

KNOWLEDGE, ATTITUDES  
AND PRACTICES REGARDING  
LIFESTYLE MODIFICATIONS  
AMONG TYPE 2 DIABETIC  
PATIENTS ATTENDING  
MAMELODI HOSPITAL,  
PRETORIA, GAUTENG

By  
**Dr. JHON BOTOMWITO IKOMBELE**  
MBCHB

Supervisor: DR. H.I OKONTA  
MD, DHSM, MMed FamMed

**KNOWLEDGE, ATTITUDES AND  
PRACTICES REGARDING LIFESTYLE  
MODIFICATIONS AMONG TYPE 2  
DIABETIC PATIENTS ATTENDING  
MAMELODI HOSPITAL, PRETORIA,  
GAUTENG**

---

By

**Dr. JHON BOTOMWITO IKOMBELE**

MBCHB

Supervisor: DR. H.I OKONTA

MD, DHSM, MMed FamMed

**KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING  
LIFESTYLE MODIFICATIONS AMONG TYPE 2 DIABETIC  
PATIENTS ATTENDING MAMELODI HOSPITAL,  
PRETORIA, GAUTENG**

By

**Dr. JHON BOTOMWITO IKOMBELE**

MBCHB

Submitted in partial fulfillment of the requirements for the Masters Degree in Family Medicine  
MMed (Fam Med) in the Department of Family Medicine and Primary Health Care, Medunsa  
Campus, University of Limpopo

Supervisor: DR. H.I OKONTA

MD, DHSM, MMed FamMed

Date submitted.....

## DECLARATION

I, Jhon BOTOMWITO IKOMBELE hereby declare that the work on which this research is based is original (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being or is to be submitted for another degree at this or any other university.

Signed .....

Date .....

## **DEDICATION**

To my parents, Bernard Botomwito and Victorine Dombi, who raised me and loved me with all their heart, giving me the opportunity to become what I am.

To my lovely wife Faniswa, to my daughter Victorine and my sons Junior and Maximus.

## ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr H.I Okonta, for his collaboration, support and guidance throughout this research. Thanks for having you as my supervisor.

My thanks also go to the management staff at Mamelodi Hospital for their support and permission to undertake this study.

Thanks to sister Violette Molobo and sister Malatji Molepo for their great assistance during the data collection process.

Thank you to the patients who participated in this study, without whom this study would not have been a reality.

Finally, I thank our lovely Father, the almighty God for his infinite love, inspiration, support and protection throughout this research process.

## ABBREVIATIONS AND ACRONYMS

ADA	American diabetic association
BMI	Body mass index
IDF	International diabetes federation
WHO	World Health Organization
QALY	Quality-adjusted life year
AHA	American heart association
GI	Glycaemic index
1RM	1 repetition maximum
IGT	impaired glucose tolerance
CVD	cardiovascular disease

## TABLE OF CONTENTS

DECLARATION.....	iii
DEDICATION.....	iv
ACKNOWLEDGEMENTS .....	v
ABBREVIATIONS AND ACRONYMS .....	vi
TABLE OF CONTENTS .....	vii
LIST OF TABLES.....	xi
LIST OF FIGURES.....	xii
ABSTRACT .....	1
CHAPTER 1 .....	3
INTRODUCTION.....	3
1.1 BRIEF OVERVIEW OF DIABETES MELLITUS.....	3
1.1.1 DEFINITION.....	3
1.1.2 CLASSIFICATION.....	3
1.1.3 DIAGNOSTIC CRITERIA.....	9
1.1.4 SYMPTOMATOLOGY .....	10
1.1.5 COMPLICATIONS .....	11
1.2 PROBLEM STATEMENT .....	14
1.3 RELEVANCE OF THE STUDY .....	15
1.4 STUDY SETTING .....	16
CHAPTER 2 .....	17
LITERATURE REVIEWS .....	17
2.1 INTRODUCTION .....	17

2.2 EPIDEMIOLOGY OF TYPE 2 DIABETES MELLITUS.....	18
2.3. RISK FACTORS OF TYPE 2 DIABETES MELLITUS.....	20
2.3.1. SEDENTARY LIFE .....	20
2.3.2. OBESITY .....	22
2.4 LIFESTYLE INTERVENTION PROGRAM IN THE MANGEMENT OF TYPE 2 DIABETES MELLITUS .....	26
2.4.1 EXERCISE TRAINING .....	28
2.4.2 NUTRITIONAL INTERVENTION.....	35
2.4.3. PSYCHOLOGICAL AND EDUCATIONAL SUPPORT.....	42
2.4.4 LITERATURE REVIEWS ON KNOWLEDGE, ATTITUDES AND PRATICES REGARDING LIFESTYLE MODIFICATIONS AMONG TYPE 2 DIABETES MELLITUS PATIENTS .....	43
2.4.5 SUMMARY OF THE LITERATURE REVIEW .....	45
CHAPTER 3 .....	49
METHODOLOGY .....	49
3.1 TITLE.....	49
3.2 RESEARCH QUESTION .....	49
3.3 AIM OF THE STUDY .....	49
3.4 OBJECTIVES OF THE STUDY .....	50
3.5 STUDY DESIGN.....	50
3.6 STUDY SETTING .....	51
3.7 STUDY POPULATION .....	51
3.8 STUDY SAMPLE .....	51
3.9 INCLUSION CRITERIA .....	54

3.10 EXCLUSION CRITERIA .....	54
3.11 DATA COLLECTION .....	55
3.11.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS.....	56
3.11.2 ANTHROPOMETRIC MEASUREMENTS .....	57
3.11.3 KNOWLEDGE, ATTITUDE AND PRACTICE ASSESSMENTS .....	57
3.12 DATA ANALYSIS.....	58
3.13. RELIABILITY AND VALIDITY .....	59
3.14 LIMITATIONS .....	60
3.14.1 SELECTION BIAS .....	60
3.14.2 SYSTEMATIC BIAS .....	61
3.14.3 TRANSLATION BIAS .....	61
3.14.4 RESPONDENT BIAS .....	61
3.15 ETHICAL CONSIDERATIONS .....	62
CHAPTER 4 .....	63
RESULTS.....	63
4.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS.....	63
4.1.1 AGE DISTRIBUTION OF RESPONDENTS .....	64
4.1.2 GENDER DISTRIBUTION OF RESPONDENTS.....	65
4.1.3 MARITAL STATUS DISTRIBUTION OF RESPONDENTS.....	65
4.1.4 DISTRIBUTION OF RESPONDENTS BY LEVEL OF EDUCATION.....	66
4.1.5 DISTRIBUTION OF RESPONDENTS BY AVERAGE MONTHLY INCOME .....	66
4.2 ANTHROPOMETRIC CHARACTERISTICS OF RESPONDENTS.....	67
4.2.1 DISTRIBUTION OF RESPONDENTS ACCORDING TO WEIGHT.....	68
4.2.3 DISTRIBUTION OF RESPONDENTS ACCORDING TO HEIGHT.....	68

4.3 KNOWLEDGE ASSESSMENT OF RESPONDENTS.....	69
4.3.1 KNOWLEDGE OF RESPONDENTS REGARDING THE BENEFITS OF EXERCISE AND WEIGHT LOSS.....	69
4.3.2 KNOWLEDGE OF RESPONDENTS REGARDING HEALTHY DIET .....	70
4.3.3 GLOBAL KNOWLEDGE OF RESPONDENTS .....	71
4.4 ATTITUDE ASSESSMENT OF RESPONDENTS.....	73
4.5 PRACTICE ASSESSMENT OF RESPONDENTS .....	75
4.5.1 LIFESTYLE MODIFICATION PRACTICE SCORE OF RESPONDENTS .....	77
4.6 CORRELATIONS BETWEEN KNOWLEDGE, ATTITUDES AND PRACTICES..	79
CHAPTER 5 .....	81
DISCUSSION.....	81
5.1 DISCUSSION OF METHODOLOGY .....	81
5.2 DISCUSSION OF RESULTS.....	82
5.2.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS .....	82
5.2.2 ANTHROPOMETRIC CHARACTERISTICS OF PARTICIPANTS.....	85
5.2.3 KNOWLEDGE ASSESSMENT OF RESPONDENTS.....	86
5.2.4 ATTITUDE ASSESSMENT OF RESPONDENTS .....	87
5.2.5 PRACTICE ASSESSMENT OF RESPONDENTS.....	88
5.2.6 CORRELATION BETWEEN KNOWLEDGE, ATTITUDE AND PRACTICE ...	89
5.3 LIMITATIONS OF THE STUDY .....	91
CHAPTER 6 .....	92
CONCLUSION AND RECOMMENDATIONS.....	92
6.1 CONCLUSION.....	92
6.2 RECOMMENDATIONS .....	93

REFERENCES.....	94
APPENDIX A-APPROVED PROTOCOL AND CONSENT FORMS .....	116
APPENDIX B-CLEARANCE CERTIFICATE.....	145
APPENDIX C- MAMELODI HOSPITAL PERMISSION.....	146

## LIST OF TABLES

TABLE 1: The international classification of adult underweight, overweight and obesity according to BMI.....	23
TABLE 2: Classification of glycemic index of foods.....	39
TABLE3. Frequency distribution of respondents according to demographic characteristics.....	63
TABLE 4: Frequency distribution of respondents by weight, height and BMI.....	67
TABLE 5: Distribution of respondents according to their knowledge regarding the benefits of exercise and weight loss.....	69
TABLE 6: Distribution of respondents according to their knowledge regarding healthy diet.....	70
TABLE 7: Distribution of respondents according their global knowledge level regarding the benefits of exercise and weight loss and healthy diet.....	71
TABLE 8: Distribution of respondents according to their attitude score for lifestyle modifications.....	73
TABLE 9: Frequency distribution of respondents by self-reported practices.....	75

**TABLE 10: Distribution of respondents according to lifestyle modification practice score.....77**

**TABLE 11: Correlation between the global knowledge, attitude and practice score.....79**

## **LIST OF FIGURES**

**FIGURE 1: Frequency distribution of respondents according to age.....64**

**FIGURE 2: Frequency distribution respondents according to level of education.....66**

**FIGURE 3: Frequency distribution of respondents by BMI.....68**

**FIGURE 4: Frequency distribution of respondents according their global knowledge level regarding the benefits of exercise and weight loss and healthy diet.....72**

**FIGURE 5: Frequency distribution of respondents according to attitude level towards lifestyle modifications.....74**

**FIGURE 6: Frequency distribution of respondents by self-reported practices .....76**

**FIGURE 7: Frequency Distribution of respondents according to practice score level regarding lifestyle modifications .....78**

## **ABSTRACT**

### **Introduction**

The burden of type 2 diabetes mellitus continues to rise and constitutes a real threat especially in the developing world. As for most non-communicable diseases, change of behavior and adoption of healthy lifestyle habits help to prevent and slow down the increase of type 2 diabetes mellitus.

### **Aim of the Study**

To establish the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetic patients attending the diabetic clinic at Mamelodi hospital.

### **Methods:**

This cross sectional study describes the knowledge, attitudes and practices regarding lifestyle modifications (KAP) among 217 type 2 diabetes mellitus patients attending Mamelodi Hospital, Pretoria, Republic of South Africa. A face-to-face interview using a structured questionnaire was carried out for data collection. Socio-demographic characteristics of the participants and anthropometric measurements were obtained and the body mass index (BMI) of participants were determined. The Knowledge, attitude and practice of participants were assessed.

**Results:** Majority of participants were female 176(81.1%), while male were 41(18.9%). This amounted to a female to male ratio of 4:1. Most participants were in the age group 51-60 years 93(42.9%). Majority of them had low level of education 108(49.5%) and low income 206(94.9%). Majority of participants were obese 153(71%) with more female diabetic patients being obese 120 (78.4%) than male 33 (21.6%). 15 participants (14 females and 1 male) were morbidly obese ( $BMI \geq 40 \text{kg/m}^2$ ). 108 participants (49.5%) did not have a formal education.

No respondent had good knowledge and 92.6% of respondents had poor knowledge of the benefits of exercise, weight loss and healthy diet. Majority of respondents (97.7%) had bad practices in relation to lifestyle modifications. Nevertheless, majority of them (84.3%) had positive attitudes toward lifestyle modifications.

Significant positive correlation ( $r= 0.170$ ,  $p=0.012$ ) was found between the global knowledge level and attitude level alone, whereas there was no significant correlation found between the global knowledge level and practice level as well as the attitude level and practice level.

**Conclusion:** In conclusion, despite positive attitudes of participants toward healthy lifestyle habits, the knowledge and practices regarding lifestyle modifications among type 2 diabetes mellitus patients attending Mamelodi Hospital were generally low. Nevertheless the positive attitudes of participants should be encouraged and the implementation of a lifestyle intervention program will help improve the knowledge and practices of type 2 diabetes mellitus patients attending Mamelodi Hospital for the better management and control of this current pandemic of type 2 diabetes mellitus.

## CHAPTER 1

### INTRODUCTION

#### 1.1 BRIEF OVERVIEW OF DIABETES MELLITUS

##### 1.1.1 DEFINITION

Diabetes comes from a Greek word meaning 'to pass or flow through' (i.e. excessive urination) and Mellitus means 'sweet' (William G, 2000). It is currently defined as a group of metabolic disorders characterized by hyperglycaemia that results from defects in the secretion or action of insulin, or both (ADA, 2010).

##### 1.1.2 CLASSIFICATION

Previously, individual with diabetes mellitus were classified as insulin dependent diabetes mellitus (IDDM) (require insulin treatment) and non-insulin dependent diabetes mellitus (NIDDM) (require insulin only when not controlled with oral tablets). With this classification, it was difficult to correctly classify individuals with NIDDM being treated with insulin. This led to confusion and incorrect classification of a large number of patients with diabetes mellitus, complicating the epidemiologic evaluation and clinical management. (J. Mayfield, 1998).

The new classification system identifies 4 types of diabetes mellitus (Report of the Expert Committee, 1997):

#### **1.1.2.1 TYPE 1 DIABETES MELLITUS**

Formerly called type I, IDDM or juvenile diabetes, type 1 diabetes mellitus is characterized by beta cell destruction caused by an autoimmune process, usually leading to absolute insulin deficiency (J. Mayfield, 1998). This form of diabetes mellitus accounts for only 5 to 10% of all diabetes mellitus cases (ADA, 2010). The onset is usually acute, developing over a period of a few days to weeks. Over 95 percent of persons with type 1 diabetes mellitus develop the disease before the age of 25, with an equal incidence in both sexes and an increased prevalence in the white population. A family history of type 1 diabetes mellitus, gluten enteropathy (celiac disease) or other endocrine disease is often found. Most of these patients have the "immune-mediated form" of type 1 diabetes mellitus with islet cell antibodies and often have other autoimmune disorders such as Hashimoto's thyroiditis, Addison's disease, vitiligo or pernicious anemia. A few patients, usually those of African or Asian origin, have no antibodies but have a similar clinical presentation; consequently, they are included in this classification and their disease is called the "idiopathic form" of type 1 diabetes mellitus (J. Mayfield, 1998) (Report of the Expert Committee, 1997).

### **1.1.2.2 TYPE 2 DIABETES MELLITUS**

Formerly called NIDDM, type II or adult-onset, Type 2 diabetes mellitus is characterized by insulin resistance in peripheral tissue and an insulin secretory defect of the beta cell (J. Mayfield, 1998). This is the most common form of diabetes mellitus. It accounts for 90% to 95% of all diabetes mellitus cases (ADA, 2010). It is highly associated with a family history of diabetes, older age, obesity and lack of exercise. It is more common in women, especially women with a history of gestational diabetes, and in blacks, hispanics and native Americans. Insulin resistance and hyperinsulinemia eventually lead to impaired glucose tolerance. Defective beta cells become exhausted, further fueling the cycle of glucose intolerance and hyperglycemia. The etiology of type 2 diabetes mellitus is multifactorial and probably genetically based, but it also has strong behavioral components (Mayfield J, 1998) (Report of the Expert Committee, 1997).

### **1.1.2.3 OTHER SPECIFIC TYPES OF DIABETES MELLITUS**

#### **1. Genetic defect of beta cells:**

Several forms of diabetes are associated with monogenetic defects in  $\beta$ -cell function. These forms of diabetes are frequently characterized by onset of hyperglycemia at an early age (generally before age 25 years). They are referred to as maturity onset diabetes of the young (MODY) and are characterized by impaired insulin secretion with minimal or no defects in insulin action. They are inherited in an autosomal dominant pattern. Abnormalities at six genetic loci on different chromosomes have been identified to date.

The hepatocyte nuclear factor (HNF)-1 $\alpha$  is the most common of these genes with mutation on the chromosome 12. Other mutations are found on chromosome 7, glucokinase (MODY2); on chromosome 20, HNF-4 $\alpha$  (MODY1); on chromosome 13, insulin promoter factor-1 (IPF-1; MODY4); on chromosome 17, HNF-1 $\beta$  (MODY5); on chromosome 2; on neuroD1 (MODY6); on mitochondrial DNA; and others (ADA, 2010).

