Cardiovascular Risk Factors Among Patients with Type 2 Diabetes in Rural Tanzania

André Thunberg
Master Thesis in Medicine
University of Gothenburg 2015

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Abstract

Master Thesis, Programme in Medicine, 2015

Cardiovascular Risk Factors Among Patients with type 2 Diabetes in Rural Tanzania.

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Introduction

Diabetes type 2 caused more than 5 million deaths 2013. Approximately 50% of the

patients with diabetes type 2 die because of cardiovascular disease (CVD), primarily

myocardial infarction and stroke. Since many of the leading risk factors for CVD

coexist and act synergistically to increase the risk of cardiovascular events, it is of

great importance to treat the total cardiovascular risk.

Objective

The aim is to give a descriptive view regarding the cardiovascular status, i.e. looking

at most of the leading cardiovascular risk factors, of a diabetic population in a rural

setting of Tanzania.

Method

Patients with a confirmed diagnose of type 2 diabetes were included consecutively as

they attended the combined diabetes and hypertension clinics in Rombo district,

Tanzania. Every patient answered a questionnaire regarding cardiovascular risk

factors. Additionally, blood pressure was measured. Random blood glucose was

measured as well as waist circumference and body mass index (BMI).

Results

The number of patients included was 164 (134 females and 30 males). The mean

values are as follow; random blood glucose 12.11 mmol/L (SD 5.8), systolic blood

pressure 158.6 mmHg (SD 28.0), BMI 26.0 kg/m^2 (SD 4.6) and waist circumference

93.0 cm (SD 10.5). 66% declared no physical activity and 85% were performing less

that the recommended guidelines from WHO. 85.4% have never smoked and 58%

stopped using alcohol after they had been diagnosed with diabetes.

Conclusions and Implications

This group of individuals with diabetes type 2 also suffer from physical inactivity,

overweight and hypertension. It is of great importance to reduce these risks in order to

reduce their total risk of cardiovascular events. The low proportion of males attending

the clinic as well as evaluating the cardiovascular status among in-patients with

diabetes are questions that needs to be addressed in the future.

Introduction

Type II diabetes is a most serious disease, which caused 5.1 million deaths in 2013. In fact, every six second, one human being dies from diabetes worldwide, and the health care spending on diabetes in 2013 was estimated to USD 548 billion (1). The disease is on the rise worldwide and it has become a huge burden, not least in low-income countries, which have developed and focused its health care system towards management and treatment of communicable diseases. The fact that non-communicable diseases like diabetes often requires a lifelong treatment and follow-up to prevent complications and death challenge the economy of many countries, including Tanzania. Hence, investigating a diabetes population, in terms of cardiovascular status, in this rural setting makes it very important. Is it possible to provide adequate health care for this costly disease with limited resources?

Definition and Aetiological Types

Diabetes is defined as a maintained (2 measurements are needed) fasting plasma glucose ≥7.0mmol/l (126mg/dl) or 2-h plasma glucose ≥11.1mmol/l (200mg/dl) (2). It is a metabolic disease with diverse aetiology that is characterized by chronic high blood glucose and disturbances of fat, carbohydrate and protein metabolism resulting from lack of insulin secretion and/or function (3). Simplified, there are three main types of diabetes mellitus:

Type 1 Diabetes

Diabetes type 1, previously referred to as insulin dependent diabetes and juvenile-onset diabetes, is most commonly caused by autoimmunity and presence of anti-GAD, islet cell or insulin antibodies. These antibodies contribute to the processes leading to destruction of the insulin producing beta-cells in pancreas. The result is insufficient production of insulin and the patient becomes dependent on insulin to prevent the development of ketoacidosis, coma and death. The rate of destruction varies. The rapidly destroying type is more often seen in children and young adults, while the slowly form generally occur among adults and are sometimes referred to as LADA (latent autoimmune diabetes in adults). Within some individuals, more often children, the first sign of the disease is ketoacidosis. Others go with slightly increased blood glucose, which rapidly could change to hyperglycaemia and ketoacidosis in times of stress, such as an infection (1, 3).

Even though the most common time of onset is during childhood and adolescence, it could occur at any time in life. When diagnosed, 85-90% of the patients have detectable autoantibodies, but within some individuals, more often among Africans and Asians, no evidence is found of autoimmunity. This non-autoimmune form is classified as "type 1 idiopathic" diagnosis (3).

