

**EFFECT OF EXERCISE PROGRAMME INTERVENTION
IN MANAGEMENT OF TYPE 2 DIABETES MELLITUS
OUTPATIENTS AT GULU REGIONAL REFERRAL
HOSPITAL, UGANDA.**

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fulfilment of the requirements for the award of Master of
Science degree in Sports Science of Kyambogo University**

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DECLARATION

This report is my original work and has not been presented for a degree or any other qualifications in any Institution.

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APPROVAL

This is to certify that this work has been done by Ojara Ricky Richard. The work has been under our supervision and now it can be submitted with our approval as the University Supervisors.

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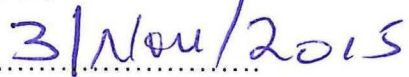
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LIST OF ACRONYMS

ACMS	American College of Medicine and Sport
ADA	American Diabetes Association
AHA	American Heart Association
BMI	Body Mass Index
CDCP	Centre for Disease Control and Prevention
GRRH	Gulu Regional Referral Hospital
HbA1c	Glycosylated Haemoglobin
HRmax	Maximum Heart Rate
IDF	International Diabetes Federation
NIHCE	National Institute for Health Care Excellence
NDS	National Diabetes Statistics
NIH	National Institute of Health
OPD	Outpatient Department
PAR	Physical Activity Readiness
PAR-Q	Physical Activity Readiness Questionnaire
RRH	Regional Referral Hospital
T2DM	Type 2 Diabetes Mellitus
UNBS	Uganda National Bureau of Standards
UW	University of Wisconsin, Hospital Madison.
WHO	World Health Organization

ABSTRACT

The purpose of this study was to determine the effect of aerobic exercise programme on Glycocylated Hemoglobin (HbA1c) in the outpatients from Gulu Regional Referral Hospital (GRRH). 50 patients with type 2 diabetes mellitus (T2DM) participated in the study. The programme was done on treadmill and bicycle ergometers, three times a week for 30-60 minutes per session, at 60-75% of the individual's maximum heart rate for 8 weeks. Descriptive statistics was used to analyze the level of participation in physical activities. Repeated measures t-test ($p < 0.05$) was used to determine significant differences in HbA1c as well as BMI of the patients. The analysis was performed using SPSS software (version 11.0). It was found that the patients did not participate in an organized exercise programme before. After the exercise, there was a significant difference in HbA1c between the experimental and the control group ($p= 0.000$). There was an average reduction of 2.22% ($p=0.000$) in HbA1c among the experimental group. However, there was no significant gender difference in HbA1c ($p= 0.88$). There was significant difference in BMI among the experimental group ($p= 0.000$). The programme was therefore effective for the T2DM patients. It is recommended that health service providers should assign exercise programmers for diabetes, sensitize patients on the importance of physical exercise in the management of sugar level.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Diabetes mellitus (DM) prevalence has been a threat to the general population world over (Arrendale et al., 2008; Moura et al., 2011; WHO, 2011). The World Health Organization [WHO] (2004) noted that at least 220 million people worldwide suffer from diabetes. Africa, like the rest of the world, is also experiencing an increasing prevalence of diabetes (Hall et al., 2011). In 2010, 12.1 million people were estimated to be living with diabetes in Africa (Sicree, 2009). In Sub-Saharan Africa this trend is emerging in those regions grappling with high rates of communicable diseases like Tuberculosis and Malaria (Hall et al., 2011). The prevalence of DM ranged from 0.6% in rural Uganda (Hall et al., 2011) to 12% in urban Kenya (Christensen, 2009). The prevalence estimates varied considerably between different studies for some countries, with an estimates ranging from 3.9% to 8.8% in rural South Africa (Erasmus et al., 2001; Motala et al., 2008).

DM is a condition in which the sugar level (glucose) in the blood is elevated. It comes as a result of either the deficiency of the hormone, insulin, in the blood (type 1 diabetes mellitus) [T1DM] or failure of the body to use the insulin produced (type 2 diabetes mellitus) [T2DM] (Sora, 2007; Trenell 2012). In both cases, the level of sugar in the blood will be increased. Insulin is the hormone that regulates the level of sugar (glucose) in the blood. It promotes glucose transport into cells, or diminishes its output from the liver, or promotes formation of storage form of sugar (glycogen) in the liver and muscle (Naheed, 2011).

T2DM is a serious condition that can lead to complications such as heart disease, stroke, renal failure, amputation and blindness (Arrendale et al., 2008; WHO, 2011). Factors such as physical inactivity, bad eating habits, high blood pressure, overweight and giving birth to a baby weighing more than 9 pounds (4.1 kg) increase the risk of developing T2DM (American Diabetes Association, ADA, 2011). Moura et al. (2011) also noted that physical activity is very important in managing the risk factors associated with T2DM. Several studies linked sedentary activities, such as, secretarial work and computer use and video-games, with increasing T2DM development (ADA, 2011; Mutebi, Nakwagala, Nambuya & Otim, 2012). Despite this information, the outpatients T2DM from Gulu Regional Referral Hospital (GRRH) apparently do not use it. It is advisable that patients manage their sugar level by increasing their levels of participation in physical activities, consuming a healthy diet, and taking medication to improve/maintain their blood glucose control. In addition, patients are encouraged to monitor their blood glucose by performing home blood or urine tests as an aid to self-management of the condition (Dino, 2012; Trenell, 2012).

Following the various strategies now available to manage T2DM, prevention of morbidity and early mortality of diabetic patients is moving towards a higher level. The regular practice of moderate intensity physical activity has shown capability to improve insulin sensitivity (Li et al., 2008). Physical activity is any bodily movement produced by skeletal muscles that result in energy expenditure (Nicol & Bredin, 2006).

Much as it was clear that physical activities and some medication were the cornerstones for the management of T2DM (Moura et al., 2011), patients from Gulu mainly depended on medication (personal interview of the doctor) which is even costly.

Although findings from some countries like America (Bacchi, 2012), India (Shenoy et al., 2009) and Britain (Moura et al., 2011), has shown positive impact of exercises on the reduction of sugar level among the patients, there is hardly any similar study conducted in Ugandan, particularly in GRRH.

1.2 Statement of the Problem

The number of persons with T2DM who attend diabetic clinics world over is reported to be increasing (Moura et al. 2011; WHO, 2011). Uganda, one of the African nations, suffers the same problem with an estimate of over 700,000 registered people with diabetes (Otim, 2012). Northern Uganda has the highest prevalence of diabetes in the country with 9.3 percent of the region's population suffering from the disease (Luxecy 2012). This resulted into increased death rate, cases of resistance to some medication and diabetes complications (Chang et al., 2011). To quell these, a number of researches involving physical activities in the management of T2DM have been done from various parts of the world, and proven to reduce the sugar level in the patients (Ajediran, 2011; Bacchi, 2012; Yavari et al., 2012). Basing on the findings, the doctors who treat diabetes always advise patients to take exercises as number one management option of the condition (Mutebi, Nakwagala, Nambuya & Otim, 2012). Indeed a proper lifestyle, proper nutrition and physical activity are the most suitable approaches to reduce the health problems associated with diabetes. Although the patients were being advised to take physical activity as one of the sugar levels management option, there was hardly any programmed physical activity prescribed and administered for outpatient diabetics at GRRH. Related, although many patients were engaged in un-programmed physical activities such as farming and housework, this barely controlled their sugar level. The researcher therefore aimed at designing and prescribing physical activity programme intervention strategy in managing T2DM for the patients in GRRH.

1.3 General Objective

The purpose of this study was to prescribe and administer an exercise programme for T2DM at GRRH in order to provide a low cost strategy of managing the condition.

1.4 Specific Objectives of the Study

The specific objectives of this study were to:-

1. Establish the level of participation in physical activities among T2DM outpatients attending the Gulu Referral Hospital.
2. Determine the effect of an 8-weeks aerobic exercise programme on the HbA1c of T2DM outpatient attending the Hospital.
3. Determine the effect of an 8-weeks aerobic exercise programme on the BMI of T2DM outpatient attending the Hospital.

1.5 Research Questions

This study was guided by the following research questions:

1. What is the level of participation in physical activities of T2DM outpatients attending GRRH?

1.6 Hypotheses

The study was also guided by the following hypotheses:

Major hypothesis

There would be no significant difference in the HbA1c level and BMI of the patients with T2DM before and after the exercise programme intervention.

Sub hypothesis:

H₀₁ There would be no significant difference in the HbA1c level of the patients with T2DM within the experimental group before and after the exercise programme intervention

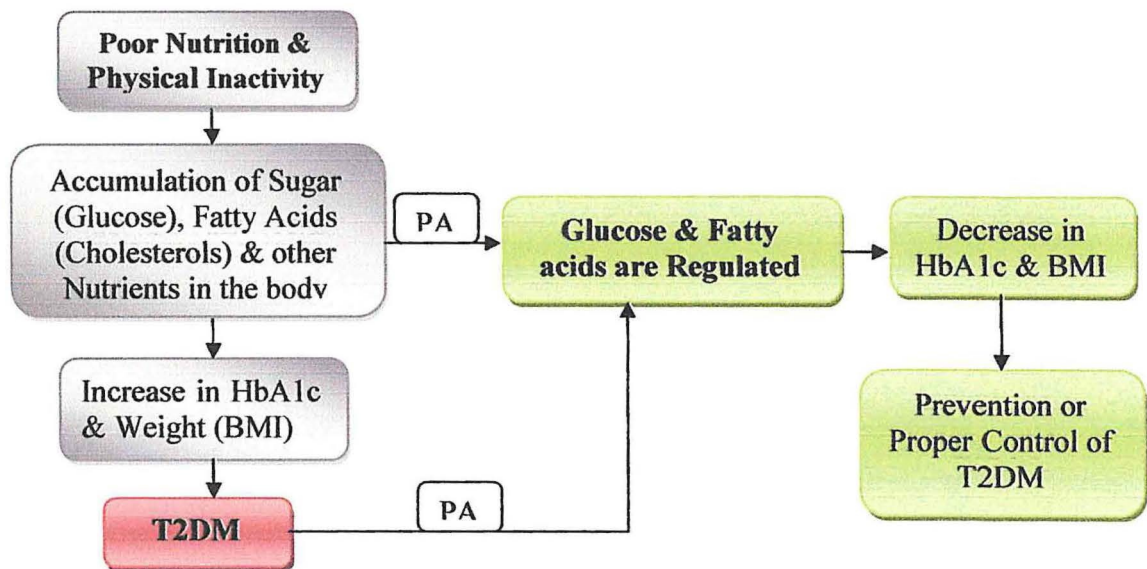
H₀₂ There would be no significant difference in the HbA1c level between the male and female patients within the experimental group before and after the exercise programme intervention.

H₀₃ There would be no significant difference in the HbA1c level between the control group and the experimental group after the 8-weeks exercise programme intervention.

H₀₄ There would be no significant difference in the BMI of the patients within the experimental group before and after the 8-weeks exercise programme intervention.

1.7 Conceptual Framework

The conceptual framework for this study was derived from Naheed (2011)



Adopted from Naheed (2011) and modified by the researcher

Figure 1.1: Relationship between Physical and T2DM

This framework shows that physical inactivity and poor nutrition lead into accumulation of sugar and cholesterol in the body hence an elevated blood sugar level and the BMI of an individual (Pignone, et al., 2010). Elevated blood sugar level and the BMI of the individual can in turn lead to T2DM and the associated complications such as heart disease, stroke, renal failure, amputation and blindness (Naheed, 2011). With PA intervention, the accumulated sugar and cholesterol will be regulated, thereby, reducing the blood sugar and BMI of the individual (Moura et al., 2011; Sharon 2015). Similarly, when an individual with T2DM is subjected PA the HbA1c and BMI of the individual will decrease. The reduction of the blood sugar and BMI can lead to the proper management or control of T2DM (Naheed, 2011).

1.8 Limitation of the Study

The study was limited by the following:

Alcohol intake, drugs, eating habits and smoking among others were not strictly controlled and these, individually or otherwise might have affected the outcome of the study.

1.9 Significance of the Study

It was deemed necessary to conduct this study since the findings from this present study would serve as a base for future comparative studies on effect of exercise programme interventions for diabetic patients in Uganda and elsewhere. Besides, such findings would inform health policy providers such as the Ministry of Health and the District Health Service on a low cost intervention to manage the sugar level in T2DM patients. The study would also be of importance to exercise programmers attached to the diabetes clinic of the hospital in prescribing effective exercise programme that can best suit the diabetics from GRRH.