## **2. Genetic defects in insulin action:**

These are unusual causes of diabetes that result from genetically determined abnormalities of insulin action. The metabolic abnormalities associated with mutations of the insulin receptor may range from hyperinsulinemia and modest hyperglycemia to severe diabetes. Some individuals with these mutations may have acanthosis nigricans. Women may be virilized and have enlarged, cystic ovaries. In the past, this syndrome was termed type A insulin resistance. Leprechaunism and the Rabson- Mendenhall syndrome are two pediatric syndromes that have mutations in the insulin receptor gene with subsequent alterations in insulin receptor function and extreme insulin resistance (ADA, 2010).

## **3. Disease of the exocrine pancreas:**

Any process that diffusely injures the pancreas can cause diabetes. Acquired processes include pancreatitis, trauma, infection, pancreatectomy, and pancreatic carcinoma (ADA, 2010).

#### **4. Endocrinopathy:**

Several hormones (e.g., growth hormone, cortisol, glucagon, epinephrine) antagonize insulin action. Excess amounts of these hormones (e.g., acromegaly, Cushing's syndrome, glucagonoma, pheochromocytoma, respectively) can cause diabetes. This generally occurs in individuals with preexisting defects in insulin secretion, and hyperglycemia typically resolves when the hormone excess is resolved. Somatostatinoma and aldosteronoma induced hypokalemia can cause diabetes, at least in part, by inhibiting insulin secretion. Hyperglycemia generally resolves after successful removal of the tumor.(ADA,2010)

#### **5. Drug- or chemical-induced diabetes:**

Many drugs or chemicals can impair insulin secretion. They may not cause diabetes by themselves, but they may precipitate diabetes in individuals with insulin resistance. Pentamidine, nicotinic acid, glucocorticoids,  $\alpha$ -interferon, thyroid hormones and others are examples of drugs or chemicals which can induce diabetes mellitus (ADA, 2010).

#### **6. Infections:**

Certain viruses have been associated with  $\beta$ -cell destruction. Diabetes mellitus may occur in patients with congenital rubella, coxsackie virus B, cytomegaloviruses, mumps and others (ADA, 2010).

## **7. Uncommon forms of immune-mediated diabetes:**

In this category, there are two known conditions which can cause diabetes: The stiff-man syndrome, an autoimmune disorder of the central nervous system and the anti-insulin receptor antibodies occasionally found in patients with systemic lupus erythematosus and other autoimmune diseases (ADA, 2010).

## **8. Other genetic syndromes sometimes associated with diabetes:**

Many genetic syndromes are accompanied by an increased incidence of diabetes. These include the chromosomal abnormalities of Down syndrome, Klinefelter syndrome, and Turner syndrome (ADA, 2010).

### **1.1.2.4 GESTATIONAL DIABETES MELLITUS**

For many years, gestational diabetes mellitus has been defined as any degree of glucose intolerance with onset or first recognition during pregnancy. Although most cases resolve with delivery, the definition applied whether or not the condition persisted after pregnancy and did not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy. Approximately 7% of all pregnancies (ranging from 1 to 14%, depending on the population studied and the diagnostic tests employed) are complicated by gestational diabetes mellitus, resulting in more than 200,000 cases annually (ADA, 2010). If untreated, gestational diabetes mellitus can lead to number of complications such as macrosomia, hypocalcaemia, increase risk of hyperbilirubinemia (Scott RV and Peters AL, 2002).

The diagnosis of gestational diabetes mellitus can be done by considering a one-step approach which consists of performing a diagnostic oral glucose tolerance test (OGTT) without prior plasma or serum glucose screening or a two-step approach which consists of performing an initial screening by measuring the plasma or serum glucose concentration 1h after a 50-g oral glucose load (glucose challenge test [GCT]) and perform a diagnostic oral glucose tolerance test on that subset of women exceeding the glucose threshold value on the glucose challenge test (GCT). When the two-step approach is employed, a glucose threshold value of 140 mg/dl (7.8 mmol/l) identifies approximately 80% of women with gestational diabetes mellitus, and the yield is further increased to 90% by using a cutoff of 130 mg/dl (7.2 mmol/l) (ADA, 2003).

### **1.1.3 DIAGNOSTIC CRITERIA**

For decades, the diagnosis of diabetes has been based on glucose criteria, either the fasting plasma glucose (FPG) or the 75-g oral glucose tolerance test (ADA, 2010). In 1997, the first Expert Committee on the Diagnosis and Classification of Diabetes Mellitus revised the diagnostic criteria (Diabetes care, 1997; ADA, 2010). The new diagnostic criteria for diabetes mellitus consist of positive findings from at least two of the following on different days (ADA, 2010):

- Glycated hemoglobin (A1C)  $\geq$  6.5%. The test should be performed in a laboratory using a method that is certified by the National Glycohemoglobin Standardization Program (NGSP) and standardized or traceable to the Diabetes Control and Complications Trial reference assay (DCCT).

- Fasting plasma glucose (FPG)  $\geq 7.0$  mmol/l (126 mg/dl). Fasting is defined as no caloric intake for at least 8 h.
- 2-hour plasma glucose  $\geq 11.1$  mmol/l (200 mg/dl) during an oral glucose tolerance test (OGTT). The test should be performed as described by the World Health Organization, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.
- In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose  $\geq 11.1$  mmol/l (200 mg/dl).

#### **1.1.4 SYMPTOMATOLOGY**

The classical symptoms of diabetes mellitus consists of: polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increased hunger), (Dugani S et al, 2009) but type 2 diabetes mellitus is largely asymptomatic (Ogunbanjo, 2006). Most patients believe that they are cured after the initial symptoms disappear with treatment. They tend not to observe healthy lifestyle habits and do not take their treatment regularly. They usually seek medical attention only when complications are present. (Joshi P. et al, 2009).

## **1.1.5 COMPLICATIONS**

### **1.1.5.1 ACUTE COMPLICATIONS OF TYPE 2 DIABETES MELLITUS**

Acute complications occur suddenly and may be the first manifestation of type 2 diabetes mellitus in a person who does not know that he is diabetic. The acute complications of type 2 diabetes mellitus may also happen when insulin therapy is suddenly withdrawn, or when infection, surgery or other stressful events occur. Common acute complications of type 2 diabetes mellitus are diabetic ketoacidosis (more common in type 1 diabetes mellitus), hyperglycaemic hyperosmolar status, hypoglycaemia and diabetic coma (J. D. Tabora, 2011).

### **1.1.5.2 LONG TERM COMPLICATIONS OF TYPE 2 DIABETES MELLITUS**

The long-term complications of type 2 diabetes mellitus occur within 10 to 15 years from the onset of diabetes (J.D Tabora, 2011). The two major complications of the chronic effect of hyperglycaemia on the small blood vessels and on the arteries are microvascular and macrovascular disease respectively (Rackel R.E, 2009; Wikipedia, 2011).

## 1. Microvascular disease

The damage to small blood vessels leads to microangiopathy, which can cause one or more of the following (Wikipedia, 2011):

- **Diabetic cardiomyopathy**, causing damage to the heart and leading to diastolic dysfunction and eventually heart failure.
- **Diabetic nephropathy**, causing damage to the kidney which can lead to chronic renal failure, eventually requiring dialysis.
- **Diabetic neuropathy**, causing abnormal and decreased sensation, usually in a 'glove and stocking' distribution starting with the feet but potentially in other nerves, later often fingers and hands. When combined with damaged blood vessels this can lead to diabetic foot. Other forms of diabetic neuropathy may present as mononeuritis or autonomic neuropathy. Diabetic amyotrophy is muscle weakness due to neuropathy.
- **Diabetic retinopathy**, causing growth of friable and poor-quality new blood vessels in the retina as well as macular edema, which can lead to severe vision loss or blindness.

## 2. Macrovascular disease

Macrovascular disease leads to cardiovascular disease (Wikipedia, 2011):

- **Coronary artery disease**, leading to angina or myocardial infarction.
  
- **Diabetic myonecrosis** ('muscle wasting')
  
- **Peripheral vascular disease**, which contributes to intermittent claudication as well as diabetic foot.
  
- **Stroke**, mainly the ischemic type.

## **1.2 PROBLEM STATEMENT**

The researcher observed that most patients who visited the diabetic clinic at Mamelodi Hospital were obese with sub-optimal blood glucose levels. In addition, some of them have hypertension, diabetic retinopathy and/or diabetic foot. Encounters with these patients reveal that most of them still smoke, drink alcohol and do not exercise despite the fact that they have at least once been counselled about lifestyle modifications. It has also been observed that some of them consume a disproportionately high carbohydrate diet and freely consume brown sugar in particular. They also mostly eat meat and very little fish and vegetables.

It is well known that lifestyle modification alone can prevent the development of diabetes mellitus and slow down its drastic expansion (Knowler W.C. et al, 2002).

In addition, the quality-adjusted life year (QALY), which is a measure of disease burden, including both the quality and the quantity of life lived, used in assessing the value for money of a medical intervention, was found to be more cost effective for patients on the lifestyle intervention program compared to those without an intensive lifestyle intervention. (Herman W.H. et al, 2005).

These observations raised the researcher's concern about the knowledge, attitude and practice of lifestyle modifications among diabetic patients at Mamelodi Hospital, which this study seeks to explore and document.

### **1.3 RELEVANCE OF THE STUDY**

In this study, the researcher aimed at establishing the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetic patients attending diabetic clinic in a South African hospital. Similar studies were done but most of them aimed at evaluating the knowledge, attitudes and practices about diabetes mellitus among diabetics rather than on lifestyle modifications (R. Ambigapathy et al, 2003; Palaian s. et al, 2006).

The result of this current study could be useful in implementing a community based awareness programme which will promote the importance of lifestyle modifications in the prevention and control of non-communicable diseases, particularly diabetes mellitus.

## **1.4 STUDY SETTING**

The study was conducted at the outpatient department of Mamelodi Hospital, Pretoria Republic of South Africa.

Mamelodi Hospital is a regional hospital with a capacity of 400 beds. The average number of patients visiting the hospital each month is 4000 with two thirds of these seen at the outpatient department, which fall under the department of Family Medicine.

The diabetic clinic which opens from Monday to Friday, receives an average of 500 diabetic patients per month.

The Hospital is located at the Eastern side of Pretoria (district of Tshwane) in the middle of Mamelodi, the biggest township in Pretoria. There are 4 clinics (Mamelodi west, Tahameng, Stanza 2, Holant Clinic ) and 1 community health center (Stanza Bopape CHC) in its catchment area.

## **CHAPTER 2**

### **LITERATURE REVIEWS**

#### **2.1 INTRODUCTION**

The literature for this study was obtained through searches on PubMed central, Google scholar, data bases. The key words and MESH terms used in this search were 'attitudes', 'diabetes', 'knowledge', 'lifestyle modifications', and 'practices'.

The relevant literature obtained through the search is presented starting with a description of the epidemiology of type 2 diabetes mellitus, then risk factors of type 2 diabetes mellitus; lifestyle intervention programme in the management of type 2 diabetes mellitus; literature reviews on knowledge, attitudes and practices regarding lifestyle modifications among diabetic patients; and a summary of the literature.

## **2.2 EPIDEMIOLOGY OF TYPE 2 DIABETES MELLITUS**

Type 2 diabetes mellitus is now one of the most common non-communicable diseases globally. It is the fourth or fifth leading cause of death in most developed countries and there is substantial evidence that it is epidemic in many developing and newly industrialized nations. The number of people with type 2 diabetes mellitus, worldwide was 194 million in 2003 and it is estimated to rise to 333 million by 2025 (Wild S et al, 2004) (Rheeder P., 2006).

In last years publication, the International Diabetes Federation (IDF) is considering even a worst scenario with a projection in 2010 of 285 million people to be affected worldwide, and a rise of 430 million diabetics by 2030 compared to previous studies with low estimates. (ADF Atlas, 2009)

Type 2 Diabetes mellitus occurs throughout the world, but is more common in the more developed countries (Wild S. et al, 2004). In Australia for example, the AusDiab study reported in 2000 that 7.4% of the population aged 25 and above had diabetes mellitus (type 2 in 90%), and the worse is that about 50% of them were undiagnosed (Dunstan D et al, 2002). The greatest increase in prevalence is, however, expected to occur in Asia and Africa, where most patients will probably be found by 2030 (Wild S. et al, 2004).

While there is good evidence for a strong genetic contribution to both obesity and diabetes mellitus, the increase in these conditions in both developed and developing countries appears to be due to a changing balance between energy intake and energy expenditure through physical activity (J.E Shaw et al, 2003). In developing countries, urbanization and lifestyle changes, perhaps most importantly adoption of a "Western-style" diet seems to also contribute to the increase in incidence of obesity and diabetes mellitus (Wild S. et al, 2004).

The global estimates of the number of people with type 2 diabetes mellitus in Africa was approximately 3 million in 1994 and was projected to go through a 2-3 fold increase by the year 2010. The highest prevalence is found in adult populations of Indian origin, followed by black populations and Caucasians. (Motala AA et al, 2003).

In South Africa, according to the Medical Research Council (MRC), diabetes mellitus was responsible for the deaths of 22 412 South Africans in 2000 which makes it the fifth leading cause of death in this country (D. Bradshaw et al,2005). Experts estimate that around 3 million South Africans have diabetes mellitus, of which approximately 95% are type 2 diabetes mellitus (Levitt NS et al, 2008). These figures are underestimated by the fact that many cases are undiagnosed (L. Hopewell, 2008). The greatest prevalence was found in the Indian community of Durban (13%) and the elderly coloured community of Cape Town (28.7%) (Rheeder P., 2006).

## **2.3. RISK FACTORS OF TYPE 2 DIABETES MELLITUS**

### **2.3.1. SEDENTARY LIFE**

The driving force for this current worldwide epidemic of type 2 diabetes mellitus seems to be environmental (Bennett PH et al, 1996). Urbanisation and globalisation are factors most prevalent in the developing world and lead to sedentary life. As more of the population move to cities, population over-crowding, increased poverty, increased levels of crime, high-density traffic, lack of parks, sidewalks and recreational sports facilities lead to a less active lifestyle and discourage participation in physical activity. (Jennifer Hicks, 2008)

According to the World Health Organization (WHO), sedentary lifestyle is one of the 10 leading causes of death and disability. It accounts for 300,000 premature deaths each year in the United States alone. These deaths are mainly from cardiovascular disease which people with type 2 diabetes mellitus and prediabetes mellitus are at a much higher risk than others. (Jennifer Hicks, 2008)

In Africa, physical inactivity is more common in the urban than in the rural regions.

In rural region, most people rely on walking for transport and often have intense agricultural activities as their main occupation (Songwi et al, 2002).

Due to urbanisation, walking time and pace is drastically reduced (by factors of 2 to 4 for walking at slow pace and 6 to more than 10 for walking at brisk pace) in the urban region (Songwi et al, 2002).

In a South African study (Omar et al, 1993), the prevalence of sedentary life in Cape Town among subjects age 30 and above, was estimated at 39 percent for men and 44 percent for women.

In recent studies, 62 percent of South African men and 48 percent of South African women 15 years or older followed a sedentary lifestyle (D.O.H, 2007).

Also, 33 percent of South African adolescent boys and 42 percent of girls had a sedentary lifestyle (Reddy SP et al, 2003).

Recent development of multiple entertaining TV programs and computer games has also negatively contributed to increased time of inactivity (Reddy SP et al, 2003).

Viewing TV for more than 3 hours per day was recorded by 22 percent of boys and 27 percent of girls. These inactive children were also overweight when compared to their active counterparts. (Reddy SP et al, 2003).

Sedentary life can lead to obesity, a major factor in developing type 2 diabetes mellitus. (Bennett PH, 1996)

### **2.3.2. OBESITY**

The WHO defined obesity and overweight as abnormal or excessive fat accumulation that may impair health (WHO, 2006).

Obesity is usually measured by using the body mass index (BMI) which has long been established as the preferred method of measuring adiposity in epidemiological studies (Keys A et al, 1971).

BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters ( $\text{kg/m}^2$ ) (WHO, 2010).

Here below is the international classification of adult weight according to the world health organization (WHO, 2006):

**Table 1: The International Classification of adult underweight, overweight and obesity according to BMI**

Classification	BMI(kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
<b>Underweight</b>	<b>&lt;18.50</b>	<b>&lt;18.50</b>
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
<b>Normal range</b>	<b>18.50 - 24.99</b>	<b>18.50 - 22.99</b>
		<b>23.00 - 24.99</b>
<b>Overweight</b>	<b>≥25.00</b>	<b>≥25.00</b>
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
<b>Obese</b>	<b>≥30.00</b>	<b>≥30.00</b>
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

As for type 2 diabetes mellitus, the burden of overweight and obesity is rising drastically. According to the WHO, by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese worldwide (WHO, 2006).

In the USA, the national Health and Nutrition Study (NHANES I, II, III) has shown the prevalence of obesity (individual with BMI>35) in adults from 1980 to 2000 has increased from 25% to 60%.

In children such an increase was also found, namely, from 13.6% to 24%. These values are for African-Americans, and for Americans of Latin descent even 10% higher. If this trend of increase in the prevalence of obesity continues, in the year 2025 the obese population in America could be 100 % ( Mukdad A et al, 2000; Ogden CL, 2006).

In Africa, the number of people who are overweight/obese increased by nearly 35% from 1990 to 2000 (Abdhalah Ziraba et al, 2009).

