaela ka gore o ka feta mo lefaseng?
3. Ke dihlohlo dife tseo o kopanang le tsona?

b. **Tsebo ya tsa phepo le go itshidulla mo taolong ya bolwetsi bja sukiri**

4. O kgotsofetse ga kakang ka tsebo ya gago mo taolong ya bolwetsi ka dijo le boitshudullo?
5. Ke ga kae o felang o eja dijo tseo o sa swanelago go di ja?
6. Ge o sa itshudulle wa swenyega?
7. O bona okare dijo tseo o dijang le seo o se dirang di tsea karolo mo taolong ya bolwetsi?

c. Karolo yeo e bapala ke ba le lapa

8. Re nyaka go tla ka programme yeo e ka thuxang taolong ya bolwetsi bja sukiri ka mo lapeng ka go shomisha dijo le go itshudulla. O bona okare ge ba le lapa la gago ba ka tsea karaolo mo taolong ya bolwetji e tla thuxa?
9. O dula le ba le lapa?
10. Ba le lapa la gago ba tseba ka bolwetsi bja gago?

APPENDIX I: EVALUATION OF IMPLEMENTATION'S QUESTIONNAIRE (ENGLISH VERSION)

No.	Item	Statement	Yes	Not sure	No
1.	Organization of educational intervention	Commendable			
		Needs improvement			
		Goals of the intervention well explained			
2.	Presentation	Commendable			
		Need improvement			
		Excellent explanations			
		Stimulate interest			
		Dynamic, engaging style			
		Good use of visual aids			
		Effective examples			
		Good summaries provided			

		Respond well to questions raised			
		Very helpful to my learning			
4.	Posters/Flyers	Did you see posters/flyers?			
		Are they informative?			
		Need improvement			
5.	Pre-and post-tests	Commendable			
		Need improvement			
		Appropriately challenging			
		Not confusing			
		Good coverage of material			
		Right length for the amount of time given			
7.	General comments				

APPENDIX J: EDUCATIONAL TOOLS

Flyer

NUTRITION AND EXERCISE DIABETES CARE

Mr. P Mphasha; Prof L Skaal; Prof TM Mothiba

RESEARCH TOPIC:

"Development and implementation of family-centred nutrition and exercise diabetes care programme for patients in Blouberg Municipality, Limpopo Province."

University Ethical Clearance Number: **TREC/35/2019:PG**
Limpopo Department of Health Permission to Conduct Study Number: **LP 201903-007**

Project leader: **Pitso Mphasha**
Contact: **076 619 9310**

Nutrition Diabetes Care

Benefits of eating healthy

- Controls blood sugar (glucose).
- Weight loss/management
- Good blood pressure control
- Good lipid profile control.
- Prevent diabetes complications.
- Prevention of diabetes among the high risk individuals.
- Reduce risk of cardiovascular diseases and certain types of cancer.
- Strengthen immune system against diseases

Food intake and medication

- Always take your medication with food.
- If you are required to wait for a particular time before eating after injecting insulin or using medications, set time reminders so that you don't forget.

Portion control

- Use plate system
- Fill half of your plate with non-starchy vegetables, such as spinach, carrots, cabbage, etc.
- Fill a quarter of your plate with a protein, such as fish, beans, lean meat or chicken, etc.
- Fill the last quarter with starchy food or starchy vegetables.
- Use small plates

Breakfast

- Eat breakfast daily
- Eat breakfast first thing when you wake up after washing teeth.
- Eat breakfast before exercise or doing household chores
- If woke up late to prepare children for school or any other urgent activity, grab something small to eat while doing such activity.
- Breakfast could be bread, tea, soft porridge, cereals or any other food you usually eat.

Food preparation

- Use as little water as possible.
- Use less salt or aromat.
- Remove the chicken skin.
- Trim visible fat from meat.
- Use healthy cooking methods such as steaming, broiling, roasting, grilling.
- Avoid frying food.