1.10 Delimitations of the Study

The study was delimited to Northern Uganda, Gulu district, specifically in the Outpatient department of GRRH.

It was conducted for a period of about three months, from July to September, 2014. Basically the study was conducted on T2DM patients. The subjects were limited to the age range of 30-61 years. An aerobic exercise programme, of 3 times a week, at 60-75% maximum heart rate and 30-60 minutes per session, was administered to the subjects for 8 weeks.

1.11 Assumptions

The following assumptions were:

Patients maintained their present medication, diet and lifestyle behavior during the 8 weeks of the study so that the findings are attributed to the aerobic exercise programme only.

Daily activities outside study parameters would be maintained relatively constant.

The participants would be objective in their responses to the engaged in PA.

1.11 Definition of Terms

Exercise Programme: Performing of exercises 3 times a week, lasting 30 to 60min, at 60 to 75% of the maximum heart rate for 8 weeks.

High sugar level: HbA1c more than 6.0 %

Glycated Haemoglobin: Amount of sugar that has got stuck on the blood cells

Patient: A T2DM outpatient in Gulu Referral Hospital

Physical Activity: Any programmed or un-programmed bodily movement produced by skeletal muscles that result in energy expenditure.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Literature was reviewed under the following topics and subtopics: The concept of DM, the effect of T2DM on the patients, prevalence of T2DM, interventional strategies, the level of participation of T2DM at GRRH in physical Activities, the effect of the aerobic exercise programme on T2DM and lastly the related studies.

2.1 The Concept Diabetes Mellitus

Diabetes is a chronic disease characterized primarily by the body's inability to produce or use insulin. Insulin is the hormone produced by the pancreas that allows glucose to enter the body's cells, where it is used as fuel for energy (Korkiakangas, 2009). For people with diabetes, glucose from sugars and starches are unable to be used by body cells and therefore remain in the blood stream resulting in elevated blood glucose levels. With time, elevated blood glucose can also lead to long-term complications of the heart, kidneys, eyes, feet, blood vessels and nerves. However, through careful daily management of diabetes, these complications may be prevented or delayed (Toth, 2009).

There are several types of diabetes namely:

Gestational diabetes is a type of diabetes that occurs during pregnancy in women who otherwise do not have diabetes. It is diagnosed in 4% of all pregnancies and is marked by insulin resistance in women who have not been previously diagnosed with diabetes (Thoenen, 2007). Testing for gestational diabetes generally occurs between the 24th and 28th week of pregnancy. Babies born to mothers with gestational diabetes may experience complications such as macrosomia, growth

restriction, Respiratory Distress Syndrome among other problems (Toth, 2009). Complications for women with diabetes during pregnancy include, but are not limited to high blood pressure, and premature birth of the baby (Toth, 2009). Women who are diagnosed with gestational diabetes “have 40 to 60 percent chances of developing diabetes in the next 5 to 10 years” (Sigal et al., 2006; Trenell, 2012). However, this study did not focus on this type of diabetes.

T1DM or Insulin Dependent Diabetes (IDDM) also referred to as juvenile onset diabetes, which is usually diagnosed before the age of 30 is another type of diabetes (Wilmore & Costill, 1999). It is a condition in which the cells of the pancreas fail to produce sufficient insulin to regulate blood sugar levels (Sigal et al., 2006; Sora, 2007). If the onset is rapid, the person will often present with severe increase in sugar, which is an acute, emergency situation characterized by extreme thirst, excessive urination, hunger and rapid weight loss (Toth, 2009). T1DM is not preventable and must be managed through lifelong use of insulin, meal planning and physical activity (Toth, 2009). This study did not also focus on this type of diabetes.

Type 2 diabetes mellitus or Non Insulin Dependent Diabetes (NIDDM) is a condition where beta cells of the pancreas are able to produce insulin, however, the body is unable to use the insulin it produces effectively (Dino, 2012). It is the most common form of diabetes, making up 85-95% of all cases (Moura et al., 2011). Diagnosis generally occurs after age 30 in people who have a family history of the disease (Toth, 2009). T2DM is associated with overweight/obesity, sedentary lifestyle, older age, family history, impaired glucose metabolism and previous gestational diabetes (Trenell, 2012). T2DM diabetes may not exhibit symptoms in the early stages and can remain undiagnosed for many years (Toth, 2009). Its symptoms may include fatigue, blurred vision, tingling, pain or numbness of the hands and/or feet and recurring skin,

gum and bladder infections. Unlike T1DM, T2DM may be prevented or delayed through regular physical activity, healthy diet and achievement of a 5-7% reduction in body weight for those who are overweight (Mensing, 2006). T2DM is usually treated with a combination of diet, physical activity or oral medication and/or insulin. The focus of this study was then on T2DM.

2.1.1 Effect of T2DM on the Patients

T2DM has a tremendous impact on patients; Such as being prone to various complications. Besides the physical manifestations and complications affecting the heart, kidneys, liver, eyes, nerves and other organs, T2DM is associated with shifts in emotions that can affect the patient and his or her family (Naheed, 2011). The complications that are related to T2DM include; retinopathy, nephropathy, neuropathy, hypertension and depression.

Diabetic Retinopathy (DR) can be defined as damage to microvascular system in the retina due to prolonged high sugar level. Diabetic retinopathy is primarily classified into Non-Proliferative Diabetic Retinopathy (NPDR), or Background Retinopathy and Proliferative Diabetic Retinopathy (PDR) (Belinda, 2009; Naheed, 2011). Progression from mild form characterized by increased vascular permeability to moderate and then to severe NPDR characterized by vascular closure and an increased risk for the development of PDR distinguished by the growth of new blood vessels on the retina and posterior surface of the vitreous. Visual impairment in diabetic retinopathy and sometimes blindness can occur due to Diabetic Macular Edema (DME) and PDR (Rajbharan et al., 2008).

Diabetic nephropathy affects the kidney and is the leading cause of chronic renal failure worldwide. It is responsible for renal failure in about one third of patients who undergo dialysis (Hassabi et al., (2008). One of the initial markers of this condition is micro-albuminuria, which

indicates an increased risk of progression to nephropathy as well as an elevated risk of cardiovascular events. Early detection of diabetic neuropathy results in less hospitalization of patients with foot ulcers and fewer lower-extremity amputations (Hassabi et al., 2008).

Hypertension is the primary preventable cause of the two major causes of mortality namely: Coronary Artery Disease (CAD), and Cerebrovascular Disease (CVD). T2DM increases the risk for CAD by two fold, CVD by seven folds and congestive heart failure by four fold. There is ample evidence for a consistent gradient relationship of blood pressure with CVD and CAD. Studies have also shown that an increase of blood pressure of 5 mm Hg is associated with a 34% increase in risk for CVD and a 21% excess risk for CAD (Rajbharan et al., 2008).

Depression is twice as much common in people with diabetes as in the general population and major depression is present in at least 15% of patients with diabetes. Depression is associated with poorer glycemic control, health complications, decreased quality of life and increased healthcare costs. Thus people with diabetes should be screened for depression regularly (Rajbharan et al., 2008).

2.1.2 Prevalence of T2DM

According to Moura et al., (2011), T2DM is now considered to be one of the diseases showing the greatest increase worldwide, becoming an epidemic. With time, the number of people with diabetes will increase even more. Moura et al., (2011) also noted that approximately 285 million people worldwide, or 6.6% in the age group 20–79, had diabetes in 2010, 70% of whom live in low and middle-income countries. This number is expected to increase by more than 50% in the next 20 years if preventive programmes are not put in place. By 2030, about 438 million people,

or 7.8% of the adult population, are projected to develop diabetes. The largest increases will take place in the regions dominated by developing economies (Moura et al., 2011).

Of all, T2DM constitutes about 85 to 95% of the diabetes in high-income countries and may make up higher percentage in low- and middle-income countries (Moura et al., 2011). WHO (2011) noted that at least 220 million people worldwide suffer from diabetes. Its incidence is increasing rapidly, and it is estimated that by 2030, this number will double (National Diabetic Statistic, [NDS], 2011). The greatest increase in prevalence is, however, expected to occur in Asia and Africa, following the trend of urbanization and lifestyle changes (NDS, 2011). Unfortunately in most developing countries such as those in Africa, patients do not receive adequate information on diabetes and the most appropriate way to treat or control the disease due funding for researches and inadequate health management programmes (WHO, 2011).

In Uganda, over 700,000 people are registered with diabetes (Otim, 2012). Northern Uganda has the highest prevalence of diabetes in the country with 9.3 percent of the region's population suffering from the disease (Luxecy, 2012). Thus Gulu, which is located in Northern Uganda, was targeted by this study. According to Luxecy (2012) the residents in Gulu region stayed in camps for so long during the war, where they were exposed to conditions that cause diabetes especially insufficient diet and depression. Luxecy (2012) also revealed that over 3,000 people from the region are receiving diabetic treatment while an estimated 24,000 people, about 3.64% of the population, are being targeted due to availability of machines to detect the disease in its early stages.

2.1.3 Intervention Strategies

Since T2DM has a physical, social and economic impact on people in a given society, interventions against it are paramount. These should focus on healthy eating, maintenance of a desirable body weight and regular, routine physical activity.

Diet intervention in T2DM is based on the fact that dietary intervention in short term trials has been shown to reduce several risk factors for both macro and micro-vascular complications. According to Athyros (2008), it still remains one of the cornerstones in the treatment and management of T2DM. The effects of diet intervention is either direct from diet itself or indirect from the effect diet on weight and body composition. It must, however, be emphasized that the benefits of this kind of intervention in reducing complications has never been proven in randomized long-term studies in T2DM (Aguilar et al., 2014). McArdle (2010) put forward the basic diabetes nutrition messages that are associated with improved outcomes. McArdle advised that people should eat similar amounts of carbohydrate throughout the day, each day, and distribute the carbohydrate fairly evenly throughout the day. In other words, people should control blood glucose levels; the first priority is to eat consistent amounts of carbohydrate at meals and to eat at similar times of day. Secondly, patients should practice portion control. Adjusting portions to reasonable sizes is essential for optimal glucose and weight control. People should be encouraged to continue to eat the foods they enjoy, but to eat smaller portions.

Further McArdle (2010), recommended that fats are skimmed since fat is loaded with calories, and all fats may be associated with insulin resistance. A reduction in fat helps with weight loss and maintenance and improves lipid levels. Additionally one should maintain a healthy weight. Overweighed patients who loose as little as 10 pounds can have significant improvements in blood glucose, blood pressure, blood lipids and can also increase insulin sensitivity.

Preventive treatment with low-dose acetylsalicylic acid and treatment with vitamin C and E are effective in the management of the disease.

Individual with T2DM who are less than 6 months of age should receive an influenza vaccine every fall. A pneumococcal revaccination is also recommended for individuals greater than 65 years of age, who were previously immunized when they were less than 65 years of age, if the vaccine was administered less than 5 years ago (ADA, 2009).

Periodic medical visits; A person with a chronic illness may need to be seen three to four times a year. Healthcare providers must then emphasize the need for regular screening and evaluation not only in these individuals, but in their family members as well.

Another intervention strategy against T2DM focuses on the engagement in Physical Activity.

The terms “physical activity” and “exercise” denote two different concepts. Physical activity refers to any bodily movement produced by skeletal muscles that results in an expenditure of energy (McArdle, Katch & Katch, 2010). It includes a broad range of occupational, leisure and daily activities such as walking, playing with children, gardening, house cleaning, playing tennis, biking, or swimming among others. Exercise refers to planned or structured physical activity. It involves repetitive bodily movements performed to improve or maintain one or more of the components of physical fitness: aerobic, muscular strength, muscular endurance, flexibility and body composition (Potte, 2011). Together, physical activity and exercise have been recognized in the management regimen of T2DM patients, which results in a variety of physiological and metabolic adaptations. The CDCP, the ACSM and Healthy People (2010) all recommend moderate intensity physical activity for a minimum of 150 minutes a week, 30 minutes per day, 5

days a week or vigorous intensity physical activity for 20 minutes per day, at least 3 days a week (CDCP, 2009).