In South Africa, it has been found that a third of men and more than half of women were overweight or obese (Puoane T, 2002).

There is a strong correlation between the increase of obesity and the frequency of type 2 diabetes mellitus (Mustafa Y, 2005).

Even though the exact mechanisms of development of type 2 diabetes mellitus in obesity are still disputed, the pathophysiology of development of type 2 diabetes mellitus in obesity seems to be through insulin resistance (Joshi P, 2009).

According to one study (Mustafa Y et al, 2003), 80 % of obese patients were found to have insulin resistance. To regulate the same amount of blood glucose, two or three times more insulin is required (compensatory hyperinsulinemia). This will lead to decrease of insulin secreting capacity by pancreatic islet- cells which results in impaired glucose tolerance (IGT) and later on in type 2 diabetes mellitus.

Obesity is the most significant factor leading to type 2 diabetes mellitus. Hence, obesity is the easiest factor in type 2 diabetes mellitus to intervene. If obesity can be prevented, so can be type 2 diabetes mellitus (Mustafa Y, 2005).

Data from previous and still ongoing studies show that reducing body weight through diet or drugs can prevent and reduces development of type 2 diabetes mellitus in obese individuals. A decrease of 4-6 kilograms of body weight has been found to prevent the development of type 2 diabetes mellitus by 30 to 60% (DPT, 2003).

Besides preventing the risk for the development of impaired glucose tolerance and type 2 diabetes mellitus, weight loss has the benefits of:

- Reducing hepatic glucose supply and output, thereby improving hyperglycemia, decreasing insulin secretion, and reducing insulin resistance
- Improvement in blood lipid levels
- Improvement in blood pressure
- Reducing risk of thrombosis and atherosclerosis
- Reducing the need for oral antidiabetics and insulin therapy.

Weight loss can be achieved by implementing an intensive lifestyle intervention program which comprises regular exercise training and healthy dietary habits with psychological support and education (Klein S. et al, 2004).

## **2.4 LIFESTYLE INTERVENTION PROGRAM IN THE MANGEMENT OF TYPE 2 DIABETES MELLITUS**

To reduce this worldwide epidemic of type 2 diabetes mellitus, lifestyle intervention seems to be the way to go. A study done in USA by the Diabetes Prevention Program (DPP) has established that the incidence of type 2 diabetes mellitus can be reduced by 58% with an intensive lifestyle intervention targeting a 7% weight loss in people with impaired glucose tolerance, while metformin therapy delayed or prevented type 2 diabetes mellitus by 31%.(WHO , 2010).

These therapies were effective in all racial and ethnic groups, and the effect of lifestyle modification was particularly potent in the elderly, while metformin showed the greatest effect in younger, more obese participants.

In addition, the quality-adjusted life year (QALY), which is a measure of disease burden, including both the quality and the quantity of life lived, used in assessing the value for money of a medical intervention, was found to be more cost effective for the lifestyle intervention in all age groups compared to metformin which was not cost effective in persons older than 65years (Knowler WC, et al, 2002).

The QALY was approximately 11,000 dollars for the lifestyle intervention and 31,300 dollars for the metformin intervention (Knowler WC, et al, 2002).

This gives a strong scientific evidence for the recommendation of an intensive lifestyle intervention programme for the prevention and management of type 2 diabetes mellitus.

The main elements of the intervention program are nutritional intervention, exercise training (minimum of 150 minutes at moderate intensity per week), psychosocial support and education (Herman W.H, et al, 2005).

Exercise training combined with nutritional intervention are the cornerstones of a lifestyle intervention programme for type 2 diabetes mellitus and should therefore be mandatory components of any lifestyle intervention programme (Herman W.H, et al, 2005).

Physically active lifestyle is a relatively effective intervention for treating the insulin resistance occurring with type 2 diabetes mellitus (Feinglos M.N, 2007).

### **2.4.1 EXERCISE TRAINING**

Physical activities in the form of exercise training have been proven to have the ability to prevent or delay the onset of illness and diseases. (Schwellnus MP, et al, 2009).

Physical activity has an impact directly on the cardiovascular system, and indirectly by inducing favourable changes in metabolism, body mass and body composition. Other benefits of exercise include:

- Increases feeling of well-being and libido
- Improves quality of sleep
- Decreases depression/anxiety
- Helps in weight reduction
- Improves self esteem

There are two main types of exercises: Aerobic and Resistance exercise. The two types of exercise differ by the duration and intensity of muscular contractions involved, as well as by how energy is generated within the muscle. (Wikipedia, 2010)

But both aerobic (endurance) as well as resistance type exercise have been shown to improve whole body insulin sensitivity and/or oral glucose tolerance. Therefore, both types of exercise are of therapeutic use in an insulin-resistant state. (S. Dugani, et al, 2009)

### **2.4.1.1 AEROBIC EXERCISE**

Aerobic exercise is defined as a physical exercise that intends to improve the oxygen system. Aerobic means "with oxygen", and refers to the use of oxygen in the body's metabolic or energy-generating process. Many types of exercise are aerobic, and by definition are performed at moderate levels of intensity for extended periods of time (Wikipedia, 2010).

Some examples of aerobic activities include: Jogging, swimming, brisk walking, bicycling, running, ice-skating, aerobic dancing, rowing, walking, etc...

During aerobic exercise, glycogen is broken down to produce glucose, which then reacts with oxygen (Krebs cycle) to produce carbon dioxide and water and releasing energy.

In the absence of these carbohydrates, fat metabolism is initiated instead.

These result in a decrease in blood glucose levels, decrease of fat, weight loss and improvement of all body insulin sensibility (Wikipedia, 2010).

Unlike individuals with normal glucose metabolism, people with type 2 diabetes mellitus may experience an immediate decline in blood glucose levels with low to moderate exercise intensity of approximately 40 minutes duration (Giacca A, et al, 1998).

The improvement of insulin sensitivity has been found to be due to either the chronic effects of training, or simply the residual effect of the last bout of exercise. Studies of healthy endurance trained males, as well as individuals with type 2 diabetes mellitus, have shown that improved insulin sensitivity is maintained up to 16 hours after a single bout of exercise, but may be diminished 60 hours after the final exercise session during repeated days of exercise training (Dela F, et al, 1995).

Therefore, to obtain optimal results, patients with type 2 diabetes mellitus should exercise multiple days per week, and thus obtain both the acute and chronic benefits of exercise.

Nevertheless, low intensity exercise seems to be a more practical and attractive option for obese diabetics and those who have a lack of physical fitness. A comparative study between a moderate intensity exercise and a higher intensity exercise has shown no significant difference in terms of improvement of insulin sensitivity (Houmard JA, et al, 2004).

O'Donovan, et al, concluded in their study that exercise involving an expenditure of 400 kcal per session, 3 times per week, was sufficient to increase insulin sensitivity, regardless of whether the exercise intensity was moderate or high (O'Donovan, et al, 2005).

In addition, other studies using patients with type 2 diabetes mellitus have demonstrated increased glucose clearance with daily walking and improved insulin sensitivity when low intensity training was added to sulfonylurea therapy (Yamanouchi K, et al, 1995) (Knowler WC, et al, 2002).

These findings support the concept that metabolic benefits can be achieved with relatively low intensity aerobic exercise.

Therefore, low intensity aerobic training, such as walking, may provide adequate metabolic improvements and be a safe, practical option for individuals with type 2 diabetes mellitus.

### **2.4.1.2 RESISTANCE EXERCISE**

Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance (i.e. resistance to being pushed, squeezed, stretched or bent). Exercises are isotonic if a body part is moving against the force. Exercises are isometric if a body part is holding still against the force. Resistance exercise is used to develop the strength and size of skeletal muscles. Properly performed, resistance training can provide significant functional benefits and improvement in overall health and well-being. (Wikipedia, 2010)

Here below are some examples of resistance training:

- Free weights – classic strength training tools such as dumbbells or barbells.
- Weight machines – these are devices that have adjustable seats with handles attached to either weights or hydraulics.
- Resistance bands – these are like giant rubber bands that provide resistance when stretched.
- Body weight: push-ups, squats.

As with aerobic exercise, resistance-oriented exercise training can also have positive effects on glucose disposal, insulin action, and lipid metabolism. The improvements in insulin sensitivity and glucose disposal in normal, insulin resistant, and type 2 diabetes mellitus populations have been shown following resistance training programs (Castaneda C, et al, 2002). Resistance training has been shown to induce a hypertrophic response and a muscle-fiber type shift in exercising muscles which effectively increases the tissue mass responsible for glucose uptake and allows for a potential increase in whole body glucose utilisation which results in an improvement of glycemic control (Randy W. Braith et al, 2006).

The use of resistance training to improve glycemic control in type 2 diabetes mellitus is supported by the American College of Sports Medicine and ADA position statements. (Albright A et al, 2000).

Unlike aerobic training, higher intensities of resistance training (3 sets of 8 to 10 repetitions at 75% to 85% of 1 repetition maximum) have not only shown benefits but also have been well tolerated by patients with type 2 diabetes mellitus . (Dunstan DW et al, 2002)

No adverse effects have been reported in the general diabetes mellitus population who reach training intensities of 80–85% of 1RM, even among the elderly, with a 90–100% compliance rate reported (Dunstan DW et al, 2002).

Resistance exercise may also be tolerated by untrained or obese individuals who have difficulty performing aerobic exercise. (Castaneda C et al, 2002)

Both aerobic and resistance training have important roles in type 2 diabetes mellitus. Recent work comparing the individual and combined effects of aerobic and/or resistance training revealed that both forms of exercise were equally beneficial for glycemic control, although aerobic training had a greater effect on body composition (except with regard to increasing muscle cross-sectional area). The combination of both forms of training was twice as effective for improving glycemic control. (Sigal RJ et al, 2007)

Nevertheless, caution should be taken when initiating any type of exercise and this should be done under strict medical attention for those with underlying cardiovascular disease.

There is now no doubt that physical activity alone can contribute to a significant weight loss with improvement of glycaemic control and insulin sensitivity in type 2 diabetes mellitus. In recent studies the combination of dietary intervention and regular exercise training was even at great benefit. (William D et al, 2006)

### **2.4.2 NUTRITIONAL INTERVENTION**

Decades of research have yet to fully illuminate all of the factors that cause type 2 diabetes mellitus. It is suggested that the disease has a genetic component since it is often seen among family members. Genes linked to type 2 diabetes mellitus have also been connected to those linked to obesity. Though it remains to be proven that type 2 diabetes mellitus is directly linked to overweight or obesity, it is a fact that the majority of those diagnosed with type 2 diabetes mellitus, approximately 90%, are overweight or obese. There is no doubt any longer that nutrition plays a large role in controlling the disease (Ryan Coisson, 2010).

Medical nutrition therapy (MNT) combined with exercise training is the cornerstone of a lifestyle intervention programme for type 2 diabetes mellitus. (Haskell WL et al, 2007)

MNT is defined as “nutritional diagnostic, therapy, and counseling services for the purpose of disease management, which are furnished by a registered dietitian or nutrition professional.” (Sara F. Morris et al, 2010)

MNT constitute important tools which can be used in the primary prevention of type 2 diabetes mellitus in those with obesity and pre-diabetes mellitus; in secondary prevention to prevent complication with metabolic control of type 2 diabetes mellitus and in tertiary prevention to prevent morbidity and mortality, when it is used to delay and manage complications of type 2 diabetes mellitus.

### **2.4.2.1 MEDICAL NUTRITION THERAPY IN PRIMARY PREVENTION OF TYPE 2 DIABETES MELLITUS**

Evidence demonstrates that structured, intensive lifestyle programs involving participant education, individualized counselling, reduced dietary energy and fat (30% of total energy) intake, regular physical activity ( 150 min/week), and frequent participant contact are necessary to produce long term weight loss of 5–7% of starting weight, thus prevent type 2 diabetes mellitus among individuals at high risk for developing the disease (Franz MJ et al, 2002).

In both the Finnish Diabetes Prevention and the Diabetes Prevention Program(DPP) study, using reduced dietary fat as intervention, particularly saturated fat, was found to reduced risk for type 2 diabetes mellitus by producing an energy-independent improvement in insulin resistance as well as by promoting weight loss.( Tuomilehto J, at all, 2001) (Knowler WC, at all, 2002)

In several studies, the increased intake of whole grains and dietary fibre has also been associated with reduced risk of type 2 diabetes mellitus. (Meyer KA, at all, 2000)( Schulze MB,2004)

Whole grain containing foods have been associated with improved insulin sensitivity, independent of body weight. It has also been found to be associated with improved ability to secrete insulin adequately to overcome insulin resistance (Liese AD et al, 2003).

### **2.4.2.2 MEDICAL NUTRITION THERAPY IN SECONDARY PREVENTION OF TYPE 2 DIABETES MELLITUS**

The primary goal in the management of type 2 diabetes mellitus is to achieve normal or near-normal levels of blood glucose. Food and nutrition interventions that reduce postprandial blood glucose excursions are important in this regard, since dietary carbohydrate is the major determinant of postprandial glucose levels. Low carbohydrate diets might seem to be a logical approach to lowering postprandial glucose. (ADA, 2008)

The amount of carbohydrate ingested is usually the primary determinant of postprandial response, but the type of carbohydrate also affects this response. (Sheard NF, et al, 2004)

To compare the postprandial responses to constant amounts of different carbohydrate containing foods, the concept called glycemic index of foods was created by David J Jenkins and colleagues. (Jenkins DJ, et al, 1981)

The glycemic index (GI) is a measure of the effects of carbohydrates on blood sugar levels. Carbohydrates that break down quickly during digestion and release glucose rapidly into the bloodstream have a high GI; carbohydrates that break down more slowly, releasing glucose more gradually into the bloodstream, have a low GI. (David J. A. Jenkins et al, 2008).

Since the glycemic index of food was created by David J. Jenkins and colleagues, some studies have shown decrease of glycaemia among type 2 diabetes mellitus patients on low glycemic index diet, whereas others did not find any significant difference. (Sheard NF, et al, 2004). Nevertheless, a recent meta-analysis of low-glycemic index diet trials in type 2 diabetes mellitus subjects showed that such diets produced a 0.4% decrement in glycosylated hemoglobin (Hb A1c) when compared with high-glycemic index diets. (Brand-Miller J, et al, 2003).

The nutritional recommendations for type 2 diabetes mellitus start by considering energy balance and weight loss strategies. The current American Diabetic Association (ADA) and American Heart Association (AHA) guideline recommendation is 60% carbohydrates, 30% fat, and 10% protein, with cholesterol limited to 300 mg/day. (Krauss RM, et al. 2000).

The caloric content should be that which permit a patient with type 2 diabetes mellitus to attain a body mass index (BMI) of  $25 \text{ kg/m}^2$ . And this can be calculated or obtained from BMI tables. Weight loss can be safely achieved if the patient is taught how to reduce caloric intake by 100 cal/day for each 0.454 kg of desired weight loss over 1 year. The diet for type 2 diabetes mellitus is based on achieving ideal body weight and following a diet of high-fibre carbohydrates with a low glycaemic index (GI) and low fat. (Krauss RM, et al. 2000).

**Table 2: Classification of Glycemic index of foods.**

<b>Classification</b>	<b>GI range</b>	<b>Examples</b>
Low GI	55 or less	most fruits and vegetables, legumes/pulses, whole grains, meat, eggs, milk, nuts, fructose and products low in carbohydrates
Medium GI	56–69	whole wheat products, basmati rice, sweet potato, sucrose
High GI	70 and above	baked potatoes, watermelon, white bread, most white rices, corn flakes, extruded breakfast cereals, glucose

#### **2.4.2.3 MEDICAL NUTRITION THERAPY IN TERTIARY PREVENTION OF TYPE 2 DIABETES MELLITUS**

Complications such as diabetic nephropathy, hypertension, blindness, micro and macroangiopathy, amputations are common among type 2 diabetes mellitus patients.

Progression of those complications may be modified by improving glycemic control, lowering blood pressure, and, potentially, reducing protein intake.

In several studies, reduction of protein intake to 0.8 –1.0 g/ kg /body weight/day were found to favourably influence the condition of subjects with type 2 diabetes mellitus and microalbuminuria, urinary albumin excretion rate and decline in glomerular filtration. (Pijls LT, et al, 2002)(Narita T, et al, 2001).

In individuals with type 2 diabetes mellitus and macroalbuminuria, reducing protein from all sources to 0.8 g /kg/body weight/day has been associated with slowing the decline in renal function (Hansen HP,et al, 2002) (Franz MJ at all, 2002).

Although, there are currently no large randomized trial to guide the medical nutrition therapy recommendation for cardiovascular disease risk reduction for type 2 diabetes mellitus patients, the benefit observed in nutritional studies in general population are probably applicable for type 2 diabetes mellitus patients as well, considering the fact that cardiovascular disease risk factors are similar for both individuals with type 2 diabetes mellitus and without diabetes mellitus. There is the need to reduce intake of saturated and trans fatty acids and cholesterol. (ADA, 2008).

