MANAGEMENT OF TYPE 2 DIABETES MELLITUS BY DIABETIC CLIENTS IN NYANDARUA COUNTY, KENYA

MUOKI FRANCIS MATHEKA (BSc.N)
Q57/CTY/PT/20598/2012

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF PUBLIC HEALTH (MONITORING AND EVALUATION) IN THE SCHOOL OF PUBLIC HEALTH OF KENYATTA UNIVERSITY

NOVEMBER, 2017
DECLARATION

This thesis is my original work and has not been presented in any other university for the award of a degree or for any other award.

Signature .................................  Date ..............................

Muoki Francis Matheka  - Q57/CTY/PT/20598/2012
Department of Community Health

SUPERVISORS

We confirm that the work reported in this thesis was carried out by the candidate under our supervision;

Signature .................................  Date ..............................

Prof. Ephantus Kabiru
School of Public Health,
Kenyatta University

Signature .................................  Date ..............................

Dr. Anthony Wanyoro
Department of Obstetrics and Gynaecology,
Kenyatta University
DEDICATION

I dedicate this thesis to diabetic clients in Nyandarua County and all persons with interest in understanding management of type 2 diabetes mellitus.
ACKNOWLEDGEMENTS

I sincerely thank my supervisors; Prof. Ephantus Kabiru and Dr. Anthony Wanyoro for their support, academic guidance and professional input throughout the study. You have been a great inspiration to me and your devotion to seeing me complete this thesis has been a great sacrifice and favour to me. God bless you abundantly.

I wish to also thank all diabetic clients who attended clinic at North Kinangop Catholic Hospital and Engineer sub-County hospital for their co-operation and participation in the study.

Lastly, my gratitude goes to my friends for their constant encouragement, support and prayers through my study period. Thank you for your patience and great love.
# TABLE OF CONTENTS

DECLARATION .............................................................................................................. ii

DEDICATION ................................................................................................................ iii

ACKNOWLEDGEMENTS ............................................................................................... iv

TABLE OF CONTENTS ................................................................................................. v

LIST OF APPENDICES ................................................................................................. x

LIST OF TABLES ........................................................................................................... xi

LIST OF FIGURES .......................................................................................................... xii

ABBREVIATIONS AND ACRONYMS .......................................................................... xiii

OPERATIONAL DEFINITION OF TERMS .................................................................. xiv

ABSTRACT ..................................................................................................................... xv

CHAPTER ONE: INTRODUCTION ............................................................................. 1

1.1 Background to the study .................................................................................... 1

1.2 Statement of the problem .................................................................................. 2

1.3 Justification of the study .................................................................................. 3

1.4 Research questions ............................................................................................ 4

1.5 Null hypothesis .................................................................................................. 4

1.6 Research Objectives .......................................................................................... 4

1.6.1 Main objective ............................................................................................... 4

1.6.2 Specific objectives ....................................................................................... 4
1.7 Significance and anticipated outcome ................................................................. 5

1.8 Conceptual framework ....................................................................................... 5

CHAPTER TWO: LITERATURE REVIEW .................................................................. 6

2.1 Overview of diabetes mellitus .......................................................................... 7

2.2 Classification of diabetes mellitus .................................................................... 8

2.2.1 Type 1 diabetes mellitus ............................................................................... 8

2.2.2 Type 2 diabetes mellitus ............................................................................... 9

2.2.3 Gestational diabetes mellitus ....................................................................... 9

2.3 Pathogenesis of type 2 diabetes mellitus ......................................................... 10

2.4 Risk factors ....................................................................................................... 11

2.5 Signs and Symptoms of diabetes .................................................................... 12

2.6 Complications of diabetes ............................................................................... 13

2.7 Diagnosis of type 2 diabetes mellitus .............................................................. 14

2.7.1 Clinical diagnosis ......................................................................................... 14

2.7.2 Laboratory diagnosis ................................................................................... 15

2.8 Management of diabetes mellitus ................................................................... 16

2.8.1 Diet ............................................................................................................... 16

2.8.2 Physical activity/exercise ............................................................................ 17

2.8.3 Blood glucose control .................................................................................. 17

2.8.4 Personal (home) glucose monitoring ........................................................... 18
2.8.5 Use of anti-diabetic drugs ................................................................. 19
2.8.5.1 Oral medication ............................................................... 19
2.8.5.2 Use of insulin ............................................................... 19
2.9 Management practices for type 2 diabetes mellitus ..................... 20
2.10 Influence of socio-demographic factors on type 2 diabetes mellitus .......... 21
2.11 Summary of literature review ................................................ 21

CHAPTER THREE: MATERIALS AND METHODS ......................... 23
3.1 Study design .................................................................................. 23
3.2 Study variables .............................................................................. 23
3.2.1 Dependent variables ............................................................. 23
3.2.2 Independent variables ........................................................... 23
3.3 Location of study ........................................................................... 24
3.4 Study population ........................................................................... 24
3.5 Inclusion criteria ........................................................................... 24
3.6 Exclusion criteria ........................................................................... 25
3.7 Sampling techniques and sample size .......................................... 25
3.7.1 Sampling techniques .............................................................. 25
3.7.2 Sample size determination ....................................................... 25
3.8 Data collection tool ....................................................................... 27
3.9 Pre-testing ........................................................................................ 27
3.9.1 Validity........................................................................................................................................... 27
3.9.2 Reliability....................................................................................................................................... 27
3.10 Data collection techniques.............................................................................................................. 28
3.11 Data management and analysis ..................................................................................................... 28
3.12 Logistical and Ethical considerations ............................................................................................ 29

CHAPTER FOUR: RESULTS.................................................................................................................. 30

4.1 Socio-demographic and economic characteristics of study respondents ........... 30
4.1.1 Socio-demographic characteristics of study respondents ..................................................... 30
4.1.2 Socio-economic characteristics of the study participants .................................................... 31
4.2 Knowledge on management interventions for type 2 diabetes mellitus ................. 31
4.2.1 Source of information on diabetes mellitus ........................................................................ 31
4.2.2 Screening for diabetes mellitus ............................................................................................. 32
4.2.3 Enrolment into diabetes follow up program ........................................................................ 33
4.2.4 Duration on follow up in the diabetes management program ............................................ 34
4.2.5 Knowledge on T2DM management interventions among study participants .......... 34
4.3 Practices for management of T2DM among study participants ...................................... 36
4.3.1 Practice on balanced diet for diabetics ................................................................................ 36
4.3.2 Duration of physical activity/exercise session .................................................................... 37
4.3.3 Frequency of body weight monitoring ................................................................................ 38
4.3.4 Use of anti-diabetic drugs (medication control) ................................................................. 38
4.4 Influence of participants’ socio-demographic and economic characteristics on T2DM management practices ................................................................. 40

4.4.1 Bivariate analysis of association between socio-demographic characteristics and management of T2DM ................................................................. 40

4.4.2 Bivariate analysis of association between socio-economic characteristics and management of T2DM ................................................................. 42

CHAPTER FIVE: DISCUSSION, CONCLUSION & RECOMMENDATIONS 43

5.1 Discussion .............................................................................................................. 43

5.1.1 Knowledge on management interventions .................................................. 43

5.1.2 Practices for management of T2DM ............................................................ 45

5.1.3 Influence of participants’ socio-demographic characteristics on management of T2DM ................................................................. 46

5.2 Conclusions ........................................................................................................ 48

5.3 Recommendations ............................................................................................. 48

5.4 Recommendation for further research .............................................................. 49

REFERENCES ........................................................................................................... 50

APPENDICES ........................................................................................................... 53
LIST OF APPENDICES

Appendix I. Informed Consent form .......................................................... 53

Appendix II. Researcher administered questionnaire .................................. 55

Appendix III. Kenyatta University Ethical approval letter .............................. 61

Appendix IV. NACOSTI Research Permit .................................................... 62

Appendix V. NACOSTI research authorization ............................................. 63

Appendix VI. Nyandarua County Commissioner research authorization ............ 65

Appendix VII. Nyandarua County Director of Health research authorization .... 66

Appendix VIII. Nyandarua County Director of Education research authorization . 67

Appendix IX. Study Area map ....................................................................... 68
# LIST OF TABLES

Table 3.1 Proportionate sampling of subjects in the study area ........................................ 26

Table 4.1 Socio-demographic characteristics of study participants ..................................... 30

Table 4.2 Socio-economic characteristics of study participants .......................................... 31

Table 4.3 Enrolment into diabetes management program ...................................................... 33

Table 4.4 Management of T2DM by use of drugs ................................................................. 39

Table 4.5 Association between respondents’ socio-demographic and socio-economic characteristics and management of T2DM ................................................................. 40

Table 4.6 Bivariate analysis of association between socio-demographic characteristics and management of T2DM ................................................................. 41

Table 4.7 Bivariate analysis of association between socio-economic characteristics and management of T2DM ................................................................. 42
LIST OF FIGURES

Figure 1.1 Conceptual framework ...................................................................................... 6

Figure 4.1 Participants’ source of information about Diabetes Mellitus .................. 32

Figure 4.2 Reasons for screening for Diabetes Mellitus ............................................. 32

Figure 4.3 Participants’ duration on follow up in diabetes management program .... 34

Figure 4.4 Participants’ level of knowledge on T2DM management interventions.... 35

Figure 4.5 Participants’ level of knowledge on T2DM management interventions.... 35

Figure 4.6 Participants’ practice on diabetic balanced diet ........................................ 37

Figure 4.7 Duration of physical activity/exercise sessions in a day ......................... 37

Figure 4.8 Frequency of body weight monitoring by the participants .................... 38
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDL</td>
<td>Chronic Disease of Lifestyle</td>
</tr>
<tr>
<td>CGM</td>
<td>Continuous Glucose Monitoring</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>GDM</td>
<td>Gestation Diabetes Mellitus</td>
</tr>
<tr>
<td>IDF</td>
<td>International Diabetes Federation</td>
</tr>
<tr>
<td>IGR</td>
<td>Impaired Glucose Regulation</td>
</tr>
<tr>
<td>IGT</td>
<td>Impaired Glucose Tolerance</td>
</tr>
<tr>
<td>KDA</td>
<td>Kenya diabetes association</td>
</tr>
<tr>
<td>KDHS</td>
<td>Kenya Demographic and Health Survey</td>
</tr>
<tr>
<td>KNDS</td>
<td>Kenya National Diabetes Strategy</td>
</tr>
<tr>
<td>KUERC</td>
<td>Kenyatta University Ethics Review Committee</td>
</tr>
<tr>
<td>MDGs</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>MODY</td>
<td>Maturity Onset Diabetes of the Young</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NACOSTI</td>
<td>National Commission for Science, Technology and Innovation</td>
</tr>
<tr>
<td>NCDs</td>
<td>Non-Communicable Diseases</td>
</tr>
<tr>
<td>NIDDM</td>
<td>Non-insulin Dependent Diabetes Mellitus</td>
</tr>
<tr>
<td>OGGT</td>
<td>Oral Glucose Tolerance Test</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>T2DM</td>
<td>Type 2 Diabetes Mellitus</td>
</tr>
<tr>
<td>WDF</td>
<td>World Diabetes Foundation</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
OPERATIONAL DEFINITION OF TERMS

**Diabetic client:** Refers to a person with diabetes, 18 years and above, who is on follow up care through diabetic outpatient clinic in a health facility.

