GLYCAEMIC CONTROL AND ASSOCIATED FACTORS IN TYPE 2 DIABETIC PATIENTS ATTENDING A PUBLIC HEALTH FACILITY CLINIC IN TANGA REGIONAL HOSPITAL, TANZANIA 2012

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GLYCAEMIC CONTROL AND ASSOCIATED FACTORS IN TYPE 2 DIABETIC PATIENTS ATTENDING A PUBLIC HEALTH FACILITY CLINIC IN TANGA REGIONAL HOSPITAL, TANZANIA 2012

By

Justin Mtefu Maeda

A dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Masters of Science (Applied Epidemiology) of Muhimbili University of Health and Allied Science

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***Glycaemic control and associated factors in type 2 diabetic patients attending a public health facility clinic in Tanga regional hospital, Tanzania,*** in (Partial) fulfillment of the requirements for the degree of Master of Science (Applied Epidemiology) of Muhimbili University of Health and Allied Sciences.

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Dr. Germana Leyna

(Supervisor)

Date: _____

_____

Dr. Steve Wiersma

(Supervisor)

Date: _____

DECLARATION AND COPYRIGHT

I, **Justin Mtefu Maeda**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature …….

ACKNOWLEDGEMENT

All honours to God the Almighty, by whose grace the work was completed.

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DEDICATION

This work is dedicated to my father who has recently been discovered to be diabetic and to all diabetic patients.

ABSTRACT

INTRODUCTION

Glycaemic control denotes regulating and maintaining blood sugar levels in diabetic patient within normal ranges. World Health Organization (WHO) recommends the use of Glycated Haemoglobin (HbA1c) test as an objective measure of Glycaemic control with a target of maintaining HbA1c at an optimal value of 7.5% or less. Long-term glycaemic control reduces later incidence of diabetic related complications, however attaining the target has been a challenge to both patients and health care providers with 40% and 60% of patient unable to reach the optimal targets in developed and developing countries respectively. Tanzania is limited in studies exploring glycaemic control at local context, but the few studies conducted show high proportion of patients (over 65%) with uncontrolled glycaemia. The study aimed at determining the magnitude of glycaemic control and its associated factors among type 2 diabetic patients attending public health facility in Regional hospital of Tanga, Tanzania.

METHODS

This was a hospital based cross-sectional design with systematic random sampling conducted from December 2012 to March 2013. Diet was assessed using Food Frequency Questionnaire (FFQ), physical activity through the International Physical Activity Questionnaire (IPAQ), anthropometric measurement performed, and blood sample collected for laboratory testing of HbA1c levels. HbA1c level (>7.5% = 1, else = 0) was set as an outcome variable with other factors being explanatory variables. Bivariate and multivariate analysis was performed and Chi Square test was used in comparing proportions with a significant different set at P value of 0.05 or less. Ethical clearance was obtained from MUHAS Institutional Review Board (IRB).

RESULTS

A total of 224 study participants were enrolled into the study. Female were 137 (61.2%). The mean age (SD) was 55.4 (12.9) years. The prevalence of unacceptable glycaemic control was 83% (186/224). Factors found to be significantly associated with unacceptable glycaemic

control in univariate analysis were, frequent fruit intake OR (95% CI): 0.3 (0.1, 0.8); Moderate physical activity, 3.0 (1.3, 6.9); Low physical active, 2.9, (1.2, 7.2); food insecurity, 7.1 (1.3, 53.9); high physical activity, 0.3 (0.1, 0.9); diabetic duration for more than 2 years, 2.5 (1.5, 5.1); Insulin treatment 6.0 (1.7, 15); being on Oral Hypoglycemic Agents (OHA) single drugs, 0.5 (0.2, 0.9; diet only therapy, 0.2 (0.1, 0.4); and satisfying self-diabetic care, 0.4 (0.2, 0.9). In multivariate analysis, significant factors were satisfying self-diabetic care practice AOR (95% CI): 0.3 (0.1, 0.8); on dietary therapy only, 0.2 (0.1, 0.6); on Insulin therapy, 6.7 (2.0, 22.4); Frequent fruit intake, 0.3 (0.1, 0.7); moderate physical activity, 3.41 (1.3, 9.0); and low physical active, 3.4 (1.3, 11.6).

CONCLUSSION

High prevalence of unacceptable glycaemic control at a tertiary diabetic care clinic level setting is alarming. Routine analysis, interpretation and use of information from patient's clinic visits record at facility needs to be empowered to facilitate close monitoring and evaluation of quality of care provided. Good practices towards achieving glycaemic control are to be encouraged to achieve a large number of patients practicing them for better glycaemic control.

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1. BACKGROUND

1.1. Definition and classification

Diabetes mellitus comprises a group of chronic metabolic diseases characterized by elevated blood sugar levels caused by inadequate Insulin secretion, insulin utilization or both. (1,2,3) Commonest early symptoms for diabetes mellitus include excessive urination (polyuria), excessive thirst (polydipsia), excessive hunger (polyphagia), increased fatigue, weight loss and progressive visual loss (1,3). Minimum diagnosis criteria for diabetes mellitus recommended by World Health Organization (WHO) include fasting plasma glucose ≥ 7.0mmol/l (126mg/dl) or 2 hours plasma glucose ≥ 11.1mmol/l (200mg/dl) (4). According to WHO and American Diabetes association (ADA) diabetes classification, four main categories of diabetes are listed: type 1, type 2, gestational, and other non-specific type of diabetes mellitus. Type 2 diabetes mellitus accounts for 90% of all diabetes patients worldwide. Other terminologies in the classification include Impaired Glucose Tolerance (IGT) and Impaired Fasting Glycaemia (IFG) termed as pre diabetic clinical stage which may predict a near future of full blown diabetes mellitus (1,2). Type 2 diabetes mellitus commonly occurs in adults and most of its patients are obese, with insulin resistance and relatively insulin deficient which are highly due to modifiable risk factors (2).

1.2. Epidemiology

It was estimated that in the year 2010 about 285 million people were living with diabetes worldwide and the number is expected to reach 439 in 2030 (5). In 2004 WHO estimated 3.4 million people to have died of high blood sugar related consequences, and 80% of these were from low and middle income countries (1). In 2010 the International Diabetic Federation estimated the prevalence of diabetes in Sub Saharan Africa to be 8.1% (5) and this has become a threatening public health problem for the region which has already been overwhelmed with the burden of infectious diseases and Tanzania being no exception (6). The prevalence of diabetes in Tanzania is estimated to be 3.2% with 9.3% IGT which marks an impending near future increase in full blown diabetes (5) and with marked difference between urban and rural

populations which are 4.0% and 1.3% respectively (7). In 2006, the Tanzania Diabetes Association (TDA) estimated over 400,000 people to have been living with diabetes in the country (8).

1.3. Disease implication

Diabetes disease progresses with time and if poorly controlled, severe complications may arise including cardiovascular diseases, progressive visual loss, renal failure, poor healing wounds and sexual dysfunctions (3). Reduction in diabetic burden and related complication is achieved through good diabetic management which involves monitoring blood sugar, early detection and treatment of diabetic complication, treating co – morbidities, patient health education and dietary counseling (9).

1.4. Glycaemic control

Glycaemic control refers to the daily maintenance of blood glucose at typical levels (Fasting blood sugar < 7.1Mmol/L or Random blood sugar < 11.1 Mmol/L). Glycaemic control can be ensured through daily blood glucose testing and recording but also through periodic (usually every 3 or 6 months) testing of glycelated hemoglobin. Blood glucose fluctuates throughout the day, hence making daily testing and recording of blood sugar level unreliable in giving the overall glycemic control level. It is due to these reasons that World Health Organization and other international health agencies recommend the use of Glycelated Hemoglobin (HbA1c) in the monitoring of glycaemic control (1,9,10). This measure of the protein glycation rate over the life span of erythrocytes is used to estimate an average fasting, before meals, and after meals blood glucose levels for the past 3 months period (11). The focus of glycaemic control has been put on targeting the HbA1c levels of <7% (12). Glycelated hemoglobin has been used as an objective measure of diabetic care and glycaemic control in most of available current guidelines including the Tanzania diabetic guideline. The aptitude of the test to be used as the best measure for glycaemic control and prediction of diabetic related complications in type 2 patients is deflated by several facts including inability to detect the

postprandial hyperglycemia and variations in presence of haemoglobinopathies in some populations which may affects its precision (13). With the existing doubts and challenges on its usefulness including its affordability and availability in low and middle income countries (14), it still has proved to be the best estimate of mean blood glucose (MBG) for the past 2 to 3 months in both types of diabetes mellitus patients (15).

However, it has never been easy in attaining the intended goal of good glycaemic control in diabetic patients due to complexities of pathophysiology for type 2 diabetes mellitus (3), its management and variability in health professional approaches and patient's differences in biological and behavioral experiences (16). This raises a need for a committed investment on specified but yet multi-disciplinary approach endorsed by strong evidence from qualified researches.

2. LITERATURE REVIEW

2.1. Magnitude of uncontrolled glycaemia

Glycaemic control remains to be a challenge among developed and developing world. In United States, among 20 million with type 2 diabetes mellitus, 40% of them had their HbA1c level above the recommended 7% target (17,18). In Jordan a study involving patients at follow up diabetic clinic, only 27.5% had HbA1c levels below 7% and this was an increase from 25.4% during their first clinic visits (19). In a study which, compared diabetes patients of Tanzania to those of Sweden, it was observed that Tanzanian patients had poorer glycaemic control with 65.5% of patient being above the acceptable HbA1c levels of 7.5% as compared to 36.5% Swedish patients. The study also revealed that patients with type 2 diabetes mellitus had a poorer health condition as compared to the general population and Swedish patients, however this was not linked well with their level of glycaemic control (20).

2.2. Known factors linked with quality of glycaemic control

Several factors have been widely being implicated in modifying the levels of glycaemic control in diabetic patients. These factors variably differ in different countries and with different ethnicities and include both modifiable and non-modifiable factors.

2.2.1. Patients factors

Patient factors such as age, sex and social economic status have been widely studied for their effect on diabetes control. In review of different studies done in developed and developing countries, sex and age of patients has not shown to affect the quality of glycaemic control (21–28), however those with poor glycaemic control were shown to be diagnosed at a slightly younger age (48 years) as compared to those with good glycaemic control (53 years) in Mexico (21). Patient's weight has also been found to affect glycaemic control from different studies. Obesity has been shown to increase insulin resistance and elevate levels of HbA1c. The proportion of patients' achieving target glycemic control has been shown to be higher among normal weighted patients (41%) as compared to overweight (34%) and obese patients

(30%) (26). Furthermore, HbA1c was significantly higher in diabetic patients with higher BMI (27).

The influence of type of treatment on glycaemic control has also been studied. Patients on different treatment modalities involving insulin among diabetic patients attending primary care in the United Kingdom had a 1.69 and 1.94 increased risk of experiencing high glycaemic index compared to patients on diet and oral medication, respectively (27) with consistency of findings from other studies in different places (24,29,30).

2.2.2. Dietary factors

Individual foods have shown to affect differently the level of glucose in blood. A randomized control trial in USA on 62 types of foods categorized them into low and high glycaemic index foods. Among foods categorized as low Glycaemic index foods which can also be found in Tanzania include whole grain cereal products, potatoes, spaghetti, dried legumes, dairy milk and orange (31). A review article with 11 clinical trial most from developed countries found consumption of the low glycaemic index (GI) foods had a significant reduction on HbA1c levels by 0.5% which is comparably higher than one achieved by oral medications (32). In Canada, a study on fruits categorizing them as high (banana, mango, pineapple, papaya and watermelon) and low (apple, orange, pear, blueberry and peach) found a significant decrease in HbA1c by 0.18 with every 1g/day increased intake of low GI fruits (33). In Africa studies focusing on diet and type 2 diabetes mellitus are scarce, a Nigerian study focusing on the effect of sucrose fruits on glycemic index found that sucrose containing foods has no worsening effect in glycaemic control, suggesting on modification in diabetic diets to serve for palatability and disease control (34). It has also shown that Very Low Carbohydrate Diets (VLCD) which promotes weight loss has not shown to have a greater impact on improving glycaemic control, hence its prescription should be given with care (35).

Adherence to prescribed foods has shown to improve glycaemic control. In Italy it was found that patient adhering to recommended diet had lower levels of HbA1c by 0.9 as compared to non-adhering patients (36). In a study done in Jordan, the proportion of patients with poor

glycaemic control was twice among patients not adhering to diet in comparison to adherent patients (29).