Hypertension, which is predictive of progression of micro- as well as macrovascular complications of type 2 diabetes mellitus, can be prevented and managed with lifestyle modifications intervention including diets such as DASH (Dietary Approaches to Stop Hypertension). The diet emphasized fruits, vegetables, and low-fat dairy products; included whole grains, poultry, fish, and nuts; and was reduced in fats, red meat, sweets, and sugar containing beverage. (Chobanian AV, et al, 2003) ( Appel LJ, et al, 2006)

Heart failure and peripheral vascular disease are common in individuals with type 2 diabetes mellitus, but little is known about the role of medical nutrition therapy in treating these complications. Nutrition recommendations from the American College of Physicians/American Heart Association suggest moderate sodium restriction (less than 2,000 mg/day) for patients with structural heart disease or symptomatic heart failure.

Alcohol intake is discouraged in patients at high risk for heart failure. (Hunt SA, et al, 2005)

### **2.4.3. PSYCHOLOGICAL AND EDUCATIONAL SUPPORT**

To improve the compliance on regular physical activities and healthy dietary habits, and guarantee the success of lifestyle intervention program, an educational intervention (Diabetes self-management education) and a psychological intervention should be considered in the management of type 2 diabetes mellitus (Alan M. Delamater, 2006).

The content of the educational and psychological program, based on the elements of a standard medical care program for type 2 diabetes mellitus patients, include some of these topics:

- Nutritional management of type 2 diabetes mellitus
- Principles of physical activity and exercise training
- Preventing, detecting and managing acute complications of type 2 diabetes mellitus (hypoglycaemia, ketoacidosis)
- Developing personal strategies to promote health and behavior changes,
- Avoiding stressful situations.

#### **2.4.4 LITERATURE REVIEWS ON KNOWLEDGE, ATTITUDES AND PRATICES REGARDING LIFESTYLE MODIFICATIONS AMONG TYPE 2 DIABETES MELLITUS PATIENTS**

Very few studies, similar to this current study, were done and most of them aimed at evaluating the knowledge, attitudes and practices about type 2 diabetes mellitus instead of lifestyle modifications among type 2 diabetes mellitus patients.

In a non-randomised study done by Z. Ghazanfari and colleagues, the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetes mellitus were evaluated following the implementation of a designed educational program on the lifestyle to type 2 diabetes mellitus patients. The outcome was a significant increase in the knowledge ( $P < 0.001$ ), attitudes ( $P < 0.01$ ) and practices ( $P < 0.01$ ) of the intervention group towards healthy behaviors regarding nutrition, physical activity and self-care. They concluded that their designed educational program could improve the lifestyle of patients suffering from type 2 diabetes mellitus. (Ghazanfari Z. et al,2007).

In a study done by S.Palaian and colleagues, they evaluated the results of counseling selected hospitalized type 2 diabetes mellitus patients about their medications, disease, and lifestyle modifications in terms of knowledge, attitude, and practice outcomes.

Although knowledge scores in the test group of patients improved, compared with those of the control group, as determined by the Mann–Whitney test ( $P < .05$ ), they did not observe significant improvement in attitude or practice outcomes. They concluded that patient counselling by a clinical pharmacist improved knowledge scores, but this improved knowledge did not lead to appropriate attitudes or practices. (S. Palaian et al, 2006).

In a cross-sectional study done by R. Ambigapathy and colleagues, which describes the knowledge, attitude and practice (KAP) among 100 type 2 diabetes mellitus patients attending the diabetic clinic at Klinik Kesihatan Seri Manjung, 87% of the respondents were able to answer 50% or more questions on knowledge correctly, while 98% of them had 50% or more score for the attitude questions. Ninety-nine percent of them reported 50% or more score for the questions on practice. However, only 56% of them practice all 4 of the practices that were asked - regular exercise, healthy diet, monitoring blood glucose level, and monitoring body weight.

There was a significant positive correlation between knowledge and attitude ( $r=0.536$ ,  $p<0.01$ ), but there was no significant correlation found between attitude and practice. The results indicate that an increase in knowledge will increase attitude, however this is not necessarily the same between attitude and practice (R Ambigapathy et al, 2009).

#### **2.4.5 SUMMARY OF THE LITERATURE REVIEW**

Type 2 diabetes mellitus is now one of the most common non-communicable diseases globally. It is the fourth or fifth leading cause of death in most developed countries and there is substantial evidence that it is epidemic in many developing and newly industrialized nations. The number of people with type 2 diabetes mellitus, worldwide was 194 million in 2003 and it is estimated to rise to 333 million by 2025 (Wild S. et al, 2004). Approximately 3 million Africans were found to have type 2 diabetes mellitus in 1994 and was due to go through a 2-3 fold increase by the year 2010 (Motala AA et al, 2003). In 2003, 3.4% of a population of 24 million South Africans between the ages of 20 and 79 were found to have type 2 diabetes mellitus. This percentage is expected to increase to 3.9% by 2025 (Rheeder P., 2006).

The driving force for this current worldwide epidemic of type 2 diabetes mellitus seems to be environmental. Urbanisation, one of the factors most prevalent in the developing world, encourages sedentary lifestyle and lack of participation in physical activities (Jennifer Hicks, 2008). This can lead to obesity, a major factor in developing type 2 diabetes mellitus through insulin resistance (Joshi P, 2009).

Several studies have established the importance of lifestyle intervention program in the management of type 2 diabetes mellitus in terms of improving the quality of life (QALY) (Knowler W.C et al, 2002); promoting physical activities and weight loss (Schwellnus MP et al, 2009) ;controlling blood sugar level and treating the insulin resistance (Feingos M.N, 2007).

According to Herman W.H and colleagues, exercise training combined with nutritional intervention are the cornerstones of a lifestyle intervention programme for type 2 diabetes mellitus and should therefore be mandatory components of any lifestyle intervention programme. (Herman W.H, et al, 2005).

Studies on exercise training showed that both aerobic and resistance training are equally effective in improvement of whole body insulin sensitivity and/or oral glucose tolerance. Therefore, both types of exercise are of therapeutic use in an insulin-resistant state (S. Dumani et al, 2009). The combination of both forms of training was twice as effective for improving glycemic control (Sigal RJ, et al, 2007) and metabolic control can be achieved with low intensity training such as walking (Yamanouchi K, et al, 1995; Knowler WC, et al, 2002).

Medical nutrition therapy was shown to be effective in the primary prevention of type 2 diabetes mellitus in those with obesity and pre-diabetes; in secondary prevention to prevent complication with metabolic control of type 2 diabetes mellitus and in tertiary prevention to prevent morbidity and mortality, when it is used to delay and manage complications of type 2 diabetes mellitus (ADA, 2008). American Diabetic Association recommend a diet, based on achieving ideal body weight, rich on high-fibre carbohydrates with low glycaemic index(GI) and low fat (Krauss RM et al, 2000).

Psychological and educational supports help improve the compliance on regular physical activities and healthy dietary habits, and guarantee the success of lifestyle intervention program (Alan M. Delamater, 2006).

Few similar studies related to the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetic patients were found during this literature reviews. Ghazanfari Z. and colleagues evaluated, in a non-randomised control trial, the knowledge, attitude and practice of lifestyle modifications among type 2 diabetic patients after implementing a designed educational programme on lifestyle. They concluded that their designed educational program could improve the lifestyle of patients suffering from type 2 diabetes mellitus (Ghazanfari Z. et al, 2007).

S. Palaian and colleagues; evaluated the results of counseling selected hospitalized type 2 diabetic patients about their medications, disease, and lifestyle modifications in terms of knowledge, attitude, and practice outcomes. They concluded that patient counselling by clinical pharmacist improved knowledge scores, which did not lead to appropriate attitudes or practices. (S. Palaian et al, 2006)

R. Ambigapathy and colleagues described the knowledge, attitude and practice on type 2 diabetes mellitus among 100 type 2 diabetic patients. Most of participants (87%) were knowledgeable with 50% or more score on knowledge questions; most of them (98%) had good attitude, with 50% or more score on attitude questions and most of them reported 50% or more score for the questions on practice. They found a significant positive correlation between knowledge and attitude( $r=0.536$ ,  $p<0.01$ ), but there was no significant correlation found between attitude and practice (R. Ambigapathy, et al, 2009).

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 TITLE**

Knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetes mellitus patients attending Mamelodi Hospital, Pretoria, Gauteng.

#### **3.2 RESEARCH QUESTION**

What are the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetic patients attending diabetic clinic at Mamelodi hospital, Pretoria, Gauteng?

#### **3.3 AIM OF THE STUDY**

The aim of the study was to establish the knowledge, attitudes and practices regarding lifestyle modifications among type 2 diabetes mellitus patients attending diabetic clinic at Mamelodi hospital, Pretoria, Gauteng.

### **3.4 OBJECTIVES OF THE STUDY**

The objectives of the study were:

1. To determine the demographic characteristics of type 2 diabetes mellitus patients attending diabetic clinic at Mamelodi Hospital.
2. To determine the knowledge, attitudes and practices of patients in relation to type 2 diabetes mellitus with reference to:
  - Diet modification
  - Importance of regular exercise
  - Weight loss
3. To investigate factors (knowledge, attitudes, demographics, and anthropometrics) associated with appropriate lifestyle modification practice.

### **3.5 STUDY DESIGN**

This study was a descriptive cross-sectional study

### **3.6 STUDY SETTING**

The study was conducted at the outpatient department of Mamelodi Hospital, Pretoria, Gauteng, Republic of South Africa.

### **3.7 STUDY POPULATION**

The study population consisted of all type 2 diabetes mellitus patients, aged 30 years and above, attending Mamelodi Hospital for regular follow-ups from the 5<sup>th</sup> December 2010 to the 5<sup>th</sup> January 2011. The cut-off age of 30 years was chosen as type 2 diabetes mellitus which usually affects individuals older than 40 years is now occurring at much younger ages (Scott RV et al, 2007). Five hundred type 2 diabetes mellitus patients attended the diabetic clinic of Mamelodi Hospital during this period.

### **3.8 STUDY SAMPLE**

The systematic sampling method was used to select 217 type 2 diabetes mellitus patients from 500 type 2 diabetes mellitus patients who attended Mamelodi Hospital for monthly follow up visits during the period of 5<sup>th</sup> December 2011 to 5<sup>th</sup> January 2011.

The sample size was calculated using Epi Info version 3.2 (CDC, 2004). The calculation involved using Epi table calculator for sample size single proportion.

Given a target population of 500 type 2 diabetes mellitus patients, an expected prevalence of 50% of type 2 diabetes mellitus patients with good knowledge, positive attitudes and good practices of healthy lifestyle modifications, and a 5% acceptable degree of error, the total sample size obtained was 217 type 2 diabetes mellitus patients at 95% confidence level.

The sample size was calculated using the formula for single proportion:

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

ss = sample size

z = the standard normal deviation, usually set at 1.96 for 95% confidence level

p = the prevalence of type 2 diabetes mellitus patients with good knowledge, positive attitudes and good practices of healthy lifestyle modifications. For this study, a prevalence of 50% was assumed.

C= confidence interval, expressed as decimal (5% in this study).

With this formula, the sample size calculated was 384. A second formula of correction for finite population was also used:

$$\text{new ss} = \frac{\text{ss}}{1 + \frac{\text{ss}-1}{\text{pop}}}$$

Where:

pop = population

For the study population of 500 type 2 diabetes mellitus patients who visited diabetic clinic at Mamelodi Hospital, the sample size required at confidence level 95% after calculation with both formulas was 217 type 2 diabetes mellitus patients.

Systematic sampling relies on arranging the target population according to some ordering scheme and then selecting elements at regular intervals through that ordered list.

Systematic sampling involves a random start and then proceeds with the selection of every  $k^{\text{th}}$  element from then onwards. In this sampling method, the formula  $k = N/n$  = the interval size, is used.  $N$  being the population size and  $n$  the sample size. Beginning with a randomly selected number between 1 and  $k$ , every  $k^{\text{th}}$  unit will be selected in the population for inclusion in the sample (K. Black, 2004).

In this study, the sampling interval was  $k = 500/217 = 2.30$ . With this noninteger sampling interval, rounding it up to 3 and taking every 3<sup>rd</sup> patient may lead to the risk of choosing the last patients who do not exist, as  $3 \times 217 = 651$ .

In the opposite, rounding it to 2 and taking every 2<sup>nd</sup> patient may lead to the risk of leaving out some patients with no chance of being selected, as  $2 \times 217 = 434$ . To ensure that every patient has equal chance of being selected, the random starting point was selected as a noninteger between 0 and 2.3. Each noninteger selected, was rounded up to the next integer (Wikipedia, 2011). With the random starting point of 1.6, the patients selected where: 2, 4, 6, 9, 11, 13, 15, 18, 20 and so on, until the last patient 217.

### **3.9 INCLUSION CRITERIA**

Type 2 diabetes mellitus patients aged 30 and above attending the diabetic clinic at Mamelodi Hospital for their regular follow up visits were included in the study.

### **3.10 EXCLUSION CRITERIA**

Patients with type 1 diabetes mellitus, gestational diabetes, other specific types of diabetes mellitus and diabetes insipidus were excluded from the study. In addition, all type 2 diabetes mellitus patients with impaired memory or cognitive functions and those younger than 30 years were also excluded.

### **3.11 DATA COLLECTION**

The data was collected by the researcher and his assistants using an adapted questionnaire (Appendix A).

The researcher adapted existing questionnaires used by Ambigapathy R. et al, and Palaian S. et al studies. Both questionnaires were used to assess the knowledge, attitude and practice on type 2 diabetes mellitus in general. The researcher considered only questions related to knowledge, attitude and practice on lifestyle modifications. (R. Ambigapathy et al, 2003; S.Palaian et al, 2006). The researcher included also in his adapted questionnaire, questions regarding exercise and weight loss from the “Spoken Knowledge in Low Literacy in Diabetes, knowledge Assessment Scale” SKILLD, a practical scale for patients with diabetes and low literacy (Russell L et al, 2005).

The researcher trained two qualified professional nurses, proficient in the local language as research assistants. They assisted him throughout the data collection processes.

The questionnaire was administered by the researcher and his two assistants.

Patients who do not speak english were served the sizulu or sipedi version of the questionnaire as these are the other two languages spoken among the study population.

The questionnaire was refined after a pilot study was conducted with 10 type 2 diabetes mellitus patients to gauge the suitability of the contents, clarity, sequence and flow of the questionnaire.

Each participant was given information on the aim and objectives of the study and asked to sign an informed consent after they agreed to participate in the study.

A total of 96 answers to be chosen were provided in the questionnaire given to participants. The questionnaire was divided into three sections:

### **3 .11.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS**

Variables such as age, sex, marital status, level of education, the average monthly income were completed by the participants with the aid of the researcher and his two assistants.

### **3.11.2 ANTHROPOMETRIC MEASUREMENTS**

All participants' weight and height were measured using a calibrated beam scale with height rod graduated in centimeters (Stadiometer). Every day, before and after participants' measurement, the scale was calibrated by the researcher. The weight was measured to the nearest 0.1 kg and the height was measured to the nearest 0.5cm.

The body mass index (BMI) of each participant was calculated by the researcher and his assistants using the formula  $BMI = \text{Weight (kg)}/\text{Height (m}^2\text{)}$  and participants were classified according to the WHO international classification of adult weight (Table 1)

### **3.11.3 KNOWLEDGE, ATTITUDE AND PRACTICE ASSESSMENTS**

Participants were asked questions on knowledge regarding prevention of type 2 diabetes mellitus (exercising and weight loss) as well as regarding healthy dietary habits (appendix A).

The researcher used the common coding system for dichotomous variables (US Census Bureau, 2003) to facilitate the entry of data to SPSS 17.0(statistical software) for analysis.

Dichotomous (or binary) variables are variables that contain information that can be sorted into categories with only 2 levels of categories and often represents the answer to a yes or no question( US census Bureau,2003).

Each correct answer was coded 1 and a wrong or I don't know answer was coded 0.

Participants also answered questions regarding their attitude and practice on lifestyle modifications; and each good attitude or practice was coded 1; and each wrong attitude or wrong practice was coded 0.

The researcher captured each respondent information and answers in a Microsoft Excel 2007 sheet and submitted it to an accredited statistician for data analysis.

### **3.12 DATA ANALYSIS**

Data was captured on window Excel 2007 by the researcher and was submitted to the statistician who exported it to SPSS 17.0(statistical software) where data analysis (descriptive statistics) was performed automatically.

The information was presented in descriptive statistics for all variables in order to determine the distribution of variables.

The descriptive statistics summarize the population data by describing what was observed in the sample numerically or graphically without attempt to change condition (Wikipedia, 2011).

The mean and standard deviation (numerical descriptors) were used to describe continuous data (knowledge, attitudes and practices scores), while frequency and percentage were used to describe categorical data (gender, marital status, level of education, average monthly income). Frequency and percentage were also used to describe other continuous variables such as age, height, weight and body mass index (BMI) of respondents.

Linear correlation (Pearson correlation coefficient) and p-values were calculated to ascertain the statistical significance of any correlation found.

Data were displayed in tables and figures.