Dietary tips

- Eat different fruits and vegetables including traditional ones.
- Eat fruits with skin.
- Do not eat too much ripe fruits.
- Eat variety of food.
- Whole grains include whole-wheat breads, cereals, pasta, and brown rice.
- Make your starchy foods the basis of each meal.
- Eat small frequent meals.
- Do not overcook vegetables and also eat them raw.
- Drink at least 6 to 8 glasses of safe clean water daily.
- Eat less sugar and sugary foods.
- Eat less of salt
- Reduce intake of fatty food
- Use soya products often
- Reduce intake of red meat.
- Avoid packaged or processed food
- Wash hands with soap and frequently when preparing food

Exercise Diabetes Care

Benefits of exercise

- Weight loss & management.
- Boost mood & self-esteem.
- Prevent against diseases and complications.
- Stabilize blood sugar levels.
- Lower blood pressure.
- Relieves stress & depression.
- Increase insulin sensitivity.
- Improves sex life
- Promotes better sleep
- improve lipid profile

Exercise prescription

- 30 minutes, 3 days a week.
- 150 minutes a week of moderate exercise.
- 75 minutes weekly of vigorous intensity.
- 10-15 minutes daily
- Two or more of exercises involving all body parts weekly.

Types of exercises

- Running
- Walking
- Household chores like cleaning, washing dishes & clothes, gardening, cutting trees, farming.
- Riding bicycle.
- Dancing.
- Aerobics.
- Stretching.
- Lifting

Exercise Tips

- Consult physiotherapists in the presence or absence of injury.
- If overweight/obese start by doing more & more of household chores.
- Exercise as a family.
- Listen to music or radio while exercising.
- Make exercise your daily life.
- Exercise at your own pace.
- Choose exercises you enjoy.
- Listen to your body when exercising.
- Avoid activities involving injured part.
- After exercise, do light exercises such as arm swinging, shoulder rolls and stretching.
- Don't worry about your mobility or health while exercise so as to enjoy.
- If worried about getting injured, choose low-risk exercises.
- If physically challenged, be creative and do exercise according to your
- abilities.
- Exercise before sunshine/ 10am and after 5pm when it is cool.
- Patients should check blood glucose before and after exercise
- Use sun screen protection such as calamine lotion during exercise
- Wear soft shoes when going for exercise.
- Eat before and after exercise
- Do not exercise when your glucose levels is too high or low.
- If you do not have glucometer, you may exercise too, as long as you do not proceed with exercise when dizzy

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Working together, we can achieve better diabetes outcomes, prevent complications and hospitalisation, improve quality of life and also reduce new diabetic cases.

Taolo ya bolwetsi bja sukiri ka go itshudulla

Diputseletso tsa go itshudulla

- Go fokotsega ga mmele goba o laola seemo sa mmele
- E tiiseletsa mood le mood le boitshepho
- E shireletsa kgahlanong le malwetsi le ditla morago tsa bolwetsi bja sukiri
- E dira gore maemo a sukiri mo mading a laolege
- E dira gore madi a magolo a laolege
- E fokotsa kgatelelo ya monagano le depression
- E oketsa insulin sensitivity
- E dira gore thobalano e be gabotse
- Go thuxa gore motho a be le boroko
- E thuxa go laola seemo sa makhura mo mmeleng

Boitshudulllo bo swanetswe go dirwa ka mokgwa ye e latelago

- Metsotso ye masometharo, gararo mo bekeng
- Metsotso ye lekgolo le masomehlano mo bekeng ka go dira boitshudullo bja magareng.
- Metsotso le masomeshupa hlano mo bekeng go dira bo itshudullo bjo bo tieletseng.
- Metsotso ye lesome go isha go ye lesomehlano ka letsatsi
- Mehuta ye mebedi go isha go ye meraro ya boitshudullo mobekeng ya go shidulla mmele ka
- moka

Mehuta ya boitshudullo

- Meshomo ya ka lapeng go swana le go fiela ka ntlong, go hlatswa dikobo, go dira tsa temo le go cutter didihlare le go kgora jarata
- Go sepela
- Go kitima
- Go reila paesekela
- Go bina
- Go dira tsa aerobics
- Go shidulla mmele