Food insecurity has also shown to impair fulfilling the objective of glycaemic control, as people had no choice on what food to take. A study done in developing countries setting of Jordan, there was a significant lower levels of mean HbA1c levels among food secured patients (8%) as compared to non food secured (8.5% in moderate food insecurity and 8.6% in severe food insecurity groups) p value = 0.04 (37).

2.2.3. Physical activity

Physical activity has shown to improve glucose uptake in muscles and increase insulin peripheral insulin sensitivity in patients with low to moderate insulin resistance (38). Above this potential effect however, impact on glycaemic control varies with level of physical activities. In the Netherlands moderate intensity physical activities done at work or during leisure time were not enough to cover for the prescribed exercise and had no effect on glycaemic control (39). Adhering to physical exercise schedules was reported to improve glycaemic control. This was proclaimed to may have resulted due to improved muscular mitochondrial functions and improvement of glucose utilization (40). Hence in Thailand, patients adhering to physical activity were 10 times more likely to achieve good glycaemic control compared to inadequatly adhering patients (41). Similar findings have been reported from Jordan where a lower proportion of patient on at least 30 minutes of moderate physical exercise per day (55%) had poor glycaemic control as compared to 74% among inactive patients (29).

2.2.4. Disease history

Most studies from both developed and developing countries show increasing glycaemic control impairment with increased duration of having diabetes. A follow up study in Swedish type 2 diabetes patients showed that duration of type 2 diabetes illness with a decline in β cells responsible for insulin production was significantly related with increased glycaemic index. The mean diabetic duration in those achieving good glycaemic control was 6.4 years as

compared to 10.6 years for those with unsatisfactory glycaemic control (42). Other several studies utilizing different methodologies and places have also shown that increased duration of diabetes mellitus disease impairs glycaemic control (19,24,27,29,43,44). Co-morbidities may be caused by the disease itself but also do to the effects of glycaemic control on these patients such as coronary heart disease, neuropathy, retinopathy and renal failure which have been shown to increase likelihood of poor glycaemic control (17,22).

2.2.5. Diabetic care

A cohort study done in Singapore investigating ethnic differences in level of blood glucose control revealed that a shared intervention between health care providers and diabetic patients significantly improved the levels of HbA1c (regression coefficient of 0.298, p value 0.07) among the followed groups (45). Regardless of the type of treatment modality and type of diabetes, patients on self-monitoring of glucose achieve a significantly better glycaemic control as compared to those not on self-monitoring (OR = 1.56, CI:; Pvalue) (29). Other factors shown to raise the frequency of occurrence of impaired glycaemic control include emotional distress (47), cigarette smoking (44) and high alcohol intake (48). Lifestyle modification, using of combined therapies and other approving mechanism of action may be necessary in achieving a certain degree of glycaemic control, however, age and co morbidities may modify such actions (49).

2.3. Effect of glycaemic control in type 2 diabetic patients

Good glycaemic control has been shown to delay and reduce the rate of diabetic related complications hence reducing the cost of treating diabetes (47,50,51). A study in Southern Korea demonstrated that tight glycaemic control reduces the risk and delays the onset of microvascular complication and coronary heart diseases. It also revealed death due to all cause was 13 times higher in group with high glycemic index (GI) levels as compared to satisfactory GI levels group (52). Similarly, in Kinshasa Congo a significant increased risk of developing cardiovascular complications including stroke as a consequence of poor glycaemic control was reported (44). Other complications such a diabetic ulcers have been implicated as a

consequence of poor glycaemic control. In Tanzania for instance, calls for multidisciplinary teams to fight for glycaemic control as a strong predictor for diabetic ulcers has been made (53).

3. PROBLEM STATEMENT

There is an appreciable global increase in the number of people living with diabetes of which the majority is type 2 diabetis. In 2010, about 285 million people were estimated to be living with diabetes and this number is expected to double by 2030 if no committed measures are taken. However, diabetic related complications and mortality related to high blood sugar are also increasing, with more than 80% of these deaths occurring in developing countries. Sub Saharan Africa faces a challenge in prevention and management of chronic diseases such as diabetes due to overburdened health system with communicable diseases hence posing for an impending near future disaster to health systems.

Poor glycaemic control has been implicated in early development of diabetic complications. A greater proportion of diabetic patients do not meet the optimal target of glycaemic control with more than 40% and 60% in developed and developing countries having HbA1c greater than 7.5% respectively. Many studies, most from developed countries have explained several factors related to glycaemic controls which include, dietary history, physical activity and disease related factors such as duration of the disease. In developing countries most studies associating such factors are from Asia, with few studies in Africa. Tanzania as with other African countries has limited data on the quality of glycaemic control experienced by diabetic patients. This leaves us with unclear explanation on the performance of our care and on the local operating factors associated with such performance in the care of type 2 diabetis. Several factors described in other studies pose some practical challenges that need to be addressed. Diet and exercise are among the ‘difficult’ lifestyle changes that patients need to adopt, which their effect on glycaemic control is essential to support for a better change in the disease management and prevention.

The increase in number of people living with uncontrolled diabetis also predicts an increase in related complications that will add an extra burden to a health system, which is already overwhelmed. Studies have shown a relationship between glycaemic control and progression of complications. Therefore this study will explore factors related to glycaemic control and its effect on disease pregression in the Tanzanian context and help to generate a strong evidence for secondary prevention strategies.

4. STUDY RELEVANCE

The need for identification of current type 2 diabetic status on glycaemic control, and identify country-specific factors contributing to and outcomes of the lack of control is essential for planning of secondary prevention strategies to reduce morbidity and mortality related to diabetis mellitus. This will at the end result in the generation of data on the performance of our health system in managing diabetic patients. It will also identify factors that may be targeted to improve diabetic control in our patients, as well as areas that clinicians and the Tanzania Diabetic Association need to address. In addition, findings from this study will be used to draw evidence in advising diabetic specialists, other health care providers, policy makers and patients on the best practice approaches and focus areas in achieving a better control of their daily blood glucose and ultimately patient outcomes.

5. RESEARCH QUESTIONS

This study at its end intended to answer three main questions:

1. What is the proportion of type 2 diabetic patients attending public health clinics who have unacceptable glycaemic control in Tanzania?
2. What are the major factors related to unacceptable glycaemic control among type 2 diabetic patients attending public health clinics in Tanzania?
3. What are the main health complications associated with unacceptable glycaemic control among type 2 diabetic patients attending public health clinics in Tanzania

6. OBJECTIVES

This study aimed at determining the magnitude and factors associated with glycaemic control in Type 2 Diabetic patients attending at public health facility clinic in Tanga Regional Hospital.

Specific objectives include:

1. To determine the magnitude of glycaemic control among type 2 diabetic patients attending public health facility clinic in Tanga Regional Hospital.
2. To determine factors affecting glycaemic control (Social demographic, diet, physical activity, disease history, and diabetic treatment and care) among type 2 diabetic patients attending public health facility clinic in Tanga Regional Hospital.
3. To assess the association between the level of glycaemic control and development of diabetic early warning signs for complications among type 2 diabetic patients attending public health facility clinic in Tanga Regional Hospital**.**

7. METHODOLOGY

7.1. Study design

This was a health facility-based cross-sectional study. The design was preferred over others as it can best address the magnitude of glycaemic control in the population as well as assessing associated factors.

Study population

The study participants were type 2 diabetic patients attending Tanga regional hospital diabetic clinic. Total number of diabetic patients in this clinic was 2,850 of which 2,532 (88.8%) were Type 2 diabetic patients. Of the 2,532 diabetic patients, females were 1,443 (57%).

Inclusion criteria:

- Any patient diagnosed by a clinician to be type 2 diabetic using WHO diagnostic criteria
- Aged above 20 years
- And who has attended the clinic for atleast 3 months.

Exclusion criteria:

- Referred or transferred patient from other health facilities within the last three months
- Person attending the clinic for a period of less than three months
- Diagnosed to have any haemoglobinopathies.

Study area and clinic operation

Tanga region is on the coast of Tanzania, located in the Northern Administrative Zone and it is divided into 7 districts. The region is about 27,000 square kilometers and it is estimated to have a population of about 1,967,000 people (National Bureau of Statistics 2002).

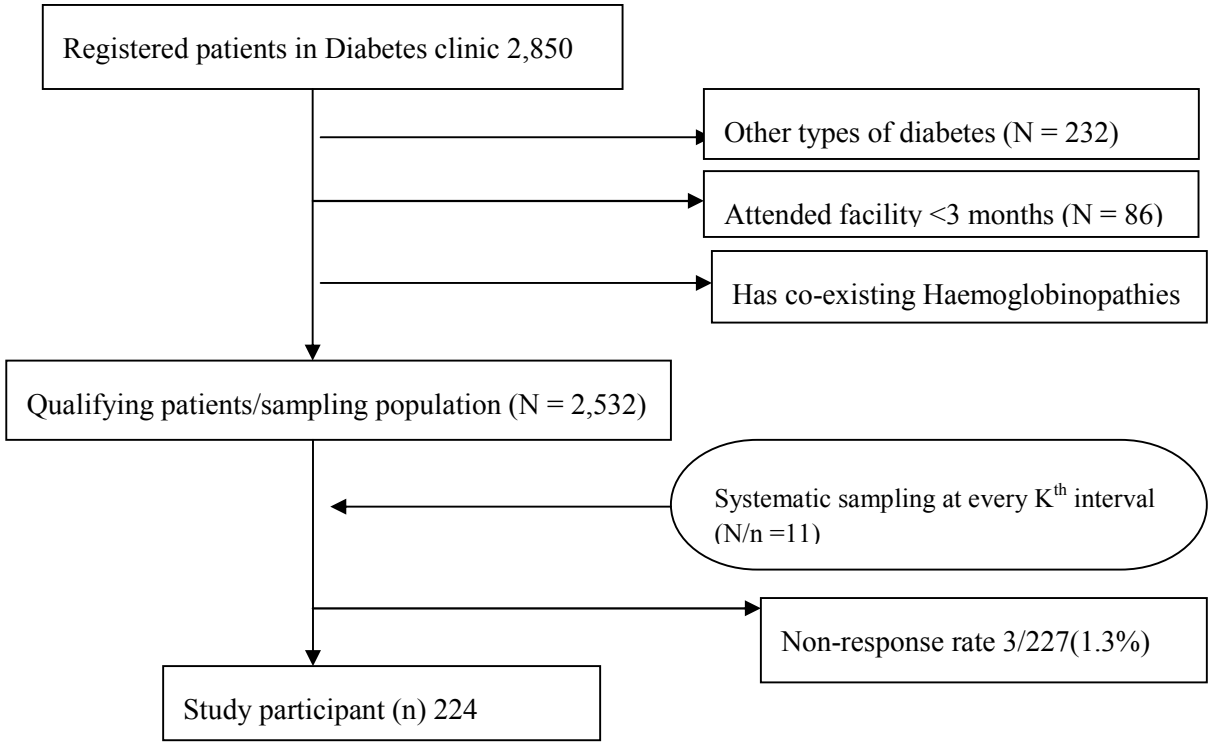
The regional hospital serves as the primary referral hospital from citizens of Tanga Municipality and as a tertiary hospital from district hospitals of the region. The hospital has

about 2,600 registered type 2 diabetic patients attending the outpatient diabetic clinic. The clinics run five days per week, attending 20 to 50 patients per clinic day and with a 3 months interval between individual clinic visits. At every clinic visit, patients are supposed to have their weight, blood pressure measured, have their blood sugar tested, and their treatment reviewed. In Tanzania patients with diabetes are supposed to receive free medical services including drugs and consultations.

Sampling and recruitment of study participant

Systematic sampling was employed to select study participants. A sampling interval, denoted as K, was calculated by dividing the total number of patient attending the clinics by the calculated sample size (2,532/224 = 11). The first participant was then randomly selected from patients attending clinic on the first day of data collection. The 11th consecutive patient attending the clinic was selected to participate in the study until the sample size was reached. If the selected patient refused to consent for the study or does not fulfill the inclusion and exclusion criteria, then the next 11th patient was selected.

Figure 1: Flow diagram for recruitment of study participants



Assuption used in Sample size calculation.

The sample size has been calculated using the following formula for a frequency in a finite population.

$([N*P(100-P)]/ [(e^2/Z^2_{1-\alpha/2}*(N-1) + P*(100-P)])/1-R$

Where

α: Type 1 error rate = 5%

e: Maximum tolerated error rate = 6%

N: Finite population size = 2850

P: Outcome frequency, expected proportion of diabetic patients with unsatisfactory glycaemic control (HbA1c level of >7.5%) assumed at 65.5% (20).