The incidence of diabetes type 1 is increasing and the reasons are still to be determined, but changes in environmental risk factors, viral infections, early events in the womb and diet in early life are suggested as reasons for the increase (1).

Type 2 Diabetes

The most common form, diabetes type 2, was in contrast to type 1 used to be called non-insulin dependent diabetes or adult onset diabetes. There is no autoimmune destruction of pancreas present in this form. These individuals do produce insulin, but either it is insufficient or they have developed a resistance towards its effect. Frequently, patients go undiagnosed for several years until negative complications occur. The explanation is that the hyperglycemia is not high enough, during these years, to create significant symptoms. Unfortunately most of the patients with type 2 diabetes are obese, and overweight itself induces insulin resistance. Other known risk factors for diabetes type 2 are poor diet, physical inactivity, advancing age, heredity of diabetes, ethnicity and raised blood glucose during pregnancy effecting the fetus (1, 3).

Gestational Diabetes

GDM or gestational diabetes is a type where woman during pregnancy, develop insulin resistance, which leads to high blood glucose. This often occurs around week 24 of pregnancy. The insulin activity is blocked and this is believed to be caused by hormones produced by the placenta. Raised blood glucose during pregnancy may lead to fetal macrosomia, which means an abnormally large baby. This in turn could force the mother to give birth through caesarean section, which increases the risk for complications, especially in areas where the access to health care is limited.

Even though gestational diabetes usually disappears after pregnancy, these mothers have an increased risk for developing gestational diabetes in subsequent pregnancies and also of developing diabetes type 2. Furthermore, the babies have an increased risk of developing obesity and diabetes type 2 (1, 3).

Prevalence

Worldwide, today the number of individuals with diabetes is estimated to 382 million and by 2035 it is estimated to have risen to 592 million, which render us with a situation where one person out of ten will suffer from this condition (1). Furthermore, the numbers would be significantly higher if "impaired glucose tolerance" and "impaired fasting glucose" were included. There is a widely spread misconception that diabetes is a disease of the wealthy, but recently published evidence shows that 80% of individuals with diabetes are living in low- or middle-income countries (1).

In Africa, the total number of individuals with diabetes is 19.8 million and this number is expected to double by 2035. Today, diabetes is considered to be accountable for 8.6% of all deaths in the African region among people between 20-79. In Tanzania the current prevalence of diabetes is 7.8% or 1.7 million people, which could be subdivided into approximately 1 million in rural areas and 0.7 million in urban areas. In addition to this, Tanzania is estimated to have 1.3 million with undiagnosed diabetes between 29-79 years of age. Diabetes caused almost 50,000 deaths in Tanzania in 2013 (1).

Diabetes and Gender Differences

There is no significant difference in prevalence of diabetes between men and women, not worldwide and not in Tanzania. However there is a vast difference in diabetes-related deaths where females have more than 50% higher risk of dying due to diabetes compared to males. This discrepancy could in part be explained by the fact that men die due to other reasons, e.g. armed conflicts, but also that men have better access to health care (1). However, recent studies have concluded that women with diabetes are more likely to suffer complications such as stroke (4) and they also have a greater mortality risk than do males with diabetes (5). This is both supported and explained by the fact that females with diabetes have a more unfavourable cardiometabolic profile, i.e. high pulse pressure, uncontrolled HbA1c, metabolic syndrome, abdominal obesity, hypo-HDL cholesterolemia and hyper-LDL cholesterolemia were more common among the females (6, 7).

Complications to Diabetes

The severe consequences of diabetes are mediated through negative effects on the heart, blood vessels, eyes, kidneys and nerves (8). The excess standardized mortality ratio (SMR) for all causes of death among diabetes patients is almost tripled compared to the general population(9). As a result, the mortality among diabetic patients is also increased three times compared to the general population.

The Global Burden of Non Communicable Diseases

A recent study, which was looking at leading risk factors globally between 1990-2010, stated that there has been a vast change from communicable diseases among children to non-communicable diseases (NCDs) among adults (10). By 2030 the NCDs (including cancer, cardiovascular disease and metabolic diseases such as diabetes and obesity) are estimated to account for 46% of all deaths in sub-Saharan Africa (11). Furthermore, according to a survey conducted in Tanzania, the death rates from NCDs were higher in all age groups between 15 and 59 compared to high-income countries (12).