**Management of T2DM:** Is the ability of a diabetic client to monitor and maintain their blood glucose within normal levels.

**Management interventions** Refers to the prescribed approaches for maintaining blood glucose within levels that do not expose the client to development of complications.

**Long-serving T2DM client:** Any T2DM client who has been on follow up for diabetes management for a period of at least six (6) months.

**Good knowledge level:** Refers to any client who had a score of 5 and above having assessed knowledge on causes of poor blood sugar levels, signs of poor blood sugar level, healthy diabetes diet, maintenance of body weight and diabetes associated complications.

**Average knowledge level:** Refers to any client who had a score of between 4 and 5 having assessed knowledge on causes of poor blood sugar levels, signs of poor blood sugar level, healthy diabetes diet, maintenance of body weight and diabetes associated complications.

**Poor knowledge level:** This refers to anyone who had a score of 3 and below having assessed knowledge on causes of poor blood sugar levels, signs of poor blood sugar level, healthy diabetes diet, maintenance of body weight and diabetes associated complications.
ABSTRACT

Type 2 diabetes mellitus (T2DM), is the most common form of diabetes, characterized by disorders of insulin resistance, insulin secretion, obesity, lipid abnormalities, hypertension, and cardiovascular diseases. Physical inactivity and the adoption of sedentary lifestyle often accompanying the transition to modern diet are key factors leading to this condition. The marked increase of Type 2 Diabetes Mellitus (T2DM) necessitates active development and implementation of efficient prevention programs as the condition is a major public health concern in the world. The main objective of the study was to determine management of T2DM by diabetic clients in North Kinangop Catholic hospital and Engineer sub-County hospital in Nyandarua South sub-County, Kenya. A cross-sectional facility based study was carried out in the two facilities. The study population comprised T2DM clients, residents of the sub-County aged 18 years and above who consented to participate in the study. Data collection was by use of researcher administered questionnaire. The data was entered, coded and cleaned in the Microsoft excel software, and then transferred into SPSS Version 20.0 (SPSS Inc, USA) for analysis. Descriptive statistics were computed to generate frequencies, mean and median. Relationship between levels of knowledge on the recommended management interventions, socio-demographic factors and management practices were examined using chi-square and bivariate analyses. Majority of the clients were females (59.5%). Majority of participants (83.3%) had never been screened for DM except at the point of diagnosis during which screening was initiated by health care providers. Participants delayed enrolling into DM management program because most of them (64.4%) did not know about it while 2.2% had to consult their families. A small proportion of the participants (28%) had good knowledge on T2DM management interventions. Practices applied by the clients in self-managing T2DM included diet, exercise, taking diabetic medications and monthly weight monitoring. Socio-demographic and economic characteristics that were found to be significantly associated with clients’ management of T2DM were college/university education level (n=294, df-3, $\chi^2$ -4.433, P- 0.035) and income level of Kshs 5,001-10,000 per month (n=294, df-3, $\chi^2$-5.999, P-0.006). Conclusions made from the study are that there is low level of knowledge on T2DM management interventions, practices for management of T2DM that participants applied included balanced diabetic diet, exercise, drug therapy and weight monitoring though fairly undertaken. Level of education and income significantly influenced clients’ management of T2DM. The study recommends creation of awareness on T2DM management in Nyandarua County so as to improve clients’ knowledge of management interventions for T2DM, health education on T2DM management practices to empower clients to effectively manage the condition. The national and Nyandarua County government’s Department of Health to subsidize diabetic services so as to improve clients’ affordability and utilization.
CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Diabetes is one of the commonest non-communicable diseases of the 21st century (International Diabetes Federation, 2013). In 2013, 382 million people had diabetes globally with 90% of the cases being type 2 Diabetes Mellitus (WHO, 2013). In 2015, the global burden of diabetes was estimated to be 415 million people with a global prevalence of 8.3%, and the IDF estimated that this figure was likely to rise to 642 million by the year 2040 (International Diabetes Federation, 2015). This rise in Type 2 Diabetes Mellitus (T2DM) is associated with demographic and social changes such as globalization, urbanization, aging population and adoption of unhealthy lifestyles such as consumption of unhealthy diets and physical inactivity (International Diabetes Federation, 2015). Type 2 Diabetes Mellitus and its associated complications have been reported to increase dramatically and this resulted in 1.5 million deaths worldwide in 2012 (WHO, 2013). Globally, in every six (6) seconds, a person dies from diabetes which has resulted into 5.0 million deaths by 2015 (International Diabetes Federation, 2015).

Africa has the fastest growth rates of overweight and childhood obesity which are risk factors for T2DM later in life (Rossouw et al., 2012). The youth of sub-Saharan Africa are particularly vulnerable to T2DM due to a lifetime accumulation of risk factors such as early weight gain (0-5 years), childhood obesity, malnutrition and sedentary lifestyle (Azevedo, 2008). While childhood diabetes mellitus cases were typically type 1, there has been a rapid increase in the development of obesity-associated T2DM among children (Tuei et al., 2010, Lee et al., 1995). Overall diabetes-induced deaths in sub-Saharan Africa significantly increased from 2.2% in 2000 to 6% in 2010 (International
Diabetes Federation, 2012). These rates were highest amongst persons between 20 and 39 years, the most economically productive members of peri-urban populations (International Diabetes Federation, 2009). In 2010, 43 million children (<5 years) were overweight globally, with 35 million of these children living in developing countries (Rossouw et al., 2012).

Type 2 Diabetes Mellitus is rapidly emerging as a major health problem in Kenya making up over 90% of all reported cases of diabetes which is mainly caused by sedentary lifestyles (Christensen et al., 2006).

Many children and adolescents remain undiagnosed due to a lack of health education and services; as well as poor consensus of the diagnostic criteria of metabolic syndrome in children (Mayosi et al., 2009). This delays initiation of treatment with the clients developing severe complications (Mayosi et al., 2009). Management of T2DM entails intensive lifestyle modification for those at risk of diabetes and aggressive treatment for those with the disease. Ineffective management of the condition increases the occurrence rate of chronic complications of diabetes that the country’s health care system is ill-prepared for, both in recurrent expenditure and facilities (KNDS, 2010).

1.2 Statement of the problem
A high proportion of undiagnosed cases of diabetes end up with irreversible complications imposing a huge economic burden to the individual, family, community and the health care system (International Diabetes Federation, 2009). In 2012, diabetes resulted in 1.5 million deaths worldwide making it the 8th leading cause of death (WHO, 2013). More than 80% of diabetic deaths occur in low and middle-income countries (Mathers & Loncar, 2006).
Globally, the burden of diabetes mellitus was estimated to be 415 million people with a global prevalence of 8.3%. The IDF estimated that this figure was likely to rise to 642 million by the year 2040 (International Diabetes Federation, 2015). In 2013, 387 million people had diabetes worldwide with Type 2 diabetes making up about 90% of the cases which is equal to 8.3% of the adult population with equal rates in both women and men (WHO, 2013). The prevalence of diabetes in Kenya in 2013 was 4.7% with the former central province leading with a T2DM prevalence of 11.4% (International Diabetes Federation, 2013; MOH, 2013). The prevalence of T2DM in Nyandarua South sub-County was 10.8% which was higher compared to the country’s prevalence (MOH, 2013).

North Kinangop Catholic Hospital and Engineer sub-County Hospital diabetic clinics records showed a total number of 703 and 547 clients in 2014, respectively who were on active follow up. The total number of new clients in the year 2014, January – September, 2014 was 74 in both facilities with an average monthly admission of patients with T2DM complications being 20 and 8 in both facilities respectively. This raises a concern on the management of T2DM by diabetic clients in Nyandarua South sub-County.

1.3 Justification of the study

Although non communicable diseases such as diabetes are largely preventable, the epidemic continues due to a lack of widespread public health prevention programmes and accessible educational resources (Mayosi et al., 2009). Due to increase in newly diagnosed type 2 diabetes cases in the Nyandarua South sub-County, the study aimed at determining the levels of diabetic clients’ knowledge on recommended management interventions and practices for management of T2DM. The study, also, aimed at generating credible information that will positively influence the management of T2DM
thus enabling the clients better manage the condition and prevent themselves from
developing diabetes related complications.

1.4 Research questions

i. What is the level of knowledge on recommended management interventions for type
   2 diabetes mellitus among T2DM clients in Nyandarua South sub-County?

ii. What practices for self-management of type 2 diabetes mellitus are applied by T2DM
    clients in Nyandarua South sub-County?

iii. What is the influence of socio-demographic factors of type 2 diabetes mellitus clients
    on management of T2DM in Nyandarua South sub-County?

1.5 Null hypothesis

$H_0$ - Individual’s socio-demographic characteristics do not influence management of
T2DM in Nyandarua South sub-County, Kenya.

1.6 Research Objectives

1.6.1 Main objective

To determine management of type 2 diabetes mellitus by diabetic clients in Nyandarua
County, Kenya.

1.6.2 Specific objectives

i. To establish the level of knowledge on recommended management interventions for
   type 2 diabetes mellitus among T2DM clients in Nyandarua South sub-County.

ii. To establish practices applied by T2DM clients in self-management of type 2
    diabetes mellitus in Nyandarua South sub-County.

iii. To determine the influence of socio-demographic factors on management of type 2
    diabetes mellitus among T2DM clients in Nyandarua South sub-County.
1.7 Significance and anticipated outcome

This study was conducted to determine the level of diabetic clients’ knowledge on recommended management interventions and practices for management of type 2 diabetes mellitus (T2DM). The findings of the study helps in addressing population knowledge gaps and behaviour towards T2DM, raising awareness of, identifying and addressing gaps in the management of T2DM. The clients will benefit from health education on gaps identified in their knowledge on management interventions and practices for managing T2DM so as to improve their health status with regard to the condition. The findings will also inform health policy and decision making processes in the sub-County aimed at increasing community’s level of knowledge and improving on the management practices aimed at delaying onset or preventing the development of T2DM related complications. The information will guide the formulation of interventions and control programmes for T2DM in the sub-County. Information from this study will be important to health care workers and policy makers in developing appropriate health messages for the clients attending diabetic clinics.

1.8 Conceptual framework

Figure 1.1 shows the relationship between factors that influence management of T2DM. The dependent variable of the study is management of type 2 diabetes mellitus (T2DM). The independent variables are factors that influence management of T2DM amongst the clients. The independent variables were divided into three categories:- socio-demographic and socioeconomic characteristics of the respondents (age, gender, marital status, education level, employment status and income level), knowledge of the recommended T2DM management interventions (diet, physical activity/exercise, anti-diabetic drugs, body weight management), and practices for control of type 2 diabetes
mellitus which included; blood glucose control, medication, weight monitoring and self blood glucose monitoring.