R: Response rate, assumed to be 80%

Z: Z – Value at 95% level of significance = 1.96

Then the sample size (n) = 227

7.2. Data collection instrument

Structured interview using questionnaire translated in Swahili was used to collect information from participant on: social demographic characteristics, diabetic disease and treatment history, habitual dietary intake, food security, physical activity, and patient care at health-facility, knowledge of patient on risk factors for diabetes and complication that may be caused by it. Other data collected included anthropometric measurements, physical examination and laboratory tests.

Data collection procedure

A consent form was provided to all eligible selected participants. Upon agreement, a questionnaire was administered. Anthropometric measurement and blood pressure were then

taken. Lastly, a venous blood sample was collected, stored and transported to Muhimbili National Hospital for laboratory testing.

Training of the research participant and pre testing of the research instrument was performed prior to onset of data collection and all necessary adjustment to the gaps corrected.

Physical examination

Height was measured using a locally manufactured height board fixed with a tape measure. Participants stood upright with their bare feet on the height board, facing forward with a headpiece laid on top of the head making 90^0 with the measuring board. Height was then recorded to the nearest 0.1 centimeter.

A standardized and pre-calibrated digital weighing scale (SECA, Germany) was used to measure body weight. Weight was measured with participants wearing light clothing, and no shoes and recorded in the nearest 100 grams.

Waist and hip circumference were also measured using a non-stretchable tape measure with the closest reading to 1.0 centimeter. The tape was snug around the body, but not pulled tight (i.e. non-constricting). Measures for waist circumference were taken twice at the midpoint between the lower costal margin and the iliac crest. Hip circumference was measured twice around the widest portion of the buttocks with the tape positioned parallel to the floor. The average of the two reading was used in the analysis. The method for measuring anthropometric parameters has been explained in detail by WHO and used in other Tanzanian studies (54,55).

Body Mass Index (BMI) was calculated from the anthropometric measures by dividing weight (Kg) with the height in Meters Square (m^2). Waist-hip ratio was also calculated (55).

Blood pressure was measured using digital sphygmomanometer (Spengler, Germany) with the patient sitting in an erect position. Two readings were taken from the right upper arm with an average reading recorded (55). The measurements were taken after the patient has rested and completed the interview.

Laboratory test

Aseptic technique was used to collect blood from the left brachial vein. A tourniquet was applied at the mid upper arm and 2 cc of blood was drawn followed by immediate emptying of the blood into an EDTA tube. The tubes were labeled with the participant's ID number, which was also filled in the patient file for easy linkage of the results. The collected samples were stored in a refregirator at less than -2^0C while waiting to be tested. The samples were then transported in cool boxes containing ice packs at 2^0C to 8^0C to the testing laboratory in Muhimbili National Hospital. All tests were performed within 2 weeks of blood collection where, HbA1c was done using SIEMENS DCA 2000 analyzer (Siemens, Germany). After every 10 samples a quality control check was performed as per the analyzer specification.

7.3. Variables and analysis plan

7.3.1. Outcome variable

The main outcome variable was the level of *Glycaemic control*, which was determined by the level of HbA1c. Unacceptable glycaemic control was defined as HbA1c of more than 7.5% and acceptable glycaemic control as HbA1c level of equal or less than 7.5%, however fasting blood glucose was also tested to complement the HbA1c test.

7.3.2. Independent variables

Social demographic factors: Individual information Age, sex, level of education, occupation, marital status and place of residence.

Dietary intake: This was assessed by using a short food frequency questionnaire based on self-reported average intake of foods consumed in the past three months. All consumed foods were later grouped into four main food groups - Carbohydrate, Protein, Fruits and Vegetables in the analysis to ease interpretation. The association was assessed between frequent intake of food groups and level of glycaemic control. Frequent consumption was defined as intake of 2 to 4 times per week or more for a specified group of food.

Food insecurity: This was assessed using questions adopted from the short form of the Household Food Insecurity Access Scale (HFIAS) which has been validated in Tanzania (56). Participant were dichotomized to experience food security (FS) or food insecurity (FIS) as described in the guideline (57).

Physical activity: Physical activity was evaluated using adopted questions from the International Physical Activity Questionnaire (IPAQ). Level of activity was categorized as high, moderate or low active groups according to IPAQ guideline for data processing and analysis of the IPAQ questionnaire available at www.ipaq.ki.se.

Diabetic care: Assessment of care offered during the respondent's last visit at the clinic was assessed using a set of question. Among services offered in the clinics that were checked included: measurement of blood pressure, testing for blood sugar, foot examination, health education and nutritional counseling. Any score above 60% of the checkup was considered as a satisfactory care.

Self-care at home: This was assessed based on questions about self-monitoring of blood glucose and self-examination at home in the past 3 months. A score of 3/5 was considered as satisfactory self-diabetic care.

Knowledge: Knowledge on nutritional, physical activity, medication, early detection of diabetes complication and self-assessment for the disease was also assessed using a set of 13 questions. Each correct response on knowledge was given an equal value and individual patient score was weighed against the total score. Knowledge was later dichotomized to satisfactory or unsatisfactory by taking the mean of the total scores as the cut-off point.

Diabetic complication warning signs: Diabetic related warning signs for complications were assessed for all patients. Presence of at least one major warning sign (Hypoglycaemia, Diabetic related hospital admission, nephropathy or retinopathy) and two minor (Weight loss, impaired ability to work or perform daily routines, peripheral neuropathies, poor wound healing, recurrent infections and sexual dysfunctions) was considered as having diabetic related warning signs.

7.3.3. Data management and analysis plan

All questionnaires were coded, checked and approved before data entry. The questionnaires with missing information or inconsistencies were sent back to the field for tracing the participants before leaving data collection sites. The database was created using Epi Info software cleaned and then analyzed using the same software.

Prevalence of unacceptable glycaemic control (HbA1c >7.5%) was calculated by dividing the number of participants with HbA1c levels of >7.5% to the total number of study participants. Categorical variables were summarized using frequency distribution tables while; continuous variables by calculating mean (standard deviation) or median (inter quartile range). Contingency tables were created for HbA1c levels against all independent variables (patient factor, dietary history, physical activity, diabetic history and other variables). Chi square test was used to assess for statistical associations between independent variables and the outcome variable. Multivariable Logistic regression was performed to determine factors independently associated with glycaemic control. Odds ratios and their 95% confidence intervals were reported. Significance of association has been set at a P- value of less than 0.05

7.4. Ethical considerations

Ethical clearance was obtained from Muhimbili University of Health and Allied Sciences Institution Review Board. A written informed consent was obtained from all study subjects prior to participating in the study (Annex 3). None of the information from the study participant was used for other purpose apart from research. The results of this study will be shared with different stakeholders in Non-communicable disease but the names of study participants' will not be revealed.

All test and measurement results have been communicated back to the participants. Those found to have high HbA1c, body mass index, waist-hip circumference and high blood pressure were advised and referred to their physician for proper treatment and management.

8. RESULTS

8.1. General characteristics of the study participants

A total of 224 type 2 diabetic patients were enrolled to the study (response rate 98.7%), the mean age was 55.4, standard deviation of 12.9 years with no age difference between male and female. Female constituted 137/224 (61.2%) of the study participants.

Table 1: Social demographic Characteristics of study participant by sex distribution

Demographic characteristics		**Overall N (%)**	**Male n (%)**	**Female n (%)**	**P value**
Age	Less than 40 Years	28 (12.5)	12 (13.8)	16 (11.7)	0.4
	40 to 59 Years	109 (48.7)	46 (52.9)	63 (46.0)	
	60 Years and above	87 (38.8)	29 (33.3)	58 (42.3)	
Education	None	43 (19.20	5 (5.7)	38 (27.7)	**<0.001**
	Primary not complete	40 (17.9)	15 (17.2)	25 (18.2)	
	Primary complete	91 (40.6)	39 (44.8)	52 (38.0)	
	Secondary and above	50 (22.3)	28 (32.2)	22 (16.1)	
Occupation	Peasants	51 (22.8)	23 (26.4)	28 (20.4)	**<0.001**
	Domestic	79 (35)	5 (5.7)	74 (54.0)	
	Manual skilled/unskilled	18 (6.1)	13 (14.9)	5 (3.6)	
	Professional	40 (17.9)	28 (32.2)	12 (8.8)	
	Business	31 (13.8)	15 (17.2)	16 (11.7)	
	Others	5 (2.1)	3 (3.4)	2 (1.5)	
Marital status	Married	176 (78.6)	77 (88.5)	99 (72.3)	**0.003**
	Single(never married)	18 (8.0)	5 (5.7)	13 (9.5)	
	*Single(ever married)	30 (13.4)	5 (5.7)	25 (18.2)	

* This include both separated, divorced and widowed

The women and men in the study population differed in respect to several socio-demographic characteristics. A larger proportion of men (32.2%) reported having secondary education or higher than women (16.1%; P = 0.001). Higher proportion of female patients belonged to domestic occupational group (54.0% Females vs 5.7% Males) with large proportion of male patients falling under professional group (32.2% Males vs 8.8% Female, P < 0.001). Most male patients were married as compared to female patients (88.5% vs 72.3%, P = 0.003). There was no significant difference in age between men and women (P = 0.40)

Table 2: Other select Characteristics of study participant by sex distribution

Demographic characteristics		**Overall**	**Male**	**Female**	**P value**
		N (%)	**n (%)**	**n (%)**	
BMI categories	Under weight	10 (4.6)	6 (7.1)	4 (3.0)	**<0.001**
	Normal weight	74 (33.8)	39 (45.9)	35 (26.1)	
	Overweight	79 (36.1)	30 (35.3)	49 (36.6)	
	Obesity	56 (26.5)	10 (11.8)	46 (34.3)	
Mode of treatment	Dieting	18 (8)	5 (5.7)	13 (9.5)	**0.008**
	OHA Single drug	59 (26.3)	26 (29.9)	33 (24.1)	
	OHA Combined drug	66 (29.5)	15 (17.2)	51 (37.2)	
	Insulin alone	81 (36.1)	41 (47.1)	40 (29.4)	
Family history with diabetes	Yes	100 (44.6)	32 (36.8)	68 (49.6)	0.06
	No	124 (55.4)	55 (63.2)	69 (50.4)	
Food security	Secure	193 (86.2)	75 (86.2)	118 (86.1)	0.93
	Mildly insecure	22 (9.8)	9 (10.3)	13 (9.5)	
	Moderately/severely insecure	9 (4.0)	3 (3.4)	6 (4.3)	

As shown in Table 2 above, a larger proportion of women (34.3%) were categorized as obese compare to men (11.4%; P < 0.001). A significantly larger proportion of men reported the use of Insulin therapy compare to women (47.1% vs. 29.4%), while more women reported use of OHA combined drugs than men (37.2% vs. 17.2%; P = 0.08). Male patients were less likely to report family history of diabetes mellitus (36.8%) as compared to female patients (49.6%), however with borderline significance (P value = 0.06). There was no significant association between food security and sex.

8.2. Magnitude of glycaemic control among the study participant

Person presenting with unacceptable levels of glycaemic control (i.e. HbA1c of more than 7.5%) were 186 (83.0%) as shown in Figure 2, with half of the patients categorized as having poor glycaemic control. Majority of the respondents 73 (77.2%) presented with high levels of Fasting Blood Sugar (FBG), (i.e. FBG of more than 7mmol/L) at time of the study. There was no statistical significant difference between males and females in relation to levels of gycaemic control.

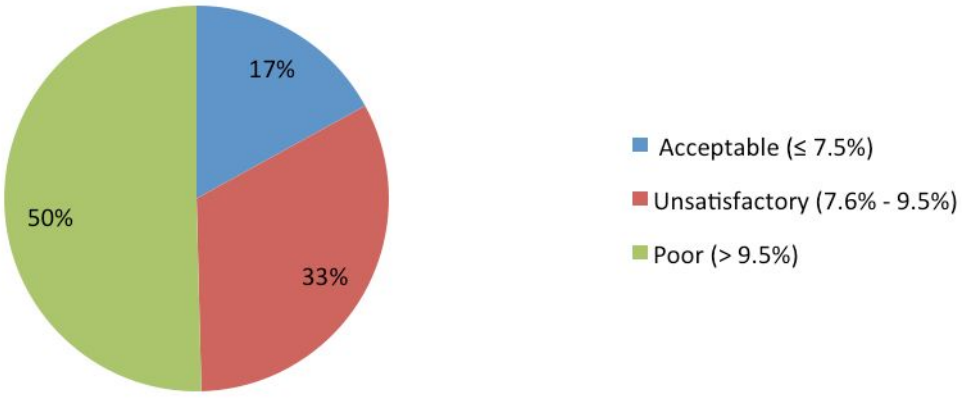


Figure 2: Proportion of patients by level of glycaemic control

8.3. Factors associated with level of glycaemic control

Physical activity

About thirty percent of the study population was categorized as having high physical activity. Majority (70.5%) of the patients reported moderate or low physical activity as indicated in Figure 3 below.