Approximately 50% of the patients with diabetes die due to cardiovascular disease, primarily heart disease and stroke (13, 14). When looking at leading cardiovascular risk factors globally, in terms of attributable deaths, you find hypertension (13% of global deaths is attributed), tobacco use (9%), raised blood glucose (6%), physical inactivity (6%) and overweight and obesity (5%) (15). Also, when looking at DALYs (disability adjusted life years), these risk factors account for a significant burden. In 2010, hypertension was accountable for 7.0% of global DALYs, smoking (including second hand smoking) 6.3% of global DALYs, high BMI 3.8% of global DALYs, high blood glucose 3.6% of global DALYs and physical inactivity 2.8% of global DALYs (10).

Furthermore, these metabolic and behavioral risk factors often coexist in one person and also act synergistically to increase that person's total risk of developing acute

vascular events, such as stroke and myocardial infarction. Moreover, trials indicate that half of all patients with diabetes also suffer from hypertension (15, 16).

Evidence Regarding Treatment in Patients with Diabetes

Glucose Control

In addition to measurements of fasting blood glucose, it has been suggested to test HbA1c at a minimum of two times per year among those with steady glucose control and quarterly among those with recently changed therapy or with trouble reaching the glycemic goals (17). A goal HbA1c of around or below 7% is feasible for non-pregnant adults (17). An investigation comparing standard glucose control with intense glucose control, showed that a HbA1c (glycated haemoglobin) value of 6.5% compared to 7.3% resulted in a 10% relative reduction of major macrovascular and microvascular events. This was mainly due to reduction in microvascular events and it resulted in a 21% relative reduction in nephropathy. In contrast, it should be stated that there also was an increase in the risk of hospitalization and hypoglycaemia when glucose control is more intense (18). A similar examination supports an association between higher levels of HbA1c and mortality, but at the same time this research group found increased mortality parallel to an intense glucose-lowering strategy among patients with HbA1c above 7% at baseline (19). Since hyperglycemia increases the risk of cardiovascular events and hypoglycemia could increase the cardiovascular mortality, an individualized approach for achieving the target HbA1c is required (20).

In low-income countries, such as Tanzania, HbA1c and fasting plasma glucose are rarely available. Instead random blood glucose is used. Gill et al. have suggested that a random plasma glucose <10 mmol/L indicates an acceptable glycaemic control in patients with non-insulin dependent diabetes mellitus type 2 (21).

With this said, data also indicate that good glucose control in patients with diabetes mellitus type 2 only account for a modest reduction in macrovascular event. Therefore a much broader treatment approach is required including antihypertensive, lipid-lowering and platelet-inhibiting treatment (22).

Lipid and Blood Pressure Lowering in Patients with Diabetes Type 2

A Kenyan study reports a significant coexistence (50%) between hypertension and diabetes mellitus (23). The author also concluded that among the diabetes patients, 75% had raised total cholesterol and 32% of the females and 16% of the males had a BMI above 30 (23). Aggressive treatment with aim to lower the serum lipids and blood pressure has been shown to result in substantial cardiovascular benefits.(14, 24) A large survey, including over 18,000 patients demonstrated that every mmol/L reduction of LDL cholesterol among diabetes patients resulted in 9% reduction of all-cause mortality and 21% reduction of major vascular events (25).

A prospective observational trial, including 3642 type 2 diabetic patients, states that each 10mmHg reduction in mean SBP (systolic blood pressure) is associated with 12% decrease in risk for any diabetic-related complication, 11% for myocardial infarction, 13% for retinopathy and nephropathy, i.e. microvascular complications and

13

15% for deaths related to diabetes (26). Regarding the target SBP for patients with

DM, investigations and recommendations are inconclusive. Earlier, the

recommendation was a SBP <130 mm Hg, but new recommendations from ESH and

ESC (European Society of Hypertension and European Society of Cardiology)

suggest that the target should be a SBP <140 mm Hg (27, 28).

Lifestyle Changes (i.e. diet, smoking, alcohol use and physical activity)

Intensive lifestyle intervention (ILI) focusing on increased individual counseling,

reduced intake of calories and increased physical activity has shown great benefits

with an 11.5% prevalence of partial or complete remission of diabetes mellitus (29).