Metabolism abnormalities leading to insulin resistance are usually reversed by management dieting and increase in physical activity and weight loss. Physical activity/Exercise may increase body's response to intrinsic insulin by multiple mechanisms including increasing the amount of transporters of glucose into the muscle cells (GLUT-4), increasing insulin receptor substrates (IRS) and increasing the muscle mass, given that more than 75% of the glucose uptake in response to insulin is by the muscular tissue. The fatty acids released from adipose tissue concentrate inside the myocytes and reduce the GLUT-4 transportation onto the cell membrane (Bello et al., 2011; Matthew et al., 2011; Moura et al., 2011). Exercise, however, will reduce the fatty acid accumulation within the myocytes, by oxidizing them. Therefore Lifestyle modification, by focusing on the weight management and increase in the physical activity, may prevent progression toward diabetes in people who have an impaired glucose tolerance test (Bonen, Dohm, & Van Loon, 2006; Praet et al., 2006).

Regular exercise may also lower the HbA1c to a level that could ultimately be effective in prevention of developing hyperglycemic complications (Moura et al., 2011; Matthew et al., 2011). For many years, physical activity has been, along with diet and medication, considered fundamental in the treatment of diabetes (Silvano, 2010). Therefore, based on a number of large randomized controlled trials, physical activity and exercise have recently been recommended to prevent and treat diabetes according to ADA and other national guidelines (ACSM, 2000; Sigal, 2004; Silvano, 2010). Moreover, considering the potential adverse effects and cost attributed to some drugs (Nissen & Wolski, 2007; Pantalone, et al., 2009), the clinical importance of physical

activity, as well as that of therapeutic education is even increasing (Silvano, 2010). This study focused on the establishing whether exercise can help in the management of T2DM among patients in GRRH.

2.2 Level of Participation of T2DM in Physical Activity

Currently, clinical guidelines on T2DM provide no detailed information on the modalities of the most effective exercise intervention in the treatment of T2DM (Praet & Luc, 2007). People managing diabetes find that regular exercise helps a lot by improving the body's ability to use insulin and process glucose. It also reduces overall body fat and improves heart and lung function (Ajediran, 2011; Bacchi, 2012).

Experts recommend that people with T2DM should perform some sort of physical activity every day, at least for 20 minutes, (Mackenzie, 2000; O'Dell, 2004). For best results, an individual should strive for moderate intensity physical activity like brisk walking, dancing, bicycling, running, or swimming for at least a half-hour five days or more per week. Strength training, two or three days a week, can also improve one's body's ability to control diabetes (Thomas et al., 2009; Timothy, et al., 2010).

Robertson et al., (2009) recommend that physical activity of 5 days a week of 30 minutes each helps the patients to manage their sugar level. They however do not clearly point out the intensity over which the activity should take place. According to Dino (2012), Sigal et al. (2006) and Trenell (2012), 30 minutes of moderate intensity three times per week, can enable the patients manage their sugar level appropriately.

There seems therefore, to be a range of frequency, intensity and time over which the activities can be performed and if properly adhered to, the T2DM patients can manage their sugar level

within a less dangerous range. From the reviewed literature, it ended that an accumulation of at least 60 minutes of moderate intensity exercise of three to five times a week is of significant importance in the management of sugar levels in T2DM patients.

2.4 Effects of Aerobic Exercise Programme on T2DM

Exercise plays a very important role in the management of T2DM. As we exercise, our muscles use stored glucose (glycogen) and glucose available in our blood, as fuel for the exercise. Following a good session of physical activity, our muscles will then replenish their stores of glycogen and will therefore take in glucose from the blood following exercise, thereby reducing the HbA1c level (Sharon 2015). Also, according to Sharon (2015), the larger our waistline, the more resistance to insulin our bodies become and therefore our blood glucose levels increase. If we can lose weight and reduce our waist size, we can improve our sensitivity to insulin and thereby improve our blood glucose levels (Sharon 2015).

Exercise can therefore lower HbA1C levels over time by increasing the effectiveness of insulin, which results in more glucose entering cells and lowers the sugar levels in the blood (Sharon 2015). According to Sigal et al., (2007), aerobic exercise over a 26-week period reduces HbA1c levels on average by 0.6 percent. Since a 1 percent drop in HbA1C levels can reduce heart disease by 15 to 20 percent and vascular complications by 37 percent, according to Sigal et al., (2007), a 0.6 percent drop can significantly reduce complications of diabetes. Likewise a reduction in the weight of an individual would mean reduction in the BMI of the individual (Owen 2014; Sharon 2015) and hence proper management of T2DM.

However, information about blood glucose control in two to three months can best be obtained through regular measurement of glycosylated haemoglobin (HbA1c) (Calisti & Tognetti, 2005; Ruchi, 2006). HbA1c refers to the portion of glucose stuck firmly to red blood cells (Arrendale, 2008). It is a test that shows the average amount of sugar attached to the haemoglobin over a period of 8-12 weeks. A normal person has HbA1c levels at about 4 to 6% (WHO, 2011). According to Ruchi (2006), a person with diabetes that can maintain the level of HbA1c in the 7% range has a better chance of delaying complications.

On the other hand Body Mass Index (BMI) is a number calculated from a person's weight and height; $BMI = \text{Weight (kg)} \div \text{square of height (m}^2\text{)}$. BMI is a fairly reliable indicator of body fatness for most people. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat (Mei et al., 2002). According to Ganz et al., (2004), a normal BMI range is 18.5–24.9 kg/m²; overweight range is 25–29.9 kg/m², Obesity range is 30 kg/m² and above. The patients should therefore aim at maintain their BMI within a normal range if they are to manage their sugar level within the 7% range (Ruchi 2006). In order to have a normal BMI, one needs to have a healthy diet and engage in regular PA. However, this study aimed at finding out whether the exercise regimen had an effect on the BMI of the patients.

2.5 Related Studies

Various authors, such as Kelly et al., (2015), Oyewole et al., (2014) and Adeniyi et al., (2013) among others conducted different studies to establish the level of participation of T2DM in PA and come out with the following findings:

Oyewole et al., (2014) conducted a study on Physical activity among T2DM adult Nigerians. They used cross-sectional study on 122 participants selected consecutively. They were

categorized as physically inactive or active using International Physical Activity Questionnaire. Data was assessed using descriptive and inferential statistics. The findings indicated that about 31% of the respondents were physically inactive, which suggests that there was prevalence of physical inactivity among T2DM patients. In conclusion, this study suggests that the prevalence of physical inactivity was high among T2DM patients and their sedentary behavior is over 4 h/day. This group of people should be encouraged to participate regularly in PA. This study however did not subject the participants to an exercise programme.

Adeniyi et al., (2013) investigated the associations among motivation, socio-demographic characteristics and low level participation in physical activity among a group of Nigerians with T2DM. A sample of 326 T2DM patients attending diabetes clinics participated in this cross-sectional study. PA levels were assessed using the International Physical Activity Questionnaire. Regression analysis was used to determine associations at $p < 0.05$. It was found that only 108 (33.1%) were active at moderate to high levels. In conclusion, Adeniyi et al. said the Nigerian patients with T2DM are appropriately motivated to do physical activity but their physical activity is largely below recommended levels.

On the other hand, Kelly et al., (2015) conducted a study on gender differences in Physical Activity Levels of Older People with T2DM. A pedometer from two cohorts of older adults with and without T2DM was used to obtain the level of PA of the patients. Multivariable regression was used to determine associations between meeting a guideline equivalent of PA in T2DM. There were 293 participants with T2DM (mean age 67.6 ± 6.8 years). T2DM in women was associated to the failure to meet the PA guidelines (OR 0.51 95% CI 0.28, 0.92, $p = 0.03$). The

associations however, were not significant in men ($p>0.05$). In general only 29.7% of those with T2DM met PA guidelines.

Again, authors such as Marcus et al., (2008), Shweta et al. (2009) and Elisabetta, et al. (2012) among others administered different exercise programmes and came up with closely related effects on the glycosylation of the haemoglobin:

In a programme designed by Shweta, Ekta, and Sandhu (2009), a total of 30 T2DM, aged between 40-70 years, were randomly assigned to a 16 weeks supervised resistant training ($n=10$), or Aerobic Exercise ($n=10$) or Control group ($n=10$). Initial baseline measurements were analyzed by ANOVA to determine differences between the groups before intervention. The exercise programme was conducted 3 times a week with each session lasting 30 minutes. The researchers noted that the plasma HbA1c levels in the aerobic group decreased significantly ($p=0.002$) in the group (8.11 ± 0.9 to 6.78 ± 1.3). Shweta et al then concluded that resistant training is a more effective form of exercise training than AE for improving glycemic control in type 2 diabetics. Closely related to this, although with a slightly higher duration per session for sedentary patients, is the work of Elisabetta, et al. (2012). They designed an exercise programme of three times per week for 60 minutes, for a period of four months. They used a randomized control trial on 40 T2DM. Repeated-measures ANOVA were used to compare changes over the intervention period. Analyses were carried out using STATA version 10.1. Their finding indicated that, after training, aerobic group showed improvement in HbA1c by 0.43% [95% CI 20.61 to 20.18] and the lean body mass improved by approximately 0.4 kg. In their conclusions, they said aerobic training improves metabolic features, insulin sensitivity and reduces abdominal

fat in T2DM patients. Much as the studies were able to manage sugar level and BMI of the patients, the intensity of the programme were not clearly stated.

Marcus et al., (2008) recruited fifteen participants with T2DM in a 16 weeks supervised exercise training programme in which 8 patients in the mean age of 58.5 years, SD=6.2 participated in the aerobic exercise programme. To compare the effects of training type on muscle composition and glucose control, Separate 2×2 repeated-measures analyses of variance were done. The aerobic group experienced decrease in mean HbA1c after training -0.31% [95% CI= -0.60 to -0.03]), greater decrease in BMI. Marcus et al. concluded that there was Significant improvements in long-term glyceemic control and thigh composition after participating in a 16-week exercise programme. First, the studies did not point out clearly the intensity of the exercise. Lastly, although the study had many similarities to the current study, it was not conducted in Uganda.

Another programme by Ng, et al., (2010), involved an intensity 65–70% maximum heart rate, for 50 minutes. The patients undertook aerobic exercise for 18 sessions over 8 weeks. Ng et al., used a randomized trial with concealed allocation, assessor blinding and intention-to-treat analysis. Sixty people with HbA1c between 8% and 10% were recruited in the study. The HbA1c was reduced by 0.3 % (SD 0.9) in the group (MD -0.1% , 95% CI -0.5 to 0.3). This study however, did not meet the target minimum frequency of 3 times per week as always recommended (ACSM, 2010; ADA, 2011). They could have achieved a better management than this. Similarly, Yavari, et al., (2012), selected 152 patients with T2DM at the mean age of 33-69 years in their interventional trial. They administered an aerobic programme using treadmill, bicycle ergometers three times per week (on non consecutive days), lasting 20 to 60 minutes per session, at 60% -75% of maximum heart rate per session. Statistical analysis was performed using Tukey

post hoc test for obtaining a significant ANOVA to compare the changes between the groups. In the study, the HbA1C (%) showed significant change from 8.5 ± 1.1 to 7.2 ± 0.8 . There was also a significant change in the BMI (30.0 ± 4.8 to 29.4 ± 5.7 kg/m²). In their conclusions, the progressive aerobic exercise therefore offers a useful alternative for patients.

Sigal et al., (2007) administered Exercise training 3 times weekly for 22 weeks. 54 adults of age 39 to 70 years with T2DM participated in the aerobic training. Single-center randomized controlled trial with a parallel-group design was used. The analysis was performed on an intention-to-treat basis. The change in the HbA1c value in the aerobic training group was -0.38 percentage point (CI, -0.72 to -0.22). The BMI also decreased in the aerobic training group ($P = 0.008$). In their conclusion, the aerobic training alone improves glycemic control in type 2 diabetes. Much as this study managed T2DM, the intensity of the exercise programme was not clearly stated.

In another study, Ajediran, Owusu-Boakye, Babatunde & Adjei (2011), randomly assigned eighteen patients with T2DM, of mean age 46.22 ± 9.79 years to an intervention or control group by ballot. They prescribed an individual aerobic exercise programme of 30 minutes, at 50%–75% of maximum heart rate three times weekly for 8-weeks. The data analysis involved paired and unpaired t-tests and mixed-design two-way analysis of variance. The intervention group improved significantly ($P < 0.05$) in their post exercise quality of life compared with baseline. They concluded that between-group comparison did not show any significant differences in physiological parameters or quality of life.