Dihla mabapi le tsa boitshudullo

- Ge go ena le kgobalo, tsamaya go yo bona ngaka ya tsa marapo goba boitshudullo go ahlaahla mehuta ye e go swanetseng ya boitshudullo
- Ge o na le mmele o montshi thoma go itshudulla ka go dira meshomo ya ka gae pele
- Le itshudulle go tee bjalo ka le lapa
- Thieletsa mmino ge o ntse go itshudulla
- Itshidulle ka go ya le ka pace ya gago
- Dira goba kgetha mohuta wa boitshudullo bjo o bo ratago
- O seke wa itshudulla ge o gobetse
- Ka morago ga o itshudulla, shidulla mmele ga nnyane gannyane
- Apara dieta tsa maleba tsa boleta ge o eya go itshudulla
- O se ke wa nagana kudu ka tsa seemo sa bophelo bja gago gore o iphine ka boitshudullo
- Ge o tshaba o gobala, kgetha tsa boitshudullo tse di sa gobatsego
- Ge o na le hlohlo ya seemo sa mmele, dira tsa boitshudullo go ya le ka seemo sa mmele wa gago
- Itshidulle e sa le ka masa go ba pele a iri ya lesome le ka morago ga bohlano mathapama, o sa fixi ka kudu
- Molwetsi wa sukiri swanetse a lekole sukiri ya gagwe pele le ka morago ga boitshudullo
- Shomixa di shireletsa kgahlanong le letsatsi tsa go swana le calamine

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Ge re bereka mmogo, re ka laola bolwetsi bja sukiri, tshireletsa kgahlanong le ditlamorago tsa bolwetsi, le go tiisa seemo sa mmele, le go fokotsa go oketsega ga bolwetsi

TAOLO YA BOLWETSI BJA SUKIRI KA DIJO LE BOITSHUDULLO

Mr. P Mphasha; Prof L Skaal; Prof TM Mothiba

RESEARCH TOPIC:

"Development and implementation of family-centred nutrition and exercise diabetes care programme for patients in Blouberg Municipality, Limpopo Province."

University Ethical Clearance Number: **TREC/35/2019:PG**
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Moetapele wa porojeke: **Pitso Mphasha**
Mohala: **076 619 9310**

Taolo ya bolwetsi bja sukiri ka dijo

Diputseletso tsa go ja dijo tsa phepo

- E laola maemo a sukiri mo mading
- Fokotsego ga mmele goba o laola seemo sa mmele
- Taolo e botse ya madi a magolo
- Taolo e botse ya seemo sa makhura a mmele
- Tshireletso kgahlanong le ditlamorago ga bolwetsi bja sukiri
- Fokotsego ya kotsi ya go ba le malwetsi a pelo
- Kgwahlisho ya mashole a mmele

Go ja le tshomixo ya dihlare

- Ka mehla ge o enwa dihlare, o dire bjalo o jele
- Ge ele gore ka morago ga go nwa dihlare goba go hlaba insulin, pele go eja, shomixa tloloko ya sesupa nako gore o ska tla wa lebala go ja

Phaphantsho ya dijo

- Tlatsa seripa sa poleiti ka merogo ye go swana le cabbage, merogo ye metala le ya setso
- Kotara ya poleiti swanetse e be dijo tsa di protein go swana le nama, masotja, bjalo le bjalo
- Kotara ye nngwe ya poleiti e be ya dijo tsa go ba le starchy go swana le bogobe.
- Shomixa poleiti tse dinnyane ge o sola

Dijo tsa mesong

- E ja dijo tsa mesong ka morago ga go hlapa meno
- Ge o ka tsoga ka pela go beakanya bana go ya skolong goba go dire meshomo ya ka pela nyana, topa sa go ja, o je o ntse o bereka
- Dijo tsa mesong e ka ba borotho goba dijo tsa go shala maabane maxego go swana le magobe
- E ja dijo tsa mesong pele ga boitshudullong

Kapeo ya dijo

- Shomixa meets a ma nnyane ge o apea dijo.
- Shomixa letswai goba aromat ye nnyane
- Tloxa letlalo la kgogo pele go apea.
- Tloxa makhura mo nameng e sweu pele o apea
- Shomixa mekgwa ye megwe ya go apea go swana le go bedixa, bjalobjalo
- Fokotsa go shomixa makhura go apea goba go foraga dijo