**Independent variables**

**Socio-demographic characteristics**
- Age, gender, marital status, education level, employment, income level

**Knowledge on management**
- Interventions - diet, exercise, anti-diabetics, body weight monitoring

**Practices for managing T2DM**
- Blood glucose control, activity medication, glucose monitoring

**Dependent variable**
- Proper management of type 2 diabetes mellitus

---

**Figure 1.1 Conceptual framework showing relationship between study variables**

**Source:** (KNDS, 2010, Mayosi *et al.*, 2009, IDF, 2013; Moodley & Rambiritch, 2007)
CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of diabetes mellitus.

Diabetes mellitus (DM) is a chronic disorder occurring throughout the world, but more common (especially type 2) in more developed countries (International Diabetes Federation, 2013). In 2007, the global burden of diabetes was estimated to be 246 million people and without effective interventions put in place, the prevalence of diabetes is expected to rise to 592 million people by 2035 (International Diabetes Federation, 2014). The growing prevalence of diabetes makes it a significant catalyst to morbidity, premature mortality, and increasing health care costs (Mayosi et al., 2009).

The International Diabetes Federation (IDF) suggests that worldwide rates of diabetes will escalate by 54% from 2010 to 2030 (284.6 to 438.4 million). For sub-Saharan Africa, this growth is estimated at 98% (12.1 to 23.9 million) (International Diabetes Federation, 2009). Notably, glucose intolerance in sub-Saharan countries is also predicted to rise by 75.8% in the same time frame (26.9 to 47.3 million). This is twofold the amount of the projected global increase of 37% (International Diabetes Federation, 2009).

According to the Kenya National Diabetes Strategy (KNDS), majority of the people with diabetes in developing countries are within the productive age range of 45–64 years (KNDS, 2010). These are the same individuals who are expected to drive the economic engines of their countries in order to achieve the agreed international development goals. Besides their reduced productivity, diabetes further imposes a high economic burden in terms of healthcare expenditure, lost productivity and foregone economic growth (KNDS, 2010).
While T2DM is largely preventable, the prevalence continues to rise due to a lack of widespread public health prevention programmes and accessible educational resources (Mayosi et al., 2009). In order to lessen the burden of diabetes, public health interventions are required to prevent diabetes or delay the onset of its complications (KNDS, 2010). This requires intensive lifestyle modification for those at risk of diabetes and aggressive treatment for those with the disease. A high-risk approach targeting individuals at risk of diabetes and a population or public health approach aimed at reducing the risk factors for diabetes at the community level are necessary (KNDS, 2010).

2.2 Classification of Diabetes Mellitus

2.2.1. Type 1 diabetes mellitus

Type 1 diabetes mellitus is also referred to as Insulin Dependent Diabetes or Autoimmune Diabetes or Juvenile diabetes or early onset diabetes mellitus. This type of diabetes is as a result of failure of the pancreas to produce insulin and comprises about 10-15% of total diabetes burden (International Diabetes Federation, 2015). Type 1 diabetes mellitus afflicts mainly young children and is perceived to be a chronic immune-mediated disease with sub-clinical prodrome characterized by selective loss of insulin producing β-cells in the pancreatic islets in genetically susceptible people (Osei et al., 2003). The immune system attacks the insulin producing β-cells of the islets of Langerhans in the pancreas. This leads to a decline in the production of insulin hence elevated glucose concentration in the blood.

The pre-clinical disease is asymptomatic and may last from a few months to more than 10 years. In acute clinical onset, ketoacidosis and dependency on exogenous insulin are characteristic features and may lead to absolute dependency on insulin injections or death (Tuei et al., 2010).
2.2.2 Type 2 diabetes mellitus

Type 2 diabetes mellitus (T2DM), also referred to as Non-insulin Dependent or Maturity onset diabetes, results from failure of the pancreas to produce adequate insulin or failure of body cell to utilize insulin or both. It accounts for 90% of total diabetes burden (International Diabetes Federation, 2009). Type 2 Diabetes Mellitus is typically a metabolic disorder of obese middle aged or old people with slow clinical onset and non-insulin dependence (Osei et al., 2003). Type 2 Diabetes Mellitus is the most common form of diabetes characterized by disorders of insulin resistance, insulin secretion, obesity, lipid abnormalities, hypertension, and cardiovascular diseases (Wylie-Rosett & Vinicor, 2001). These features are usually present at the time the condition is clinically manifest (National Institute for Health and Clinical Excellence, 2011).

Between 50 and 65 per cent of T2DM patients remain undiagnosed because of the lack of specific symptoms (Mollentze, 2012). As a result, a number of T2DM patients are admitted in hospitals to have their feet or legs amputated, cataracts removed, or to be treated for kidney failure and stroke due to late diagnoses.

The rise in new cases of T2DM is also a consequence of associated factors such as dietary changes, increased inactivity, aging populations, and insufficient prevention and management interventions (Wild et al., 2004). These factors are further compounded by social obstacles such as poverty, marginalisation, poor education, illiteracy, and a lack of access to health care (Azevedo, 2008).

2.2.3 Gestational diabetes Mellitus (GDM)

Pregnant women who have never had diabetes before but who have high blood sugar (glucose) levels during pregnancy are said to have gestational diabetes. Gestational
Diabetes Mellitus (GDM) affects about 4% of all pregnant women and starts when the body is not able to make and use all the insulin it needs for pregnancy. Due to this insulin insufficiency, available glucose in the circulation cannot leave the bloodstream for conversion into energy (Osei et al., 2003).

Other forms of diabetes mellitus include; diabetes as part of other endocrine syndromes, drug induced diabetes, pancreatic disease and monogenic diabetes previously referred to as Maturity Onset Diabetes of the Young (MODY) (National Institute for Health and Clinical Excellence, 2011).

2.3 Pathogenesis of type 2 diabetes mellitus

Type 2 diabetes mellitus (T2DM) develops when the body can still make some insulin, but not enough, or when the insulin that is produced does not work properly (known as insulin resistance) and in most cases is linked with being overweight. The prevalence of type 2 diabetes has risen dramatically in the past decade in large part linked to the trends in obesity and sedentary lifestyle (National Institute for Health and Clinical Excellence, 2011; Stumvoll et al., 2005).

The condition is characterized by hyperglycemia, insulin resistance, and relative impairment in insulin secretion. When insulin secretion is impaired, the body is unable to utilize available glucose leading to high glucose level in the circulation (hyperglycemia) that further alters circulation in the small blood vessels (Adams, 2008). The resulting hyperglycemia can also impair pancreatic beta-cell function and exacerbate insulin resistance, leading to a vicious cycle of hyperglycemia causing a worsening metabolic state (National Institute for Health and Clinical Excellence, 2011). Hyperinsulinemia that
occurs in response to insulin resistance may play an important role in the genesis of these abnormalities.

Type 2 diabetes is often accompanied by other conditions, including hypertension, high serum low-density lipoprotein (LDL) cholesterol concentrations, and low serum high-density lipoprotein (HDL) cholesterol concentrations that increase cardiovascular risk (Stumvoll et al., 2005). This collection of clinical conditions is known as the metabolic syndrome. If not timely diagnosed and consequently managed, results in serious and long-term complications including heart disease, stroke, blindness, kidney disease and amputation leading to disability and premature mortality (Adams, 2008).

2.4 Risk factors

Risk factors for T2DM include;

i. **Weight.** Being overweight or obese with a waistline greater than 94 cm (37 inches) for men or greater than 90 cm (35 inches) for men of South Asian origin. For women, having a waistline greater than 80 cm (31.5 inches), being more than 40 years old, having a brother or sister with T2DM increase the risk of developing the condition. The more fatty tissue one has, the more resistant their cells become to insulin and this places them at greater risk of T2DM (Tuei et al., 2010).

ii. **Physical inactivity.** The less active a person is, the greater the risk for T2DM since physical activity helps one control their weight by using up glucose as energy and making body cells more sensitive to insulin.

iii. **Family history.** The risk for T2DM increases if a parent or sibling has type 2 diabetes.
iv. **Race.** People who are African-American, Asian-American, Latino-Hispanic-American, Native American, or Pacific Islander have a greater risk of developing T2DM than other groups.

v. **Age.** The risk for T2DM increases with age. This is partly because people tend to exercise less, lose muscle mass and gain weight as they age though T2DM is also increasing dramatically among children, adolescents and younger adults (KNDS, 2010).

vi. **Gestational diabetes.** The risk of developing pre-diabetes and type 2 diabetes later in life increases if a woman developed gestational diabetes when she was pregnant. Giving birth to a baby weighing more than 9 pounds (4 kilograms) also increases the risk of type 2 diabetes among women (KNDS, 2010).

vii. **Polycystic ovary syndrome.** Women having polycystic ovary syndrome, a condition characterized by irregular menstrual periods and obesity have a greater risk of developing type 2 diabetes.

viii. **High blood pressure.** Having blood pressure over 140/90 mmHg is also linked to an increased risk of type 2 diabetes.

ix. **Abnormal cholesterol and triglyceride levels.** Low levels of high-density lipoprotein (HDL) or good cholesterol increases the risk of type T2DM. People with high levels of triglycerides also have an increased risk of T2DM (Tuei et al., 2010, Rheeder, 2006).

### 2.5 Signs and Symptoms of diabetes

Diabetes mellitus presents with three (3) typical signs including; excessive urine production (polyuria), excessive thirst (polydypsia) and increased hunger (polyphagia). Other symptoms include elevated blood sugar level (hyperglycemia), sugar in urine
(glycosuria), frequent itching around the genitals, emaciation, dry mouth, unexplained weight loss, fatigue, blurred vision, headaches and loss of consciousness (Mollentze, 2012).

When severe diabetes is allowed to progress without proper treatment, coma ensues with weakness and sweet (acetone) odour of breath, nausea, headache, vomiting, dyspnoea, sense of intoxication, delirium, and deep coma resulting to death (Dropkin, 2010).

2.6 Complications of diabetes

Patients suffering from T2DM are at a great risk of developing complications including:-

i. **Eye disease.** The development of diabetic retinopathy is strongly related to the length of time diabetes has been present and the degree of blood glucose control. Regular eye checkups and treatment can prevent serious eye problems and blindness caused by diabetic retinopathy. This leads to damage of the eye and affect vision (Tuei et al., 2010).

ii. **Kidney disease.** Over time, diabetes can cause damage to the kidneys (diabetic nephropathy). If the kidneys fail, toxic waste products remain in the body, fluids build up and the chemical balance is upset. The risk of developing kidney problems is reduced by managing your blood glucose levels, having regular kidney and blood pressure checks and leading a healthy lifestyle. Early signs of kidney problems can be detected through a urine test and treatment at this time can prevent further damage (Ogbera, 2006).

iii. **Nerve damage and lower limb complications.** Diabetic neuropathy is the progressive damage to the nervous system caused by diabetes which can lead to loss of sensation in the hands and feet. Reduced circulation resulting from high blood glucose impairs normal wound healing in the extremities thus minor damage can
linger and develop into permanent injury. Personal daily foot checks and thorough annual foot examinations conducted by a doctor will help reduce the risk of lower limb complications (Ogbera, 2006).

iv. **Heart disease and stroke.** People with diabetes are at increased risk of heart disease and stroke due to raised blood glucose levels (BGLs) in association with high blood pressure and cholesterol. A third of diabetic patients also present with hypertension and obesity (Mollentze, 2012).

v. **Sexual health.** Sexual dysfunction is more common in people with diabetes because poorly controlled diabetes damages blood vessels and nervous system causing reduced blood flow and loss of sensation in sexual organs. This can contribute to vaginal dryness in women and erection difficulties in men (Tuei *et al.*, 2010).