Smoking cessation is another important step, hence it has been shown to ameliorate

metabolic parameters such as blood pressure, dyslipidemia, glycemic control and

insulin resistance (30). Furthermore it was associated with a decrease in the

prevalence of neuropathy, microalbuminuria and peripheral vascular disease (30).

Both physical inactivity and a high BMI are associated with an excess risk of

myocardial infarction among diabetes patients (31). Research has presented a dose-

dependent excess in risk of cardiovascular events CVE and all-cause mortality among

heavy drinkers compared to the absolutist (32). However, a moderate consumption, of

wine in particular, was associated with a decreased risk of CVE and all-cause

mortality compared to the individuals with no consumption of alcohol (32).

Treat the "Total Cardiovascular Risk"

As described above, the treatment of patients with diabetes requires so much more than just monitoring and regulating the blood glucose. Today there is strong scientific evidence that reducing the total cardiovascular risk results in the prevention of myocardial infarction and stroke. For example, intensified interventions targeting multiple risk factors in patients with type 2 diabetes and microalbuminuria could cut the risk of cardiovascular and microvascular events by 50% and death of any cause by 20% (15, 33, 34).

Health Care in Tanzania

The Ministry of Health (MoH) and the President's Office Regional Administration and Local Government (PORALG) are responsible for providing public health care in Tanzania. There is a structural hierarchy in the Tanzanian health system, described as a pyramid. The MoH is at the top, followed by the specialized university hospitals, regional health services (regional hospitals), district health services (district hospitals), urban and rural health services (health centers), community dispensaries and at the bottom village health posts (35).

ADMINISTRATIVE LEVEL	SERVICE STRUCTURE	PERSONNEL IN-CHARGE
National Level	Ministry of Health	Permanent Secretary
Zonal Level	Specialized/University Hospitals	Medical Superident Director
Regional Level	Regional Health Services	Regional Medical Officer
District Level	District Health Services	District Medical Officer
Divisional Level	Urban/Rural Health services	Clinical Officer in-charge
Ward Level	Community Dispensaries	Clinical Assistant
Village Level	Village Health Posts	Village Health Worker
Houshold level	THE COMMUNITY — Family	Mother/Father

Health Insurance in Tanzania

The health care in Tanzania is to 70% funded from taxes. There is also a fee for every visit to a health facility. The National Health Insurance (NHI) is a complete insurance that covers all medical expenses, but only applies to the government workers (i.e. health care employees, politicians etc.). Then, specific work groups have their own insurances like the electricians (TANESCO), the telecom workers (AA Insurance) and the bankers (National Microfinance Bank Insurance). The ones not covered by any of the ones stated above are, if they can afford, covered by the CHF (community health found), to which the family pays 10,000 Tsh/year (1USD is approx. 1600TSH). All these insurances, except the NHI, are partly covering, i.e. the patients also have to pay for every visit or surgery. Drugs are however supposed to be covered. What happens to those who can't afford insurance or pay for their visit? This probably differs between the hospitals, but at Huruma, where this examination took place, patients received treatment unconditionally.

Moreover, there are groups of patients whose health expenditures are covered by the government and foreign founds. These are children <5 years old, HIV/AIDS-patients, tuberculosis patients and people > 65 years of age (although there is an ongoing discussion whether the last group should be covered or not).

Management of Diabetes in Tanzania

Several studies from high-income countries have concluded that establishing primary care led management of many of our chronic diseases results in improved health-outcomes (36-38).

In 2014, a study was published presenting the preparedness of Tanzanian health facilities to tackle diabetes and hypertension. It was conducted in collaboration with health care managers and policy makers and included 24 public health facilities in urban and rural settings in northwestern Tanzania. Several challenges as well as strengths were described. For example they found out that half of the health centres reported that, on regular basis they referred the patients with diabetes and hypertension to hospitals, even though the guidelines suggest that these diseases could be managed in primary care facilities. Peck et al. (2014) declared key areas for improving the management. Establishing clinical guidelines, providing basic diagnostic equipment and first-line drugs for all NCDs are important. They also suggested regular training, reporting and supervision to ensure that healthcare workers have sufficient knowledge and experience. Since the care and management of HIV at these facilities were well functioning, they may serve as a model for improving the care of NCDs (39).