### **3.13. RELIABILITY AND VALIDITY**

Reliability refers to how consistent a measurement is when performed by different observers under the same conditions or by the same observer under different conditions. (S. Dumani, 2009)

To ensure reliability, the researcher adapted existing questionnaires from the “Spoken Knowledge in Low Literacy in Diabetes, knowledge Assessment Scale” SKILLD (Russell L. Rothman, et al, 2006) and from similar researches. (R. Ambigapathy, et al, 2003) and (S. Palaian, et al, 2005)

Validity refers to the extent to which a measurement approaches what it is designed to measure. It is determined by the accuracy and reliability of the test. (S. Dumani, 2009)

To ensure validity a pilot study of 10 type 2 diabetes mellitus patients was done to test the designed questionnaire. None of the participants expressed problems in the understanding of any of the items in the questionnaire. All comments and feedback on this pilot study was noted and considered in the refinement of the questionnaire. .

### **3.14 LIMITATIONS**

In this study, the following biases were identified:

#### **3.14.1 SELECTION BIAS**

The selection bias is a statistical bias in which there is an error in choosing the individuals or groups to take part in a scientific study. Most often, it refers to the distortion of a statistical analysis, resulting from the method of collecting samples. (Wikipedia, 2010)

To minimize this bias, the researcher selected eligible type 2 diabetes mellitus patients attending the hospital's outpatient department using a systematic sampling method.

### **3.14.2 SYSTEMATIC BIAS**

A systematic bias is a 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 (Wikipedia, 2010).

To minimize this bias, the weighing scale was calibrated by the researcher each day before and after weighing patients.

### **3.14.3 TRANSLATION BIAS**

The use of Isizulu or Sepedi questionnaires could lead to mistranslation of the respondents' answers into the research language. To minimize this bias, the researcher used a multiple choice type questionnaire translated by an accredited translator.

### **3.14.4 RESPONDENT BIAS**

Some respondents could answer favourably to please the interviewers or to hide any lack of knowledge. To minimize this bias, the questionnaire was completed anonymously.

### **3.15 ETHICAL CONSIDERATIONS**

A signed written informed consent (appendix A) was obtained from type 2 diabetes mellitus patients who agreed voluntarily to participate in the survey.

Confidentiality of the participants was kept by anonymous completion of the questionnaire. The data was captured and analysed anonymously as group data. All information volunteered in the questionnaires were treated with strict confidence.

Permission to carry out this study was obtained from the management of Mamelodi Hospital (appendix C).

The study protocol was approved by Medunsa Research and Ethics Committee of the University of Limpopo (MREC) with clearance certificate number: MREC/M/224/2010: PG (appendix B)

## CHAPTER 4

### RESULTS

Questionnaires from 217 respondents were captured and analysed with the following results:

#### 4.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

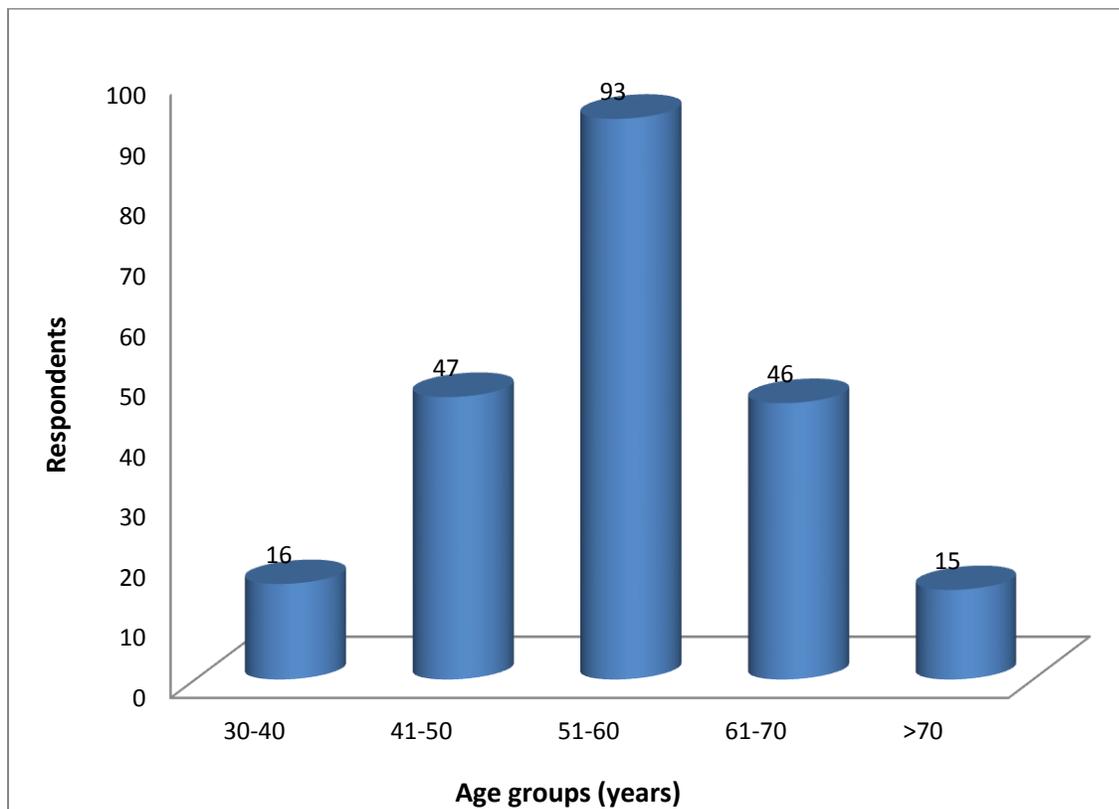
**Table3: Frequency distribution of respondents according to demographic characteristics**

Variable	Number	Percentage (%)
<b>Age groups(years)</b>		
30-40	16	7.4
41-50	47	21.6
51-60	93	42.9
61-70	46	21.2
>70	15	6.9
TOTAL	217	100
<b>Gender</b>		
Male	41	18.9
Female	176	81.1
TOTAL	217	100
<b>Marital Status</b>		
Single	25	10.8
Married	115	53.8
Divorced	24	11.3
Widowed	53	24.1
TOTAL	217	100
<b>Level of education</b>		
No formal education	108	49.5
Primary school	95	43.9
High school	14	6.6
Tertiary education	0	0.0
TOTAL	217	100

<b>Average Monthly Income( Rands)</b>		
<500	40	17.9
500-999	55	24.5
1000-1999	111	52.4
2000-4000	10	4.7
>4000	1	0.5
<b>TOTAL</b>	<b>217</b>	<b>100</b>

The demographic characteristics of respondents are presented in table 3.

#### **4.1.1 AGE DISTRIBUTION OF RESPONDENTS**



**Figure 1: Distribution of respondents according to age**

Figure 1 shows that 16 respondents (7.5%) were in the age group 30-40, 47 respondents (21.6%) were in the age group 41-50, 93 respondents (42.9%) were in the age group 51-60, 46 respondents (21.2 %) were in the age group 61-70 and 15 respondents (6.9%) were above 70 years old.

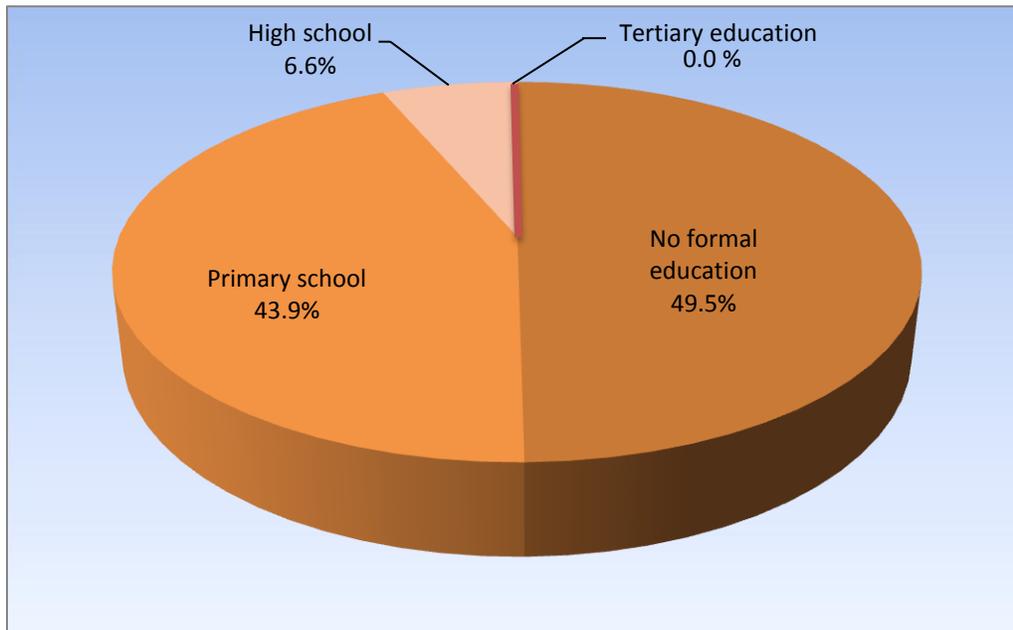
#### **4.1.2 GENDER DISTRIBUTION OF RESPONDENTS**

There were 41 male respondents (18.9%) and 176 female respondents (81.1%).  
(Table 3)

#### **4.1.3 MARITAL STATUS DISTRIBUTION OF RESPONDENTS**

25 respondents (10.8%) were single, 115 respondents (53.8%) were married, 24 respondents (11.3%) were divorced and 53 respondents (24.1%) were widowed.  
(Table 3).

#### 4.1.4 DISTRIBUTION OF RESPONDENTS BY LEVEL OF EDUCATION



**Figure 2: Distribution of respondents according to educational level**

Figure 2 shows that 108 respondents (49.5%) did not have any formal education, 95 of them (43.9%) completed primary school, 14 of them (6.6%) completed high school and none of them had tertiary education (Figure 2).

#### 4.1.5 DISTRIBUTION OF RESPONDENTS BY AVERAGE MONTHLY INCOME

40 respondents (17.9%) were earning less than 500 rand per month, 55 of them (24.5%) were earning between 500 rand and 900 rand per month, 111 of them (52.4%) were earning between 1000 rand and 1999 rand per month, 10 of them (4.7%) were earning between 2000 rand and 4000 rand per month, 1 respondent (0.5%) was earning more than 4000 rand per month. (Table 3)

## 4.2 ANTHROPOMETRIC CHARACTERISTICS OF RESPONDENTS

**Table 4: Frequency distribution of respondents according to weight, height and body mass index(BMI)**

Variable	Number	Percentage (%)
<b>weight(kg)</b>		
52 - 72	27	12.4
73 - 94	148	68.2
95 - 115	41	18.9
116+	1	0.5
TOTAL	217	100
<b>Height(cm)</b>		
154 - 161	96	44.2
162 - 169	107	49.3
170 - 178	14	6.5
TOTAL	217	100
<b>BMI(kg/m<sup>2</sup>)</b>		
Normal	16	7.4
Overweight	47	21.6
Obese class 1	94	43.3
Obese class 2	45	20.7
Obese class 3	15	7
TOTAL	217	100

The anthropometric characteristics of respondents are presented in table 4.

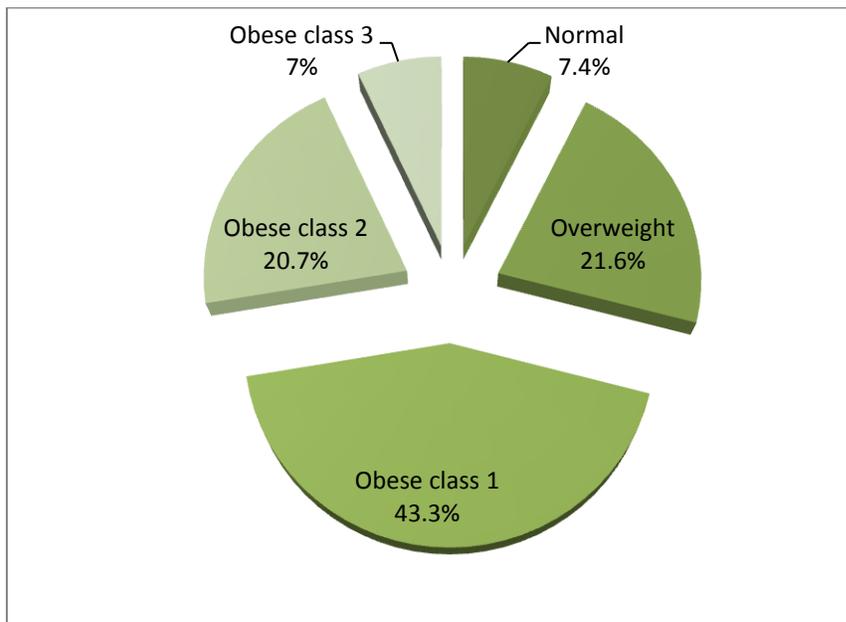
#### **4.2.1 DISTRIBUTION OF RESPONDENTS ACCORDING TO WEIGHT**

Of the 217 respondents, 27 respondents (12.4 %) had their weight between 52 kg and 72 kg, 148 of them (68.2%) had their weight between 73 kg and 94 kg, 41 of them (18.9%) had their weight between 95 kg and 115 kg, and one respondent (0.5%) weighed more than 116 kg. (Table 4)

#### **4.2.3 DISTRIBUTION OF RESPONDENTS ACCORDING TO HEIGHT**

In terms of height, 96 respondents (44.2%) had their height between 154 cm and 161 cm, 107 of them (49.3%) had their height between 162 cm and 169 cm; and 14 of them (6.5%) had their height between 170 cm and 178 cm. (Table 4)

#### **4.2.3 DISTRIBUTION OF RESPONDENTS ACCORDING TO BODY MASS INDEX (BMI)**



**Figure 3: Distribution of respondents according to BMI**

Figure 3 shows that 16 respondents (7.4%) had a normal BMI, 47 of them (21.6%) were overweight; 94 of them (43.3%) had class I obesity; 45 of them (20.7%) had class II obesity, 15 of them (7%) had class 3 obesity.

### **4.3 KNOWLEDGE ASSESSMENT OF RESPONDENTS**

#### **4.3.1 KNOWLEDGE OF RESPONDENTS REGARDING THE BENEFITS OF EXERCISE AND WEIGHT LOSS**

**Table 5: Distribution of respondents according to their knowledge regarding the benefits of exercise and weight loss**

Knowledge score	Number of respondents	Percentage (%)
0-2 (Poor knowledge)	200	92.1%
3-4 (Average knowledge)	16	7.4%
5-6 (Good knowledge)	1	0.5%
Total	217	100%

The distribution of respondents according to their knowledge regarding the benefits of exercise and weight loss is presented in table 5.

The maximum possible score in this segment of the assessment is 6. The knowledge scores of respondents were graded. Those with scores between 0 to 2 were considered to have poor knowledge; those with scores between 3 to 4 had average knowledge; while those with scores between 5 to 6 had good knowledge.

Table 5 shows that 200 respondents (92.1%) had poor knowledge level regarding the benefits of exercise and weight loss; 16 respondents (7.4%) had average knowledge level; and 1 respondent (0.5%) had good knowledge level.

#### **4.3.2 KNOWLEDGE OF RESPONDENTS REGARDING HEALTHY DIET**

**Table 6 : Distribution of respondents according to their knowledge regarding healthy diet**

Knowledge score	Number of respondents	Percentage (%)
0-5 (Poor knowledge)	159	73.3%
6-9 (Average knowledge)	58	26.7%
10-12 (Good knowledge)	0	0.0%
Total	217	100%

The distribution of respondents according to their knowledge regarding healthy diet is presented in table 6.

The maximum possible score in this segment of the assessment is 12. Respondents were considered to have poor knowledge level regarding healthy diet when their knowledge scores were between 0 to 5; average knowledge level when their knowledge scores were between 6 to 9 and good knowledge level when their knowledge scores were between 10 to 12.