Reduction of other risk factors for complications of diabetes, include the early detection and management of hypertension, drug treatment to modify lipid levels. Monitoring and early intervention prevents diabetes related complications including cardiovascular disease, feet problems, eye problems, kidney problems and neuropathy (National Institute for Clinical Excellence, 2008).

2.7 **Diagnosis of type 2 diabetes mellitus**

2.7.1 **Clinical diagnosis**

Health care providers should conduct a full physical and medical examination which should cover the following areas as;

i. Height and weight measurements

ii. Blood pressure measurements

iii. Thyroid examination

iv. Examination of hands, fingers, feet, and toes for circulatory abnormalities
v. Family history of diabetes, cardiovascular disease, and stroke
vi. Prior infections and medical conditions
vii. Current medications including prescribed medications, over-the-counter medications
viii. Vitamin, mineral or herbal supplements, eating and exercise habits
ix. Smoking history, including encouragement to stop smoking
x. Signs of complications with pregnancy or trying to get pregnant for female patients
xi. Vision abnormalities, to check for eye health issues
xii. Urination abnormalities, which can indicate kidney disease (Dropkin, 2010; Walker, 2007).

2.7.2 Laboratory diagnosis

Type 2 diabetes can also be made by an observation of the following parameters:-

i. Random blood sugar test. This test involves taking a person’s blood sample at a random time. Regardless of when the person last ate, a random blood sugar level of 200 milligrams per decilitre (200 mg/dL) or 11.1 millimoles per litre (mmol/L) or higher suggests diabetes (Walker, 2007).

ii. Fasting blood sugar test. A blood sample is taken after an overnight fasting and a blood sugar level of less than 100 mg/dL (5.6 mmol/L) is normal while fasting blood sugar level from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered pre-diabetes. If the value is 126 mg/dL (7 mmol/L) or higher on two separate tests person is considered diabetic (National Institute for Health and Clinical Excellence, 2011).

iii. Oral glucose tolerance test. For this test, one fast overnight and the fasting blood sugar level is measured. Then drinks a sugary liquid, and blood sugar levels are
tested periodically for the next two hours. A blood sugar level of less than 140 mg/dL (7.8 mmol/L) is considered normal while a reading of more than 200 mg/dL (11.1 mmol/L) after two hours indicates diabetes. A reading between 140 and 199 mg/dL (7.8 mmol/L and 11.0 mmol/L) indicates pre-diabetes (Walker, 2007).

iv. **Glycated hemoglobin (HbA1C) test.** This blood test indicates average blood sugar level for the past three (3) months. It measures the percentage of blood sugar attached to hemoglobin. The poor the control over the last three months, the higher the HbA1C (WHO, 2013). Glycated hemoglobin reflects the diabetic client’s level of control of blood sugar.

### 2.8 Management of diabetes mellitus

The goals in managing patients with diabetes mellitus are to eliminate symptoms and to prevent, or at least slow the development of complications (International Diabetes Federation, 2013). Micro-vascular (eye and kidney disease) risk reduction is accomplished through control of glycemia and blood pressure; macro-vascular (coronary, cerebrovascular, peripheral vascular) risk reduction, through control of lipids and hypertension, smoking cessation, and metabolic and neurologic risk reduction through control of glycemia. Diabetes care is best provided by a multidisciplinary team of health professionals with expertise in diabetes, working in collaboration with the patient and family (Mollentze, 2012).

#### 2.8.1 Diet

Diet management requires control and awareness of the types of nutrients entering the digestive system, and hence allows indirectly, significant control over changes in blood glucose levels (Walker, 2007). T2DM patients experience dramatic effects on their blood sugars through controlling their diet, and some can fully control the disease by dietary
modification. As diabetes can lead to many other complications, it is important to maintain blood sugars as close to normal as possible and diet is the leading factor in this level of control (Ono, 2008). Therefore, the caloric intake for diabetic persons must be limited to that which is necessary for maintaining a healthy weight.

2.8.2 Physical activity/exercise

Physical activity/exercise lowers blood sugar level by moving sugar into the cells where it is used for energy making it easier for a diabetic to control their blood glucose level. Muscles in turn use glucose without insulin while exercising and as a result, blood glucose level goes down. It also makes insulin more effective thus insulin resistance goes down when one exercises and body cells can use the glucose more effectively (Maina et al., 2011; KNDS, 2010).

Exercise helps people with T2DM avoid long-term complications, including arteriosclerosis which can lead to a heart attack. The aim of activity is to get at least thirty (30) minutes of aerobic exercise most days of the week. The exercises include; walking, jogging/running, swimming, cycling (Knowler et al., 2002).

2.8.3 Blood glucose control.

Proper blood glucose control refers to the diabetic’s ability to maintain their blood glucose at normal levels (euglycemia) for persons with diabetes mellitus (Adams, 2008). Many of the long-term complications of diabetes, especially the micro-vascular complications, result from many years of hyperglycemia (Adams, 2008). Blood sugar level is measured by means of a glucose meter, with the result either in mg/dL (milligrams per deciliter in the USA) or mmol/L (millimoles per litre in Canada and
Europe) of blood. The average normal person should have a glucose level of between 4.5 to 7.0 mmol/L (80 to 125 mg/dL).

Optimal management of diabetes involves patients measuring and recording their own blood glucose levels. By keeping a diary of their own blood glucose measurements and noting the effect of food and exercise, patients can modify their lifestyle to better control their diabetes (Huang et al., 2007). For patients on insulin, their involvement is important in achieving effective dosing and timing. Because blood sugar levels fluctuate throughout the day and glucose records are imperfect indicators of these changes, the percentage of hemoglobin which is glycosylated is used as a proxy measure of long-term glycemic control in clinical care of people with diabetes.

Perfect glycemic control would mean that glucose levels were always normal (70–130 mg/dl, or 3.9-7.2 mmol/L) and indistinguishable from a person without diabetes (Huang et al., 2007). Poor glycemic control refers to persistently elevated blood glucose and glycosylated hemoglobin levels, which may range from 200–500 mg/dl (11-28 mmol/L) and 9-15% or higher over months and years before severe complications occur (Walker, 2007).

2.8.4 Personal (home) glucose monitoring

Control and outcomes of T2DM may be improved by patients using home glucose meters to regularly measure their glucose levels (Huang et al., 2007). Glucose monitoring is both expensive (largely due to the cost of the consumable test strips) and requires significant commitment on the part of the patient. The effort and expense may be worthwhile for patients when they use the values to sensibly adjust food, exercise, and oral medications or insulin.
These adjustments are generally made by the patients themselves following training by a clinician or health care providers trained on diabetes management. This reduces hospital admission of diabetic patients (Kibriya et al., 1999). However, patients on oral medication who do not self-adjust their drug dosage will miss many of the benefits of self-testing. Continuous Glucose Monitoring (CGM) technology has been rapidly developing to give people living with diabetes an idea about the speed and direction of their glucose changes (International Diabetes Federation, 2012).

2.8.5 Use of anti-diabetic drugs

2.8.5.1 Oral medication.

The most prevalent form of medication is hypoglycemic treatment by either oral hypoglycemics including metformin, sulphonylureas, pioglitazone, and/or insulin therapy (Mealey, 2006). Metformin (Glucophage, Glumetza) is mainly the first medication prescribed for T2DM. These diabetes medications stimulate the pancreas to produce and release more insulin, inhibit production and release of glucose by the liver, thus one will require less insulin to transport sugar into the cells.

Other medications block the action of stomach or intestinal enzymes that break down carbohydrates or make tissues more sensitive to insulin (National Institute for Health and Clinical Excellence, 2011). Patient education and compliance with treatment is very important in managing the disease since improper use of medications and insulin can be very dangerous causing hypo- or hyper-glycemic episodes.

2.8.5.2 Use of insulin

Some type 2 diabetic patients eventually fail to respond to the oral anti-diabetic medications and therefore must proceed to insulin therapy. Many types of insulin are
available, including rapid-acting insulin, long-acting insulin and intermediate options (National Institute for Health and Clinical Excellence, 2011). Insulin cannot be taken orally to lower blood sugar because stomach enzymes interfere with insulin's action. Often insulin is injected using a fine needle and syringe or an insulin pen.

2.9 Management practices for type 2 diabetes mellitus
Management practices for T2DM include; achieving and maintaining a healthy weight, effective weight loss programmes, physical activity, cultural appropriateness, integrating national strategy on non communicable diseases, local joint strategic needs assessment, developing a local strategy, conveying messages to the whole population, promoting a healthy diet, promoting physical activity, training those involved in promoting healthy lifestyles (Dropkin, 2010). Changes on the risk factors are most likely to occur with effective implementation of a coordinated range of interventions to encourage individuals to maintain a healthy weight, participate in daily physical activity, and consume a healthy diet (Dropkin, 2010).

Education is central to implementing such changes and it is more effective when provided through multiple methods and sites, such as community groups, schools, workplaces, mass media, religious organizations and health centres (KNDS, 2010). Educational messages are also more effective if they are reinforced by action (National Institute for Health and Clinical Excellence, 2011).

However, both in health and economic terms, neglecting chronic diseases such as diabetes is very expensive. The costs of treatment and loss of productivity undermine and stunt economic growth and negatively impact on realization of the Millennium
Development Goals (MDGs), vision 2030 and other national development targets (WDF, 2007).

2.10 Influence of socio-demographic factors on type 2 diabetes mellitus

The rise in diabetes is associated with demographic and social changes such as globalization, urbanization, aging population and adoption of unhealthy lifestyles such as consumption of unhealthy diets and physical inactivity (Wild et al., 2004). For instance, in the 2014 Kenya Demographic and Health Survey (KDHS) more than 20% of women and 7% of men in the country were overweight or obese which predisposes to T2DM (KDHS, 2014).

Secondly, the low level of community knowledge of diabetes reflects on the extent of health promotion for most chronic non-communicable diseases (Moodley & Rambiritch, 2007). At the moment, there are improved and comprehensive primary care programmes for diabetes in the country and diabetes health education is done within health facilities through micro-teaching and only that it targets those with diabetes (KDHS, 2014). This therefore leaves the rest of the public ignorant of the disease.