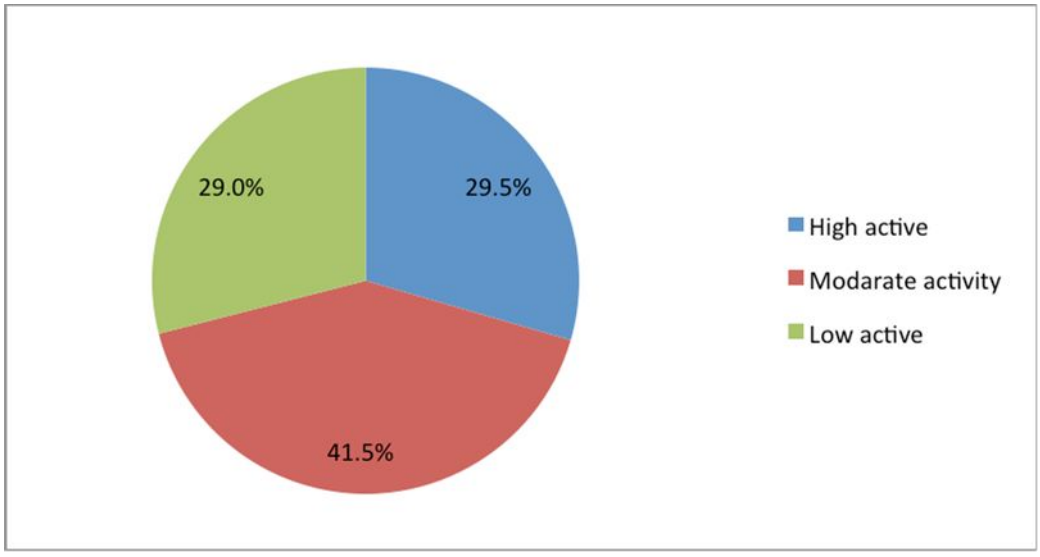


Figure 3: Proportion of level of physical activity in the study population

Illness history for the past 3 months

During the period of three months prior to the time of study, 108 (48.4%) patients had suffered an illness that required medical attention with malaria contributing to 65.4% as shown in figure 4 below. Malaria, cellulitis and other skin infections, cardiac related diseases and Upper respiratory tract infection were found to be the commonest co morbidities among diabetic patients.

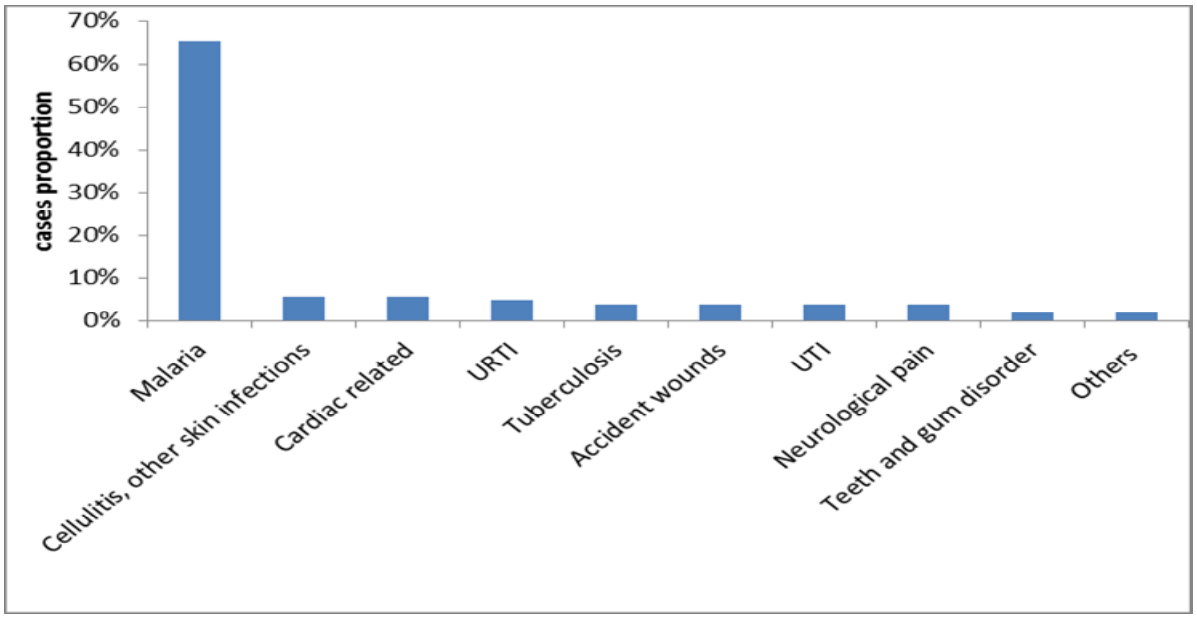


Figure 4: History of illness in diabetic patients for the past 3 months prior to study

Diabetic care and knowledge

Majority of the patients (59.8%) were receiving satisfactory diabetic care (scoring atleast 6/9 of the minimum "required to do" check ups per visit) at the clinics. Ninety-nine out of two hundred and twenty four patients (44.2%) had received a satisfactory health education as per Tanzanian diabetic patient health education package. About 88.4% had satisfactory knowledge (above average knowledge score = 66%) on diabetic disease.

Dietary history

The commonest consumed foods by the study population are as shown in table 3 below.

Table 3: Commonest foods by type and proportion of study participant who consume it frequently*

Starch	**%**	**Proteins**	**%**	**Vegetables**	**%**
Bread	58	Fresh fish	78	Okra	59
Plantain	53	Soya	44	Sweet potatoes leaves	51
Whole maize mill	52	Beef	37	Cabbages	49
Processed grain mill	47	Dagaa (dried)	36	Amaranth leaves	40
Rice	44	Kidney beans	36	Kachumbari (salad)	39
Fruits	**%**	**Beverages**	**%**		
Oranges	62	Non sugared tea/coffee	79		
Cucumber	57	Fresh milk	70		
Banana	53	Processed milk	21		
Papaya	40	Fresh juice	17		
Water melon	22	Sugared tea/coffee	5		

* Frequent consumption was defined as consumption of 2 to 3 times per week or more

Table 4: Univariate analysis of level of glycaemic control by socio-demographic characteristics of study participants

Variable		HbA1c >7.5 (%)	HbA1c ≤7.5 (%)	OR	95% CI*	P value
Sex	Male	81.6	18.4	0.85	0.42, 1.72	0.7
	Female	83.0	16.1	Ref		
Age	<40 Years	85.7	14.3	Ref		
	40 to 59 Years	83.5	16.5	0.84	0.26, 2.72	0.8
	> 60 Years	81.6	18.4	0.74	0.23, 2.43	0.6
Education	No schooling	81.4	18.6	Ref		
	Primary not complete	75.0	25.0	0.68	0.24, 1.94	0.48
	Primary complete	90.1	9.9	2.08	0.74,5.84	0.16
	Secondary and above	78.0	22.0	0.81	0.29, 2.24	0.69
Occupation	Peasants	78.4	21.6	Ref		
	Domestic	84.8	15.2	1.53	0.62, 3.80	0.35
	Manual skilled/unskilled	77.8	22.2	0.96	0.26, 3.52	0.95
	Professional	85.0	15.0	1.56	0.52, 4.66	0.42
	Business and others	86.1	13.9	1.71	0.54, 5.42	0.37
Marital status	Married	81.8	18.2	Ref.		
	Single (never married)	83.3	16.7	1.1	0.30, 4.07	0.87
	Single (ever married)	90.0	10.0	2.0	0.57, 7.00	0.28

Among social demographic characteristics, none was associated with unacceptable glycaemic control (i.e. HbA1c levels above 7.5%). However, several factors had an observed association with level of glycaemic control in the univariate analysis of dietary and physical activity as displayed in table 5 below.

Table 5: Univariate analysis of level of glycaemic control by dietary and physical activity characteristics of study participants

Variable		HbA1c >7.5 (%)	HbA1c ≤7.5 (%)	OR	95% CI	P value
Dietary factors						
Frequent Fruits intake	Yes	66.7	33.3	**0.35**	**0.14, 0.84**	**0.02**
	No	85.3	14.7	Ref		
Frequent Protein intake	Yes	77.9	22.1	0.53	0.26, 1.08	0.08
	No	86.8	13.2	Ref		
Frequent vegetable intake	Yes	84.5	15.5	1.39	0.67, 2.88	0.38
	No	79.7	20.3	Ref		
Frequent starch intake	Yes	83.9	16.1	1.11	0.54, 2.28	0.78
	No	82.5	17.5	Ref		
BMI	Normal	92.9	7.1	Ref		
	Overweight	86.1	13.9	0.36	0.15, 0.88	**0.02**
	Obesity	87.5	12.5	0.43	0.16, 1.15	0.09
Food Security	Insecured	96.8	3.2	7.11	1.00, 53.9	**0.028**
	Secured	80.8	19.2	Ref		
Physical activity						
Activity level	High active	71.2	28.8	Ref		
	Moderate activity	88.2	11.8	3.01	1.32, 6.87	**0.009**
	Low active	87.7	12.3	2.88	1.15, 7.17	**0.02**

Respondents who reported taking fruits frequently had a decreased likelihood of having unacceptable glycaemic levels than those who reported less frequent intake of fruits (66.7%

vs. 85.3%; OR = 0.35; 95%CI: 0.1, 0.8; P = 0.02). Conversly, frequent consumption of proteins (77.9%) was associated with 50% reduces odds of having unacceptable glycaemic control compared to patients who reported infrequent intake (86.8%; P = 0.08), although this only reached borderline significance. Overweight and obesity had a reduced likelihood of unacceptable glycaemic control by 64% (86.1% vs 92.9%; OR = 0.36; P = 0.02) and 57% (87.5% vs 92.9%; OR = 0.43; P = 0.09) respectively, compared to patients who were categorized as having normal BMI.

Food insecured patients had a 7 folds increased odd of unacceptable glycaemic control when compared to food secured patients (96.8% vs 80.8%; OR = 7.1; p = 0.03). Respondents who had low physical activity levels and those with moderate physical activity levels both had a three fold increased odds of unacceptable glycaemic control when compared to highly physically active patients (88.2% vs. 71.2%; P =0.009 and 87.2% vs. 71.2%; P = 0.02, respectively).

Table 6: Univariate analysis of level of glycaemic control by disease history anad diabetic care characteristics of study participants

Variable		HbA1c >7.5%	HbA1c ≤7.5%	OR	95% CI	P value
Disease history						
Family history with diabetes	Yes	86.0	14	1.47	0.72, 3.03	0.29
	No	80.6	19.4	Ref		
Diabetic duration	> 2 years	87.3	12.7	2.52	1.23, 5.15	**0.009**
	≤ 2 years	73.1	26.9	Ref		
Time with symptoms prior to diagnosis	≤ 1 month	89.6	10.4	2.21	0.96, 5.10	0.058
	> 1 month	79.6	20.4	Ref		
Age of diagnosis with diabetes	≤ 40 years	84.9	15.1	1.2	0.51, 2.80	0.67
	> 40 years	82.5	17.5	Ref		
Diabetic treatment and care						
Insulin treatment	Yes	95.1	4.9	6.00	2.05, 17.6	**0.0003**
	No	76.2	23.8	Ref		
OHA mono therapy	Yes	74.6	25.4	0.48	0.23, 0.99	**0.04**
	No	86.1	13.9	Ref		
OHA combined therapy	Yes	84.8	15.2	1.21	0.55, 2.65	0.6
	No	82.3	17.7	Ref		
Dieting only	Yes	50.0	50	0.16	0.06, 0.45	**0.0001**
	No	85.9	14.1	Ref		
Diabetic knowledge	Satisfactory	81.8	18.2	0.38	0.08,	0.1
	Unsatisfactory	92.3	7.7	Ref		
Care at diabetic clinic	Satisfactory	82.8	17.2	0.97	0.47, 1.97	0.9
	Unsatisfactory	83.3	16.7	Ref		
Diabetic self-care	Satisfactory	72.9	27.1	0.45	0.21, 0.96	**0.04**
	Unsatisfactory	85.8	14.2	Ref		

From table 6 above, patients who have been with the disease for more than 2 years had 2.5 folds increased likelihood of unacceptable glycaemic control, in contrast to those with the disease for 2 years or less (87.3% vs 73.1%; OR 2.5; P = 0.009).