Chetna et al., (2012), on the other hand conducted a Study on Correlation between Exercises, BMI and Heart Rate in which a total of 57 individuals of age group 19 to 39 were selected for the

study. Out of 57 subjects, 45 subjects were exercising in gymnasium while 12 did not attend gymnasium. The study adopted a cross-sectional study. 34 participants exercised regularly, and were included in the analysis. Mean BMI of the exercising group before starting exercise was $27.42 \pm 5.8 \text{ kg/m}^2$ and after exercise was $26.48 \pm 6.1 \text{ kg/m}^2$. The reduction in BMI was statistically significant ($p=0.01$). They then concluded that exercise helps in bringing BMI towards normal and up to 45 minutes to 1 hour exercise for longer duration is beneficial for weight management. However, the frequency, intensity and duration the aerobic exercise took were not stated.

In this study, the researcher tried as much as possible to address all the above challenges and the outcome was compared.

2.6 Summary

From all the above studies, it is confirmed that T2DM if not managed can result into complications that lead to death. Literature has also confirmed that PA is very essential in the management of T2DM. Much as the scholars agreed on this intervention, they came out with various levels of participation to be undertaken by the patients. Generally the patients should take about 30 minutes of moderate intensity aerobic exercise, at least 3 times a week, if they are to realize a better management of their sugar levels and the BMI.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the procedure that was used to conduct the study. It has the following sections: research design; variables; location of the study; target population; sampling technique and sample size; research instruments; validity and reliability of the instruments; data collection procedure; data presentation and analysis and ethical considerations.

3.1 Research Design

This study adopted a Cross-sectional approach to investigate the level of participation of T2DM patients in physical activities. The design was used because the researcher wanted to study the entire section of the population at ones and generate hypotheses on the effect of exercise programme on the patients. A quasi-experimental research design was used to determine the effect of the aerobic exercise programme on the patients. The design was used because a complete control of extraneous variables was not possible since the patients were commuting from their respective residences. The researcher used 2 groups, control and experimental groups and manipulated the exercise programme to find its effect on HbA1c and BMI. However, the selection of the subjects was not randomly done as only those who wanted to participate in the research were used.

3.2 Location of the Study

The study was conducted in Gulu RRH. The hospital is located in Gulu district, Northern part of Uganda, located in East Africa.

3.3 Study Variables

Programmed aerobic exercise was the core independent variable while the sugar (HbA1C) level and body mass index (BMI) of the patients were the dependent variables.

3.4 Target Population

The study targeted about 67 T2DM patients who visit the Outpatient department at GRRH per day for the management of their sugar level. There were two days for the visitation per week (Tuesday and Friday).

3.5 Sample Size and Sampling Procedure

50 patients at the age range of 30-61 years were recruited into the study to establish the level of participation of T2DM in Physical activities. This sample size was obtained using Base Sample-size Calculation (Magnani, 1997) which was largely determined by three factors: (i) the estimated prevalence of the variable of interest (p) – T2DM in this instance, (ii) the desired level of confidence (t) and (iii) the acceptable margin of error (m). The sample size required (n) was then calculated as:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

Where; **n** = required sample size, **t** = confidence level at 95% (which has a standard value of 1.96), **p** = estimated percentage population occupied by T2DM (percentage prevalence) in the project area (0.0364), **m** = margin of error at 5% (which has a standard value of 0.05).

This gave a total of 53 patients but only 50 patients filled and returned the questionnaires.

Out of the 50 T2DM, 30 patients who met the requirement for beginning exercise volunteered to participate in the aerobic exercise programme.

Out of the 30 patients who volunteered, 15 patients (8 males and 7 females) participated in the exercise programme while the remaining 15 were the control group.

Purposive sampling was used to obtain 50 T2DM outpatients in GRRH. This was because the data could only be obtained from these patients. Volunteer sampling was used to obtain the 30 patients with T2DM who were willing to undertake the study. Stratified random sampling was used to select both male and female participants. Thus a sample of 50 participated in answering the questionnaires. Out of the 50 patients, 30 volunteered for the experiment. Included were patients with T2DM for more than one year; HbA1c level from 6.1 to 16.4%. Patients with Body Mass Index (BMI) greater than 32, severe diabetes complication were excluded from this study since they would require a special exercise programme. A pre-test was performed to establish the initial HbA1c and BMI of the patients, and the data were entered in a data entry table in appendix XII.

3.6 Research Instruments and Tools

The following instruments were used for data collection.

3.6.1 Questionnaire

Structured questionnaire, (appendix VII), derived from International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003; Viñas et al., 2010) was administered to the patients to explore the level of participation and the type of activity (ies) the patients were engaged in at that moment. The questionnaire focused on the frequency, intensity and duration of their activity.

3.6.2 Physical Activity Readiness Questionnaire

Physical activity readiness questionnaire (PAR-Q) (appendix IX) was administered to the patients to obtain physical activity readiness (ACSM, 2005; Quinn, 2008; Warburton et al., 2011). Their responses were used to assess their readiness to take part in the study.

3.6.3 Diabetics' database.

Other diabetics' complications such as stroke, renal failure, amputation and blindness in the patient from GRRH were obtained from the data base of the patients.

The following tools were used for data collections:

3.6.4 Blood pressure monitor

The Omron HEM-790IT was used to obtain the blood pressure of the patients in millimeter mercury, (mmHg).

3.6.5 Weighing scale

Weight was measured on a GSE 450 electronic scale.

3.6.6 Stadiometer

The height was measured using a standard stadiometer, Seca 213 Portable Measuring Rod.

The BMI was then calculated by dividing the weight (kg) of the patient by his/her square height (m^2).

3.6.7 Auto Hba1c Analyzer 6600

The HbA1c concentration was measured using auto Hba1c Analyzer 6600.

3.6.8 Heart Rate Monitor

Heart rate monitor was used continuously throughout the programme to monitoring the HR during the exercise. $HR_{max} = 205.8 - (0.685 \times \text{age})$, Polar F6™ Fitness Heart Rate Monitor (Sport tester CE 0537; Polar, Oy; Finland).

3.7 Validity and Reliability of the Research Instruments

International Physical Activity Questionnaire (IPAQ) is a standardized questionnaire used worldwide (Craig et al., 2003; Viñas et al., 2010). However the questionnaire was modified by the researcher to suit the types of activities the patients mainly engage in, such as farming.

The Omron HEM-790IT was validated and stamped by Uganda Bureau of Standards (UBS). Blood pressure and pulse progress can be tracked over time (Fankhauser, 2008; Perloff, et al., 2013). The batteries were regularly replaced to ensure consistency during measurement. It is resistance to weather changes.

GSE 450 electronic scale and Standard stadiometer was validated and stamped by (UBS). These measures provided immediate/instant result without requiring very technical knowledge of their use besides their resistance to weather changes. Many studies have been conducted using the same instruments (Timothy, 2010), and have produced undisputed result. The battery of the electronic scale was regularly replaced to ensure consistency during measurement.

Auto Hba1c Analyzer 6600 was validated and stamped by Uganda Bureau of Standards (UBS). Errors were eliminated through gas solution and bubble-removal technology. The batteries of the analyzers were regularly replaced to ensure consistency during measurement. It is resistance to weather changes.

3.8 Data Collection Procedure

The study proposal was presented to Faculty of Science, Kyambogo University from where an introduction letter was obtained (appendix I), and later submitted to Lacor Institutional Review Committee (LIRC) for review and to the National Council for Science and Technology (NCST)

to ensure protection of the rights of the participants. Permission was got from the LIRC (appendix II), NCST (appendix III) and from GRRH (appendix IV) prior to conducting the study. A notice about the study (appendix V a & b) was posted in the clinic, inviting patients to voluntarily enroll to participate in the study. All participants who volunteered to participate in the study signed informed consent form (appendix VI a & b). The participants placed the completed instruments (appendix VII) in a sealed envelope and submit to the researcher. Again the participants who volunteered to participate in the exercise programme filled PAR-Q (appendix IX) and medical clearance form (appendix X), in case of a “Yes” in appendix IX

After a medical screening of the patient using the inclusion criteria, a one week orientation was performed two sessions per week with a progressive time of 20 to 30 minutes at moderate intensity including warm-up and cool down, to familiarize the participants with the training protocols. The subjects who showed better adherence and acceptance to the one-week orientation were selected to perform an 8-week exercise training protocol. According to Ruchi (2006) and WHO (2011), the 8 weeks were the minimum period required for glycosylation (the process by which sugar sticks to the red blood cells) to take place.

3.8.1 Exercise Training Protocol

The exercise sessions were held three times a week with a close supervision by the researcher and/or project staff and trainers, who were briefed by the researcher prior to the exercise programme and signed Confidentiality agreement. Moreover, the too much drop in sugar level during the sessions was monitored and blood pressure fluctuations were assessed regularly. The subjects were asked to take glucose tablets or drinks as a precaution in case of too much drop in sugar level, but not to use their lunches or medications just before the beginning of an exercise

session to avoid gastrointestinal problems. Water required by their bodies in the middle of the sessions was provided.

All sessions included 5 minutes of war-up followed by stretching as well as 5 minutes of relaxation activities to cool down. All types of exercise training were done according to the ACSM guidelines (ACSM, 2010; ADA, 2011). The diabetic programme included a multidisciplinary team consisting of Medical doctor, Instructor and Researcher (table 3.1).

Table 3.1 Multidisciplinary Research Team

Members	Number	Roles
Medical doctor	01	Provided support and information associated with self-care needs, assessed any complications, monitored blood glucose level during each session.
Instructor	02	Setting and monitoring the machines, implementing the prescribed exercise, recording the attendance.
Researcher	01	Monitoring and analyzing the daily activities, monitoring exercise progression.
Total	04	

The Aerobic exercise programme was performed using treadmill and bicycle ergometers, three times per week (on non consecutive days). Duration of the sessions increased from 30 minutes per session (at 60% of maximum heart rate) to 60 minutes (at 75% of maximum heart rate) per session (Appendix XIII) Patients' HbA1C levels were monitored prior and after completion of the study, by POLE medical Laboratory.

3.8.2 Blood Drawing

In order to evaluate the levels of glycosylated hemoglobin, 5 cc of blood was drawn from anti-cubital vein and tested, following bandaging. The drawing was done at the beginning of the trial (pre-test), and at the end of the tenth week (post-test).

3.9 Data Presentation and Analysis

Descriptive statistics, (means, mode and standard deviation) were used to summarize the level of participation in physical activities among the T2DM patients (Burns & Grove, 2005). Repeated Measures t-test was used to determine significant differences between the means and SD of the pre and post-tests HbA1c level of the experimental and the control groups after the intervention as well as the significant difference in HbA1c level and BMI of the experimental. The analysis was performed using SPSS software (version 11.0). A *p*-value less than 0.05 were considered as a statistically significant. The data were presented using table, charts and graphs.

3.10 Ethical Considerations

The study proposal was submitted to the Institutional Review Board of Lacor hospital for review and to the National Council for Science and Technology for accreditation to ensure protection of the rights of the participants. All participants who met the inclusion criteria signed informed consent forms. They were then familiarized with the experimental procedures.

All data were kept confidential and seen only by the researcher and data entry personnel. Experimental forms were coded and no names were used. Results were communicated with the participants at conclusion of the study.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

The main objective of this study was to establish the effect of an aerobic exercise programme in the management of T2DM outpatients at GRRH. To achieve this purpose the following objectives were formulated, to:

1. Establish the level of participation in physical activities among T2DM outpatients attending the Gulu Referral Hospital.
2. Determine the effect of an 8-weeks aerobic exercise programme on the HbA1c of T2DM outpatient attending the Hospital.
3. Determine the effect of an 8-weeks aerobic exercise programme on the BMI of T2DM outpatient attending the Hospital.

To attain the objectives, a research question null hypotheses were formulated and tested using a t-test. All the hypotheses were either accepted or rejected using a $p < 0.05$ alpha level.

4.2 Presentation of the Findings of the Study

In this section, the findings of the study were presented and analyzed according to the objectives above.

4.2.1 Demographic Data of the Patients

In the study, the patients included were 25 males and 25 females with T2DM for a period of one year and above, of age 30 to 61 years and HbA1c of 6.1 to 16.4%. The BMI were between 16 and 30 kg/m², blood pressure < 140/90 mmHg, without diabetes complications such as heart disease, stroke, renal failure, amputation and blindness.