2.11 Summary of literature review

Literature reviewed reveals that management of T2DM remains a huge global challenge. This can be managed by diabetic clients effectively controlling their caloric intake, consistently taking their anti-diabetic medication and engaging in physical activity which helps utilize glucose in the body. This will help avoid long-term complications which result from prolonged periods of elevated blood glucose.

The control outcomes of T2DM can be improved by patients using home glucose meters to regularly measure their blood glucose levels although it requires significant
commitment on the part of the patient. Gaps in literature were apparent on knowledge of T2DM management interventions, practices for management of T2DM and the extent of socio-demographic factors that influence management of T2DM among diabetic clients.
CHAPTER THREE: MATERIALS AND METHODS

3.1 Study design

A descriptive cross-sectional facility based design was used. This design enabled description of management of T2DM by the respondents at one point in time, during the study without influencing their behaviour in any way. The design was appropriate to the study because screening, enrolment, management and follow up care for diabetic clients take place within health facilities.

3.2 Study variables

3.2.1 Dependent variables

The dependent variable for the study was management of type 2 diabetes mellitus by T2DM clients in Nyandarua South Sub-County, Kenya.

3.2.2 Independent variables

The independent variables for the study included;

i. Level of knowledge on management interventions for T2DM (causes and signs of poor blood sugar, diabetic diet, foods that elevate blood sugar level, body weight management, complications and their prevention among others).


iii. Socio-demographic and economic characteristics of the respondents (age, gender, marital status, level of education, employment status and income level).
3.3 Location of study
The study was carried out in Nyandarua South sub-County, Nyandarua County (Appendix 5). Nyandarua County is located in the central part of Kenya with a total surface area of 3,245.2km² and had a total population of 596,000. The population is expected to grow to 723,000 by 2017 (KNBS, 2013). The County has five constituencies; Kipipiri, Ndaraagwa, Ol’kalou, Ol’joroOrok and Nyandarua South (Kinangop). Nyandarua South sub-County is the largest with an area of 822 km². The total population of the sub-County was 192,000 and is expected to be 233,000 by 2017 (KNBS, 2013). The sub-County has two (2) main health facilities; North Kinangop Catholic hospital and Engineer sub-County hospital. The facilities serve as the main centres for provision of care and follow up services to diabetic clients including monthly clinical review, health education, weight and blood sugar monitoring and nutritional counseling. The study area had reported increased number of cases of T2DM who in turn developed severe diabetes complications as it was reflected in the hospitals’ health records.

3.4 Study population
The study population included adult T2DM clients attending diabetic clinic for their monthly check up at North Kinangop Catholic hospital and Engineer sub-County hospital in the sub-County.

3.5 Inclusion criteria
The study included long-serving T2DM clients who were on follow up through the diabetic clinics for a period of at least six (6) months, residents of Nyandarua South sub-County (at least six (6) months), aged eighteen (18) years and above, and consented to participate in the study.
3.6 Exclusion criteria

The study excluded T2DM clients who were severely sick during the study period, those aged below eighteen (18) years, T2DM clients receiving care outside Nyandarua South sub-County and those who declined consenting for participation in the study.

3.7 Sampling techniques and sample size

3.7.1 Sampling techniques

The study was conducted in two (2) health facilities within Nyandarua South sub-County. Purposive sampling method was used in the selection of Nyandarua South sub-County. This was due to the observed increase in the number of T2DM clients admitted with diabetes related complications. Probability proportionate to size (PPS) strategy was used to obtain the number of respondents from each facility (Table 3.1). Type 2 Diabetes Mellitus clients in both facilities were divided into four (4) groups each scheduled to visit the hospitals for review once every month. Systematic random sampling method, with an interval of five (5) clients, was used to select consenting respondents as they met the inclusion criteria until the required sample was obtained.

3.7.2 Sample size determination

The sample size was determined by the formula, \( n = \frac{z^2pq}{d^2} \) as used by Fisher et al., (2002) where;

\( n \) = desired sample size,
\( z \) = standard normal deviate (set at 1.96 which corresponds to the 95% confidence level).
\( p \) = proportion in the target population estimated to have the characteristics being measured (0.5). Represents the proportion of T2DM clients enrolled into the follow up program.
\( q=1-p \).
\( d \) = the desired degree of accuracy (0.05)  
\( n = 384 \)

Since the estimated total population (\( N \)) is less than 10,000 {1,250 being the total population of T2DM clients receiving care in Nyandarua South sub-County}, (annual report on T2DM from the hospitals’ health records), the following formula was used to adjust the sample size;  
\[ n_f = \frac{n}{1 + \left( \frac{n}{N} \right)} \]

Where;  
\( N = \) total population of T2DM clients i.e. 1,250.  
\( n_f = \) is the desired sample size (when the population is less than 10,000),  
\( n = \) desired sample size (when the population is more than 10,000),  
\( N = \) estimate of the population  

Therefore;  
\[ n_f = \frac{384}{1 + \left( \frac{384}{1,250} \right)} = 293.7575 \]  
\( n_f = 294 \) Thus, the minimum sample size required for the study was 294.

The sample was proportionately selected as indicated in table 3.1.

**Table 3.1 Proportionate sampling of subjects in the study area**

<table>
<thead>
<tr>
<th>Name of facility</th>
<th>Number of T2DM clients</th>
<th>Percentage required</th>
<th>Number of clients selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Kinangop Catholic hospital</td>
<td>703</td>
<td>56.24%</td>
<td>165</td>
</tr>
<tr>
<td>Engineer sub- County hospital</td>
<td>547</td>
<td>43.76%</td>
<td>129</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1250</strong></td>
<td><strong>100%</strong></td>
<td><strong>294</strong></td>
</tr>
</tbody>
</table>
3.8 Data collection tool

Data collection tool for the study was a semi-structured questionnaire (Appendix II) which was constructed through formulation of relevant questions based on the study objectives.

3.9 Pre-testing

The data collection tool was pre-tested at Ol’kalou sub-County hospital in Nyandarua North sub-County. The facility has similar statistics for T2DM and is found in the same geographical area. Twenty five (25) questionnaires were administered during the pre-test. Corrections and re-organizations of the data collection tool were then made prior to the actual data collection.

3.9.1 Validity

Data validity was achieved by ensuring that the data collection tool was formulated based on the study objectives with adequate number of questions addressing each of the study variables. The questionnaires were numbered in a sequential order before being dispatched to the field and confirmed after a day of data collection. The study was limited to the area of study.

3.9.2 Reliability

Reliability was ensured through the use of a standard well-designed questionnaire and; proper selection, training and supervision of research assistants on interview techniques. The research assistants were also involved in pre-testing to ensure they administered the questionnaires correctly during the actual data collection. Completed questionnaires were checked at the end of each day of data collection.
3.10 Data collection techniques

The data collection tool for the study was a semi-structured questionnaire (Appendix II), which sought information on the participants’ socio-demographic characteristics, level of knowledge on recommended management interventions for T2DM and management practices for T2DM. The interviewer would introduce him/herself to the participant, and having obtained an informed consent, he/she would read out the questions to the participant as they were on the questionnaire and allow the participant to respond appropriately without any influence.

3.11 Data management and analysis

Data was collected, coded and entered in the excel software, Microsoft office Excel 2010. All statistical analyses were performed using statistical package for social sciences (SPSS) software version 20 (SPSS Inc., USA). Descriptive statistics were computed to generate frequencies, mean, median and standard deviation. Proportions for categorical data were computed while mean and standard deviation were reported for age. Chi-square test was used to examine differences in proportions between socio-demographic variables and the dependent variable. A P - value of less than 0.05 (P<0.05) at 95% CI was considered significant for all statistical analysis. Bivariate analysis was computed to determine the association between socio-demographic characteristics and management of T2DM.

To determine the level of knowledge, a Likert scale was used. Each correct response from the cluster questions was assigned a score of 1.0 and each incorrect score was allocated 0. The overall score for each individual was calculated for all the nine (9) questions on knowledge. The maximum expected score was 9. The cut off point was 5 out of the maximum 9. The overall mean level of knowledge score on causes, signs,
foods increasing blood sugar, complications, prevention, management interventions and whether one knew that T2DM is controllable was computed. Anyone scoring less than 3 was termed as having poor knowledge, between 4 and 5 as having average knowledge while above 5 was classified as having good knowledge. The results were summarized and presented in graphs and tables.

### 3.12 Logistical and Ethical considerations

This study was approved by Kenyatta University Graduate School and ethical approval to carry out the study was obtained from Kenyatta University Ethics Review Committee (Appendix III). Authority to conduct the study was sought from the National Commission for Science, Technology and Innovation (NACOSTI), (Appendix V). Administrative authorization to carry out the study was sought from administration of both North Kinangop Catholic hospital and Engineer sub-County in Nyandarua South sub-County (Appendix VII). Informed consent was obtained from each prospective participant prior to their participation (Appendix I). Participants’ identity remained anonymous throughout the study to guarantee privacy. The study participants were assured of confidentiality of the information they gave. Copies of signed consent forms were kept in a lockable cabinet and access controlled by the researcher.
CHAPTER FOUR: RESULTS

4.1 Socio-demographic and economic characteristics of study respondents

4.1.1 Socio-demographic characteristics of study respondents

Table 4.1 shows socio-demographic characteristics of the study participants. The participants’ median (range) age was 64.0 (18-91) with slightly more than half (56.7%) aged above 60 years. Most of the respondents (59.5%) were females. A larger proportion of the respondents (43.9%) had primary level of education while those with college/university education were the least (5.8%). Majority of the participants, (92.2%) were married.

Table 4.1 Socio-demographic characteristics of study participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency (n=294)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>Median (range)</td>
<td>64.0 (18-91)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;20</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>18 – 29</td>
<td>11</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>30 – 39</td>
<td>15</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>40 – 49</td>
<td>29</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>50 – 59</td>
<td>71</td>
<td>24.0</td>
</tr>
<tr>
<td></td>
<td>≥ 60</td>
<td>167</td>
<td>56.7</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>119</td>
<td>40.5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>175</td>
<td>59.5</td>
</tr>
<tr>
<td>Marital status</td>
<td>Married</td>
<td>271</td>
<td>92.2</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>20</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Divorced</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Level of education</td>
<td>Non-formal</td>
<td>83</td>
<td>28.2</td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>129</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>65</td>
<td>22.1</td>
</tr>
<tr>
<td></td>
<td>College/university</td>
<td>17</td>
<td>5.8</td>
</tr>
</tbody>
</table>
4.1.2 Socio-economic characteristics of the study participants

Table 4.2 shows participants’ socio-economic characteristics. Majority of the participants (72.8%), were self-employed while casual labourers, (1.4%) were the least. A larger proportion of the participants (53.7%) earned less than Kshs 5000 while the least proportion (5.4 %) earned between Kshs 10,001-15,000 per month.