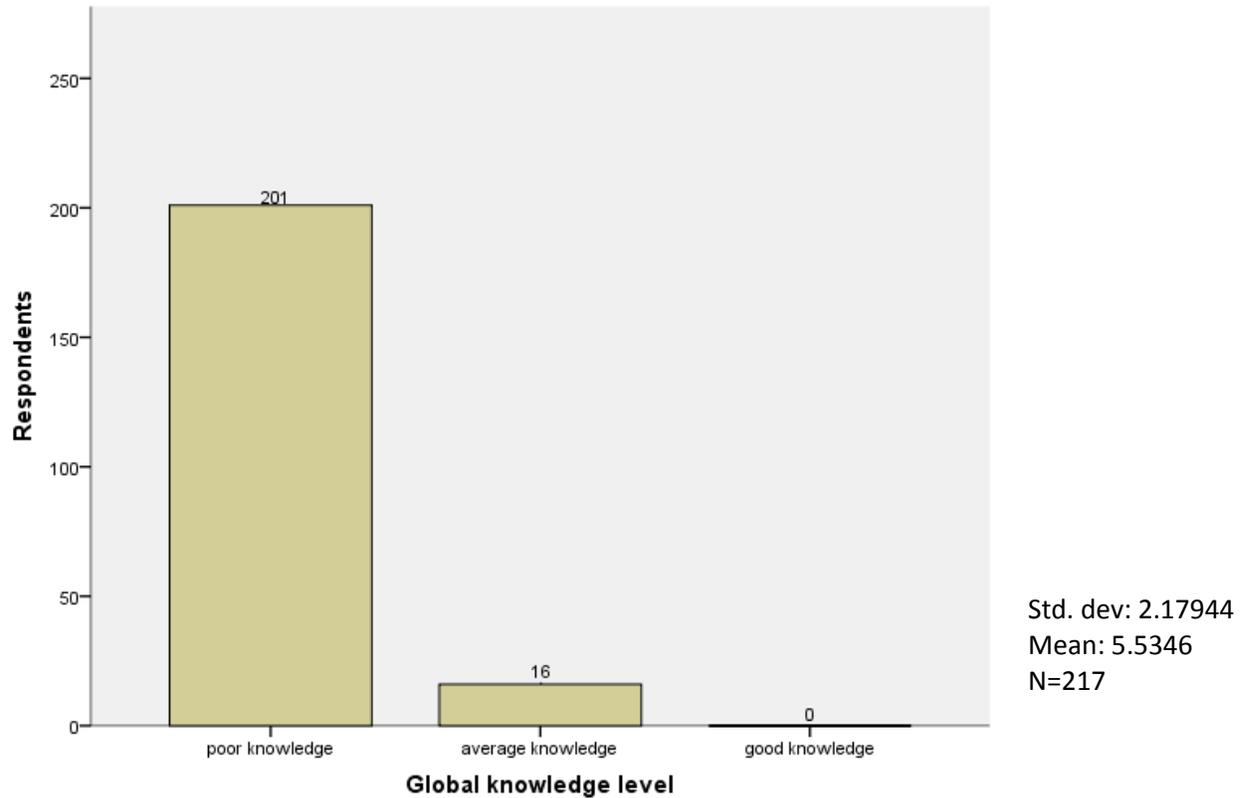
Table 6 shows that 159 respondents (73.3%) had poor knowledge level regarding healthy diet; 58 respondents (26.7%) had average knowledge level and no respondent (0.0%) had good knowledge level.

#### **4.3.3 GLOBAL KNOWLEDGE OF RESPONDENTS**

**Table 7: Distribution of respondents according their global knowledge regarding the benefits of exercise and weight loss and healthy diet.**

Knowledge score	Number of respondents	Percentage (%)
0-8 (Poor knowledge)	201	92.6%
9-13 (Average knowledge)	16	7.4%
14-18 (Good knowledge)	0	0.0%
Total	217	100%

The distribution of respondents according to their global knowledge on benefits of exercise and weight loss and on healthy diet is presented in table 7.



**Figure 4: Frequency distribution of respondents according to their global knowledge level regarding the benefits of exercise and weight loss and healthy diet**

The maximum possible score in the global assessment is 18. Respondents were considered to have poor global knowledge level on benefits of exercise and weight loss as well as on healthy diet when their global knowledge scores were between 0 to 8; average global knowledge level when their knowledge scores were between 9 to 13; and good global knowledge level when their knowledge scores were between 14 to 18.

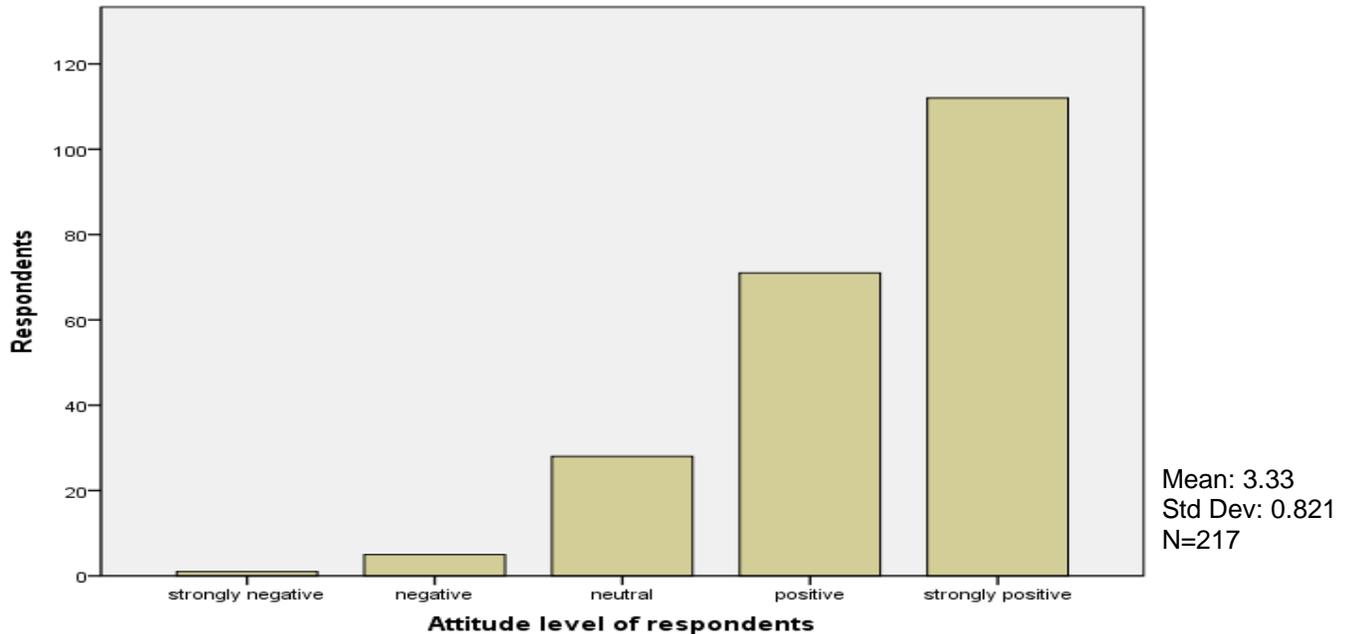
Table 7 and figure 4 show that 201 respondents (92.6%) had poor global knowledge level regarding the benefits of exercise and weight loss as well as healthy diet, 16 respondents (7.4%) had average global knowledge level and no respondent (0.0%) had good global knowledge level. The global knowledge score of the respondents ranged from 0 to 13, with a mean global knowledge score of  $5.5346 \pm SD 2.17944$ .

#### **4.4 ATTITUDE ASSESSMENT OF RESPONDENTS**

**Table 8: Distribution of respondents according to their attitude score for lifestyle modifications**

Attitude Score	Number of respondents	Percentage %
0 (Strongly negative)	1	0.5%
1 (Negative)	5	2.3%
2 (Neutral)	28	12.9%
3 (Positive)	71	32.7%
4 (Strongly positive)	112	51.6%
Total	217	100%

The distribution of respondents according to their attitude level towards lifestyle modifications is presented in table 8.



**Figure 5: Frequency distribution of respondents according to attitude level towards lifestyle modifications**

The attitude score of respondents were also graded. Respondents with a score of zero were considered to have strongly negative attitude towards lifestyle modifications; respondents who scored 1 have negative attitude; respondents who scored 2 have neutral attitude; respondents who scored 3 have positive attitude; and respondents who score 4 have strongly positive attitude towards lifestyle modifications.

Table 8 and figure 5 show that 1 respondent (0.5%) had a strongly negative attitude towards lifestyle modifications, 5 respondents (2.3%) had a negative attitude towards lifestyle modifications, 28 respondents (12.9%) had a neutral attitude towards lifestyle modifications,

71 respondents (32.7%) had a positive attitude towards lifestyle modifications and 112 respondents (51.6%) had a strongly positive attitude towards lifestyle modifications.

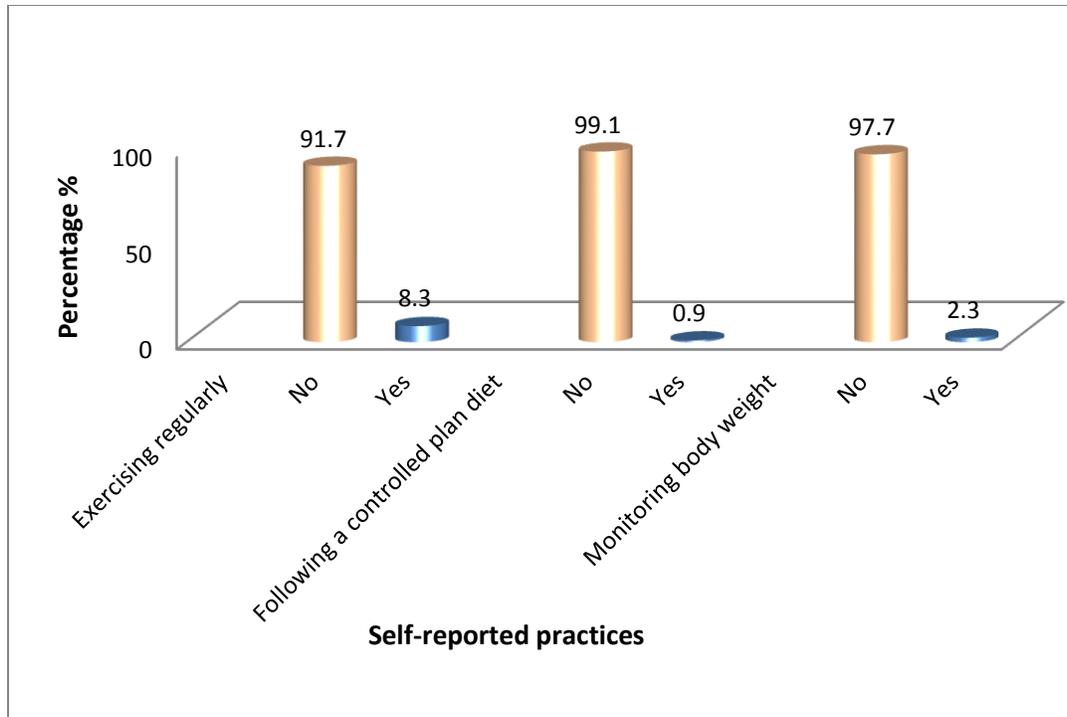
The attitude score ranged from 0 to 4, with a mean attitude score of  $3.33 \pm \text{SD } 0.821$ .

#### **4. 5 PRACTICE ASSESSMENT OF RESPONDENTS**

The distribution of respondents by self-reported practices is presented in table 9.

**Table 9: Frequency distribution of respondents by self-reported practices**

Variable	Number	Frequency (%)
<b>Exercising regularly</b>		
No	199	91.7
Yes	18	8.3
TOTAL	217	100
<b>If yes, how often</b>		
30 min/day or 150 min/week	1	5.6
Less than 30 min/day or less than 150 min/week	17	94.4
More than 30 min/day or more than 150 min/week	0	0
TOTAL	18	100
<b>Following a controlled and planned diet</b>		
No	215	99.1
Yes	2	0.9
TOTAL	217	100
<b>Monitoring body weight</b>		
No	212	97.7
Yes	5	2.3
TOTAL	217	100



**Figure 6: Frequency distribution of respondents by self-reported practices**

Table 9 and figure 6 show that 199 respondents (91.7%) were not exercising regularly and 18 (8.3%) were exercising regularly. Among those respondents 18(8.3%) who reported to exercise regularly, one (5.6%) reported to exercise 30 minutes per day or 150 minutes per week, 17(94.4%) of them reported to exercise less than 30 minutes per day or less than 150 minutes per week, and no one reported exercising more than 30 minutes per day or more than 150 minutes per week.

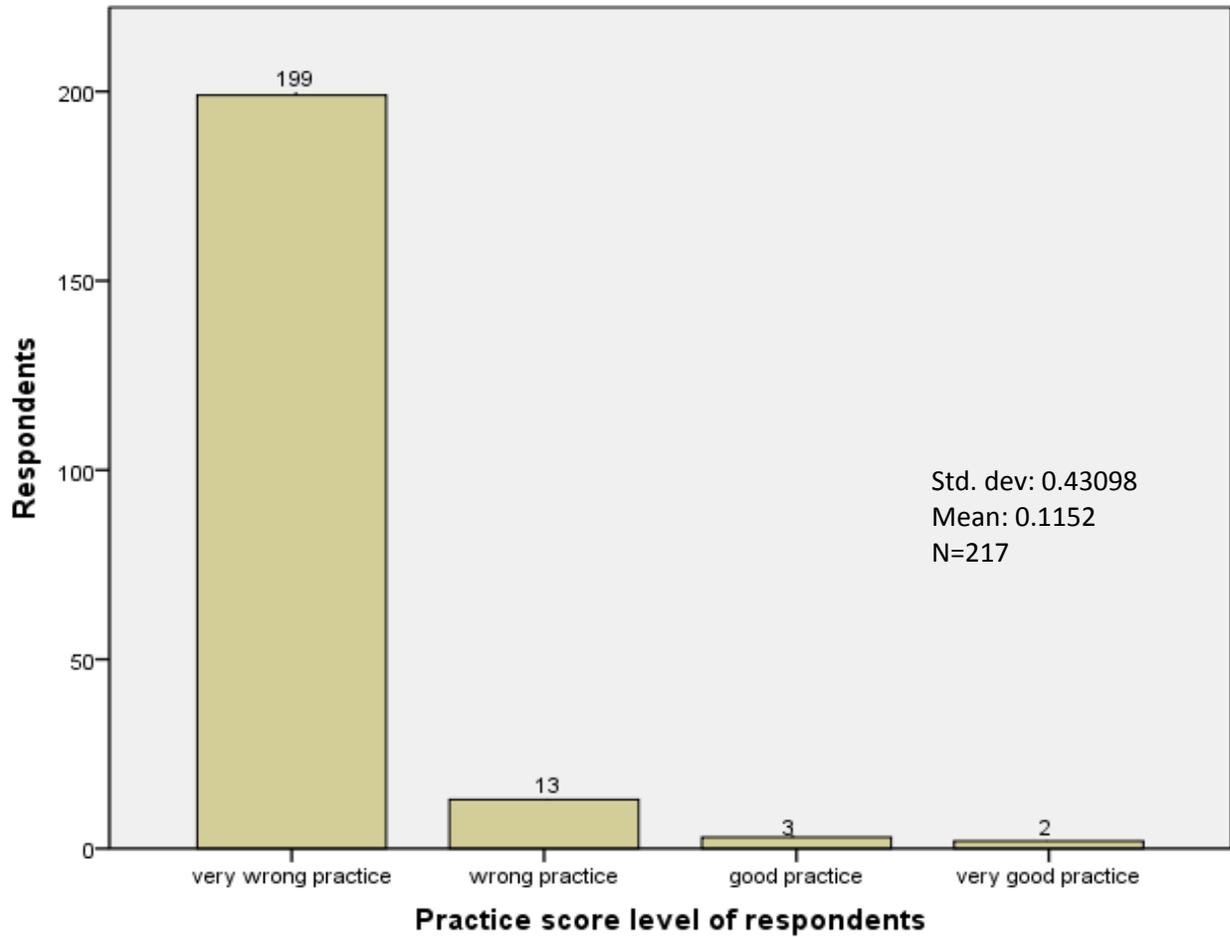
Also, 215 respondents (99.1%) were not following a controlled and planned diet and 2 (0.9%) were following a controlled plan diet; 212 respondents (97.7%) were not monitoring their body weight and 5 (2.3%) were monitoring their body weight.

#### 4.5.1 LIFESTYLE MODIFICATION PRACTICE SCORE OF RESPONDENTS

**Table 10: Distribution of respondents according to lifestyle modification practice score.**

Practice score	Number of respondents	Percentage %
0 (very wrong practice)	199	91.7%
1 (wrong practice)	13	6.0%
2 (good practice)	3	1.4%
3 (very good practice)	2	0.9%
Total	217	100%

The distribution of respondents according to their lifestyle modification practice score is presented in table 10.



**Figure 7: Distribution of respondents according to practice score level regarding lifestyle modifications**

The maximum possible score for this segment of the assessment is 3.

The lifestyle modification practice score of respondents were graded as very wrong practice for respondents who scored zero, wrong practice for respondents who scored 1, good practice for respondents who scored 2 and very good practice for respondents who scored 3.

Table 10 and figure 7 show that 199 respondents (91.7%) had very wrong practice habits regarding lifestyle modification, 13 respondents (6.0%) had wrong practice habits regarding lifestyle modification, 3 respondents (1.4%) had good practice habits regarding lifestyle modification and 2 respondents (0.9%) had very good practice habits regarding lifestyle modification.

The practice score of respondents ranged from 0 to 3, with a mean practice score of  $0.1152 \pm SD 0.43098$ .

#### **4.6 CORRELATIONS BETWEEN KNOWLEDGE, ATTITUDES AND PRACTICES**

**Table 11: Correlations between the global knowledge, attitude and practice level regarding lifestyle modifications**

		Global knowledge level	Attitude level	Practice level
Global knowledge level	Pearson Correlation	1	.170*	.037
	Sig. (2-tailed)		.012	.587
	N	217	217	217
Attitude level	Pearson Correlation	.170*	1	.102
	Sig. (2-tailed)	.012		.132
	N	217	217	217
Practice level	Pearson Correlation	.037	.102	1
	Sig. (2-tailed)	.587	.132	
	N	217	217	217

\*. Correlation is significant at the 0.05 level (2-tailed).

The correlations between the global knowledge, attitudes and practice level are presented in Table 11.

It shows that there is a positive Pearson correlation of 0.170( $p=0.012$ ) between the global knowledge level and the attitude level; a positive Pearson correlation of 0.037 ( $p= 0.587$ ) between the global knowledge level and practice level, a positive Pearson correlation of 0.102( $p=0.132$ ) between the attitude level and practice level.