4.2.2 Level of Participation of T2DM in Physical Activities

Questionnaire was designed and administered to 50 patients from the outpatient department of GRRH to establish the participation of the patients in PA. In this study physical activity was divided into two; namely, programmed aerobic/anaerobic exercises and un-programmed physical activities. The programmed physical activities included digging, bicycle riding, walking to work place and household/compound activities. The findings related to PA are presented:

4.2.2.1 Participation in Programmed Physical Activities (Aerobic and/or Anaerobic)

The patients were asked on the level of participation in programmed aerobic and/or anaerobic physical exercises and their responses are summarized in Figure 4.1

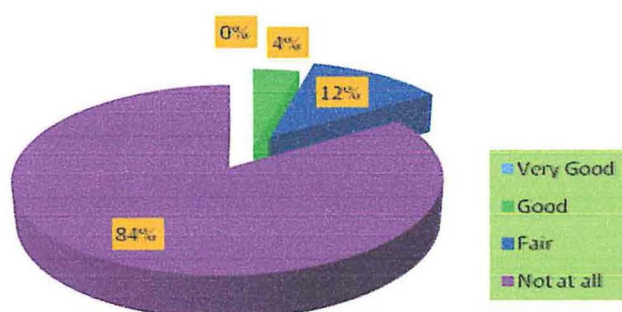


Figure 4.1 Level of participation of T2DM in programmed exercise

From Figure 4.1, findings from the 50 patients to whom the questionnaire were administered revealed that no patient had reached the maximum level of participation in a programmed physical exercises expected of T2DM patients. Only 2 out of 50 (04%) of the respondents were accumulating 20 to 30 minutes of moderate intensity in a day, at a frequency of 3 times a week. Six out of fifty (12%) of the respondents accumulated 40 to 50 minutes of moderate intensity of aerobic exercise performing at a frequency of 2 times a week.

42 out of 50 (84%), of the respondents never participated in any programmed aerobic and/or anaerobic exercise. A similar finding was obtained by Adeniyi et al., (2013) who investigated the associations among motivation, socio-demographic characteristics and low level participation in physical activity among a group of Nigerians with T2DM. They found that only 33.1% were active at moderate to high levels. A closely related finding was obtained by Kelly et al., (2015) conducted a study on Gender Differences in Physical Activity Levels of Older People with T2DM. In general they found that only 29.7% of those with T2DM met PA guidelines. They then concluded that the PA level of T2DM patients was then below the recommended levels, as it is also with this study.

4.2.2.2 The level of participation in un-programmed physical activities

Un-programmed physical activities are also expected to be equally good in the management of the sugar level in the patients. These activities included gardening, bicycle riding, walking to work place and household/compound works (Thomas et al., 2009; Timothy et al., 2010). A scale was developed and used to rate the level of participation of T2DM in the activities (Appendix VIII b). The patients were asked about their participation in these activities and their responses were summarized in Figure 4.2.

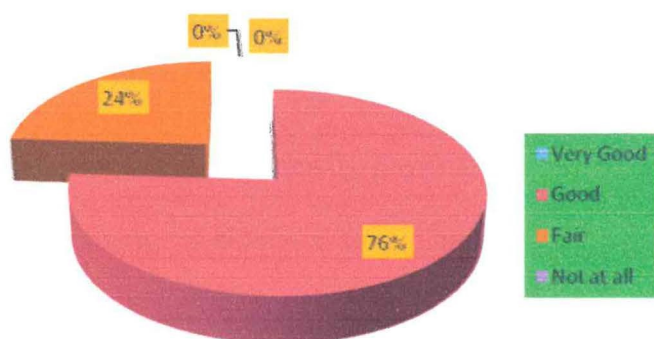


Figure 4.2 Level of participation in un-programmed physical activities

From Figure 4.2, no respondent had very good participation in the un-programmed physical activities. They were not stretching before and after workout. This implies that the bodies were not prepared for the activities, and the muscles were not relaxed after the workout. Stretching before and after workout is important in injury prevention and burning of lactic acid to prevent its accumulation in the muscle (Dino, 2012; Trenell, 2012). The patients therefore missed all these benefits.

38 out of 50 (76%) of the respondents had good participation in the un-programmed physical activities. Since most of the patients were peasant farmers they participated in gardening, riding bicycle, walking as means of transport and engaged in household/ compound works. This could have helped the patients to manage their sugar level to some good extent.

12 out of 50 (24%) of the respondents were mainly involved in household/ compound works. They did not engage in gardening; used vehicles or motorcycles for transport and 3 out of 12 patients who showed fair level of participation in un-programmed PA had housemaids. This therefore limited their participation in physical activities. The findings are similar to what Oyewole et al., (2014), found among Nigerian diabetics. Being physically inactive may contribute the increased HbA1c and abnormal BMI (Naheed, 2011).

Thomas et al. (2009) and Timothy et al. (2010) also recommended that an individual should strive for moderate intensity physical activity like walking briskly, dancing, bicycling, running, or swimming for at least a half an hour five days or more per week; strength training two or three days a week since it improves the body's ability to control diabetes.

4.2.3 Effect of an 8-Week Aerobic Exercise Programme on T2DM

An 8 weeks aerobic exercise programme was designed and administered to 15 patients and the results are presented below.

4.2.3.1 Pre and Post Test Sugar (HbA1c) Level of the Experimental Group.

The patients in the experimental group were tested before (pre-test) and after the experiment (post-test) and their results were presented in the Table 4.1.

Table 4.1 Percentage change in HbA1C level among the experimental group

Patients' Code	Pretest HbA1C (%)	Posttest HbA1C (%)	Difference HbA1C (%)
4001	16.40	11.00	5.40
4002	06.60	05.60	1.00
4003	06.10	05.10	1.00
4004	06.62	05.00	1.62
4006	07.50	06.30	1.20
4007	07.00	05.30	1.70
4008	10.95	08.40	2.55
4015	07.54	06.00	1.54
4018	09.30	06.00	3.30
4019	11.11	09.00	2.11
4021	06.40	05.00	1.40
4024	06.40	04.91	1.49
4025	13.30	09.11	3.92
4027	06.31	05.10	1.21
4029	10.80	06.91	3.89
Total			33.30
Average			2.22

From Table 4.2, generally the sugar level of all the patients dropped. On average the HbA1c was

reduced by 2.22%. Yavari, et al., (2012) also noted administered an aerobic program using treadmill, bicycle ergometers three times per week, lasting 20 to 60 minutes per session, at 60% - 75% of maximum heart rate per session. In the study the HbA1C (%) changed from 8.5 ± 1.1 to 7.2 ± 0.8 . The scholars then concluded that the exercise had been important in the management of the sugar levels among the patients as it was also in this study.

When a Repeated Measure t-test was performed to establish if there was significant difference in the pre- test and post-test results of HbA1c within the experimental group at 95% CI, a mean of 2.2373, a SD of 1.34980, and a *p* value of $< 0.05(0.000)$ was obtained. It therefore indicated that there was a significant difference in HbA1c within the experimental group. The null hypothesis which stated that there would be no significant difference in the sugar level among the experimental group before and after the intervention is therefore rejected. The exercise programme was therefore effective in the management of HbA1c in this group.

A closely related finding was produced by Marcus et al., (2008). They recruited fifteen participants with T2DM in a 16 weeks supervised exercise training programme in which 8 patients in the mean age=58.5 years, SD=6.2 participated in aerobic exercise programme. The group experienced a mean decrease of -0.31% [95% CI= -0.60 to -0.03] in the HbA1c after training. Similarly, Elisabetta, et al. (2012) designed an exercise programme of three times per week for 60 minutes, for a period of four months, and found that after training, aerobic group showed improvement in HbA1c by 20.40% [95% CI 20.61 to 20.18]. Another program by Ng, Goh, Malhotra, Østbye, & Tai (2010) put forward an intensity 65–70% maximum heart rate, for 50 minutes. The HbA1c was reduced by 0.3 % (SD 0.9) in the group.

In this study, the exercise might have increased the body's response to intrinsic insulin, by multiple mechanisms including increasing the amount of transporters of glucose into the muscle

cells (GLUT-4), increasing insulin receptor substrates (IRS) and increasing the muscle mass, given that more than 75% of the glucose uptake in response to insulin is by the muscular tissue. The fatty acids released from adipose tissue concentrate inside the myocytes and reduce the GLUT-4 transportation onto the cell membrane (Bello et al., 2011; Dominique, 2013; Matthew et al., 2011).

4.2.3.2 Differences in HbA1c between the Male and Female Patients

After the intervention, the sugar levels of the two sexes were isolated for comparison and the results are presented in Table 4.2.

Table 4.2 Difference in HbA1c between Male and Female patients.

Male		Female	
Patients' Code	HbA1C (%)	Patients' Code	HbA1C (%)
4001	05.40	4008	02.55
4002	01.00	4015	01.54
4003	01.00	4018	03.30
4004	01.62	4019	02.11
4006	01.20	4021	01.40
4007	01.70	4025	03.92
4024	01.49	4027	01.21
Total	13.41	Total	16.03
Average	1.91	Average	2.29

As shown in Table 4.2, on averages the reduction in HbA1c has been slightly higher among the female participants (2.29%) than in the male participants (1.91%). Much as there was difference

in average values of the HbA1c between the male and female, when a Repeated Measure t-test was performed to establish if there was significant difference in the pre- test and post-test HbA1c between the two groups at 95% confidence level, a mean of -0.0738, SD of 1.41390 and a *p* value of 0.88 was obtained. This indicated that there was no significant difference in the HbA1c between the sexes after the 8 weeks intervention and the null hypothesis is accepted. This is similar to that found by Ewenighi et al., (2012) who conducted a study on the effect of age, gender, level of adiposity and diabetes duration on glycosylated hemoglobin reduction after anti-diabetic therapy in T2DM patients. However, Ewenighi et al., (2012) observed that HbA1c reduction did not indicate significant sex differences. Similarly, Fare & Khaldon, (2012) concluded that Jordanian females groups had no statistically significant better control of T2DM than males. William et al., (2012) also confirmed that despite many similarities in physiological adaptations between men and women, there are also inherent differences in their anatomy and physiology. These differences are related to body composition, strength, power, endurance and aerobic capacity. They noted that despite the presence of differences between sexes, adaptability to exercise training does not appear to be notably influenced by sex. That is, when presented with the same exercise stimulus with respect to intensity, frequency and duration, men and women experience similar improvements in functional capacity. The exercise might have as well increased body's response to intrinsic insulin slightly above that of male by all the multiple mechanisms. The better reduction in the HbA1c in female could have come as a result of better increase in the muscle mass, given that more than 75% of the glucose uptake in response to insulin is by the muscular tissue (Bello et al., 2011; Dominique, 2013).

4.2.3.3 Differences in HbA1c Level between the Experimental and Control Groups

After the completion of the 8 weeks intervention programme, the HbA1c level of the experimental group and control group were compared. The results are presented in Table 4.3.

Table 4.3 The differences in HbA1c level between the control group and the experimental group

Experimental group				Control group			
Patients' Code	Pre-test HbA1c	Post-test HbA1c	Difference in HbA1c	Patients' Code	Pre-test HbA1c	Post-test HbA1c	Difference in HbA1c
4001	16.40	11.00	5.40	4005	05.11	05.15	- 0.04
4002	06.60	05.60	1.00	4009	07.33	07.32	- 0.01
4003	06.10	05.10	1.00	4010	04.94	04.93	+0.01
4004	06.62	05.00	1.62	4011	03.97	03.97	+0.01
4006	07.50	06.30	1.20	4012	04.44	04.47	- 0.03
4007	07.00	05.30	1.70	4013	04.16	04.16	+0.00
4008	10.95	08.40	2.55	4014	07.52	07.49	+0.03
4015	07.54	06.00	1.54	4015	07.63	07.02	+0.61
4018	09.30	06.00	3.30	4017	10.10	10.12	- 0.02
4019	11.11	09.00	2.11	4020	04.97	04.97	+0.00
4021	06.40	05.00	1.40	4022	05.30	05.31	- 0.01
4024	06.40	04.91	1.49	4023	07.00	07.01	- 0.01
4025	13.30	09.11	3.92	4026	12.00	12.03	- 0.03
4027	06.31	05.10	1.21	4028	08.42	08.50	- 0.08
4029	10.80	06.91	3.89	4030	07.63	07.64	- 0.01
			Total 33.30				Total 0.42
			Average 2.22				Average 0.028

From Table 4.3, there was an average reduction of 2.22% in the HbA1c in the patients in the experimental group. However, four patients in the control group also realized drops in their HbA1c with one of them registering a reduction of 0.6%.