Setting and Health Care in Rombo District, Tanzania

Rombo district is a rural area in the Kilimanjaro region with 260 000 inhabitants. The main ethnic group is Chagga and 90% live of farming, 7% of small businesses and 3% are employed workers. There are a total of 43 health facilities and they consist of 2 hospitals (Huruma and Ngoyoni), 4 health centres and 37 dispensaries. According to the district council, the top three health challenges in the region are: shortage of

skilled heath care workers, inadequate supply of medicines from the medical store department and inadequate supply of medical equipment and supplies (40).

Huruma Hospital is a district hospital owned by the Catholic Diocese of Moshi and is situated in Ibukoni village, Rombo District. It has 300 beds for in-patients and serves as referral hospital for the four health centres; Keni, Kirwa, Tarakea and Karume. In turn, Kilimanjaro Christian Medical Centre (KCMC) serves as a specialist referral hospital for Huruma. In 2013, the mean value of daily visitors at the out patient department (OPD) was 117 and out of the total 43,000 appointments at the OPD, 570 (362 females and 208 males) were due to diabetes. At the OPD, diabetes was the fourth most common reason in both males and females above 5 years old. The most common was "non-infectious eye disease" (not further specified), followed by caries and cataract. Diabetes was number 3 in causes of death at the combined surgical/ medical ward and number 6 in the medical ward (41).

Diabetes Care in Rombo District

When detecting an elevated random blood glucose (RBG) the patient is asked to return the next day to complement this with a fasting blood glucose (FBG). They are also recommended to attend the diabetes clinic. The diabetes clinic at Huruma Hospital was established in 2012 and the number of diagnosed patients raised dramatically. Hence, in January 2014 all the four health centres in the region also founded diabetes clinics. Currently, Huruma hospital and the four health centres each have a combined diabetes/hypertension clinic once a week. The patients are divided

into two groups and each group attend the clinic every second week. The blood glucose and blood pressure are checked every time and if needed, drugs are added and doses are adjusted. Also, the clinics educate the patients about diet, exercise, foot care etc. They are also screened for complications. If a patient is very ill they are referred to Huruma hospital. According to a report composed by Rombo diabetic clinic, some of the main difficulties are: shortage of staff, shortage of drugs (especially insulin), poor knowledge about DM among the members and overweight.

In collaboration with Tanzania diabetes federation (TDF), the Kilimanjaro Diabetic Program (KDP) founded a diabetes club in 2012 to which all the diabetes patients are welcome to join. The cost for membership is 5,000 TSH and yearly there is a fee of 3000 TSH. Every visit at the clinic cost 1000 TSH for a member and this is to cover for the lancets and cuvettes used for measuring blood glucose. All the members get a little book, which the patient brings to every visit for storing all data, i.e. ID for follow-up, height, weight, waist circumference, random blood glucose/fasting blood glucose (RBG) and blood pressure. There are also spaces to fill out information about visual acuity (VA), proteinuria/ketonuria, medicine, diet, exercise and foot status. Furthermore there is vital information for the patient concerning the condition, diet, alcohol, foot care, physical exercise and complications.

Aim and Purpose

The purpose of this survey is to increase the knowledge about the presence of

cardiovascular risk factors among diabetes patients in rural Tanzania. The aim is to

give a descriptive view regarding the cardiovascular status, i.e. looking at most of the

leading cardiovascular risk factors, of a diabetic population in an urban setting of

Tanzania.

Method

Study Setting

This trial was conducted at the combined diabetes/hypertension clinic at Huruma hospital and the four health centres to which Huruma serves as a referral hospital. They are all situated in Rombo District, Kilimanjaro region, Tanzania. Huruma has 81 registered diabetes patients (61 females and 20 males) and the numbers for the health centres are as follow; Keni 62 (49 females, 13 males), Kirwa 45 (36 females, 9 males), Tarakea 54 (45 females, 9 males) and Karume 48 (36 females, 12 males).

Study Design

A descriptive quantitative study investigating the cardiovascular status among the diabetes population of Rombo district.

Data were obtained between September and November of 2014.

Selection of Patients

Patients of all ages with a confirmed diagnose of diabetes mellitus attending the diabetes and hypertension clinics were included consecutively. No in-patients were included. Patients with diabetes type 2 were incorporated, while the patients with diabetes mellitus type 1 were excluded. Patients with previous diagnose of diabetes (i.e. no longer on antidiabetic medication due to normal glucose values) were also included.