Dihla mabapi le tsa dijo

- Eja merogo le dienywa tse di fapanego
- Eja dienywa le matlalo a gona
- Eja dijo ka mehutahuta ya tsona
- Dijo tsa go ba le starchy di swanetse go jewa mehla le mehla
- Eja dijo tse di nnyane kgafetsakgafetsa
- O se ke wa apea merogo nako ye telele goba ka kudu
- Eja merogo le ge e sa apeiwa
- Shomixa dijo tsa go ba le soya ka mehla
- Fokotsa go ja nama e hwibidu
- Enwa meetse a go lekana di tlelase tse 6-8
- Reka dijo tsa go ba le seemo sa fase sa sukiri
- Fokotsa shomixa ya dijo tsa go processed
- Hlapa diatla ka sesepe, pele go swara dijo

Posters

NUTRITION DIABETES CARE

Mr. P Mphasha; Prof L Skaal; Prof TM Mothiba

Research Topic: *"Development and implementation of family-centred nutrition and exercise diabetes care for patients in Blouberg Municipality, Limpopo Province"*

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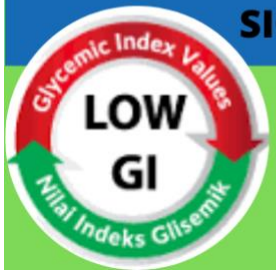
EAT VARIETY OF FOOD

BUY FOOD WITH FOLLOWING SIGNS



BENEFITS OF NUTRITION

- Controls blood glucose (sugar)
- Weight loss/management
- Controls blood pressure
- Controls lipid profile
- Prevents against diabetes complications
- Prevents diabetes among the high risk individuals
- Reduce the risk of cardiovascular diseases
- Strengthen immune system againgst diseases

DIETARY TIPS

- Eat different types of fruits and vegetables including traditional ones.
- Eat fruits with skin, and not too ripe fruits.
- Make starchy foods the basis of each meal.
- Eat small frequent meals.
- Do not overcook vegetables and also eat them raw.
- Drink at least 6 to 8 glasses of safe clean water daily.
- Use soya products more often.
- Eat less sugar and sugary foods.
- Reduce intake of red meat.
- Avoid packaged or processed food
- Use as little water as possible.
- Use less salt or aromat.
- Remove chicken skin and trim fats from red meat
- Use healthy cooking methods such as steaming, broiling, roasting, grilling.
- Avoid frying food.
- Eat breakfast daily after washing teeth, before exercise

FOOD PORTIONING

- Use plate system to control portion sizes.
- Fill half of your plate with non-starchy vegetables, such as spinach, carrots, cabbage, etc.
- Fill a quarter of your plate with a protein,
- such as fish, beans, lean meat or chicken, etc.
- Fill the last quarter with starchy food
- Use small plates

EXERCISE DIABETES CARE

Mr. P Mphasha; Prof L Skaal; Prof TM Mothiba

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EXERCISE WITH PARTNER

EXERCISE PRESCRIPTION

- 30 minutes, 3 days a week.
- 150 minutes a week of moderate exercise.
- 75 minutes weekly of vigorous intensity.
- 10-15 minutes daily
- Two or more of exercises involving all body parts weekly.

BENEFITS OF EXERCISE

- Weight loss & management.
- Boost mood & self-esteem.
- Prevent against diseases and complications.
- Stabilize blood sugar levels.
- Lower blood pressure.
- Relieves stress & depression.
- Increase insulin sensitivity.
- Improves sex life
- Promotes better sleep
- improve lipid profile

TYPES OF EXERCISE

- Household chores like cleaning, washing dishes & clothes, gardening, cutting trees.
- Walking.
- Running.
- Riding bicycle.
- Dancing.
- Aerobics.
- Stretching.