Patients on insulin treatment had an increased odds of higher unacceptable glycaemic level above the target as in comparison to other treatment modalities (95.1% vs 76.2%; 95% CI: 2.05, 17.6; P = 0.0003). Those on OHA monotherapy and diet had an opposite effect to that of insulin with reduced odds of higher glycaemic level by 52% (OR = 0.48; 95CI 0.23, 0.99; P = 0.04) and 84% (OR = 0.16; 95%CI 0.06, 0.45; P = 0.0001) respectively. Patients who reported satisfactory self-diabetic care also had reduced likelihood of unacceptable glycaemic control by 55% (OR = 0.45; 95%CI: 0.21, 0.96 P = 0.04).

Table 7: Factors associated with glycaemic control from a multivariate analysis

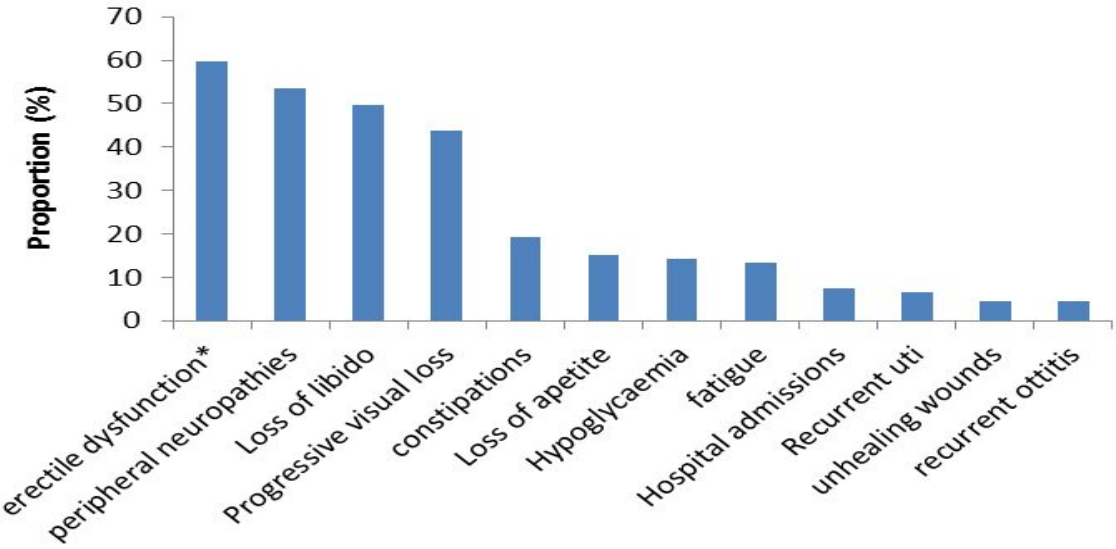
Variable		Adjusted Odds Ratio	95% Confidence Interval	P-Value
Agegroup	Less than 40 years	Ref		
	40 to 59 Yearss	0.57	0.14, 2.32	0.43
	60 Years and above	0.47	0.11, 2.01	0.31
Sex	Male	1.09	0.08, 2.56	0.85
	Female	Ref		
Frequent fruit intake	Yes	0.25	0.09, 0.72	**0.01**
	No	Ref		
Physical activity	Low active	3.99	1.37, 11.66	**0.01**
	Moderate activity	3.41	1.30, 8.96	**0.01**
	High active	Ref		
Satisfactory self diabetic care	Yes	0.32	0.13, 0.82	**0.02**
	No	Ref		
Dieting therapy	Yes	0.20	0.06, 0.63	**0.006**
	No	Ref		
Insulin therapy	Yes	6.72	2.01, 22.4	**0.002**
	No	Ref		

* Adjusted for age, sex and other potential confounders.

From the multivariate analysis shown in Table 7 above, factors that were found to be persistently significant associated with reduced odds of unacceptable glycaemic control were; frequent fruits intake, satisfactory self-diabetic care and being on dieting therapy only. However, having low physical activity or moderate physical activity levels as compared to high physical activity and being on insulin therapy were associated with an increased odd of unacceptable glycaemic control.

8.4. Diabetic warning signs

Thirty patients (13.4%) presented with one or more diabetic warning signs of which 13/30 (43.3%) had major warning signs. Below is Figure 5 summarizing the frequency of occurrence of the different diabetic warning signs reported by the participants in the study.



* Frequency was calculated for males only

Figure 5: Proportion of commonest diabetic related warning signs among study participants

The commonest observed diabetic warning signs were erectile dysfunction, peripheral neuropathies, loss of libido, progressive visual loss and constipation. Having HbA1c level above 7.5% was not significantly shown to increase overall likelihood of developing diabetic related warning signs in this study, i.e. Odds Ratio (OR) (95% Confidence interval (95% CI)

was 0.79 (0.3 to 2.1). Futher analysis of glycaemic control for the occurance of individual diabetic warning signs was done as shown in the table 8 below.

Table 8: Odds of diabetic related warning signs by level of glycaemic control among study participant*

	Diabetic complications		OR	95% CI	P value
	Yes	**No**			
Unacceptable Glycaemic control (HbA1c >7.5%)					
Erectile dysfunction (N = 87)					
Yes	64.8	35.2	3.07	1.0, 9.43	**0.04**
No	37.5	62.5	Ref		
Peripheral neuropathies (N=224)					
Yes	56.5	43.5	1.99	0.98, 4.05	0.06
No	39.5	60.5	Ref		
Progressive visual loss (N=224)					
Yes	46.2	53.8	1.86	0.88, 3.91	0.10
No	31.6	68.4	Ref		
Constipation (N=224)					
Yes	20.4	79.6	1.69	0.62, 4.63	0.3
No	13.2	86.8	Ref		
Loss of libido (N=224)					
Yes	51.1	48.9	1.44	0.71, 2.91	0.3
No	42.1	57.9	Ref		
loss of appetite (N=224)					
Yes	17.2	82.8	3.74	0.86, 16.33	0.06
No	5.3	94.7	Ref		
Hypoglycaemia (N=224)					
Yes	14.0	86.0	0.87	0.33, 2.28	0.8
No	15.8	84.2	Ref		
Diabetic related admissions (N=224)					
Yes	8.6	91.4	3.48	0.45, 27.09	0.2
No	2.6	97.4	Ref		

*Reference is acceptable level of glycaemic control **HbA1c ≤7.5%**

Unacceptable levels of glycaemic control were found to be significantly associated with increased odds of erectile dysfunction by 3 folds, (OR (95% CI) was 3.1 (1, 9.4), p value = 0.04). It was also shown to increase the odds of peripheral neuropathies and loss of apetite by about two folds, however with borderline significance level (p value = 0.06).

9. DISCUSSION

9.1. Main findings

The aim of this this study was to determine the magnitude of glycaemic control and its associated factors in type 2 diabetes attending public health facilities. The overall prevalence of unacceptable glycaemic control level was high (83%). Factors independently associated with decreased likelihood of unacceptable glycaemic control level were frequent fruit intake, high levels of physical activity and self-diabetic care and been on dieting therapy only, while been on Insulin therapy was found to increase the likelihood for unacceptable glycaemic control. The frequency of occurrence of diabetic complications was about 13%. No statistical association was observed between unacceptable glycaemic control level and overall diabetic complications. However, unacceptable glycaemic control level was found to be associated with individual diabetic complications such as development of erectile dysfunction among male patients.

9.2. Prevalance of unacceptable glycaemic control level

Prevalance of unacceptable glycaemic control was high by both tests done. First is with HbA1c level, which reflects the average control over the past three months and secondly, with FBG which reflect the control over the past 12 hours. Glycated Haemoglobin (HbA1c) is not routinely used as a target measure for glycaemic control due to its inaccessibility at this clinic and many others. Fasting blood glucose is routinely used instead. The probability of FBG to underestimate the magnitude of unacceptable glycaemic control is higher due to its inability to capture aspects of glycaemic levels in its totality, which includes random and postprandial glycaemia. The inadequate explorative ability of FBG makes it an inferior test to be used as a target indicator for good glycaemic control. However, the unmet target for glycaemic control in this population even with the use of FBG was still high. Previously reported levels of glycaemic control in Tanzania were high although our study observed higher occurrences. (20) Differences observed in the two studies may be explained by differences in the two populations. Also, this study was conducted in a tertiary health facility expected to offer more

and better quality care as compared to lower level health facilities. This may indicate poorer glycaemic control in lower level health facilities where services are generally limited. Never-the-less our findings should be taken into consideration when developing strategies to address diabetic care in all levels of health care. Several other developing countries have reported high proportions of unacceptable glycaemic control of 50% to 70%, with a lower cutoff point of 7% HbA1c levels (19,58–60). Intricacy involved between an increased number of diabetic patient (5) and high level of unmet glycaemic control, signpost upcoming blast of devastating diabetic illnesses to patients hence imposing a bigger burden to health system.

9.3. Factors associated with unacceptable glycaemic control

We have reported frequent fruit intakes to be in favour of achieving acceptable glycaemic control. Similar observations have also been reported elsewhere (32). Among the five (5) frequently consumed fruits reported by the study population, 3 were low glycaemic index fruits (Oranges, cucumber and banana), one intermediate (Papaya) and the other a high glycaemic index fruit (watermelon). Other studies have also shown a clinical improvement of low glycamaemic index fruits and foods among diabetic patients pointing out its effect in reducing insulin secretion and reduced insulin demand. (32,61) Other food groups did not show any significant association with glycaemic control, this has also been observed in Australia whereby low intake of carbohydrate were not associated with improved glycaemic control(35). Majority of the study participants frequently consumed vegetables. The inability of our questionnaire to differentiate frequent consumers may have contributed to the unobserved association with glycaemic control.

Our findings showed no association between overweight / obesity and unacceptable levels of glycaemic control in the multivariate analysis. However, the odds of unacceptable glycaemic control were lower in overweight and obese diabetic patients than in normal weight patients in the univariate analysis. This has also been reported in a study done in Jordan whereby the lowest mean HbA1c was observed in overweight group as compared to normal weight group (7.91% vs 8.25%; P = 0.01). The observation may suggest reverse causality as most diabetic

patients who are overweighed and/or obese may have lost their weight due to uncontrolled blood sugar levels.

The normal teaching during a diabetic health education session is physical activity is an important part of diabetic therapy. Patients are directed to excersize for atleast 30 minutes (example a brisk walk) for atleast 3 days per week. In this study it was observed that those with low and moderate physical activity levels to have higher proportions of unacceptable glycaemic control as compared to those who were highly active. Similar findings have also been reported elsewhere (39). Physical activity programs not emphasizing for high physical activity might work better in prevention of chronic NCD like diabetes, but may not show benefits in preventing high levels of glucose in the body once an individual is diabetic.

The protective association of self-diabetic care and unacceptable glycaemic level observed in this study have been reported in other studies (46,62). The complexity of tight glycaemic control and diabetic management needs involvement of both the health providers and a larger part the patients' themselves. Patients who have a good self-care of their disease are more likely to detect any treatment failure or unmet target and take actions promptly, hence pointing to the plausibility of the observation.

Patients on insulin therapy had 6 times higher probability of not achieving the target glycaemic control. These patients may have been switched to insulin after other drugs failed to control their glycaemic levels. It is probable that they may have other unknown underlying pathophysiological defects on insulin utilization, or poor adherence to therapy. There is a need for more studies on adherence of treatment in diabetic patients. The integrity of different treatment modalities of diabetes may change with time which insulin is not an exclusion (63,64). Hence, early detection of such treatment failure is essential to guide on treatment modification. It should be noted that the difference observed between patients on dieting therapy only and those on insulin may not suggests the superiority of the former treatment option against the latter one but rather the difference in severity of disease and type of patients who are on these therapies.

9.4. Influence of unacceptable glycaemic control on diabetic related warning signs

Inspite of the high levels of unacceptable glycaemic control levels, only a few patients had presented with diabetic related warning signs. However, of the few who had at least three diabetic related early warning signs, about 40% had major warning signs. With exception of erectile dysfunction, which was found to be associated with glycaemic control others had borderline or weak significance associations. This observation suggests that, prediction of complication by the use of glycaemic control level only might not be a good approach without taking into account the paradigm of diabetic management in its totality. However in absence of other objective predictors, the measures of glycaemic control as a proxy to treatment failure maybe the best option available. Complication was measured relying on the reported information, the objectively measure of diabetic complication by conducting related tests will have accurately estimated the prevalence of complication among diabetic patients.