The drop in the HbA1c among the control group could be attributed to other factors other than the physical activity. Three patients in the control did not realize either reduction or increase in their HbA1c. On average there was a reduction of 0.028% in the HbA1c, originating from the abnormal reduction of 0.6% from one of them.

When a Repeated Measure t-test was performed to determine if the difference was significant at 95% CI, a mean of 2.1900, SD of 1.35915, a *p* value of < 0.05(0.000) were obtained. It therefore, indicated that there was significant difference in the HbA1c between the experimental group and the control group after the intervention. The null hypothesis which states that there would be no significant difference in the sugar level between the control group and the experimental group after the 8-weeks intervention was therefore rejected. The findings are supported by Shweta, Ekta, and Sandhu (2009) in their study, a total of 30 T2DM, aged between 40-70 years, were randomly assigned to a 16 weeks supervised Resistant Training (n=10), or Aerobic Exercise (n=10) or Control group (n=10). The exercise programme was conducted 3 times a week with each session lasting 30 minutes. The researchers noted that the plasma HbA1c levels in the aerobic group decreased significantly (*p*=0.002) in the group (8.11 ± 0.9 to 6.78 ± 1.3) and those in the control group did not show any difference. Similarly Sigal et al., (2004) administered Exercise training 3 times weekly for 22 weeks. 54 adults age 39 to 70 years with T2DM participated in the aerobic training. Single-center randomized controlled trial with a parallel-group design was used. The analysis was performed on an intention-to-treat basis. The change in the HbA1c value in the aerobic training group was -0.38 percentage point (CI, -0.72 to -0.22). As with this study also, the exercise programmes were effective in the management of HbA1c in T2DM.

From this finding, a number of physiological changes might have taken place resulting into the reduction of HbA1c including insulin sensitivity in the experimental group. Sharon & Denise (2011) noted that exercise increases non-insulin-dependent uptake of glucose into the active skeletal muscle. They continued that studies have shown increased insulin sensitivity and glucose tolerance as a result of exercise training (Sigal et al., 2006). Because the control group did not engage in physical activities of the same intensity and durations, there was minimal

reduction in their HbA1c. Because the control group was not engaged in the exercise programme they might have missed the benefits such as increase body's response to intrinsic insulin, by the multiple mechanisms as put forward by Estaghamati et al. (2008) and Matthew et al. (2011).

4.2.4 Change in the BMI of the Experimental Group

After the exercise programme, the pre-test and post-test BMI of the experimental group were recorded and the result is presented in Table 4.4.

Table 4.4 The change in the BMI among the experimental group

Patients' Code	BMI (Kg/m²) Pretest	BMI (Kg/m²) Post-test	Differences (Kg/m²)
4001	23.42	22.35	1.07
4002	26.17	24.74	1.43
4003	26.33	24.65	1.68
4004	29.04	27.46	1.58
4006	27.20	26.26	0.94
4007	16.94	16.44	0.50
4008	24.49	24.33	0.13
4015	26.08	24.69	1.39
4018	26.50	25.35	1.15
4019	26.19	25.17	1.02
4021	24.65	23.44	1.21
4024	23.81	23.03	0.78
4025	26.17	24.90	1.27
4027	26.54	25.62	0.92
4029	25.80	24.95	0.85
Average			1.06

The result as presented in Table 4.4, relates that the BMI of the patients decreased on average by 1.06 kg/m². Similarly, Yavari, et al., (2012), administered an aerobic program using treadmill, bicycle ergometers three times per week (on non consecutive days), lasting 20 to 60 minutes per session, at 60% -75% of maximum heart rate per session on 152 patients with T2DM at the mean age of 33-69 years in their interventional trial. The finding showed that, there was a significant change in the BMI (30.0±4.8 to 29.4 ± 5.7 kg/m²). Elisabetta, et al. (2012) also designed an exercise programme of three times per week for 60 min, for a period of four months. The finding indicated that, after training, aerobic group showed improvement in the lean body mass improved by approximately 0.4 kg.

When a Repeated Measure t-test was performed to establish the significant difference in the BMI within the experimental group at 95% CI, a mean of 1.06, SD of 0.40, and a *p* value of < 0.05(0.000) was obtained. This therefore indicated that there was a significant difference between the pre-test and post-test BMI of the experimental group. The null hypothesis which states that there would be no significant difference in the BMI of the experimental group after the 8-weeks intervention is therefore rejected. From this findings, the exercise programme had been effective in the management of the BMI of the patients in the Experimental group.

The same way, Sigal et al., (2004) administered Exercise training 3 times weekly for 22 weeks. 54 adults age 39 to 70 years with T2DM participated in the aerobic training. Single-center randomized controlled trial with a parallel-group design was used. The analysis was performed on an intention-to-treat basis. The BMI decreased in the aerobic training group (*p* = 0.008).

According to Yavari et al. (2012), exercise improves and maintains body composition. They however, noted that combined nutrition therapy and regular exercise are more effective for the

improvement of metabolic control than when applied alone (Albright et al., 2000). Since weight loss through metabolic effects of exercise has greater potential for energy expenditure hence reduction in BMI, aerobic exercise has greater potential than resistance training to yield results (Marcus et al., 2008). In the study of Yavari et al. (2012), weight loss that causes reduction in BMI was significant in the intervention group, although their programme included exercise plus nutrition classes, which was an additional positive effect.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMENDATIONS

5.0 Introduction

This chapter the summaries of the findings, conclusion and recommendations of the study are covered.

5.1 Summary

The study was conducted on T2DM outpatients from Gulu Regional Referral Hospital (OPD). Fifty patients were selected. Questionnaire was issued to obtain the data related to participation in physical activities. Out of the 50 T2DM, 30 volunteered to participate in the experiment. 15 were in the experimental group and 15 in the control group. The aerobic exercise programme was administered to the experimental group. The data was analyzed using descriptive statistics. Quasi-experimental research design was used to compare the changes between the groups. The findings were as follows;

5.1.1 The Level of Participation in Physical Activities.

The findings indicated that no patients had reached the maximum level of participation in programmed physical activities as expected of T2DM patients. Majority [38 (76%)] of the patients, participated in un-programmed physical activities that even did not significantly help them control their HbA1c.

5.1.2 Effect of Exercise on HbA1c and BMI

On average the HbA1c among the Experimentall group was reduced by about 2.22%. Female patients however, registered better decrease than the male. The control group registered a negligible reduction in the HbA1c. On average the BMI of the patients in the experimental group

was reduced by 1.06 kg/m²

5.2 Conclusion

From the findings of the study it can be concluded that;

T2DM outpatients in Gulu Referral Hospital did not participate in organized physical exercise.

However, when subjected to an 8 weeks exercise programme, there was significant reduction in the HbA1c and BMI. Thus exercise can be used to manage T2DM.

5.3 Recommendations for Practice and Policy Change

Based on the findings of the study, the following recommendations have been made.

The T2DM patients should take aerobic exercise as a strategy in the management of HbA1c level and control of body weight.

Gulu District health service commission should employ exercise programmers to diabetes clinic to recommend an individualized exercise programmes for the diabetes patients.

There is need for health sector and exercise programmers to continuously sensitize patients on the importance of physical exercise in the management of sugar level.

Gulu District health sector should motivate patients to actively participate in physical activities.

5.4 Recommendations for Further Research

There is need to conduct research on the effectiveness of exercise intervention on T2DM in other regional hospitals in Uganda

There is need to conduct research on the use of diet in management of T2DM

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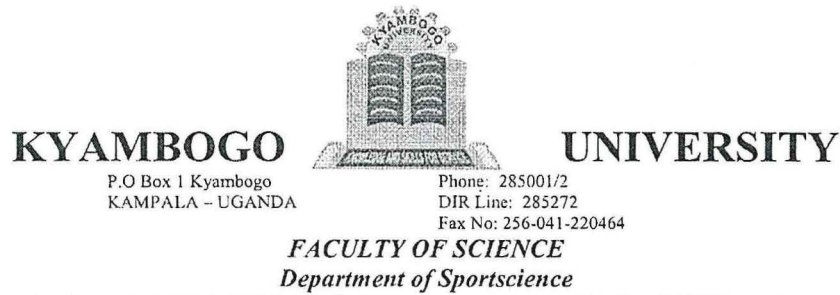
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APPENDICES

Appendix I Introduction Letter from Kyambogo University



12-02-2013.

To Whom It May Concern

Dear Sir/Madam,

INTRODUCTION OF MASTER OF SCIENCE RESEARCH STUDENT


The bearer of this letter, *Mr.Ojara Ricky Richard* is an M.Sc. Sports science research student (Reg. No. 2011/U/HD/187/MSc.SS) in the Sports science Department.

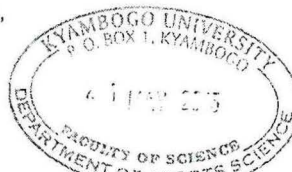
He is conducting research for his MS.c in Sports science entitled, "*Exercise intervention programme for the management of type 2 diabetes mellitus of Gulu Regional Referral Hospitals out patient department.*"

The purpose of this letter is to introduce to you the student and request you assist him conduct research in your organization.

Looking forward to your cooperation,

Yours faithfully,


Mukana Roland (Ph.D)
COORDINATOR, Post graduate Programs [Sports science Department]



Appendix II Approval from Institutional Review Committee



ST. MARY'S HOSPITAL LACOR

P.O. Box 180 - GULU - UGANDA

Tel: +256 - 471- 432310, Fax: +256 - 471- 432665

Email: Info@lacorhospital.org Website: lacorhospital.org

20th March 2014

To Ojara Ricky Richard
Gulu University
P.O Box 166, Gulu
Contact: 0782152624
Email: rickyojara@email.com

LHIREC number 001/01/14 Study title: Exercise programme intervention for Outpatients type 2 Diabetes Mellitus from Gulu Regional Referral Hospital

This is to inform you that Lacor hospital Institutional Research and Ethics Committee (LHIREC) reviewed the above research proposal on the 13th February 2014 and approved it pending minor corrections. These corrections have now been made and full approval is therefore granted.

Please note that your study protocol number with LHIREC is: 001/01/14. Please be sure to reference this number in any correspondence with LHIREC. Also note that your study was first approved by LHIREC on 13th February 2014 and therefore approval expires at every annual anniversary of this approval date. The current approval is therefore valid until: 13th February 2015. If it is necessary to continue with the research beyond expiry date, a request for continuation should be made in writing to the secretary LHIREC.

Continued approval is conditional upon your compliance with the following requirements:

- 1) No other consent form(s), questionnaire and/or advertisement documents should be used. The consent form(s) must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject must be given a copy of the signed consent form.
- 2) All protocol amendments and changes to other approved documents must be submitted to LHIREC and not be implemented until approved by LHIREC except where necessary to eliminate apparent immediate hazards to the study subjects.
- 3) Significant changes to the study site and significant deviations from the research protocol and all unanticipated problems that may involve risks or affect the safety or welfare of subjects or others, or that may affect the integrity of the research must be promptly reported to LHIREC.

Please complete and submit reports at completion, termination, or if not renewing the project - send a final report within 90 days upon completion of the study to LHIREC.

You are also advised to register with Uganda National Council for Science and Technology (UNCST).

Yours sincerely

Dr. Martin Ogwang
LHIREC Chairperson

Logistic Office Kampala: Tel. +256 - 414 - 223014, Fax: +256 - 414 - 223013

Appendix III Research Approval from National Council for Science and Technology



Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Our Ref: HS 1614

13th August 2014

Ojara Ricky Richard
Kyambogo University
Kampala

Re: Research Approval: Exercise programme intervention for outpatient type2 diabetes mellitus form Gulu regional referral hospital

I am pleased to inform you that on 14/05/2014, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of 14/05/2014 to 14/05/2015.

Your research registration number with the UNCST is HS 1614. Please, cite this number in all your future correspondences with UNCST in respect of the above research project.

As Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the research protocol or the consent form (where applicable) must be submitted to the designated local Institutional Review Committee (IRC) or Lead Agency for re-review and approval prior to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local IRC for review with copies to the National Drug Authority.
4. Unanticipated problems involving risks to research subjects/participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST review.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.
6. A progress report must be submitted electronically to UNCST within four weeks after every 12 months. Failure to do so may result in termination of the research project.