EXERCISE TIPS

- Consult physiotherapists in the presence or absence of injury.
- Listen to music or radio while exercising.
- Make exercise your daily life.
- Exercise at your own pace.
- Choose exercises you enjoy.
- Listen to your body when exercising.
- Avoid activities involving injured part.
- After exercise, stretch your muscles or body
- Wear soft shoes when exercising
- Start with low-risk exercises.
- If physically challenged, be creative and do exercise according to your abilities.
- Exercise before sunshine or 10am and/or after 5pm when it is cool.
- Diabetes patients should check blood glucose before and after exercise
- Use sun screen protection such as calamine lotion during exercise.
- Eat before and after exercise

TAOLO YA BOLWETSI BJA SUKIRI KA DIJO

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E JA DIJO KA MEHUTAHUTA

ELA HLOKO MASWAO A LATELAGO GE O REKA

DIPUTSELETSO TSA GO JA DIJO TSA PHEPO

- E laola maemo a sukiri mo mading
- Go fokotsega ga mmele goba o laola seemo sa mmele
- Taolo e botse ya madi a magolo
- Taolo e botse ya seemo sa makhura a mmele
- Go shireletsa kgahlanong le ditlamorago ga bolwetsi bja sukiri
- Go fokotsega ga kotsi ya go ba le malwetsi a pelo
- Kgwahlisho ya mashole a mmeleng

DINHLA MABAPI LE TSA PHEPO

- Eja merogo le dienywa tse di fapanego
- Eja dienywa le matlalo a gona
- Eja dijo ka mehutahuta ya tsona
- Dijo tsa go ba le starchy di swanetse go jewa mehla le mehla
- Eja dijo tse di nnyane kgafetsakgafetsa
- O se ke wa apea merogo nako ye telele goba ka kudu
- Eja merogo le ge e sa apeiwa
- Shomixa dijo tsa go ba le soya ka mehla
- Fokotsa go ja nama e hwibidu
- E ja dijo tsa mesong ka morago ga go hlapa meno
- Ge o ka tsoga ka pela go beakanya bana go ya skolong goba go dire meshomo ya ka pela nyana, topa sa go ja, o je o ntse o bereka
- Reka dijo tsa go ba le seemo sa fase sa sukiri
- Fokotsa shomixa ya dijo tsa go processed
- Hlapa diatla ka sesepe, pele go swara dijong
- Ka mehla o enwa dihlare o jele
- Ge ele gore ka morago ga go nwa dihlare goba go hlaba insulin, pele go eja, dira beakanya nako ya gago gore o ska tla wa lebala go ja
- E ja dijo tsa mesong pele go itshidulla
- E ja dijo go ya ka go fapafapana a tsona
- Dijo tsa mesong e ka ba borotho goba dijo tsa go shala maabane maxego go swana le magobe

GE O SOLA DIJO

- Tlatsa seripa sa poleiti ka merogo ye go swana le cabbage, merogo ye metala le ya setso
- Kotara ya poleiti swanetse e be dijo tsa di protein go swana le nama, masotja, bjalo le bjalo
- Kotara ye nngwe ya poleiti e be ya dijo tsa go ba le starchy go swana le bogobe.
- Shomixa di poleiti tse dinnyane ge o solang

TAOLO YA BOLWETSI BJA SUKIRI KA BOITSHUDULLO

Mr. P Mphasha; Prof L Skaal; Prof TM Mothiba

Research Topic: *"Development and implementation of family-centred nutrition and exercise diabetes care for patients in Blouberg Municipality, Limpopo Province"*

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ITSHIDULLO LE MOLEKANI WA GAGO

PHETHAGATSO YA BOITSHUDULLO

- Metsotso ye masometharo, gararo mo bekeng
- Metsotso ye lekgolo le masomehlano mo bekeng ka go dira boitshudullo bja magareng.
- Metsotso le masomeshupa hlano mo bekeng go dira bo itshudullo bjo bo tieletseng.
- Metsotso ye lesome go isha go ye lesomehlano ka letsatsi
- Mehuta ye mebedi go isha go ye meraro ya boitshudullo mobekeng ya go shidulla mmele ka moka

DIPUTSELETSO TSA BOITSHUDULLO

- Go fokotsega ga mmele goba o laola seemo sa mmele
- E tiiseletsa mood le mood le boitshepho
- E shireletsa kgahlanong le malwetsi le ditla morago tsa bolwetsi bja sukiri
- E dira gore maemo a sukiri mo mading a laolege
- E dira gore madi a magolo a laolege
- E fokotsa kgatelelo ya monagano le depression
- E oketsa insulin sensitivity
- E dira gore thobalano e be gabotse
- Go thuxa gore motho a be le boroko
- E thuxa go laola seemo sa makhura mo mmeleng