## **CHAPTER 5**

### **DISCUSSION**

#### **5.1 DISCUSSION OF METHODOLOGY**

The study design used in this study was a descriptive cross sectional study; an efficient way of collecting information on knowledge, attitudes and practices of lifestyle modifications, at a specific period of time from a large number of Type 2 diabetic patients attending the diabetic clinic at Mamelodi Hospital. This study design was appropriate for the information needed. It was quick, cheaper to conduct and easy to administer.

## **5.2 DISCUSSION OF RESULTS**

### **5.2.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS**

#### **5.2.1.1 AGE DISTRIBUTION OF RESPONDENTS**

The overwhelming majority of respondents in this study came from the age groups 41-50 years, 51-60 years and 61-70 years with 21.6%, 42.9% and 21.2% of respondents respectively, which add up to 85.7 % of respondents. This is reflective of the fact that type 2 diabetes mellitus usually has onset after 40 years (S Dugani et al, 2009).

The preponderance of these age groups is also consistent with findings in the 1998 and 2003 South African Demographic and Health Survey in which the majority of South Africans who attended public health facilities in the preceding 30 days period were in the over 45 year age group. (SADHS, 1998; SADHS, 2003).

#### **5.2.1.2 GENDER DISTRIBUTION OF RESPONDENTS**

More females (81.1%) than males (18.9%) participated in this study, a reflection of the gender ratio attendance of patients in the diabetic clinic at Mamelodi hospital.

This finding is in keeping with the results from a study of glycemic control in type 2 diabetes mellitus black South Africans in which 72.5% were female and 27.5% were males (R.T Erasmus et al, 1999).

It also agrees with the result of other morbidity studies which show a preponderance of females in a disease profile study in Umtata General Hospital with 60% females and 40% males (Ragavan M, 1996); and a South India knowledge, attitude and practice study on the effect of diabetes counseling programme with 58.9% females and 41.1% males. (R. Malathy et al, 2011).

### **5.2.1.3 DISTRIBUTION OF RESPONDENTS BY LEVEL OF EDUCATION**

Respondents with no formal education (49.5%) and respondents with primary education (43.9%) jointly constitute an overwhelming 93.4% of respondents in this study.

This indicates that most respondents have little or no education.

This result may be the direct consequence of the past political history of this country in which only few individuals managed to attain high level of education. (M. L Ocampo, 2004)

This finding is similar with the results of Erasmus et al in a study of glycemic control in black South African with type 2 diabetes mellitus which showed that 70.6% of their study patients had less than standard 8 education (R.T Erasmus et al, 1999). It is also consistent with the 1998 South African Demographic and Health Survey in which only 41% of females and 44% of males had some form of primary education. (SADHS, 1998).

#### **5.2.1.4 DISTRIBUTION OF RESPONDENTS BY AVERAGE MONTHLY INCOME**

Majority of respondents in this study have income between 1000 rand and 1999 rand (52.4%) followed by respondents in the 500 rand to 999 rand income bracket (24.5%) and less than 500 rand income bracket (17.9%). These three groups jointly constitute a majority 94.8% of poverty stricken respondents.

Poverty and low income amongst majority of respondents could limit their accessibility and affordability of a well-balanced diet and healthy food. This could explain the result of this study with an overwhelming majority of respondents with less than acceptable lifestyle modification practice score despite a strongly positive attitude.

This finding is in keeping with the results from a study of trends in South African income distribution and poverty in which 64% of black South African have low income (poverty line 515 per capita per month)( Leibbrandt M. et al, 2010).

### **5.2.2 ANTHROPOMETRIC CHARACTERISTICS OF PARTICIPANTS**

Majority of respondents (43.3%) have class I obesity, followed by 20.7% with class 2 obesity, and 7% with class 3 obesity (morbid obesity). 21.6% were overweight and only 7.4% had a normal BMI. Obese respondents (71%) and overweight respondents (21.6%) jointly constitute an overwhelming 92.6 % of respondents in this study.

Obesity has been shown to be one of the major risk factors in the development of type 2 diabetes mellitus (Mustafa Y, 2005). This study has just demonstrated that. In addition, lack of physical activities and adoption of a sedentary life among respondents, seem to contribute to the high proportion of overweight and obese persons.

This high prevalence of overweight (21.6 %) and obesity (71%) among type 2 diabetes mellitus patients who participated in this study have also been documented in other studies. In the study done by Groenewald A.J and colleagues, twenty-three per cent of women were overweight and 41.6% were obese, compared to 14.6% and 7.5% of men respectively. The prevalence of overweight and obesity was the highest (39.6% and 37.2%, respectively) in respondents in the age group 51 to 60 years (Groenewald A.J et al, 2009).

### **5.2.3 KNOWLEDGE ASSESSMENT OF RESPONDENTS**

No respondent had good knowledge and 92.6% of respondents had poor knowledge of the benefits of exercise, weight loss and healthy diet.

This finding agrees with that of R. Malathy and colleague in which majority of respondents (83.3%) had poor knowledge of the benefits of exercise, weight loss and healthy diet (R. Malathy et al, 2011). Low level of education amongst majority of respondents and lack of a well-organized medical nutrition therapy program within the hospital may have contributed to this result.

In contrast to this finding, Ambigapathy and colleagues found in their study that majority of respondents (67.0%) were knowledgeable about lifestyle modifications. They scored 50% and above of the total score for all the categories of questions asked (Ambigapathy R. et al, 2006). The difference in the findings among those studies may be due to the differences in the literacy level of the study patients, the training received by them and availability of information on type 2 diabetes mellitus. In the study by Ambigapathy et al, 47% of respondents had at least secondary education and they had accessibility to a well organised awareness programme on diabetes mellitus which accounts for 45.5% of their sources of knowledge.

The diabetic clinic in which the study was conducted is well equipped with special charts and hand outs on the recommended diet, the importance of exercise and other preventive measure, as well as on symptoms and complications of type 2 diabetes mellitus. Patients are also frequently advised by the medical personnel during their check-ups (Ambigapathy et al, 2003). In this study setting, these facilities are not available for type 2 diabetes mellitus patients and hence might have contributed to a low level of knowledge.

#### **5.2.4 ATTITUDE ASSESSMENT OF RESPONDENTS**

The majority of respondents (51.6%) have strongly positive attitude towards lifestyle modifications, followed by 32.7% of respondents who have positive attitude. These two groups of respondents jointly constitute 84.3% of respondents with positive attitudes in this study.

This finding is similar to those of Mukhopadhyay P et al and of Upadhyay DK. et al in which the majority of respondents (82.8% and 60.3% respectively) had positive attitude towards lifestyle modifications (Mukhopadhyay P et al, 2010) (Upadhyay DK et al, 2008).

### **5.2.5 PRACTICE ASSESSMENT OF RESPONDENTS**

The proportion of respondents with very wrong practice (91.7%) and those with wrong practice (6%) jointly add up to an overwhelming 97.7% majority of respondents with less than acceptable lifestyle modification practice score.

This study was conducted in Mamelodi Township which is one of the biggest Township in Pretoria and also known with high level of crime. This could discourage majority of respondents participating in out-door regular training in terms of jogging or walking for fear of being attacked. Also, majority of them had limited resources and low income which limit their affordability for a well-equipped, secure indoor training center. Finally, lack of information about the role of exercise and weight loss in prevention and management of diabetes mellitus type 2 due to lack of an awareness program on lifestyle modification within the hospital may have contributed to this result.

This finding is similar to those of W.M Kiberenge and colleagues in which majority of respondents (75.6%) had bad practices in relation to lifestyle modifications (W.M Kiberenge et al, 2010).

In contrast to the findings in this study, Ambigapathy R. and colleagues found that majority of respondents (99%) had 50% and above of the total scores on practice (Ambigapathy R. et al, 2006).

### **5.2.6 CORRELATION BETWEEN KNOWLEDGE, ATTITUDE AND PRACTICE**

There was a significant positive correlation ( $r= 0.171$ ,  $p=0.012$ ) between the global knowledge level and the attitude level of respondents in this study. This means that the better respondents were knowledgeable, the better they were willing to observe healthy lifestyle habits. There was a very weak, non-significant positive correlation ( $r=0.037$ ,  $p=0.587$ ) between the global knowledge level and practice level of respondents.

This means that being knowledgeable did not necessarily translate to healthy lifestyle practices.

Finally, there was a weak positive correlation ( $r=0.102$ ) between attitude level and practice level of respondents which was also not significant ( $p=0.132$ ).

This also demonstrates that positive attitude did not necessarily translate to good lifestyle modification practices.

The results found in this study were similar to those in the study by Ambigapathy R. and colleagues in which a significant positive correlation ( $r=0.536$ ,  $p<0.01$ ) was found between knowledge and attitude scores (Ambigapathy R. et al, 2003).

It also agrees with the study results of W.M Kiberenge and colleagues in which a positive correlation was found between knowledge and practice. In this study, 50.7% of respondents with good knowledge had good practices as compared to 37.4% of respondents with poor knowledge of type 2 diabetes mellitus who had good practices. Conversely, 49.3% of those with good knowledge had bad practices compared to 62.6% of those without knowledge. (W.M Kiberenge et al, 2010)

Lack of knowledge and skills of Mamelodi healthcare workers in motivational behaviour change facilitation might have contributed to this result.

There is evidence in the literature that good knowledge can be translated into healthy lifestyle practices by promoting behaviour change using a patient-centred motivational interviewing approach. In a study by Calhoun and colleague in which the utility of motivational interviewing techniques to improve management of type 2 diabetes mellitus among residents of an American Indian reservation was assessed, the comparisons of the means with paired sample t-tests comparing pre- and post-intervention scores showed a decrease in mean unhealthy dietary choices score from 7.92(SD  $\pm$ 2.73) to 7.18 (SD  $\pm$ 1.87) and an increase in mean score of self-reported hours of exercise per week with a positive mean change score of 1.395 (SD  $\pm$ 11.303) (Calhoun et al, 2010).

Also, in a randomized control trial study by West S.D and associates which attempted to determine whether adding motivational interviewing to a behavioural weight control program improves weight loss outcomes and glycemic control for overweight American women with type 2 diabetes mellitus, the comparisons of the mean weight loss scores between the intervention group and the control group after 18 months of intervention showed that both group were effective in promoting weight loss but women in the motivational interviewing group lost significantly more weight than control subjects with a mean weight loss score of 3.5 kg(SD± 6.8) and 1.7 kg( SD± 5.7) respectively. P value  $\leq 0.04$  (West S.D et al, 2007).

### **5.3 LIMITATIONS OF THE STUDY**

In this study, the researcher used a cross-sectional study design which only allowed him to obtain a snap shot of information about the knowledge, attitudes and practices of lifestyle modifications among type 2 diabetes mellitus patients attending diabetic clinic at Mamelodi hospital. He could not establish the causality of the research findings.

Also, very few studies similar to this current study were found in the literature review and most of them aimed at evaluating the knowledge, attitudes and practices about type 2 diabetes mellitus in general instead of lifestyle modifications among type 2 diabetes mellitus patients.

## CHAPTER 6

### CONCLUSION AND RECOMMENDATIONS

#### 6.1 CONCLUSION

The discussion on the findings of this study can be concluded as follows:

1. The knowledge and practice levels of lifestyle modifications among type 2 diabetes mellitus patients attending Mamelodi Hospital are generally low. Nevertheless, majority of these patients have positive attitudes toward healthy lifestyle habits.
2. There is significant positive correlation ( $r= 0.012$ ,  $p<0.05$ ) between knowledge and attitude, and there is a weak non-significant correlation between knowledge and practice as well as attitude and practice.

## **6.2 RECOMMENDATIONS**

The following measures are recommended to address the knowledge and practice deficits uncovered in this study:

1. There is need for the implementation of hospital based lifestyle intervention program to improve the knowledge of patients regarding healthy lifestyle and emphasize the importance of exercise and weight loss in the management of type 2 diabetes mellitus. This should be extended to the primary health care clinics where the majority of patients are seen.
2. Medical nutrition intervention program should be implemented with a multidisciplinary team (Doctor, dietician, social worker, psychologist...)
3. Empower Mamelodi healthcare workers with motivational interviewing knowledge and skills to promote behaviour change and adoption of healthy lifestyle practices by patients.

## REFERENCES

Abdhalah K Ziraba, Jean C Fotso and Rhouné Ochako. Overweight and obesity in urban Africa: A problem of the rich or the poor? BMC Public Health, 2009.

American Diabetes Association. Diagnosis and classification of Diabetes Mellitus. Diabetes Care, Volume 33, Supplement 1, January 2010.

Alan M. Delamater. Improving Patient Adherence. Clinical Diabetes; April 2006 vol. 24 no. 2. 71-77

Albright A, Franz M, Hornsby G, Kriska A, Marrero D, Ullrich I, Verity LS. American College of Sports Medicine position stand: exercise and type 2 diabetes. Med Sci Sports Exerc. 2000;32:1345–1360

Ambigapathy R , Ambigapathy S , H.M Ling: a knowledge, attitude and practice (kap) study of diabetes mellitus among patients attending klinik kesihatan seri manjung. NCD Malaysia 2003, volume 2, No.2

American Dietetic Association: Comparison of the American Dietetic Association (ADA) Nutrition Care Process for nutrition education services and the ADA Nutrition Care Process for medical nutrition therapy (MNT) services [article online]. Available from [www.eatright.org/advocacy/mnt](http://www.eatright.org/advocacy/mnt). Accessed 10 August 2010

American Diabetes Association: Nutrition Recommendations and Interventions for Diabetes: A position statement of the American Diabetes Association. *Diabetes care*, volume 31, no supplement 1, January 2008. S69-S70

American Diabetes Association: Summary of Revisions for the 2010 Clinical Practice Recommendations. *Diabetes care*. Volume 33. no supplement 1, January 2010. S3

Appel LJ, Brands MW, Daniels SR, Karanja N, Elmer PJ, Sacks FM: Dietary approaches to prevent and treat hypertension: a scientific statement from the American Heart Association. *Hypertension* 47:296 –308, 2006

Baptiste-Roberts K, Barone BB, Gary TL, et al. Risk factors for type 2 diabetes among women with gestational diabetes: a systematic review. *Am J Med*. Mar 2009; 122(3): 207-214.e4.

Bennett PH, Rewers MJ, Knowler WC: Epidemiology of diabetes mellitus. In: Daniel Porte, Jr and Robert S Sherwin eds Ellenberg and Rifkin's Diabetes Mellitus 1996 ,fifth edition: 373-4001.

Black K. (2004). Business Statistics for Contemporary Decision Making (Fourth (Wiley Student Edition for India). [http://en.wikipedia.org/wiki/Systematic\\_sampling#cite\\_ref-ken\\_black\\_india\\_0-0](http://en.wikipedia.org/wiki/Systematic_sampling#cite_ref-ken_black_india_0-0). Access online on the 14<sup>th</sup> October 2010.

D. Bradshaw, M. Schneider, R. Norman, D. Bourne. Mortality patterns of chronic diseases of lifestyle in South Africa. <http://www.mrc.ac.za/chronic/cdlchapter2.pdf>. Access online on the 10<sup>th</sup> July 2011.

Braith RW, Magyari PM, Pierce GL, Edwards DG, Hill JA, White LJ, Aranda JM Jr. Effect of resistance exercise on skeletal muscle myopathy in heart transplant recipients. *Am J Cardiol.* 2005;95:1192–1198.

Brand-Miller J, Hayne S, Petocz P, Colagiuri S: Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. *Diabetes Care* 26:2261–2267, 2003

Burnet D.L, L.D Elliott, MT Quinn et al. Preventing Diabetes in the Clinical Setting.  
J Gen intern med 2006; 21:84–93

Calhoun Darren, Rod Brod, Kristin Kirlin, Barbara V.et al. Effectiveness of motivational interviewing for improving self-care among Northern Plains Indians with Type 2 Diabetes. Diabetes Spectrum Volume 23, Number 2, 2010.

Castaneda C, Layne JE, Munoz-Orians L, Gordon PL, Walsmith J, Foldvari M, Roubenoff R, Tucker KL, Nelson ME. A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. Diabetes Care. 2002; 25: 2335–2341

Charlton KE, Levitt NS, Lombard CJ. The prevalence of diabetes mellitus and associated risk factors in elderly coloured South Africans. S Afr Med J 1997; 87 (suppl 3):364-7

Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr, Roccella EJ: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 289:2560– 2572, 2003.

David J. A. Jenkins et al. "Effect of a Low–Glycemic Index or a High–Cereal Fiber Diet on Type 2 Diabetes". JAMA. 2008; 300(23):2742-2753.

Dela F, Larsen JJ, Mikines KJ, Ploug T, Petersen LN, Galbo H. Insulin-stimulated muscle glucose clearance in patients with NIDDM. Effects of one-legged physical training. Diabetes 1995; 44:1010–1020.

Diabetes prevention program (DPT), Diabetes care 2003; 25: 10, 1869

Department of Health & South African Medical Research Council. 2007. Adult Health Risk Profiles. Second South Africa Demographic and Health Survey 2003. Chapter 13. (Full Report). Pretoria: DOH. (In press).