10. CONCLUSSION AND RECOMMENDATIONS

The prevalance of unacceptable glycaemic control levels among type 2 diabetic patients attending tertiary level public health facilities is high. Frequent intake of low glycaemic index fruits, self-diabetic care, physical activity and treatment modalities of patients were the main factors found to independently influence levels of glycaemic control. The frequency of individual diabetic complications among type 2 diabetic patient was low with the exception of erectile dysfunction in men. The level of glycaemic control predicts occurrence of some diabetic complications.

Based on our study findings, we recommend that:

- There is a need of routine analysis of patient's clinic visit records and interpretation and sharing of information starting at health facility levels basing on the available indicator for glycaemic control (in most been FBG). This will help clinicians and facility management to identify the areas of strength and weakness for prompty actions.

- In tertiary health facilities, there is a need of introducing more sensitive indicator measures of glycaemic control such as Glycated haemoglobin (HbA1c) or Glycated albumin to help in patient managements as well as in monitoring and evaluating of the quality of care provided to diabetic patients or other diabetic interventions in place. Through available Tanzania Diabetic Association, there is a need of joint agreement setting between health care providers and patients on feasible and affordable measures to take and strengthern the capacity of patients on self monitoring and caring of their glucose.
- Dietary education in diabetic patients should emphasize frequent intake especially of low glycaemic index fruits to promote glycaemic control.
- Daily physical activities of more than 30 minutes of moderate to vigorous activities should be encouraged among patients practicing them and influenced among the non-practicing. The government should be encouraged to create work and neighbourhood environment that may encourage physical activity.
- Review of diabetic mellitus management guidelines should be based on the local studies recommendation and findings, this will at the end conveys the efforts made by research in improving quality of care to diabetic patients.
- This is a paucity of literature on diabetes in Tanzania. More research needs to be done to explore uncaptured factors such as the cause of insulin treatment failure, use objective measure of diabetic complications to ascertatin the frequency of occurrence among diabetic patients as well as to identify population and area-specific factors that may affect management and prevention of diabetis.

11. STRENGTH AND LIMITATIONS OF THE STUDY

This study utilized Glycated Haemoglobin (HbA1c) as an outcome measure of glycaemic control instead of the routinely used Fasting Blood Glucose (FBG). This increases the sensitivity of the study in detecting patients with uncontrolled glycaemia and reflecting the magnitude over a wider range of time. Even though dietary, physical activity, food security and diabetic care information were collected through reporting, we utilized standardized tools that have been tested elsewhere in developing countries which reduce the possibilities of biases.

The use of reported history as a measure of several variables such as diabetic warning signs might have underestimated the true picture among the diabetic patients. Thorough training of research assistants, piloting and review of the research tools was done prior to data collection to increase the sensitivity of the questions in capturing such factors.

This was a hospital-based study and may not reflect to a large extent all diabetic patients in Tanga and Tanzania as a whole. The population studied may have been a select group of people with distinct characteristics from the general population. However, being a public facility, the probability of it being representative of the socio-demographic and economic characteristics of those who attend is large.

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Annex 1. Questionnaire English

QUESTIONNAIRE FOR GLYCAEMIC CONTROL STUDY OCTOBER TO DECEMBER 2012

Questionnaire Number _____ Health facility name: _____

Date of interview ___/____/_____ Type II Diabetes patient? Yes No

(Look details from the patient file if no stop the interview)

Initials of the interviewer _____ Participant address_____

A. PARTICIPANT PERSONAL DETAILS:

1. Age (years): _____ 2. Sex: i. Male ii. Female

3. What is the highest level of education attained?

i. Noneii. Primary education (not completed) iii. Primary education (completed) iv. Secondary education v. college/university education

4. Which of the following best describe your employment?

a. Peasants b. Housewife/domestic services c. unskilled manual d. skilled manuale. Clerical f. Professional/technical/managerial g. self-employed/business h. student

5. Marital status:

a. Married b. co habiting c. Single d. Divorced/separated e. widowed

B. DISEASE HISTORY

I will now ask you some questions on the history of the disease

6. Date of first diagnosis with diabetes___/___/_____ 7. Age ate your first diagnosis with diabetes____

8. How long were you on Diabetic symptoms prior to diagnosis? _____ Months/Years

9. Is there a history of diabetes in your family? 1. Yes 2. No 9. (b). If yes specify relationship a. Spouse b. Parents c. Grandparents d. Siblings e. Uncle/aunt Brother/sister

10. In the past three months have you suffered any illnesses which lead you to seek for a health care?
    1. Yes
    2. No
11. If yes above which illness did you have _____

12. Do you have any other chronic illness apart from diabetes (e.g. hypertension, heart disease, renal disease?)
    1. Yes
    2. No

C. NUTRITIONAL HISTORY

I will now ask you some questions about your dietary habits

In the past three months, how frequently did you eat the following foods?

Food frequency table (tick the appropriate box on the table)

Food item	**Type**	**1. Less than 1month/ never**	**2. Once per month**	**3. 2-3 times per month**	**4. once a week**	**5. 2-4 times per week**	**6. 5-7 times per week**	**7. 2-3 times daily**
Starch foods								
Stiff porridge	12. processed maize mill							
	13. wholegrain maize mill							
	14. Cassava/mtama mill							
15. Rice								
16. Banana								
17. Makande								
18. Spaghetti								
19. Chapatti								
20. Bread								
Cassava	21. Boiled							

	22. Fried							
23. Sweet potatoes								
24. Irish potatoes								
Animal Proteins								
Meat	25. Beef							
	26. Lamb/goat							
	27. Poultry							
Fish	28. Fresh							
	29. Dried							
	30.Dagaa							
Legumes	31. Kidney beans							
	32. Soya							
	33. green beans							

	34. Mbaazi							
	35. Njugu							
Green vegetables	36. Cabbages							
	37. Spinach							
	38. Okra							
	39. Cassava leaves							
	40. Amaranth leaves							
	41. Sweet Potatoes leaves							
	42. Cowpea leaves							
	43. Mnafu							
	44. Mchunga							
45. Kachumbari								

Fruits								
46.Banana								
47. Papaya								
48. Water melon								
49. Cucumber								
50. Oranges								
51. Sugar cane								
52. Avocado								
53. Pineapple								
Beverages								
54. Fresh milk								
55. Processed milk								
56. Fresh juice								
57. processed juice								
58. Soda (coca cola etc)								

Tea/coffee	59. Sugared							
	60. Non sugered							
	61. Sweetened							

D. HOUSEHOLD FOOD SECURITY STATUS

I will now ask you questions on the availability of food at your household

62. In the past 4 weeks did you get worried that your household will not have enough food?

    1. Yes, rarely (once or twice)
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often(more than 10 times)
    4. No

63. In the past 4 weeks were you or any household member not able to eat the kind of food you referred due to lack of resources?

    1. Yes, rarely(once or twice
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often(more than 10 times)
    4. No

64. In the past 4 weeks did you or any of the family members have to eat limited amount of foods due to lack of resources?

    1. Yes, rarely (once or twice)
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often (more than10 times)
    4. No

65. In the past 4 weeks did you or any family member had to eat some food that you really did not want to eat because of lack of resources to obtain other type of food?

    1. Yes, rarely (once or twice)
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often (more than 10 times
    4. No

66. In the past 4 weeks did you or any other household member had to eat a smaller meal than you felt you needed because there was not enough food?

    1. Yes, rarely (once or twice
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often (more than 10 times)
    4. No

67. In the past 4 weeks did you or any other household member had to eat fewer meals in a day because there was no enough food?

    1. Yes, rarely (once or twice)
    2. Yes, sometimes (3 to 10 times)
    3. Yes, often (more than 10 times)
    4. No

68. In the past 4 weeks was there ever no food to eat of any kind in your household because of lack of resources to get food?

        1. Yes, rarely (once or twice)
        2. Yes, sometimes (3 to 10 times)
        3. Yes, often (more than10 times)
        4. No

69. In the past 4 weeks did you or any member of the household go to sleep at night hungry because there was no enough food?

        1. Yes, rarely (once or twice)
        2. Yes, sometimes (3 to 10 times)
        3. Yes, often (more than10 times)
        4. No

70. In the past 4 weeks did you or any member of the household go a whole day and night without eating because there was no enough food?

            1. Yes, rarely(once or twice)

2. Yes, sometimes (3 to 10 times)
3. Yes, often (more than 10 times
4. No

E. PHYSICAL ACTIVITY AND EXERCISE

I will now ask you question related to your daily physical activity and exercises

71. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **Days per week**

☐ No vigorous physical activities → ***Skip to question 3***

72. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **Minutes per day**

☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

73. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or swimming? Do not include walking.

_____ **days per week**

☐ No moderate physical activities → ***Skip to question 5***

74. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

75. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

76. How much time did you usually spend **walking** on one of those days?

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

77. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **minutes per day**

☐

Don't know/Not sure

F. MEDICATIONS

I will now ask you question on your treatment of the disease

78. Mode of treatment (Look into the patient file and feed the current treatment information)

a) Dieting only
b) Oral Hypoglycemic Agents (OHA) one drug
c) More than one drug
d) Drugs with insulin
e) Insulin alone

79. Mode of treatment (Look into the patient file and feed the current treatment information)

□ Metformin □ Glibenclamide □Clopropamide □ Gliclazide □ Tolbutamide

□ Glipizide □ Pioglitazone □ Arcabose □ Others (specify) _____

80. For the past 3 months have you missed you medication for any reasons?

1. Yes
2. No

80b. If yes what was the reason for you skipping_____

81. In the past 3 months have you changed your medication?

1. Yes
2. No

G. CARE AT HEALTH FACILITY

I will now ask you questions on the care you have been receiving in this clinic

During the past three months, on your visit to the health care facility, did the health care provider check you for any of the following?

82. Blood glucose	1. Yes	2. No
83. Blood pressure	1. Yes	2. No
84. Body weight	1. Yes	2. No
85. Urine for protein	1. Yes	2. No
86. Had your foot inspected	1. Yes	2. No
87. Educational advice	1. Yes	2. No
88. Nutritional counseling	1. Yes	2. No
89. Reviewed your medication	1. Yes	2. No
90. Checked you for other illnesses	1. Yes	2. No

91. In the past 3 months have you used any traditional medicine for Diabetes?

    1. Yes
    2. No

92. If yes while using traditional medication did you stop your hospital medication?

    1. Yes
    2. No

H. DIABETIC SELF CARE

I will now ask you question on self-caring for the disease at home.

During the past three months have you ever done any of the following at home?

93. Self-tested for your blood sugar at home

94. Had your daily blood sugar level recorded in your diary

95. Had a non-clinic health facility visit to check for your health

96. Asked a health worker for advice on your illness

97. Regularly examine your feet after bath

I. DIABETES RELATED EFFECTS

I will now ask you questions on the effect of the disease you have experienced

In the past 3 months, have you experienced any of the following?

□ 98. Weight loss □ 99. Increased fatigue □ 100. Inability to perform your daily routines

□ 101. Performed less than you would preferred on your work/daily activity

□ 102. Numbness in the extremities □103. Non healing wounds

□ 104. Urinary tract infections □105. Ear infections □ 106. Loss of libido

□ 107. Erectile dysfunction □ 108. Increased urination frequency □ 109. Loss of appetite □ 110. Increased hunger

□ 111. Increased thirsting frequency □ 112. Constipations

113. For the past 3 months have you suffered a low sugar level attack?

1. Yes 2. No

114. If yes how many times_____

115. For the past 3 months have you been admitted due to diabetic related illness?

1. Yes 2. No

116. For the past one year have you experienced any visual loss or ability to reads on things that you could see and read previously?

1. Yes 2. No

J. HEALTH EDUCATION

Have you ever been taught in the clinic or anywhere else on the following diabetic topics?

	Yes, and I understand completely	**Yes, and I understand pretty well**	**Yes, but I am still confused**	**No, never**
117. How to take care of your feet				
118. How to take your medication				
119. How to recognize and treat symptoms for low or high blood sugar				
120. How to choose your food appropriately				
121. How and when to test your blood sugar				
122. What are the complications of diabetes and how to avoid them				
123. How to exercise appropriately				
124. How often to see a doctor				
125. How to decide on whether to use traditional medicine				
126. How to maintain normal blood pressure				

K. KNOWLEDGE ON DIABETES

Kindly state whether the following statements concerning diabetes are true or false	**True**	**False**
127. Diabetes is serious, but it can be controlled.		
128. Diabetes is infectious especially for couples.		
129. Mothers who have diabetes deliver babies with diabetes.		