Below is a list of documents approved with this application:

	Document Title	Language	Version	Version Date
1	Research proposal	English	N/A	N/A
2	Participant Consent form	English	N/A	N/A
3	Questionnaires	English	N/A	N/A
4	Medical Clearance form	English	N/A	N/A

Yours sincerely,

Hellen N Opolot
for: Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

LOCATION/CORRESPONDENCE

Plot 6 Kimera Road, Ntinda
P. O. Box 6884
KAMPALA, UGANDA

COMMUNICATION

TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: <http://www.uncst.go.ug>

Appendix IV Authority to conduct the Study in Gulu Regional Referral Hospital

10 JUN 2014

GULU UNIVERSITY,
P.O BOX 166,
ULU.

6th June, 2014.

THE DIRECTOR GULU RR HOSPITAL,
P.O BOX 166,
GULU.

ONE
Copy
7/7/14

RECEIVED
THE DIRECTOR
GULU RR HOSPITAL
P.O BOX 166 G. U.

Dear Sir,

Re REQUEST TO CONDUCT A RESEARCH IN THE HOSPITAL

I hereby request you for the above reference for a period of about eight (8) weeks.

I am a Master of Science in Exercise Science Student of Kyambogo University. I have Bachelor degree in Sport Science from Gulu University.

The main feature of the research project is given below.

Title of research project: Exercise Programme Intervention for Outpatients type 2 diabetes mellitus from Gulu Regional Referral Hospital.

The research is for Academic Award of M.Sc. in Exercise Science of Kyambogo University

General objective

The main objective of this study is to design exercise programme for the management of T2DM among diabetic patients at Gulu Referral Hospital, Gulu Municipal

Specific objectives of the study

The specific objectives of this study will be to:-

- Determine the risk factors for developing T2DM among diabetic outpatients attending the Gulu Referral Hospital.
- Establish the level of participation in physical activities among outpatients diabetic attending the Gulu Referral Hospital.
- Determine the effect of an 8-weeks aerobic exercise programme on diabetic outpatients attending the Gulu Referral Hospital.

Significance of the study

The findings of this study will be of great importance to;

- Exercise programmers attached to the hospital's diabetes clinic in designing exercise program that will best suit the diabetics from Gulu Referral Hospital Out Patient Department.
- The diabetics in the management of their sugar level.
- Public health policy providers in designing intervention programmes aimed at helping individuals with T2DM to manage their condition.

Selection of subjects

The participants will be will patients with T2DM for more than one year; with relatively inactive lifestyle, HbA1c level $\leq 10\%$; and exclude participants with hypertension, Body Mass Index (BMI) ≥ 32 , age over 60 years, severe retinopathy, nephropathy and neuropathy, history of serious cerebrovascular or cardiovascular diseases, and severe musculoskeletal problems restricting physical activity. At least 50% of the patients who will meet the inclusion criteria will be selected.

Ethical considerations/ protection of human subjects

The study proposal was submitted to an Institutional Review Board of Lacor Hospital for review and to the National Council for Science and Technology for accreditation to ensure protection of the rights of the participants. Permission were sought from both, prior to conducting the study.

A notice about the study will be posted in the clinic, inviting patients to voluntarily enroll to participate in the study.

All participants who will qualify for the study will sign informed consents.

The invitation and cover letter will include the purpose of the study, participant rights, and informed consent forms.

Participants will place the completed instrumentation in a sealed envelope and submit to the researcher.

Participants will be familiarized with the experimental procedures; informed of the associated benefits and risks and all will sign written informed consent.

All data will be kept confidential and seen only by the researcher and data entry personnel. Experimental forms will be coded with a patient number.

Results will be communicated with the participants at conclusion of the study.

The diabetic program will include a multidisciplinary team consisting of the advanced practice nurse, and case manager, whom will provide support and information associated with self-care needs, prevention of complications, monitoring blood glucose levels.

Attached hereto are some supporting documents, including CV.

I shall be grateful of your consideration

Yours faithfully



OJARA Ricky Richard

Referees: Dr Nsibambi Connie (Ph.d) 0700370848 Kyambogo University
Dr Maria Alai (Med.) 0782926021 Lacor Hospital

Appendix V a) Participants' ethics information letter

You are invited to participate in a research project studying **Effect of exercise Programme Intervention for Management of type 2 Diabetes Mellitus Outpatients from Gulu Regional Referral Hospital**. The findings of this study will be of great important to exercise programmers attached to the hospital's diabetes clinic in designing exercise program that will best suit the diabetics from Gulu Referral Hospital Out Patient Department. Furthermore, the study will help the diabetics in the management of their sugar level.

The lead researcher on this project is **Ojara Ricky Richard**, Master of Science in Sport Science studies at Kyambogo University. This study fulfils the requirements for a directed study course, toward the completion of an MSc.SS degree, supervised by **Dr. Constance Nsibambi (PhD) and Dr. Roland Mukana (PhD)**.

There are no reasonably foreseeable harms that may arise from participating in this research. However there might be cases of hypoglycaemia, minor foot injuries incase canvas are not used. While benefits that may arise include a greater personal fitness and good management of the patient's sugar level.

Here are some of the real benefits of the exercise programme:

- Improves your muscles sensitivity to insulin.
- Helps to reduce the blood sugar level to normal (even if you don't lose weight)
- Lowers A1C level
- Reduce the need for insulin or pills to control the blood sugar
- Reduces body weight or helps to maintain the healthy weight.
- Lower blood pressure level.
- Raises good cholesterol (HDL) and lowers bad cholesterol (LDL).
- Relieves arthritis pain (a good reason for older people)
- Reduce the risk of some cancers and the bone thinning condition Osteoporosis.
- Improves heart, lungs, blood vessels and strengthens your circulatory system
- Reduce the risk of heart disease and stroke.
- Makes you feel stronger and healthier
- Increases your energy level.
- Builds strong muscles, bones, and joints
- Reduce your stress and improves mild to moderate hypertension
- Increases your body flexibility
- Makes you look and feel better
- Improves your mood and sleep

The contact information about Ojara Ricky Richard in the case that you need to contact him at any time after this intervention is:

Ojara Ricky Richard,
Kyambogo University, P.O Box 1, Kyambogo

0782152624/0702152624
rickyojara@gmail.com

Appendix V b) Participants' ethics information letter in Luo

Alwongi me bedo i kwed malube ki yenyo yoo me tic ki tuku ma kicano maber kore ki kore me lweny i kom two cukari. Kwed man bitime i kom lutwo ma woto awota me nongo yat ki i Ot Yat Madit me Gulu.

Adwogi me kwed man bibedo ki kony madit tutwal bot jo ma miyo tuku ma kicano kore ki kore bot lutwo cukari pi miyo tic ma rwate pi lutwo magi. Kwed man bene bikonyo lutwo magi me lweny i kom two man.

Ngat ma bitelo kwed man aye **Ojara Ricky Richard**, Latin kwan me rwom ma malo atika i kom Tuku ki adwogi pa tuku i kom Dano. En kwano i gang kwan madit ma kilwongo ni Kyambogo Unibwaciti, dok tye Lapwon me tuku i Gang kwan madit me Gulu Unibwaciti. Jo ma tye ka lubu kor kwed man obedo Lupwonye ma okwano kwan ma lamal maloyo. Gin aye **Dr. Constance Nsibambi Tel; 0700370848 and Dr. Roland Mukana Tel; 0701098555** ma gin pwonyo I Kyambogo Unibwaciti.

Pe tye peko mo madit ma kwed man bikelo ikom jo ma bibedo i kwed man, tutwale jo ma bigamo lapeny keken. Kono, pi jo ma kibiyeko gi me bedo ka tuku, omyero gin oruk war wek ogeng nongo ret mogo ma reb reb i tyen gi.

Ber pa kwed man dwong tutwal, makato, bot jo ma obi bedo ka tuku. Ber pa kwed man aye;

- Weko ringo komi cako cwiyo cukari ma i remoni maber atika. Man weko cukari ma i remo dok ping maber atika.
- Weko itiyo ki yat atuca manok tutwal onyo pe itiyo kwede bene kulu.
- Weko pek mameri bedo ma opore.
- Weko yo pa remo bedo ma twolo dok ma pwot.
- Dwoko ping moo ma pe mte i kom dano.
- Dwoko ping arem me wang mwot onyo lugaga.
- Dwoko ping arem me cogo.
- Weko adunu ki oboo bedo ma wing wing atika.
- Dwoko ping two ma mako adunu oboo ki yo pa remo.
- Medo kero ni dok ibedo ma komi yot atika.
- Weko ringo ki ler me komi, cogo komi, ki wang mwot ducu bedo matek.
- Dwoko rwom me cwer cwinyi ping tutwal.
- Weko mwot komi gom maber atika calo pobo ma oner.
- Weko neno in bedo mit atika I wang dano.
- Weko inino maber calo lalal.

Pi ngec mukene go cim bot Ojata R. R.

Nama; 0782152624/ 0702152624

Appendix VI a) Participant ethics consent form

Participants Code **T2DM/ORR/2014/.....**

I consent that Directed Study student, **Ojara Ricky Richard**, may ask me questions (for a maximum of 20 minutes) about my physical activity readiness, (PAR) and prescribe for an **Aerobic Exercise Program, Lasting 20-60 minutes per day, 3 times per week, for 8 weeks** for managing my sugar level,. I confirm that in advance of this questionnaire and Intervention, I received, from **Ojara Ricky Richard**, a letter of information and have had all of my questions addressed to my satisfaction.

I understand that data resulting from my participation in this study will not identify me in any way and that all of my responses are private and confidential. I also understand that I am free to opt out of the program at any time and have any collected data removed from the database, or that I may decline to answer specific questions without penalty.

I understand that 5 ml of blood will be withdrawn from anti-cubital vein in a time less than 1 min following bandaging with tourniquet in a sitting position after 12 hours of fasting in the beginning of the trial (pre-test), and at the end of the tenth week (post-test).

I understand that I may contact the supervisors, Dr. Mukana Roland **Tel; 0701098555** and Dr. Constance Nsibambi, **Tel; 0700370848** at anytime by phone,

I understand that all research assistants working on this project will comply with the University of Kyambogo Standards for the Protection of Human Research Participants and will sign a confidentiality agreement.

I understand that the information I will give, will be recorded and that the recordings, questionnaire transcripts, and field notes will be used for educational and research purposes only, including research articles, presentations and teaching. I also understand that the recordings, questionnaire transcripts, and field notes will be kept in a secure locked place for a minimum of five years and then destroyed. All data for all uses will be handled in compliance with the aforementioned Institutional Review Board and National Council for Science and Technology Standards.

I hereby give my permission to participate in the study.

Participant's Signature..... Date/...../.....

Investigator's Signature: Date/...../.....

Appendix VI b) Participant ethics consent form in Luo

Aye ni lakwed me kwan Ojara Ricky Richard, twero penya (pi dakika ma pe kato 20) i lok ma dok i kom ngo ma okelo two man i koma, kit ma atye ka tic kwede ki yoo me tuku pi lweny i kom two man, dok aye ni en twero mina tuku ma kicano kore ki kore kun pe ki tuku ki kero madit tutwal, pi dakika maromo 20 me oo 60 i nino acel acel, kun atimo tyen 3 i cabit acel (pe late wadi) pi cabit 8.

- Anongo waraga ki bot Ojara R.R. ma lega me gamo lapeny, ki bedo i kin jo ma bibedo i yub me tuku ma kicano kore ki kore, ka ki yera, dok ayeng ki gin ma en otita ma lube ki rac kacel ki ber pa tuku man, ki anga ma atwero penyo kace peko mo tye.
- Aniang ni adwogi me bedo i yub me tuku ki gamo lapeny man pe dibedo me cimo toka iyoo mo keken dok kibigwoko ne i mung.
- An bene aniang ni atwero aa woko ki i yub me tuku ki gamo lapeny man labongo dic, dok bene ngec malube ki lok koma bene atwero gamo ne woko ki bot lakwed me kwan man labongo pwod.
- Angeyo ni atwero nongo ngec mukene ki bot lapwony pa lakwed man, macalo **Dr. Nsibambi Connie (PhD) Tel; 0700370848 and Dr. Mukana Roland (PhD) Tel; 0701098555**
- Aniang ni ngat ma bikonyo kor lakwed man bilubu cik ma gwoko twero pa dano ma bibedo i kwan man, dok gin bene bicono alama mamegi kun cike me gwoko mung malube ki lok kom jo ma bibedo i kwan man.
- Aniang maber ni pi jo ma kibiyeko gin me bedo i yub me tuku makicano kore ki kore, kibikwanyo remo gi manok atika (cc 5) me apima pi neno kit ma cukari dwong kwede i komgi. Dok aniang ni kwanyo remo man bibedo tyen 2, ii acaki ki ii agiki me kwed.
- Aniang ni ngec ma an abimiyo ni kibicoyo, dok lapeny magi kibitiyo kwede me kwan ki nongo ngec ma lube ki two cukari i kom jo ma nongo kony me yat ki i Ot yat madit, Gulu; coc me mino ngec bot lwak me wilobo ducu i kom adwogi me kwan man; ki me pwoonyo lwak kun kijenge i kom adwigi me kwed man.
- Aniang bene ni lagam ducu kibigwoko pi kare maromo mwaka 5 mapeya kibalo.
- Aniang bene ni ngec ma mite pi coc ki kwed man kibitic kwede ma lube ki cik me woro twero pa dano ma Uganda National Council me Technology, kacel ki Institutional Review Board mito.
- Dong kombedi amiyo twero ki Lakwed man me penya/ yera me bedo i yub me tuku ma kicano kore ki kore.