Table 4.2 Socio-economic characteristics of the study participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency (n=294)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment status</td>
<td>Employed</td>
<td>26</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>Self-employed</td>
<td>214</td>
<td>72.8</td>
</tr>
<tr>
<td></td>
<td>Unemployed</td>
<td>50</td>
<td>17.0</td>
</tr>
<tr>
<td></td>
<td>Casual labourer</td>
<td>4</td>
<td>1.4</td>
</tr>
<tr>
<td>Level of income per month (Kshs)</td>
<td>&lt; 5000</td>
<td>158</td>
<td>53.7</td>
</tr>
<tr>
<td></td>
<td>5001 – 10,000</td>
<td>90</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>10,001 – 15,000</td>
<td>16</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>≥ 15,000</td>
<td>30</td>
<td>10.2</td>
</tr>
</tbody>
</table>

4.2. Knowledge on management interventions for Type 2 Diabetes Mellitus (T2DM)

4.2.1 Source of information on diabetes mellitus

Figure 4.1 shows participants’ source of information on diabetes mellitus. The highest proportion of the participants (42.2%), indicated that their first source of information on
diabetes mellitus was health talks by health care providers while posters and billboards were the least (5.0%).

Figure 4.1 Participants’ source of information about diabetes mellitus

4.2.2 Screening for diabetes mellitus

Figure 4.2 shows participants’ reasons for screening for diabetes mellitus. The highest proportion of the participants (49.0%) indicated that they were screened for T2DM following health care providers’ initiative at the clinics while (2.1%), screened during health outreaches.

Figure 4.2 Reasons for screening for diabetes mellitus
4.2.3 Enrolment into diabetes follow up program

Table 4.3 shows participants’ enrolment into diabetes management program. A large proportion of the participants (82.7%), enrolled into diabetes management program immediately after they were diagnosed with the condition. Majority of the participants (85.2%), enrolled into the program following doctor’s recommendation. Among the participants who delayed enrolment, slightly more than half (64.5%) reported that they were not aware about the diabetes management program.

Table 4.3 Enrolment into diabetes management program

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency (n=294)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate enrolment</td>
<td>Yes</td>
<td>243</td>
<td>82.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>51</td>
<td>17.3</td>
</tr>
<tr>
<td>Reason for immediate enrolment</td>
<td>Doctor’s recommendation</td>
<td>207</td>
<td>85.2</td>
</tr>
<tr>
<td></td>
<td>Advice from relatives</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Friends’ advice</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Fear of complications</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Perceived benefits from program</td>
<td>11</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>To understand the condition</td>
<td>15</td>
<td>6.3</td>
</tr>
<tr>
<td>Reason for delayed enrolment</td>
<td>Did not know about the program</td>
<td>33</td>
<td>64.5</td>
</tr>
<tr>
<td></td>
<td>Fear of being known to be diabetic</td>
<td>8</td>
<td>15.6</td>
</tr>
<tr>
<td></td>
<td>Not believed the diagnosis</td>
<td>7</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>Not aware of services offered</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Had to consult the family</td>
<td>1</td>
<td>2.2</td>
</tr>
</tbody>
</table>
4.2.4 Duration on follow up in the diabetes management program

Figure 4.3 shows participants’ duration on follow up in the diabetes management program. A large proportion of the participants (76.4%), reported to have been on follow up for T2DM for at least ten (10) years while the least (2.1%), having been on follow up for more than thirty (30) years.

![Figure 4.3 Participants’ duration on follow up in diabetes management program](image)

4.2.5 Knowledge on T2DM management interventions among study participants

Figure 4.4 and 4.5 show participants’ level of knowledge on T2DM management interventions. Majority of the participants (95.6%) knew that T2DM was controllable. Regarding the level of knowledge on T2DM management interventions, a large proportion of the participants (60%), had poor knowledge on signs of poor blood sugar level while a very low proportion (7.8%) were rated as having good knowledge. A large proportion of the participants (42.5%) had average knowledge on T2DM complications. Most of the participants (45.6%) had good knowledge on management of body weight
while the least (23.5%) had poor knowledge. A small proportion of the participants had good knowledge on prevention of foot ulcers while the majority (50.3%) had poor knowledge.

Figure 4.4 Participants’ level of knowledge on T2DM management interventions
4.3 Practices for management of T2DM among study participants

4.3.1 Practice on balanced diet for diabetics

Figure 4.6 shows participants’ practice on balanced diet for diabetics. A large proportion of the participants (46.6%) had poor practices while the least (20.1%) indicated good
practice. This was rated in reference to the diabetic plate outlining balanced diet for diabetics in the recommended nutrient proportions.

**Figure 4.6 Participants’ practice on balanced diet for diabetics**

### 4.3.2. Duration of physical activity/exercise session

Figure 4.7 shows participants’ duration of physical activity in a day. Slightly more than half of the participants (56.5%) exercised for at least thirty (30) minutes in a day while one fifth (20.4%) exercising for 0 - 15 minutes daily.

**Figure 4.7 Duration of physical activity/exercise sessions in a day**
4.3.3 Frequency of body weight monitoring

Figure 4.8 shows participants’ frequency of body weight monitoring. Most of the participants (79.9%), indicated to have been monitoring their body weight once every month while the least (2.4%), monitored once every three (3) months.

![Bar chart showing frequency of body weight monitoring]

**Figure 4.8 Frequency of body weight monitoring by the participants**

4.3.4 Use of anti-diabetic drugs (medication control)

Table 4.4 shows participants’ management of T2DM using drugs. Majority of the study participants (98.3%), indicated to have been on drugs for type 2 diabetes treatment. A large proportion of the participants (70.6%) were on oral medications. Majority of participants (86%), were taking the drugs twice daily. Respondents who were not on medication (1.7%) indicated that they were on diet therapy. Slightly more than half of
the participants (56.3%), indicated that they had been on anti-diabetic drugs for a period of between 0 - 5 years.

Table 4.4 Management of T2DM by use of drugs

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency (n = 294)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants on drugs</td>
<td>Yes</td>
<td>289</td>
<td>98.3</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>5</td>
<td>1.7</td>
</tr>
<tr>
<td>Mode of treatment</td>
<td>Oral medication</td>
<td>204</td>
<td>70.6</td>
</tr>
<tr>
<td></td>
<td>Insulin injection</td>
<td>67</td>
<td>23.2</td>
</tr>
<tr>
<td></td>
<td>Combined (orals &amp; injection)</td>
<td>18</td>
<td>6.2</td>
</tr>
<tr>
<td>Frequency of taking drugs (daily)</td>
<td>Once</td>
<td>26</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Twice</td>
<td>249</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Thrice</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Years since started on drugs</td>
<td>0-5</td>
<td>166</td>
<td>56.3</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>59</td>
<td>20.1</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>33</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>16-20</td>
<td>10</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>21-25</td>
<td>17</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Above 25</td>
<td>9</td>
<td>3.1</td>
</tr>
</tbody>
</table>
4.4. Influence of participants’ socio-demographic and economic characteristics on T2DM management practices

Table 4.5 shows association between respondents’ socio-demographic and economic characteristics and management of T2DM. Socio-demographic and socio-economic characteristics that were found to be significantly associated with management of T2DM were education level ($n = 294, df-3, \chi^2 -4.433, P- 0.035$) and income level ($n = 294, df-3, \chi^2 -5.999, P - 0.006$).

Table 4.5 Association between respondents’ socio-demographic and economic characteristics and management of T2DM

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\chi^2$</th>
<th>P- value</th>
<th>No. of valid cases</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.043</td>
<td>0.836</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Marital status</td>
<td>3.131</td>
<td>0.209</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Education level</td>
<td>4.433</td>
<td>0.035</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Employment status</td>
<td>0.049</td>
<td>0.825</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Income level</td>
<td>5.991</td>
<td>0.006</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

4.4.1 Bivariate analysis of association between socio-demographic characteristics and management of T2DM

Table 4.6 shows bivariate analysis results of socio-demographic characteristics of the participants. Participants who had College/ university education were 5.4 times more likely to practice good management of T2DM (OR 5.3666 (1.47-19.58), 95% CI, 1.47-19.58, $P=0.0109$) compared to those with non-formal, primary and secondary education.
levels. There was no significant association between participants’ age, gender and marital status with good management practice.

Table 4.6 Bivariate analysis of association between socio-demographic characteristics and management of T2DM

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good management (155)</th>
<th>Poor management (139)</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> - median, (range)</td>
<td>68.00 (IQR=21)</td>
<td>62.00 (IQR=20.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>62 (40.00%)</td>
<td>57 (41.01%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>93 (60.00%)</td>
<td>82 (58.99%)</td>
<td>1.0427 (0.65-1.66)</td>
<td>0.8606</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>69 (44.52%)</td>
<td>60 (43.17%)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>33 (21.29%)</td>
<td>32 (23.02%)</td>
<td>1.1152 (0.61-2.03)</td>
<td>0.7204</td>
</tr>
<tr>
<td>College/ university</td>
<td>14 (10.07 %)</td>
<td>3 (1.94%)</td>
<td>5.3666 (1.47-19.58)</td>
<td>0.0109</td>
</tr>
<tr>
<td>Non-formal</td>
<td>50 (32.26%)</td>
<td>33 (23.74%)</td>
<td>0.7590 (0.43-1.33)</td>
<td>0.3340</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>9 (5.81%)</td>
<td>11 (7.91%)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>144 (92.90%)</td>
<td>127 (91.37%)</td>
<td>0.7216 (0.29-1.80)</td>
<td>0.4835</td>
</tr>
<tr>
<td>Divorced</td>
<td>2 (1.29%)</td>
<td>1 (0.72%)</td>
<td>0.5337 (0.03-5.28)</td>
<td>0.4933</td>
</tr>
</tbody>
</table>
4.4.2 Bivariate analysis of association between socio-economic characteristics and management of T2DM

Table 4.7 shows bivariate analysis results of socio-economic characteristics of the study participants. Participants who had an income level of between Kshs 5,001-10,000 per month were 2.2 times more likely to practice good management of T2DM (OR \textbf{2.1562} (1.27-3.66), 95% CI, 1.27-3.66, \( P = 0.0044 \)).