130. Diabetics have to omit their treatment during fasting.		
131. Regular medical check-ups are important for managing diabetes.		
132. Persons with diabetes are not allowed to give birth.		
133. Diabetics should avoid using alcohol.		
134. Complications from diabetes can be prevented.		
135. Operations should be avoided as diabetic wounds do not heal.		
136. Diabetics cannot eat fruits.		
137. Diabetes can only be treated by traditional healers.		
138. Diabetes is controlled by eating only vegetables and protein food.		
139. Lifestyle changes (such as diet, physical activity, cessation of smoking/tobacco use) can help manage diabetes.		

L. MEASUREMENTS AND TESTS

140. Body weight (kg) _____

141. Height (cm) _____

142. Waist circumference (cm)_____

143. Hip circumference (cm)_____

144. Systolic BP _____

145. Diastolic BP _____

146. Pulse rate (beats/min) _____

147. FBG/ level (mmol/L) _____

148. HbA1c Level _____

Annex 2. Swahili Questionnaire

Namba ya dodoso_____ jina la kituo cha afya_____

Tarehe ya mahujiano_____/_____/_____

Mgonjwa wa kisukari?(Aina ya ii) 1. Ndio 2. Hapana

A. TAARIFA BINAFSI ZA MSHIRIKI:

1. Umri (katika miaka)_____ 2. Jinsia: i. mume ii. Mke
3. Kiwango cha elimu ulichofikia:
    1. Sikusoma
    2. Elimu ya msingi (sijamaliza)
    3. Elimu ya msingi (nimehitimu)
    4. Elimu ya sekondari
    5. Chuo/ elimu ya juu

4 Nini kati ya vifuatavyo huelezea vizuri ajira yako

1. Mkulima
2. Mama wa nyumbani
3. Kazi za kujiajiri /zisizohitaji ujuzi
4. Kujiajiri zinazohitaji nguvu
5. Kazi za kitaaluma
6. Biashara
7. Mwanafunzi

5 Hali ya ndoa

1. Nimeolewa/nimeoa
2. Tumaishi pamoja

3. Sjaoa/sijaolewa
4. Tumeachana/ tengana

B. TAARIFA ZA UGONJWA

Nitakuhoji/ kuuliza maswali juu ya historia ya ugonjwa

6. Tarehe ya kwanza kugundulika na kisukari ___/____/_____
7. Umri uliogundulika na kisukari mara ya kwanza _____
8. Ni kwa muda gani ulikuwa na dalili kabla ya kugundulika kuwa na kisukari _____
9. A. Kuna historia ya ndugu wa familia yako kuwahi kuugua ugonjwa wa kisukari?
    1. Ndio
    2. Hapana

   B.Kama ndio eleza uhusiano wako na huyo ndugu
    1. Mwenza
    2. Mzi/wazazi
    3. Bibi/babu
    4. Ndugu wa tumbo moja
    5. Mjomba/ shangazi/Binamu
10. Katika miezi mitatu iliyopita umewahi pata maradhi/ ugonjwa uliokuhitaji kupata huduma ya afya?
    1. Ndio
    2. Hapana
11. Kama jibu lako ni ndio, ni maradhi/ ugonjwa gani _____
12. Una ugonjwa/ maradhi yoyote sugu mbali na kisukari? (mfano: shinikizo la damu, ugonjwa wa moyo, ugonjwa wa figo)
    1. Ndio
    2. Hapana

C. TAARIFA ZA CHAKULA

Nitakuuliza juu ya tabia / taratibu zako za ulaji

Katika miezi mitatu iliyopita ni mara ngapi ulikula vyakula vifutavyo?

Chakula	**aina**	**Chini ya mara 1kwa mwezi/hakuna**	**2. mara moja kwa mwezi**	**3. mara 2-3 kwa mwezi**	**4. mara moja kwa wiki**	**5. mara 2-4 kwa wiki**	**6. mara 5-7 kwa wiki**	**7.mara 2-3 kwa siku**
Chakula cha wanga								
Ugali	12. sembe							
	13. dona							
	14. mihogo/mtama							
15. wali								
16. ndizi								
17. Makande								
18. Spaghetti								
19. Chapati								
20. mkate								
mhogo	21.							

	iliyochemshwa							
	22. iliyokaangwa							
23. viazi vitamu								
24. viazi mviringo								
Protini ya wanyama								
Nyama	25. ng'ombe							
	26. mbuzi							
	27. kuku							
Samaki	28. Fresh							
	29. wakavu							
	30.Dagaa							
Jamii za mikunde	31. maharagwe							
	32. Soya							
	33. maharagwe ya kijani							
	34. Mbaazi							
	35. Njugumawe							

Mbog za majani	36. kabeji							
	37. Spinach							
	38. Bamia							
	39. kisamvu							
	40. mchicha							
	41. matembele							
	42. majani ya kunde							
	43. Mnafu							
	44. Mchunga							
45. Kachumbari								
matunda								
46.ndizi								
47. papai								
48. tikiti maji								
49. tango								
50. machungwa								
51. muwa								
52. Parachichi								
53. nanasi								

vinywaji								
54. maziwa fresh								
55. maziwa ya viwandani								
56. juisi ya matunda								
57. juisi ya kiwandani								
58. Soda (coca cola etc)								
Chai/kahawa	59. iliyo na sukari							
	60. isiyotiwa sukari							
	61. vidonge vya utamu							

D. UHAKIKA WA UPATIKANAJI CHAKULA KATIKA KAYA

Nitakuuliza juu ya upatikanaji wa chakula katika kaya yako

62. Katika wiki 4 zilizopita umewahi pata hofu kuwa kaya yako itakosa chakula cha kutosha?

    5. Ndio, mara chahe (mara moja au mbili)
    6. Ndio , wakati mwingine (mara 3 hadi 10)
    7. Ndio, mara kwa mara(zaidi y mara 10)
    8. Hapana

63. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako hakuweza kula chakula kwasababu kilikosekana?

    5. ndio, mara chache (mara moja au mbili
    6. ndio, wakati mwingine (mara 3 hadi 10)
    7. ndio, mara kwa mara (zaidi ya mara 10)
    8. hapana

64. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi kula chakula kisichotosha kwa sababu hakipo cha kutosha?

    1. ndio, mara chache (mara moja au mbili
    2. ndio, wakati mwingine (mara 3 hadi 10)
    3. ndio, mara kwa mara (zaidi ya mara 10)
    4. hapana

65. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi kula chakula asichokipenda kwa sababu ya ukosefu wa rasilimali za kupata aina nyingine ya chakula?

    1. ndio, mara chache (mara moja au mbili
    2. ndio, wakati mwingine (mara 3 hadi 10)
    3. ndio, mara kwa mara (zaidi ya mara 10)
    4. hapana

66. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi kula chakula kisichotosha kwa sababu ya kutokuwa na chakula cha kutosha?

    1) ndio, mara chache (mara moja au mbili
    2) ndio, wakati mwingine (mara 3 hadi 10)
    3) ndio, mara kwa mara (zaidi ya mara 10)
    4) hapana

67. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi kula milo michache kwa sababu ya kutokuwa na chakula cha kutosha?

    1. ndio, mara chache (mara moja au mbili
    2. ndio, wakati mwingine (mara 3 hadi 10)
    3. ndio, mara kwa mara (zaidi ya mara 10)
    4. hapana

68. Katika wiki 4 zilizopita kumewahi kosekana chakula cha aina yoyote ile katika kaya yako kwa sababu ya kukosa rasilimali za kuweza pata chakula?

    1. Ndio, mara chahe (mara moja au mbili)
    2. Ndio , wakati mwingine (mara 3 hadi 10)
    3. Ndio, mara kwa mara(zaidi ya mara 10)
    4. Hapana

69. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi kulala bila kula kwasababu hakukuwa na chakula cha kutosha?

    1. Ndio, mara chahe (mara moja au mbili)
    2. Ndio , wakati mwingine (mara 3 hadi 10)
    3. Ndio, mara kwa mara(zaidi ya mara 10)
    4. Hapana

70. Katika wiki 4 zilizopita je wewe au mtu yeyote katika kaya yako amewahi tokea kushinda njaa siku nzima na usiku bila kula kwa sababu hakukuwa na chakula cha kutosha?

    1. Ndio, mara chahe (mara moja au mbili)
    2. Ndio , wakati mwingine (mara 3 hadi 10)
    3. Ndio, mara kwa mara(zaidi ya mara 10)
    4. Hapana

E. KAZI NA MAZOEZI

Sasa nitakuuliza maswali yanayohusiana na utaratibu wako wa kazi za kila siku pamoja na mazoezi.

71. Katika siku saba zilizopita, ni kwa siku ngapi ulifanya mazoezi mazito kama vile kunyanyu vitu vizito, kulima, kuendesha baiskeli?

    _____ **Siku katika wiki**

    ☐ Hakuna mazoezi yoyote ***rukia swai la*** →

72. Ni muda gani ulitumia kufanya shughuli/mazoezi hayo mazito katika moja ya siku hizo?

    _____ **Dakika kwa siku moja**

☐ Sijui/sina hakika

Fikiria kuhusu kazi zako za kila siku kwa siku 7 zilizopita. Kazi za kiasi ni zile zinazokuhitati kutumia nguvu kiasi na zinazobadili upumuaji wako kuwa wa zaidi ya kawaida. Fikiria kuhusu kazi za aina hiyo zilizokuchukua zaidi ya dakika 10

73. Katika kipindi cha siku saba zilizopita ni siku ngapi ulifanya shughuli/ mzoezi ya wastani kma ile kubeba vitu vyepesi, kuendesh biskeli kwa spidi ya kawaida au kuogelea? Usijumuishe kutembea

_____ **Siku ndani ya wiki**

☐ Hakuna shugli/mazoezi ya kiasi hicho → ***nenda swali la75***

74. Uikuwa ukitumia muda gani katika kufnya shughuli/ mazoezi hayo ya wastani katika siku hizo?

_____ **Dakika katika siku**

☐ Sijui/sina hakika

Sasa fikiria siku zote ulizotembea katika siku 7 zilizopita. Hii inahusisha wakati wa kwenda na kutoka kazini, katika matembezi binafsi na hata ukiwa kazini.

75. Katika kipindi cha siku saba zilizopita ni kwa siku ngapi ulitembea kwa angalau dakika 10?

_____ **Siku katika wiki**

☐ sikutembea → ***nenda swali la 77***

76. Ni muda gani ulitumia kutembea ktika siku hizo?

_____ **Dakika katika siku**

☐ Sijui/ sina uhakika

Swali la mwisho ni kuhusu muda uliotumia ukiwa umekaa katika siku za kawaida zisizokuwa sikukuu au siku za mwisho wa wiki ukiwa nyumbani, ukiwa unafanya shughuli zako na katika mapumziko

77. Katika siku 7 zilizopita ni muda gani ulitumia ukiwa umekaa kwa siku za katikati ya juma?

_____ **Dakika katika siku**

☐

F. TAARIFA ZA TIBA YA KISUKARI

Sasa nitakuulia juu ya matibabu ya magonjwa

78. Aina ya uthibiti wa kisukari unayotumia (Anglia kwenye faili la mgonjwa na jaza taharifa za sasa zilizopo)

    1. Lishe/ chakula pekee
    2. Dawa za kushusha sukari, aina moja
    3. Dawa za kushusha sukari zaidi ya aina moja
    4. Dawa na insulini
    5. Insulin pekee

79. Ni aina gani ya dawa za kumeza unatumia? (angalia kwenye faili la mgonjwa weka vema kwa zinazohusika)

□ Metformin □ Glibenclamide □Clopropamide □ Gliclazide □ Tolbutamide

□ Glipizide □ Pioglitazone □ Arcabose □ nyingine (elezea) _____

80. Umewahi kushindwa kumeza dawa zako kwa miezi mitatu iliyopita kwa sababu yoyote ile?

    1. Ndio
    2. Hapana

80b. kama ndio nini ilikuwa chanzo cha wewe kushindwa kumeza_____

81. Katika miezi mitatu iliyopita umewahi badilisha dawa?

    1. ndio
    2. hapana

82. Katika miezi mitatu iliyopita umewahi tumia dawa zozote za asili kwa kutibu kisukari?

    1. Ndio
    2. Hapana

83. Wakati ulipokuwa ukitumia tiba za asili uliacha kutumia dawa zako za hospitali?

    1. Ndio
    2. Hapana

G. TAARIFA YA HUDUMA ZA KITABIBU

Sasa nitakuuliza juu ya huduma unayopata katika kliniki hii ya kisukari

Katika miezi mitatu iliyopita ulipokuwa ukihudhuria matibabu katika cliniki hii, je mhudumu wa afya alikutazama au kufanya yafuatayo au kukupima?