MEHUTA YA BOITSHUDULLO

- Meshomo ya ka lapeng go swana le go fiela ka ntlong, go hlatswa dikobo, go dira tsa temo
- le go cutter didihlare le go kgora jarata
- Go sepela
- Go kitima
- Go reila paesekela
- Go bina
- Go dira tsa aerobics
- Go shidulla mmeleng

DINHLA MABAPI LE BOITSHUDULLO

- Ge go ena le kgobalo, tsamaya go yo bona ngaka ya tsa marapo goba boitshudullo go ahlaahla mehuta ye e go swanetseng ya boitshudullo
- Ge o na le mmele o montshi thoma go itshudulla ka go dira meshomo ya ka gae pele
- Le itshudulle go tee bjalo ka le lapa
- Thieletsa mmino ge o ntse go itshudulla
- Itshidulle ka go ya le ka pace ya gago
- Dira goba kgetha mohuta wa boitshudullo bjo o bo ratago
- O seke wa itshudulla ge o gobetse
- Ka morago ga o itshudulla, shidulla mmele ga nnyane gannyane
- Apara dieta tsa maleba tsa boleta ge o eya go itshudulla
- O se ke wa nagana kudu ka tsa seemo sa bophelo bja gago gore o iphine ka boitshudullo
- Ge o tshaba o gobala, kgetha tsa boitshudullo tse di sa gobatsego
- Ge o na le hlohlo ya seemo sa mmele, dira tsa boitshudullo go ya le ka seemo sa mmele wa gago
- Itshidulle e sa le ka masa go ba pele a iri ya lesome le ka morago ga bohlano mathapama, o sa fixi ka kudu
- Molwetsi wa sukiri swanetse a lekole sukiri ya gagwe pele le ka morago ga boitshudullo
- Shomixa di shireletsa kgahlanong le letsatsi tsa go swana le calamineng

APPENDIX K: CODING CERTIFICATE

Qualitative data analysis

PhD in Public Health

Mr Mabitsela Hezekiel 'Pitso' Mphasha

THIS IS TO CERTIFY THAT:

Professor MS Maputle has co-coded the following qualitative data:

Unstructured one-to-one interviews with diabetic patients

For the study:

DEVELOPMENT AND IMPLEMENTATION OF FAMILY CENTERED NUTRITION AND EXERCISE PROGRAM FOR DIABETES PATIENTS OF BLOUBERG MUNICIPALITY, LIMPOPO PROVINCE

I declare that the candidate and I have reached consensus on the major themes reflected by the data. I further declare that adequate data saturation was achieved as evidenced by repeating themes.

Prof MS Maputle MS Maputle

October 2019

MS Maputle (PhD)

APPENDIX L: LETTER FROM EDITOR

NSUKU PUBLISHING CONSULTANCY

NSUKU Publishing Consultancy (Pty) Ltd
Enterprise Number: 2017/240535/07
Director: Nkateko Priscilla Masinga
1049 Rainbow Trout street, Garsfontein
Pretoria East, South Africa

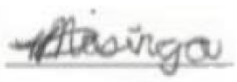
School of Health Care Sciences
Faculty of Health Sciences
University of Limpopo
South Africa

01/09/2021

CONFIRMATION OF ACADEMIC EDITING AND PROOFREADING SERVICES

This letter serves as confirmation that the thesis titled 'Development and Implementation of a Family-centred Nutrition and Exercise Programme for Diabetes Mellitus Patients of Blouberg Municipality, Limpopo Province', by Mabitsela Hezekiel Mphasha, a PhD candidate in the Faculty of Health Sciences (School of Health Care Sciences) at the University of Limpopo, was edited and proofread by Nkateko Priscilla Masinga and her team at Nsuku Publishing Consultancy.

Best regards,



Nkateko Priscilla Masinga

Founder and Managing Director of Nsuku Publishing Consultancy

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