Table 4.7 Bivariate analysis of association between socio-economic characteristics and management of T2DM

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good management (155)</th>
<th>Poor management (139)</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>118 (76.13%)</td>
<td>96 (69.06)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>13 (8.39%)</td>
<td>13 (9.35%)</td>
<td>1.2292 (0.54-2.78)</td>
<td>0.6196</td>
</tr>
<tr>
<td>Casual labourer</td>
<td>1 (0.65%)</td>
<td>3 (2.16%)</td>
<td>3.6875 (0.38-36.02)</td>
<td>0.2618</td>
</tr>
<tr>
<td>Unemployed</td>
<td>23 (14.84%)</td>
<td>27 (19.42%)</td>
<td>1.44 (0.78-2.68)</td>
<td>0.2448</td>
</tr>
<tr>
<td>Monthly income (Kshs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 5000</td>
<td>92 (59.35%)</td>
<td>64 (46.04%)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>5001 - 10000</td>
<td>\textbf{54 (38.85%)}</td>
<td>\textbf{36 (23.23%)}</td>
<td>\textbf{2.1562} (1.27-3.66)</td>
<td>\textbf{0.0044}</td>
</tr>
<tr>
<td>10001-15000</td>
<td>9 (5.81%)</td>
<td>7 (5.04%)</td>
<td>1.1181 (0.40-3.16)</td>
<td>0.8331</td>
</tr>
<tr>
<td>15001 and above</td>
<td>18 (11.61%)</td>
<td>14 (10.07%)</td>
<td>1.1181 (0.52-2.41)</td>
<td>0.7758</td>
</tr>
</tbody>
</table>
CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Knowledge on management interventions

The findings from this study show that the level of knowledge on the T2DM management interventions among the participants was low. This was also reflected in their knowledge of T2DM management interventions. These findings are similar to those by the Kenya National Diabetes Strategy which indicated that there is a low level of public knowledge, (below 30%), about diabetes in Kenya (KNDS, 2010). Majority of the participants did not know foods which increase blood sugar level as they were not able to identify examples of the foods. These findings are similar to those from a study conducted in Mombasa which established that despite listing sugary and starchy foods, many patients were not able to mention many actual examples of these types of foods that increase blood sugar (Dropkin, 2010). This is because having good knowledge on foods which increase blood sugar results in good management of T2DM. Similar findings were reported in a study conducted in South Africa which indicated that proper diabetic diet among diabetics require good knowledge and proper control of the types of nutrients entering their digestive system, and hence allows indirectly, significant control over changes in blood glucose levels (Mollentze, 2012).

Knowledge on signs and symptoms of T2DM among the participants was poor. A large proportion of the participants were not able to identify T2DM related signs and symptoms. This is similar to findings from a study conducted in Sweden which indicated low level of knowledge on signs and symptoms of diabetes among diabetic clients (Trepp et al., 2010).
Level of knowledge on T2DM complications was poor among the study participants. Majority of the participants were not able to identify T2DM complications. These results are similar to those from a study conducted in sub-Saharan Africa which found out that T2DM clients knew one to three of the proven complications and that educating patients about the many complications of diabetes is an important step in motivating them to control their blood sugars (Tuei et al., 2010). This is critical because chronic complications occur in significant proportions of T2DM clients with both early and sub-optimally controlled long-standing T2DM. If left untreated or poorly managed, patients suffering from T2DM are at greater risk of developing cardiovascular disease, diabetic retinopathy, diabetic neuropathy (resulting in autonomic dysfunction), and potential complications resulting in lower extremity amputation (Mollentze, 2012).

The study indicated low uptake of screening for T2DM in the area as only a small proportion of the participants had been screened for diabetes before they were diagnosed with the condition. The participants reported reasons for not screening including fear of being known to be diabetic, not feeling like they had the condition, lack of information on diabetes screening and lack of awareness about screening services. The participants reported various reasons for screening including doctors’ recommendation, media and relatives influence as well as health care providers’ initiative at the clinics. Most of participants had not been screened for T2DM due to fear of being diagnosed with the condition and consequently being labelled as diabetic. These findings are similar to those from a study conducted in South Africa which indicated that a large population of T2DM patients had remained undiagnosed because of the lack of early screening and knowledge of symptoms (Mash, 2007). This delayed diagnosis is costly to diabetics since most of
clients end up being admitted to hospitals for treatment of complications which could have averted through early screening (Maina et al., 2011).

The participants’ main source of information on diabetes was health talks by health care providers which was mainly accessible at the hospitals. The findings are similar to those by the KDHS which indicated that health education talks done within health facilities is a major source of information only that it targets those with diabetes (KDHS, 2014). The KNDS also reported that health education is central to implementing changes when provided through multiple methods and sites, such as community groups, schools, workplaces, mass media, religious organizations and health centres (KNDS, 2010).

Majority of the participants enrolled into diabetes management program immediately after diagnosis following doctors’ recommendation. Participants who delayed enrolment reported that they were not aware about the diabetic management program while others feared being known to be diabetic. These results are similar to those from a study conducted in Canada which established that lack of enrolment and consistent follow up at diabetic management centres was a stumbling block among most diabetics who chose to keep off follow up due to negative perception and fear of disclosure of their diabetic status (Huang et al., 2007).

5.1.2 Practices for management of T2DM

A large proportion of the participants knew that T2DM is controllable. However, their responses on practices for control of the condition rated poorly. The participants reported to have been undertaking exercise as they could tolerate with slightly more than half of them reporting to have been exercising for at least thirty (30) minutes daily. This findings are similar to those by Knowler et al., (2002) who established that exercising for
thirty (30) minutes daily, (usually by walking), for at least five (5) days a week would alleviate severity of the condition.

Most of the participants monitored their blood sugar level once every month during review clinics. This is not an appropriate approach to monitoring blood sugar because it only gives the patient a short term picture of their control and general blood sugar level. Similar findings are found in a study carried in Canada which established that many T2DM patients check their blood sugar with a glucometer once a month mostly in health facilities while others tested when they experienced symptoms of high blood sugar (Huang et al., 2007).

The use of oral hypoglycemics was the main treatment modality for a large proportion of the study participants. Participants who were not on anti-diabetic drugs indicated that they were on nutritional therapy. The participants were compliant to the treatment regimen and did not report any side effects from the drugs. These findings are similar to those from a study in Armenia which established that the most prevalent form of medication administration for T2DM treatment was oral administration which was tolerable and with minimal or no side effects (Mealey, 2006).

5.1.3 Influence of participants’ socio-demographic characteristics on management of T2DM

On the influence of socio-demographic and socio-economic characteristics on management of T2DM, the study established a significant association between education and income levels among the diabetes mellitus clients and management of T2DM. There was no association between age, gender, marital status and employment and management practices for T2DM among the clients. Education and income were
significantly associated with management of T2DM. Participants with college and university education were more likely to manage the condition effectively. This finding is dissimilar to those from a study carried out in Qassim which found out that education level had no influence on diabetes management (Ahmad & Rasheed, 2014).

Participants’ level of income was also found to be associated with management of T2DM. Higher income level was associated with good management of T2DM including consistent access to health care, and improved access to affordable healthful foods. This was found to be similar to findings from a study carried out in Amman city in Jordan which established that as the diabetic client’s annual income increased their management of diabetes was better as they were able to afford new methods of diabetes self-management. (Mezyed & Yahya, 2013).
5.2 Conclusions

i. The study revealed low level of knowledge on T2DM management interventions among the participants. Most of them did not know the causes of poor blood sugar level, signs of poor blood sugar control, T2DM healthy dietary measures and measures prevention of T2DM complications. The major source of information on diabetes mellitus among the participants was health care facilities.

ii. Practices applied in management of T2DM amongst the participants included anti-diabetic drugs and tolerable activity leaving out self blood glucose monitoring exercise and drug therapy were fairly undertaken by the participants.

iii. Participants’ levels of education and income were found to be significantly associated with management of T2DM. Participants with College/university education and higher income level practiced good management of T2DM.

5.3 Recommendations

i. The national and Nyandarua County government’s Department of Health to improve on creation of awareness on T2DM management interventions and diversify the media so as to reach most people. This should be standardized across the health facilities in order to improve the level of knowledge on management interventions for T2DM among diabetic clients.

ii. The County’s Department of Health to organize for health education sessions on practices for management of T2DM in the community through community outreach programs and barazas. This will empower T2DM clients to understand and effectively apply the practices for good management of T2DM.
iii. The County Department of Education to plan for academic seminars through which to create awareness on the importance of formal education because a higher level of education significantly influences the management of T2DM.

5.4 Recommendation for further research

Research into the other factors that influence choice of follow up care among T2DM clients in the study area including cultural attributes, religion, accessibility to the facility, in order to provide information necessary for planning and improving T2DM management programs.
REFERENCES


APPENDICES

Appendix I. Informed Consent form

My name is Francis Matheka Muoki. I am a Masters student from Kenyatta University. I am conducting a study on “MANAGEMENT OF TYPE 2 DIABETES MELLITUS BY DIABETIC CLIENTS IN NYANDARUA SOUTH SUB-COUNTY, KENYA” The information gathered will be used by the ministry of health and the Sub-County health management team in improving the community’s knowledge on management guidelines and practices for the control of type 2 diabetes mellitus and the prevention of diabetes related complications among diabetic clients in the Nyandarua South sub-county community.

Participation. Your participation in this study is voluntary and requires that you fill in the questions asked in the questionnaire. You will fill the questions with the guidance of the interviewer. You have the right to refuse participation in this study without any penalty. You may ask questions for clarification related to the study at any time. You may as well withdraw from the study at any time without any consequences now or thereafter.

Benefits. There are no monetary or material benefits from participation in this study. However, your participation in the study will help us learn more about management of type 2 diabetes mellitus in the sub-county and the information gathered will help create more awareness of recommended management guidelines and in the improvement of the services you receive for better management of the condition. This will thus reduce on Type 2 diabetes related complications among diabetic clients in the community.

Risks. There are no risks associated with your participation in the study and the information that you will give will not be used in any way to compromise on the services you receive from the facility. However, filling out this questionnaire will take you about 10 minutes and in case you are uncomfortable to answer some questions, you are free to skip them.

Privacy and confidentiality. You are requested to fill this questionnaire in a private setting and please DO NOT indicate your name on the questionnaire. The questionnaires
will be kept in a locked cabinet for safe keeping and the information you will give will be kept confidential.

If you have any questions you may contact me on 0727 407 039. You can also contact my supervisors: Dr. Wanyoro on 0722 747 903 or Professor E. Kabiru on 0721 998 558. You can also contact the Kenyatta University Ethics Review committee secretariat on; 
chairman.kuerc@ku.ac.ke.

**Participant’s declaration.** The above information regarding my participation in the study is clear to me and my participation in this study is voluntary. I understand that the information I will give will be kept confidential and that I can opt out of the study at any time. I understand that I will not be penalized or discriminated even if I declined to participate in this study and that the study has no risks neither will it affect my services in the facility.

______________________________  ________________
Signature or Thumbprint        Date

**Investigator’s declaration**

I, the undersigned, have explained to the participant in a language he/she understands the procedures to be followed in the study and the risks and benefits involved.

Name researcher………………………………

Researcher signature......................... Date.................................
Appendix II. Researcher administered questionnaire

Section 1. Socio-demographic information

1. How old are you? ______________ (years)
2. Gender:  Male  Female
3. What is your highest level of education? Tick one that is applicable to you.
   - Primary
   - Secondary
   - College/University
   - Don’t know
4. What is your marital status? Tick one that is applicable to you.
   - Single
   - Married
   - Divorced
   - Separated
5. What is your employment status? Tick one that is applicable to you.
   - Self-employed
   - Employed
   - Casual labourer
   - Unemployed
6. What is your average household income per month (in Kshs)?
   - Less than 5,000
   - 5,001-10,000
   - 10,001-15,000
   - Over 15,000

Section 2. Knowledge

7. What was your first source of information about diabetes mellitus?
   i. Television
   ii. Radio
   iii. Newspapers
   iv. Magazines
v. Healthy facilities fliers
vi. Posters/ billboards
vii. Health talks by health care providers
Vii. Message by attending clinician

ii. Any other (specify)................................................................................................................................