84. Kiwango cha sukari katika damu 1. Ndio 2. Hapana

85. Shinikizo la damu 1. Ndio 2. Hapana

86. Uzito wako 1. Ndio 2. Hapana

87. Protini kwenye mkojo 1. Ndio 2. Hapana

88. Kukagua miguu yako 1. Ndio 2. Hapana

89. Elimu/ ushauri 1. Ndio 2. Hapana

90. Ushauri juu ya chakula 1. Ndio 2. Hapana

91. Kuhakiki/ kupitia dawa zako 1. Ndio 2. Hapana

92. Kukuchunguza kuhusu magonjwa mengine 1. Ndio 2. Hapana

H. HUDUMA BINAFSI ZA UGONJWA

Sasa nitakuuli juu ya matunzo binafsi kwa ugonjwa huu nyumbani

Katika kipindi cha miezi mitatu iliyopita umewahi fanya yafuatayo nyumbani?

93. kujipima kiwango cha sukari nyumbani

94. kurekodi/ kunakili viwango vya sukari katika damu kwenye daftari lako?

95. umewahi kutembelea kituo cha tiba tofauti na utaratibu wa kliniki yako kwa ajili ya kupima afya yako?

96. umewahi kuomba ushauri toka kwa mhudumu wa afya juu ya ugonjwa ulio nao?

97. Kuchunguza miguu yako mara kwa mara baada ya kuoga

II. MADHARA YAAMBATANAYO NA KISUKARI

Sasa nitakuuliza juu ya madhara yatokanayo na ugonjwa ulionao

Katika kipindi cha miezi mitatu iliyopita umewahi kupatwa na yafuatayo?

□ 98. Kupungua uzito kupita kiasi □ 99. Kuchoka haraka na sana □ 100. Kushindwa fanya ratiba na shughuli zako za kila siku

□ 101. kufanya shughuli chini yakiwango ambacho ungetaraji katika shughuli zako za kila siku

□ 102. Miguu yako kushikwa ganzi □103. Vidonda visivyopona

□ 104. Mkojo mchafu/ backteria katika mkojo□105. Magonjwa wa masikio□ 106. Kukosa hamu ya kujamiana

□ 107. Kupungukiwa na nguvu za kiume □ 108. Kwenda haja ndogo mara kwa mara

□ 109. Kukosa hamu ya kula □ 110. kusikia njaa mara kwa mara

□ 111. Kusikia kiu mara kwa mara □ 112. Kukosa choo kubwa

113. Katika kipindi cha miezi mitatu iliyopita sukari yako iliwahi kushuka kupita kiasi?

1. Ndio 2. Hapana

114. Kama ndio mara ngapi?_____

115. Katika kipindi cha miezi mitatu iliyopita umewahi kulazwa kwa ugonjwa unaohusiana na kisukari
1. ndio 2. Hapana

116. Je katika kipindi cha mwaka mmoja umepata tatizo la kupoteza uwezo wako wa kuona au kusoma maandishi ambayo awali ulikuwa unaweza kuona?

1. Ndio 2. Hapana

J. ELIMU YA AFYA

Umewahi fundishwa kliniki au mahali pengine yafuatayo kuhusu kisukari

	Ndio na ninaelewa kabisa	**Ndio na ninaelewa vizuri**	**Ndio lakini bado inanichanganya**	**Hapana sijawahi**
117. Jinsi ya kutunza miguu yako				
118. Jinsi ya kutumia dawa				
119. jinsi ya kufahamu na kutibu dalili za sukari kuwa juu au kuwa chini				
120. jinsi ya kuchagua aina ya chakula kutumia				
121. jinsi na lini unatakiwa kupima kiwango cha sukari katika damu				
122. madhara yatokanayo na kisukari na jinsi ya kujikinga nayo				
123. jinsi ya kufanya mazoezi				
124. mara ngapi uonane na daktari				
125. jinsi ya kuamua kuhusu kutumia dawa/tiba asili				
126. jinsi ya kulinda shinikizo la damu				

K. UELEWA WA UGONJWA WA KISUKARI Eleza kama yafuatayo juu ya kisukari ni kweli au siyo kweli	**True**	**False**
127. kisukari ni tatizo kubwa lakin linaweza tibika		
128. kisukari ni ugonjwa wa kuambukizwa hasa kwa walio katika ndoa		

129. mama mwenye kisukari hujifungua watoto wenye kisukari		
130. wagonjwa wa kisukari wanapaswa kacha matibabuu kipindi cha mfungo		
131. uchunguzi wa afya wa mara kwa mara ni muhimu kwa tiba ya kisukari.		
132. Watu wenye kisukari hawaruhusiwi kuzaa/ kuwa na watoto.		
133. Watu wenye kisukari hawapaswi kutumia pombe.		
134. Madhara yatokanayo na kisukari yanazuilika.		
135. Upasuaji unapaswa kuepukwa kwa mtu wenye kisukari kwakuwa vidonda vyao haviponi		
136. Watu wenye kisukari hawawezi kula matunda		
137. Kisukari kinatibika kwa waganga wa kienyeji tu.		
138.., kisukari kinatibiwakwa kula mboga za majani tu na chakula cha protini		
139.. Mabadiliko ya tabia(kama vile chakula, mazoezi, kuacha kuvuta sigara) inaweza saidia tiba ya kisukari		

L. VIPIMO

140. uzito (kg) _____

141. urefu (cm) _____

142. mzingo/ mzunguko wa kiuno (cm)_____

143. Mzingo wa mapaja (cm)_____

144. Systolic BP _____

145. Diastolic BP _____

146. Pulse rate (beats/min) _____

147. FBG/ level (mmol/L) _____

148. HbA1c Level _____

Annex 4. Consent Paper for the study-English

TITLE: GLYCAEMIC CONTROL AND ASSOCIATED FACTORS IN TYPE II DIABETIC PATIENTS ATTENDING PUBLIC HEALTH FACILITIES IN TANZANIA

Foreword

My name is Dr Maeda, Justin M., a researcher from Muhimbili University of Health and Allied Sciences. I am investigating Glucose control among type II diabetic patients who attend public health facilities and factors related to poor glucose control.

How to participate in this study

You're asked to participate in this study because you're a diabetic patient who has been attending diabetic clinics for more than three months. If you will agree to participate you will be asked several questions that explore your daily practices in managing the disease, knowledge on the disease and health care services that you have been receiving while attending the health facility. A blood sample will also be taken to investigate how well your blood sugar has been controlled for the past 3 months. You will also have your weight, height and blood pressure measured.

Purpose of the study

This study is important to describe the level of blood sugar control among diabetic patients as well as to identify factors influencing poor control that may lead to diabetic related complications. Findings from this study will be used to advise diabetic patients, diabetic specialists, other health care providers and policy makers on the effectiveness of current blood sugar control approaches; and areas to focus in helping diabetic patients to have a better control of their blood sugar.

Confidentiality

Any information collected during the study will remain confidential and will be used for research purpose only. The investigation team will compile a report from the findings of the study which will contain information of all diabetic patients who participated in the study. Each individual participant will be treated anonymously and no personal links such as name, id number, or file number will appear on the report document.

Risks

We do not expect any harm to happen as a result of this investigation. During blood sample collection, competent and trained health personnel will be used. All safety precautions will be observed and the syringe used will be shown to you before being opened from its seal, the area to be punctured will be cleaned to avoid introduction of infection into your blood system.

Right to participate in the study

Decision to participate in this study is completely of your choice. You can decide not to participate without giving or being asked for reasons for your decision. Once agreed to participate you can still decide to withdraw from participating at any stage of the investigation. Your decision to participate or not participate will not by any means affect your right of service as a diabetic patient from your diabetic clinic.

Who to contact

If you have any questions about this study you are free to contact, the principal investigator, Dr. Maeda, Justin M. telephone number: 0754-400051, 0655-400051

If you have any questions/concerning your rights as a participant you may contact Prof. Moshi, Director for Research and Publications MUHAS. P.O.BOX 65001 Dar es Salaam. Tel 0222150302-6

If you agree to this interview, please sign this consent form.

I …… have and understood the contents of this consent form and my questions have been sufficiently answered. I therefore consent to participate in this study.

Signature of the interviewee ……..... Date ……

Signature of the interviewer ……....……. Date ……

Annex 5. Consent paper for the study-Swahili

Kichwa cha Utafiti.

UDHIBITI WA KIWANGO CHA SUKARI KWENYE DAMU NA SABABU ZINAZOAMBATANA NAZO KWA WAGONJWA WANAOHUDHURIA KLINIKI ZA KISUKARI KWENYE VITUO VYA TIBA VYA UMMA

Utangulizi

Jina langu ni Dk. Maeda, Justin Mtefu, mtafiti kutoka Chuo Kikuu cha Sayansi na Tiba Muhimbili. Ninafanya uchunguzi kuhusu udhibiti wa kiwango cha sukari kwenye damu na sazabu zinazoweza kupelekea kushindwa kudhibiti wingi wa sukari kwa wagonjwa wa sukari wanaohudhuria vituo vya tiba vya serikali.

Jinsi ya kushiriki katika utafiti huu

Unaombwa kushiriki katika utafiti huu kwa sababu wewe ni mgonjwa wa kisukari na umekuwa ukihudhuria kliniki ya kisukari kwa zaidi ya miezi mitatu. Endapo utakubali kushiriki katika utafiti huu, tutakuuliza maswali machache yanayohusu taarifa zako za kila siku za kisukari, uelewa wako kuhusu kisukari, na kuhusu huduma za kitabibu ambazo umekuwa ukizipata katika vituo vya tiba. Kiasi kidogo cha damu kitachukuliwa pia kwa ajili kuchunguza mwenendo wa udhibiti wako wa sukari kwa muda wa miezi mitatu iliyopita. Tutakupima pia uzito, urefu, na shinikizo lako la damu.

Dhumuni la utafiti

Utafiti huu ni muhimu kwani matokeo yake yatatumiwa katika kupanga mikakati ya kuimarisha huduma za udhibiti wa sukari na kusaidia katika harakati za kuepusha madhara yaambatanayo na sukari kuwa juu kwa muda mrefu.

Usiri

Kila taarifa itakayokusanwa kipindi cha utafiti itabakia kuwa siri na itatumika kwa sababu za kiutafiti tu. Timu ya utafiti itakusanya matokeo ya utafiti na kutengeneza taarifa ya jumla yenye matokeo ya utafiti kutoka kwa washiriki wote waliohusishwa katika utafiti huu. Uhusika wa kila mshiriki hautawekwa wazi katika utafiti huu kwani hamna jina, anwani, namba maalumu ya kutibiwa au namba ya faili zitakazotumika au kutajwa kwenye majumuisho ya taarifa za utafiti huu.

Madhara

Hatutegemei kuwepo kwa madhara yoyote ya kiafya yatokanayo na utafiti huu kwako. Damu kwa ajili ya vipimo zitatolewa na watumishi wa afya ambao ni wazoefu katika kutoa damu na ambao wamepata pia mafunzo maalumu kabla ya utafiti huu. Tahadhari zote za kuepusha maambukizi yatokanayo na ukusanyaji wa sampuli za damu zitachukuliwa, na mtafiti atakuonyesha bomba la sindano atakalolitumia kutolea damu kabla ya kulifungua kwenye ganda lake.

Haki ya kushiriki

Ushiriki wako katika utafiti huu ni wa hiari. Unaweza kukubali au kukataa kushiriki katika utafiti huu bila kuulizwa au kutakiwa kotoa sababu za kutokushiriki kwako. Hata baada ya kukubali kushiriki waweza kujitoa katika ushiriki muda wowote na katika hatua yoyote ya mwendelezo wa utafiti huu. Kutokushiriki kwako hakuta athiri kwa namna yoyote ile haki yako ya msingi ya kupata huduma za tiba katika kituo hiki.

Ukiwa na maswali yoyote kuhusu utafiti huu, uwe huru kuwasiliana nami, mtafiti mkuu Dk. Maeda Justin M. kwa namba ya simu 0754400051

Kama utakuwa na maswali kuhusu haki zako kama mshiriki, unaweza pia kumpigia Prof. Moshi, Mkurugenzi wa utafiti MUHAS. Simu namba 0222150302-6

Kama umekubali kushiriki, tafadhali saini hapa:

Mimi……., nimesoma na kuelewa kilichoelezwa kwenye fomu hii na maswali yangu yamejibiwa kiufasaha. Hivyo ninakubali kushiriki katika utafiti huu.

Sahihi ya Mshiriki …….. Tarehe ……..

Sahihi ya Mtafiti…… Tarehe……