Alama pa ngat ma oyee me bedo I kwed man..... Nino dwe...../...../.....

Alama pa Lakwed..... Nino dwe...../...../.....

Appendix VII The level of participation of T2DM in physical activities

Dear Sir / Madam

This instrument seeks to collect data on the topic to establish the level of participation of Diabetic Type 2 in Physical Exercise. Please answer the following questions as honestly as possible. The information you will give will be subject to confidentiality and strictly for academic purposes.

1. How old are you?..... years
2. Do you currently accumulate at least 30 minutes of moderate to high intensity activity on most days of the week?
Yes No
3. On average, how many times a week do you perform aerobic exercise for at least 20 consecutive minutes?
Never
Less than one time
One to two times a week
Three or more time for a week
4. When you do aerobic exercise, approximately how long do you spend performing the activity?
Less than 20 minutes
20-30 minutes
30-60 minutes
More than 60 minutes
5. Do you participate in resistance training activities?
Yes No
6. If you are presently exercising, briefly describe your program:
How much time can you comfortably allocate per workout session base on your lifestyle?
Check the answer that most closely applies:
30 minutes or less
30-45 minutes
45-60 minutes
60-90 minutes
7. How often do you stretch your muscles after workout
Never
Occasionally
Often
8. What means of transport do you regularly use?
Walking
Riding bicycle
Use motorcycle/ Boda
Use motorcar
9. For roughly how many minute do you always walk and/or ride bicycle?.....minutes

10. Do you have housemaid?
 Yes No
11. If you are presently exercising, briefly describe your program:
 How much time can you comfortably allocate per workout session base on your lifestyle?
 Check the answer that most closely applies:
 30 minutes or less
 30-45 minutes
 45-60 minutes
 60-90 minutes
12. What is your occupation.....?
13. Does occupation require vigorous physical activity
 Yes No
14. Do you perform some compound work/household activities when you are at home?
15. What days of the week do you find it more convenient for you to participate in physical exercise? (**TICK 3**)
- | | |
|-----------|--------------------------|
| Sunday | <input type="checkbox"/> |
| Monday | <input type="checkbox"/> |
| Tuesday | <input type="checkbox"/> |
| Wednesday | <input type="checkbox"/> |
| Thursday | <input type="checkbox"/> |
| Friday | <input type="checkbox"/> |
| Saturday | <input type="checkbox"/> |

Trainer & Staff Notes:

Appendix VIII The rating of the level of participation in Physical Activities

a) The rating of the level of participation in programmed physical exercises

Participation	Description
Very good	150 minutes of moderate intensity, 5 times a week
Good	60 - 90 minutes of moderate intensity, 3-5 times a week
Fair	40-50 minutes of moderate intensity, 2 times a week
Not at all	0 minutes of activity a week

b) The rating of the level of participation in other physical activities

Participation	Description
Very good	Garden work, riding bicycle, walking as means of transport, household/ compound works and stretching after workout.
Good	Garden work, riding bicycle, walking as means of transport, household/ compound works.
Fair	Household/ compound works
Not at all	None of the above.

Appendix IX Physical activity readiness questionnaire (PAR-Q)

Dear Sir / Madam

This instrument seeks to collect data on the topic to establish the level of participation of Diabetic Type 2 in Physical Exercise. Please answer the following questions as honestly as possible. The information you will give will be subject to confidentiality and strictly for academic purposes.

If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you significantly change your physical activity patterns. If you are over 69 years of age and are not used to being very active, check with your doctor. Common sense is your best guide when answering these questions.

Please read carefully and answer each one honestly: check YES or NO.

Please tick either YES or NO

1. Has your doctor ever said you have a heart condition and that you should only do physical activity recommended by a doctor? Yes No

2. Do you feel pain in your chest when you do physical activity? Yes No

3. In the past month, have you had a chest pain when you were not doing physical activity? Yes No

4. Do you lose your balance because of dizziness or do you ever lose consciousness? Yes No

5. Do you have a bone or joint problem (for example, back, knee, or hip) that could be made worse by a change in your physical activity? Yes No

6. Is your doctor currently prescribing medication for your blood pressure or heart condition? Yes No

7. Do you know of any other reason why you should not do physical activity? Yes No

If yes comment on it

.....

YES to one or more questions:

You should consult with your doctor to clarify that it is safe for you to become physically active at this current time and in your current state of health.

NO to all questions:

It is reasonably safe for you to participate in physical activity, gradually building up from your current ability level. A fitness appraisal can help determine your ability levels.

I have read, understood and accurately completed this questionnaire. I confirm that I am voluntarily engaging in an acceptable level of exercise, and my participation may involve a risk of injury.

Signature.....

Date.....

Appendix X Medical clearance form

Having answered YES to one of the above, I have sought medical advice and my GP has agreed that I may exercise.

Participant's Code **T2DM/ORR/2014/** Date: _____

Physician's Name _____

Physician's Phone Number (____) _____

Person to contact in case of Emergency:

Name _____ Date _____ Phone _____

Are you taking any medication or drugs? If so, please list medication, dose, and reason.

Describe any physical activity you do somewhat regularly.

Signature _____

Date _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the 7 questions

Any questions I had were answered to my full satisfaction.

Number _____

Signature _____ Date _____

CONFIDENTIAL

[Information to be used by training staff only and kept in a confidential file]

Delay becoming much more active:

If you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or if you are or may be pregnant – talk to your doctor before you start becoming more active.

YES to one or more questions

Appendix XI Confidentiality Agreement for Research Personnel

Project title: **Effect of Exercise Programme Intervention in Management of Type 2 Diabetes Mellitus Outpatients at Gulu Regional Referral Hospital, Uganda.**

I, _____, the _____ (specific job description, e.g., interpreter/translator) have been hired to _____.

I agree to:

1. Keep all the research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g., disks, tapes, transcripts) with anyone other than the *Researcher(s)*.
2. Keep all research information in any form or format (e.g., disks, tapes, transcripts) secure while it is in my possession.
3. Return all research information in any form or format (e.g., disks, tapes, transcripts) to the *Researcher(s)* when I have completed the research tasks.
4. After consulting with the *Researcher(s)*, erase or destroy all research information in any form or format regarding this research project that is not returnable to the *Researcher(s)* (e.g., information stored on computer hard drive).

(Print name) (Signature) (Date)

Researcher(s)

(Print name) (Signature) (Date)

Appendix XII Data Entry Form

Project title: **Effect of Exercise Programme Intervention in Management of Type 2 Diabetes Mellitus Outpatients at Gulu Regional Referral Hospital, Uganda.**

Participant's Code **T2DM/ORR/2014/** Sex

Principal investigator:

Name: Ojara Ricky Richard

Institution: Kyambogo University

Address: P.O Box 1, Kyambogo

Phone Number: +256-(782152624/702152624/752152624)

E-mail Address: rickyojara@gmail.com

Sugar levels primary data and Body mass Index as secondary data

Independent variables	Pre-Test	Post-Test
HbA1c		
BMI		

TYPE OF INTERVENTION

Aerobic Exercise

FREQUENCY

3 Times per Week

DURATION

8 weeks

Appendix XIII Exercise Programme

Participants code **T2DM/ORR/2014/**

The objectives of the program, while receiving treatment, are to:

- Improve or maintain cardiovascular function, muscular strength/endurance
- Reduce or help manage fatigue and other side effects associated with diabetes
- Improve quality of life
- Educate participants about the benefits of exercise and guidelines for safe exercise
- Provide program satisfaction
- Release contracted muscles, tendons, and fascia
- Mobilize joints
- Improve cardiorespiratory capacity
- Improve coordination
- Improve balance
- Promote relaxation
- Improve exercise performance and functional capacity (endurance)

Everyday's activities will involve

- Warm up and perform stretching (5-10 min).
- Cool down and perform stretching (5-10 min).

The stretching exercises involves the major muscle tendon groups of body (i.e., neck, shoulder, upper and lower back, pelvis, hips and legs) with **4 or more repetitions per muscle group holding each stretch for 5 seconds** performed 3 times per week. They include;

Bend and Reach, Rear Lunge, Overhead Arm Pull, Thigh Stretch, Single-leg over, Walking quad stretch, Kneeling hip flexor, Quad stretch, Compound Joint Press, Quadriceps Extension, The Rower, Squat Bender, Forward Lunge, Prone Row, Bent-leg Body Twist, Sit-up, Hamstring Curl Knee Planks, Birddog, Crunches, Crunches with Twist, Leg Lifts, Reverse Crunch, Classic Wood Chop, Advanced Birddog, Crunches with Medicine Ball, Twist with Medicine Ball, Oblique Wood Chops, Chest stretch, Lunge walk, High knee lift, Elbow-to-inside-of-ankle lunge, Calf walk Sideways and backwards skipping/running, Simulated running arm action,

standing or seated, Leg drives, Leg cycling, Squat Thrust, Fast Feet on Box, Alternating Split Squat, Squat to Presses, Single Leg Kickbacks, Forward Lunges.

The programme

Week	days	objectives	Activities	Intensity	Time
1	Tue Thursday Sun	Improve or maintain cardiovascular function ; Reduce or help manage fatigue Educate participants about the benefits of exercise and guidelines for safe exercise; Provide program satisfaction	Riding cycle ergometer and/or Jogging/running on treadmill	60 % HR max	30 min
2	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Reduce or help manage fatigue Educate participants about the benefits of exercise and guidelines for safe exercise, Provide program satisfaction; Mobilize joints; Improve coordination; Reduce rigidity, Improve balance; Promote relaxation; Improve endurance	Riding cycle ergometer and/or Jogging/running on treadmill	60 % HR max	40 min
3	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Reduce or help manage fatigue Release contracted muscles, tendons, and fascia; Improve cardiorespiratory capacity; Improve coordination; Reduce rigidity; Improve balance; Promote relaxation	Riding cycle ergometer and/or Jogging/running on treadmill	65 % HR max	50 min
4	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Reduce or help manage fatigue Release contracted muscles, tendons, and fascia; Mobilize joints; Improve cardiorespiratory capacity; Improve coordination; Improve balance; Promote relaxation; Improve exercise endurance	Riding cycle ergometer and/or Jogging/running on treadmill	65 % HR max	60 min

5	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Reduce or help manage fatigue Release contracted muscles, tendons, and fascia; Mobilize joints Improve cardiorespiratory capacity Improve coordination; Improve balance; Promote relaxation Improve exercise endurance	Riding cycle ergometer and/or Jogging/running on treadmill	70 % HR max	60 min
6	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Improve quality of life Provide program satisfaction Release contracted muscles, tendons, and fascia; Mobilize joints; Improve cardiorespiratory capacity; Improve coordination; Improve balance Promote relaxation; Improve exercise endurance	Riding cycle ergometer and/or Jogging/running on treadmill	70 % HR max	60 min
7	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Improve quality of life; Release contracted muscles, tendons, and fascia; Mobilize joints; Improve cardiorespiratory capacity; Improve coordination; Improve balance Promote relaxation; Improve exercise endurance	Riding cycle ergometer and/or Jogging/running on treadmill	75 % HR max	60 min
8	Tue Thursday Sun	Improve or maintain cardiovascular function, muscular strength/endurance Improve quality of life; Release contracted muscles, tendons, and fascia; Mobilize joints; Improve cardiorespiratory capacity; Improve coordination; Improve balance Promote relaxation; Improve exercise endurance	Riding cycle ergometer and/or Jogging/running on treadmill	75 % HR max	60 min