8. When were you diagnosed with diabetes? ................................................................................................

9. Had you screened for diabetes before the diagnosis?
   YES ☐
   NO ☐  *If NO, skip to question 10*

If Yes, what had made screening for diabetes?
   a. Doctor’s recommendation ☐
   b. Television/ radio/ magazines/ brochures ☐
   c. Relative/ friend advice ☐
   d. Attend health workshop/ outreach ☐
   e. Health care provider initiated it at the clinic ☐
   f. It’s a standard/ requirement of care at clinic ☐
   g. Others (specify)...........................................................................................................................

10. Did you enrol into the diabetic management program immediately?
    YES ☐
    NO ☐  *If NO, skip to part b.*

If Yes, (a) what made you enrol into the diabetes management program immediately?
   a. Doctor’s recommendation ☐
   b. Relatives recommendations ☐
   c. Advised by friends ☐
   d. Fear of complications ☐
   e. To understand my condition ☐
   f. Perceived benefits from the program ☐
   g. Better management my blood sugars ☐
   
   Any other (specify)..........................................................................................................................
(b) What made you delay enrolling into the diabetes management program?
   a. Fear of being known to be diabetic
   b. I Did not believe the diagnosis
   c. I was not sure of the services offered
   d. Not aware of the program
   e. I had to consult my family
   f. I feared being stigmatised
   g. Any other (specify).............................

Section 2. Knowledge on T2DM management interventions

11. a. Is diabetes mellitus controllable?
    YES ☐
    NO ☐ If NO, skip to question.12

b. What management interventions for type 2 diabetes mellitus do you know?
   a. Exercise/activity
   b. Diabetic diet therapy
   c. Drug therapy
   d. Frequent checkups for blood sugar

12. What causes of poor blood sugar control do you know?
   a. Not taking drugs/ anti-diabetics
   b. Failure to exercise
   c. Feeding on high fat diet
   d. Taking carbohydrate rich meals
   e. Not going for clinical check ups
   f. Any other (specify).................................................................

13. What signs of poor blood glucose do you know?
   a. Frequent passage of urine
   b. Feeling thirsty
   c. Hunger
   d. Tremors
   e. Sweating
   f. Blurred vision
g. Heavy headedness
h. Nausea
i. Vomiting

Any other (specify)..........................................................................................

14. Which complications of Diabetes Mellitus do you know?
   a. Loss of sight/blindness
   b. Foot ulcers
   c. Stroke
   d. Heart attack
   e. Kidney failure
   f. Any other (specify)....................................................................................

15. Which types of food do you include in your daily meals?
   a. ..................................................................................................................
   b. ..................................................................................................................
   c. ..................................................................................................................
   d. ..................................................................................................................

16. Which foods increase blood sugar level the most?
   a. ..................................................................................................................
   b. ..................................................................................................................
   c. ..................................................................................................................
   d. ..................................................................................................................

17. How do you prevent yourself from developing foot ulcers?
   a. Proper drying after bathing/washing
   b. Avoiding injuries
   c. Avoid tight shoes
   d. Putting on fitting socks
   e. Avoiding open shoes
   f. Any other (specify).....................................................................................
18. How do you prevent yourself from developing diabetes complications?
   a. Exercising regularly
   b. Taking medications as instructed
   c. Self blood glucose monitoring
   d. Attending clinics as appointed
   e. Taking meals as instructed by nutritionist
   f. Going for regular blood glucose check ups
   g. Any other (specify) .................................................................

Section 3. Type 2 DM management practices

a. How is your regular meal composition?
   i. ........................................................................................................
   ii. .......................................................................................................
   iii. ..................................................................................................
   iv. ...................................................................................................
   v. .....................................................................................................

(b). Exercise

How often do you exercise? .................................................................

How long is your exercise session in a day? (Minutes)

   a. 0-5
   b. 5-10
   c. 10-15
   d. 15-20
   e. 20-30
   f. More than 30

(c) Weight monitoring

   How often do you go for weight monitoring?
   i. Weekly
   ii. Monthly
   iii. Every three months
   iv. Every six months
v. Yearly

Any other (specify).................................................................................................

(d). Use of anti-diabetic medications

i. Are you currently on drugs for diabetes treatment?
   Yes □ No □

ii. If Yes, which ones are you taking? ..............................................................

iii. When were you started on the drugs? ......................................................

iv. How often do you take them? .................................................................

v. Do you experience side effects after taking the drug?
   Yes □ No □

If yes, what side effects have you experienced?

   a......................................................................................................................
   b......................................................................................................................
   c......................................................................................................................
   d......................................................................................................................
Appendix III. Kenyatta University Ethical approval letter

KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Email: chairman.kuerc@kua.ke
secretary.kuerc@kua.ke
ecfku2008@gmail.com
Website: www.ku.ac.ke

P. O. Box 43844 - 00100 Nairobi
Tel: 8710301/12
Fax: 8711242/8711575

Our Ref: KU/K/COMM/31/490
Date: 9th July, 2015

Muoki Francis Matheka
Kenyatta University,
P.O Box 43844,
Nairobi

Dear Matheka

RE: APPLICATION NUMBER PKII/358/1 352 – “MANAGEMENT OF TYPE 2 DIABETES MELLITUS BY DIABETIC CLIENTS IN NYANDARUA SOUTH-SUB-COUNTY, KENYA”

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic “Management of type 2 diabetes mellitus by diabetic clients in Nyandarua South-Sub-County, Kenya” received on 5th May, 2015 and discussed on 1st July, 2015.

2. APPLICANT
Muoki Francis Matheka, Department of Community Health

3. STUDY SITE
Engineer and North Kinangop Catholic Hospital, Kenya

4. DECISION
The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines AND APPROVED that the research may proceed for a period of ONE year from 9th July, 2015.

5. ADVICE/CONDITIONS
   i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study.
   ii. Serious and unexpected adverse events related to the conduct of the study are reported to this board immediately they occur.
   iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.
   iv. Submit an electronic copy of the protocol to KUERC.

If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.

PROF. NICHOLAS K. GIKONYO
CHAIRMAN ETHICS REVIEW COMMITTEE

[Signature]

Accept the advice given and will fulfill the conditions therein.

Dated this day of __________ 2015.

cc. Vice-Chancellor
Appendix IV. NACOSTI Research Permit

THIS IS TO CERTIFY THAT:

MR. MUOKI FRANCIS MATHEKA

of KENYATTA UNIVERSITY, 0-90137

KIBWEZI, has been permitted to conduct research in Nyandarua County

on the topic: MANAGEMENT OF TYPE 2 DIABETES MELLITUS BY DIABETIC CLIENTS IN NYANDARUA SOUTH SUB-COUNTY, KENYA

for the period ending: 31st October, 2015

Applicant's Signature

Permit No: NACOSTI/P/15/5784/6141

Date Of Issue: 27th July, 2015

Fee Received: Ksh 1,000

Director General

National Commission for Science, Technology & Innovation
Appendix V. NACOSTI research authorization

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

Ref: No.

NACOSTI/P/15/5784/6141

Muoki Francis Matheka
Kenyatta University
P.O Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Management of Type 2 Diabetes Mellitus by diabetic clients in Nyandarua South Sub-County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Nyandarua County for a period ending 31st October, 2015.

You are advised to report to the County Commissioner, the County Director of Education and the County Coordinator of Health, Nyandarua County before embarking on the research project.

On completion of the research, you are expected to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

SAID HUSSEIN
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nyandarua County.

The County Director of Education
Nyandarua County.
The County Coordinator of Health
Nyandarua County.
Appendix VI. Nyandarua County Commissioner research authorization

THE PRESIDENCY
MINISTRY OF INTERIOR AND COORDINATION
OF NATIONAL GOVERNMENT

Telegram: ......................
Fax No. 020-2196509
Email.countrynyandarua@yahoo.com

When replying please quote

REF. NO. CTY/CORR.3/3/VOL.1/62

COUNTY COMMISSIONER
NYANDARUA COUNTY
P.O. BOX 3
OL KALOU

29th July, 2015

Muoki Francis Matheka
Kenyatta University
P.O. Box 43844-00100
NAIROBI

RE: RESEARCH AUTHORIZATION - MUOKI FRANCIS MATHEKA

Following your application for authority to carry out research on “Management of Type 2 Diabetes Mellitus by diabetic clients In Nyandarua South Sub-County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Nyandarua South Sub-County for a period ending 31st October, 2015.

You are advised to report to the Deputy County Commissioner, Nyandarua South before embarking on the research project.

JUSTIN MAINA
FOR: COUNTY COMMISSIONER
NYANDARUA COUNTY

cc. Deputy County Commissioner
NYANDARUA SOUTH SUB-COUNTY
Appendix VII. Nyandarua County Director of Health research authorization

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NYANDARUA
OFFICE OF THE DIRECTOR -HEALTH SERVICES

Telephone. 0724315197
Email. healthcoordinator@nyandaruacounty.or.ke

P.O. Box 221–20303
Ol'Kalou

REF: NYA/CHC/071/VOL.1/16

11th August 2015

Muoki Francis Mathoka
P.O. Box 43844-00100
NAIROBI

RE: RESEARCH AUTHORIZATION

Following authorization by National Commission for Science, Technology and Innovation to carry out research in Nyandarua County Via the letter Ref: NACOST/I/15/5784/6141 27th July 2015 on “Management of Type 2 Diabetes Mellitus by diabetic clients”, Nyandarua County Health Department gives you authority to carry on with the research.

Kindly share the results of your research with the office of County Director of Health, Nyandarua County upon completion of your research.

Wish you all the best.

DR. KARIUKI GICHUKI
COUNTY HEALTH DIRECTOR OF HEALTH
NYANDARUA COUNTY

c.c

Medical superintendent
Engineer Hospital
Nyandarua County
Appendix VIII. Nyandarua County Director of Education research authorization

MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY

Email: cdenyandcounty@yahoo.com
Cellphone: 0725711938
When replying please quote

COUNTY EDUCATION OFFICE,
NYANDARUA COUNTY,
P.O. BOX 197
OL. KALOU.

REPUBLIC OF KENYA

NYA/CTY/36/VOL 1/29 29th July, 2015

Muoki Francis Matheka
Kenyatta University
P.O Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Reference is made to the National Commission for Science, Technology and Innovation letter ref. NACOSTI/P/15/5784/6141 dated 27th July, 2015 on the above subject.

You are hereby granted permission to conduct your research on “Management of type 2 Diabetes Mellitus by Diabetic clients in Nyandarua South Sub- County, Kenya” for the period ending 31st October, 2015.

COUNTY DIRECTOR OF EDUCATION

ROSEMARY NGUGI
FOR; COUNTY DIRECTOR OF EDUCATION
NYANDARUA

Copy to:

Secretary/CEO
National Commission for Science, Technology and Innovation
County Commissioner - Nyandarua
Appendix IX. Study Area map

Map of Kenya

Map of Nyandarua South sub-County