Dugani S, D.Lam. Toronto Notes 2009: Comprehensive Medical Reference annual. University of Toronto. PH16-PH17

Dugani S, D.Lam. Toronto Notes 2009: Comprehensive Medical Reference annual. University of Toronto. FM21-FM23

Dugani, D.Lam. Toronto Notes 2009: Clinical Handbook. Diabetes mellitus.

University of Toronto. Page 115

Dunstan DW, Daly RM, Owen N, Jolley D, De Courten M, Shaw J, Zimmet P.

High-intensity resistance training improves glycemic control in older patients with type 2 diabetes. *Diabetes Care* 2002; 25: 1729–1736

Dunstan D, Zimmet P, Welborn T, et al. The rising prevalence of diabetes and impaired glucose tolerance: the Australian Diabetes, Obesity and Lifestyle Study. *Diabetes Care* 2002; 25: 829-834

Erasmus RT, Blanco EB, Okesina AB, Gqweta Z, Matsha T: Assessment of glycaemic control in stable type 2 black South African diabetics attending a peri-urban clinic. *Postgrad. Med. J.* 75:603-606.

Feinglos M.N and Bethel M. A.Type 2 Diabetes Mellitus: An Evidence-Based Approach to Practical Management. Humana Press, Totowa, NJ: 135-147,2007

Franz MJ, Bantle JP, Beebe CA, Brunzell JD, Chiasson JL, Garg A, Holzmeister LA, Hoogwerf B, Mayer-Davis E, Mooradian AD, Purnell JQ, Wheeler M: Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. *Diabetes Care* 25:148 –198, 2002

Giacca A, Groenewoud Y, Tsui E, McClean P, Zinman B. Glucose production, utilization, and cycling in response to moderate exercise in obese subjects with type 2 diabetes and mild hyperglycemia. *Diabetes* 1998;47:1763–1770.

Ghazanfari Z, F Ghofranipour , SS Tavafian , F Ahmadi, A Rajab. Lifestyle Education and Diabetes Mellitus Type 2: A Non-Randomized Control Trial. *Iranian J Publ Health*, Vol. 36, No.2, 2007, pp.68-72

Groenewald AJ, Van Wyk HJ, Walsh CM, Van Zyl S, Van der Merwe LJ. Prevalence of diabetes mellitus in the rural southern Free State. *SA Fam Pract* 2009, Vol 51 No 6

Hansen HP, Tauber-Lassen E, Jensen BR, Parving HH: Effect of dietary protein restriction on prognosis in patients with diabetic nephropathy. *Kidney Int* 62:220– 228, 2002

Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; 116: 1081-93.

Haslett C, Bonn Ann and Chilvers E. 2002. Diabetes Mellitus. *Davidson's Principles of Medicine* 19<sup>th</sup> Edition. pp 642-682.

Herman W.H, et al. "The cost effectiveness of lifestyle modification or metformin preventing type 2 diabetes in adults with impaired glucose tolerance".  
*Ann Intern Med.* 2005 Mar 1; 142 (5): 323-32.

Houmard JA, Tanner CJ, Slentz CA, Duscha BD, McCartney JS, Kraus WE.  
Effect of the volume and intensity of exercise training on insulin sensitivity.  
*J Appl Physiol* 2004;96:101–106.

<http://medical.bizcommunity.com>. The growing global burden of diabetes.  
Access on line on 27/5/2008

<http://www.who.int/dietphysicalactivity/en/>. "Diet and physical activity: a public health priority". Access online on the 3<sup>rd</sup> Jun 2010

<http://www.who.int/dietphysicalactivity/en/>. “The global strategy on diet, Physical activity and Health”. Access online on the 4<sup>th</sup> Jun 2010.

<http://www-personal.ksu.edu/~goe/lec05bsl/index.htm>. “Types of probability sampling designs”. Access online on the 3<sup>rd</sup> Jun 2010.

Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, Konstam MA, Mancini DM, Michl K, Oates JA, Rahko PS, Silver MA, Stevenson LW, Yancy CW, Antman EM, Smith SC Jr, Adams CD, Anderson JL, Faxon DP, Fuster V, Halperin JL, Hiratzka LF, Hunt SA, Jacobs AK, Nishimura R, Ornato JP, Page RL, Riegel B: ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult–Summary Article: ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Rhythm Society. *Circulation* 112:1825– 1852, 2005

Maria Lizet Ocampo. A brief history of educational inequality from apartheid to the present. [http://www.stanford.edu/~jbaugh/saw/Lizet\\_Education\\_Inequity.html](http://www.stanford.edu/~jbaugh/saw/Lizet_Education_Inequity.html). Accessed on 8 Jun 2011.

International Diabetes Federation (2009): IDF Diabetes Atlas, 4<sup>th</sup> edition. Available at <http://www.idf.org> (accessed 16/08/2010).

Jenkins DJ, Wolever TM, Taylor RH, Barker H, Fielden H, Baldwin JM, Bowling AC, Newman HC, Jenkins AL, Goff DV: Glycemic index of foods: a physiological basis for carbohydrate exchange. *Am J Clin Nutr* 34:362–366, 1981

Jennifer Hicks. A Sedentary Lifestyle and Diabetes. <http://diabetes.about.com/od/familymatters/a/lifewirewriters.htm>. Updated November 04, 2008, access online on 05/08/2010

Joshi P, Joshi S. Management of Type 2 diabetes: Treating targets and strategies. *SA Fam Pract* 2009;51(1):05-09

Keys A, Taylor HL, Blackburn H, Brozek J, Anderson JT. Mortality and coronary heart disease among men studied for 23 years. *Arch Intern Med* 1971; 128: 201-214.

Kiat H. East-west Medical Makeover. Sydney: Image of Distinction, 2002

Kiberenge W. M, Ndegwa Z.M, E. Wangechi Njenga, E. Wangui Muchemi. Knowledge, attitude and practices related to diabetes among community members in four provinces in Kenya: a cross sectional study. The Pan African Medical Journal, 2010; 7:2

Klein S, Sheard NF, Pi-Sunyer X, Daly A, Wylie-Rosett J, Kulkarni K, Clark NG: Weight management through lifestyle modification for the prevention and management. Am J Clin Nutr. 2004 Aug;80(2):257-63.

Knowler WC, Barrett-Connor E, Fowler SE, et al. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002; 346:393-403.

Krauss RM, et al. 2000. AHA Dietary Guidelines. Revision 2000: A statement for healthcare professionals from the nutrition committee of the American Heart Association. Stroke: 31: 2751-66

Leibbrandt M, Ingrid Woolard, Arden Finn, Jonathan Argent

"Trends in South African Income Distribution and Poverty since the Fall of Apartheid",

OECD Social, Employment and Migration Working Papers. No. 101, 2010

Leigh Hopewell. The growing global burden of diabetes. <http://medical.bizcommunity.com>.

Access on line on 27/5/2008

Levitt N.S. diabetes in Africa: epidemiology, management and healthcare challenges.

Heart 24(2008): 1376-1382.

Liese AD, Roach AK, Sparks KC, Marquart L, D'Agostino RB Jr, Mayer-Davis EJ:

Whole-grain intake and insulin sensitivity: the Insulin Resistance Atherosclerosis

Study. Am J Clin Nutr 78:965–971, 2003

R Malathy, MP Narmadha, S Ramesh, Jose M Alvin, and Babu N Dinesh. Effect of a diabetes counseling programme on knowledge, attitude and practice among diabetic patients in Erode district of South India. J Young Pharm. 2011 Jan-Mar; 3(1): 65–72.

Management of type 2 diabetes: rationale and strategies: a statement of the American Diabetes Association, the North American Association for the Study of Obesity, and the American Society for Clinical Nutrition. *Diabetes Care* 27:2067–2073, 2004

Mayfield J. Diagnosis and classification of Diabetes Mellitus: New Criteria. *American Academy of Family Physician*. October 15, 1998. Access only on 20 July 2011.

Meyer KA, Kushi LH, Jacobs DR Jr, Slavin J, Sellers TA, Folsom AR: Carbohydrates, dietary fiber, and incident type2 diabetes in older women. *Am J Clin Nutr* 71:921–930, 2000

Motala AA, Omar MA, Pirie FJ: Diabetes in Africa. *Epidemiology of type 1 and type 2 diabetes in Africa. J Cardiovasc Risk* 2003, 10:77-83.

Mukdad A, et al. NHANES III Diabetes *Care* 2000; 23: 1278-83

Mukhopadhyay P, Bhaskar P, Debasis D, Nilanjan S, Rachna M. Perceptions and practices of type 2 diabetes: A cross-sectional study in a tertiary care hospital in Kolkata. *Int J Diab Dev Ctries*. July-September 2010. Volume 30. Issue 3.

Mustafa Yenigün, Tunga Türker, Hayriye Esra Ataoğlu, Levent Ümit Temiz, Süleyman Ahbab. From obesity to Diabetes. Cilt: 43 Sayı: 1 Mart 2005..

Nation Health and Nutrition Examination survey-I (NHANES-I) Follow -up study. U.S Healty and Human services. National. Center for Health statistics, 2000.

Narita T, Koshimura J, Meguro H, Kitazato H, Fujita H, Ito S: Determination of optimal protein contents for a protein restriction diet in type 2 diabetic patients with microalbuminuria. Tohoku J Exp Med 193:45–55, 2001.

O'Donovan G, Kearney EM, Nevill AM, Woolf-May K, Bird SR. The effects of 24 weeks of moderate- or high-intensity exercise on insulin resistance. Eur J Appl Physiol 2005; 95:522–528.

Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA 295:1549-1555. 2006

Ogunbanjo GA ( 2006) Type 2 Diabetes: An evidence-based approach to its management by the Family Practitioner. CME; 24(10): 568-572.

Omar MA, Seedat MA, Dyer RB, et al. South African Indians show a high prevalence of NIDDM and bimodality in plasma glucose distribution patterns. *Diabetes Care* 1994; 17:70-3.

S.Palaian , et al. Knowledge, Attitude, and Practice Outcomes: Evaluating the Impact of Counseling in Hospitalized Diabetic Patients in India. 384 P&T. July 2006. Vol. 31 No. 7

Pijls LT, de Vries H, van Eijk JT, Donker AJ: Protein restriction, glomerular filtration rate and albuminuria in patients with type 2 diabetes mellitus: a randomized trial. *Eur J Clin Nutr* 56:1200–1207, 2002.

Puoane T, Steyn K, Bradshaw D, Laubscher R, Fourie J, Lambert V, et al. Obesity in South Africa: the South African demographic and health survey. *Obesity Research* 2002; 10(10): 1038–48.

Ragavan M. Disease profile of adult patients seen in the department of family medicine Umtata general hospital, Umtata. *S Afr Fam Pract* 1996;17: 16-21.

Rakel R.E. textbook of family medicine. Diabetes mellitus. 2009, Chap 24: 989-1020.

Randy W. Braith and Kerry J. Stewart. Resistance Exercise Training: Its role in the prevention of cardiovascular disease. *Circulation* 2006;113;2642-2650

Reddy SP, Panday S, Swart D, Jinabhai CC, Amosun SL, James S, et al. A national youth risk behaviour survey was conducted in 2002 in which young people aged 13-19 years reported on their physical activity and television viewing patterns. Umthenthe Uhlaba Usamila – The South African Youth Risk Behaviour Survey 2002. Cape Town: 10 South African Medical Research Council, 2003. [On line]. Available: <http://www.mrc.ac.za/healthpromotion/reports.htm>. [2011, 15 January].

Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 1997, 20:1183-1197.

Resistance training

:[http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Resistance\\_training](http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Resistance_training), accessed online on 1 August 2010.

Rheeder P. Type 2 diabetes:the emerging epidemic. *SA Fam Pract* 2006;48(10):20

Russell L. Rothman, Robb Malone, et al. The Spoken Knowledge in Low Literacy in Diabetes Scale: A Diabetes Knowledge Scale for Vulnerable patients.

The Diabetes Educator 2005; 31; 215

Ryan caisson. Medical Nutrition Therapy for Successful Control of Type 2 Diabetes

<http://ezinearticles.com/?Medical-Nutrition-Therapy-For-Successful-Control-of-Type-2-Diabetes&id=4358580>. Access online on the 6<sup>th</sup> December 2010.

SADHS,” Educational level of household member”

<http://www.doh.gov.za/facts/sadhs2003/part2.pdf>, accessed online 15/03/2011

SADHS. “Self-reported chronic condition”

<http://www.doh.gov.za/facts/1998/sadhs98/chapter2.pdf>, accessed online 15/03/2011

Sara F. Morris and Judith Wylie-Rosett. Medical Nutrition Therapy: A Key to Diabetes Management and Prevention. Clinical Diabetes; January 1, 2010 vol. 28 no. 1. 12-18

Schwellnus MP, Derman EW, Dreyer M, Nossel C, Whitesman S, Patel DN.

“Healthy lifestyle interventions in general practice part 4: Lifestyle and diabetes mellitus”

SA Fam Pract 2009; 51(1): 19-25

Schulze MB, Liu S, Rimm EB, Manson JE, Willett WC, Hu FB: Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *Am J Clin Nutr* 80:348–356, 2004

SEMDSA. Type 2 diabetes prevalence data. Available from <http://www.semDSA.org.za/prevalencedata.htm> (Accessed 03/12/2007).

Sheard NF, Clark NG, Brand-Miller JC, Franz MJ, Pi-Sunyer FX, Mayer-Davis E, Kulkarni K, Geil P: Dietary carbohydrate (amount and type) in the prevention and management of diabetes: a statement of the American Diabetes Association. *Diabetes Care* 27:2266–2271, 2004

Sigal RJ, Kenny GP, Boulé NG, Wells GA, Prud'homme D, Fortier M, Reid RD, Tulloch H, Coyle D, Phillips P, Jennings A, Jaffey J. Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: a randomized trial. *Ann Intern Med.* 2007; 147:357–369.

Stephan F. E. Praet and Luc J. C. van Loon. “Optimizing the therapeutic benefits of exercise in type 2 diabetes”. *Appl physiol*, 2007 Oct;103(4): 1113-20 Epub 2007 Jul 26

Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, Hadden D, Turner RC, Holman RR: Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 321:405–412, 2000

Subish Palaian , et al. Knowledge, Attitude, and Practice Outcomes: Evaluating the Impact of Counseling in Hospitalized Diabetic Patients in India. 384 P&T. July 2006. Vol. 31 No. 7

Tabora J.D. Diabetes mellitus complications.

<http://www.healthypinoy.com/health/articles/diabetes/complications.html>. Access online on the 08/08/2011.

Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V, Uusitupa M: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 344:1343–1350, 2001

Upadhyay DK, Palaian S, Shankar R, Mishra P. Knowledge, attitude and practice about diabetes among diabetes patients in western Nepal. *Rawal Med J.* 2008;33:1

U.S. Department of Health and Human Services: Final MNT regulations.CMS-1169-FC. Federal Register, 1 November 2001. 42 CFR Parts 405, 410, 411, 414, and 415

West S.D, V. Dilillo, Z. Bursac, S. A. Gore, P.G. Greene .Motivational interviewing improves weight loss in women with type 2 diabetes. Diabetes care volume 30, number 5, may 2007.

WIKIPEDIA, the free Encyclopedia. Aerobic training.

[http://en.wikipedia.org/wiki/Aerobic\\_exercise#cite\\_ref-0](http://en.wikipedia.org/wiki/Aerobic_exercise#cite_ref-0). Access online on the 10<sup>th</sup> December 2010.

WIKIPEDIA, the free Encyclopedia. Resistance training.

[http://en.wikipedia.org/wiki/Resistance\\_training](http://en.wikipedia.org/wiki/Resistance_training). Access online on the 10<sup>th</sup> December 2010.

WIKIPEDIA, the free Encyclopedia. [http://en.wikipedia.org/wiki/Selection\\_bias](http://en.wikipedia.org/wiki/Selection_bias). Accessed online on September 17, 2010.

WIKIPEDIA, the free Encyclopedia.[http://en.wikipedia.org/wiki/Systematic\\_bias](http://en.wikipedia.org/wiki/Systematic_bias). Retrieved on September 17, 2010.

WIKIPEDIA, the free Encyclopedia. [http://en.wikipedia.org/wiki/Systematic\\_sampling](http://en.wikipedia.org/wiki/Systematic_sampling). Accessed online on April 10, 2011.

WIKIPEDIA, the free Encyclopedia. <http://en.wikipedia.org/wiki/Statistics>. Accessed online on July 18, 2011

Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27:1047–53.

Williams G, Pickup JC. *Handbook of Diabetes* 2000; 16-17.

William D. McArdle, Frank I. Katch, Victor L. Katch. *Essentials of exercise physiology*, Volume 1. Education 2006; Chap 16: 615

W.H.O. “The global strategy on diet, Physical activity and Health”.  
<http://www.who.int/dietphysicalactivity/en/>. Access online on the 4<sup>th</sup> Jun 2010.

World Health Organization/International Diabetes Federation. Report of WHO/IDF consultation. Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia. Geneva: WHO Press; 2006:1-46.

Yamanouchi K, Shinozaki T, Chikada K, et al. Daily walking combined with diet therapy is a useful means for obese NIDDM patients not only to reduce body weight but also to improve insulin sensitivity. *Diabetes Care* 1995;18:775–778.