There was no effort made to achieve equal amount of males and females since there was a vast difference in numbers attending the clinic. Patients without firm diagnose of diabetes mellitus who were there for their first, second or third measurements of blood glucose were not included. We were two students conducting trials at the clinic at the same time using the same questionnaire even though my colleague was studying hypertension. We helped each other out, but only the patients with diagnose of diabetes were included in this analysis. The number of patients from each health centre was depending on the amount attending the days we were there. Circumstances out of our reach affected the number of participants, since many of the patients covered a long distance on foot to get to the clinic.

Interpreters

Two newly examined nurses were used as interpreters. They were not professional interpreters and they had never preformed such work before. First, patients filled out the questionnaire. The nurses explained the purpose and informed that participation was voluntary. In the majority of the cases the nurses had to read and fill out the questionnaire, since the patients either were analphabetic or suffered from bad vision.

Description of Questionnaire

The questionnaire (see appendices) was approved and translated into Swahili by Wilbroad Kyejo, doctor in charge at Huruma hospital. It included questions regarding gender, age, smoking habits, alcohol use, diagnosis (tuberculosis, HIV, malaria, diabetes (type 1, type 2), hypertension), duration of diabetes, medication of diabetes, compliance, diagnosed complications (myocardial infarction, stroke, congestive heart

failure, renal failure, limb amputation, cataract), physical exercise and heredity (diabetes, hypertension, myocardial infarction, stroke).

These questions were chosen since they are regarded to be the leading cardiovascular risk factors (15). The complications were suggested by dr. Kyejo, medical officer in charge at Huruma Hospital.

Since physical inactivity earlier has been suggested as less than 30 minutes of moderate physical activity 5 times per week, the definition of physical activity in this examination was set to 30 minutes of moderate exercise (15). Moderate activity was e.g. walking or riding bicycle. Vigorous activity, such as running, for 15 minutes was also considered physical activity. Then patients filled out the frequency of exercise according to our definition.

In a few cases not all questions were answered or all measurements could not be made (i.e. one patient was paraplegic why height and weight were not obtained, and two glucose measurements were to high for the machine to analyse), explaining why the number of measurements differed between patients.

Description of Physical Examination

The physical examination included: mean blood pressure, height, weight, waist circumference and random blood glucose (RBG).

- *Height and weight* was measured using an analogue scale. Body-mass index (BMI) was calculated from weight in kilograms divided by the square of the height in meters. *Waist circumference* was measured in a standing position with a tape between the lowest rib and iliac crest, crossing the navel. Since the measurement took place in public areas and that two patients often were examined at the same time, the patients were not without clothes while measuring waist circumference and body weight.

- *Blood pressure* was measured using a digital machine (Microlife watch BP Home) in a sitting position after 5 minutes of rest to make sure that the pressure was stabilized (27, 28). Blood pressure was measured once in each arm and the mean values of SBP and DBP were used.

- *Random blood glucose* was obtained since fasting blood glucose could not be guaranteed. It was measured with a HemoCue Glucose 201 RT. Two machines were used and they, as well as the microcuvettes (HemoCue 201 RT) and lancets (HemoCue safety lancet) were donated by HemoCue and given to the hospital after the analysis was finished. Eurotrol GlucoTrol-NG was used in the verification of the precision and accuracy of the HemoCue glucose system. Both of the machines were tested before, in the middle and after the data was collected and they performed accurately.

The data was recorded for our survey, but also all measurements were inserted in the patient's file or personal book. After participation, all the patients met their regular physician, whom used our data and adjusted medicines as well as addressed the patients' needs.

Statistical Analysis

All the data were approximated to the closest unit and entered into SPSS. Mean values and standard deviation of blood pressure, body mass index, waist circumference and random blood glucose were measured. No comparisons between gender or subgroups were performed as a result of the uneven gender distribution and the limited total study group.

Ethical Considerations

The medical officer in charge at Huruma Hospital, Dr Wilbroad Kyejo, approved of the trial before it was carried out.

It was voluntary to take part in the investigation and the patients were free to leave at any point without any specific reason mentioned. Whether the patients participated or not, they were given the same treatment at the clinic. Before we started, our interpreters, i.e. the two nurses, explained the purpose and asked the patients if they wanted to take part. No names were recorded and except for the measurements inserted in the patient's file as a part of the diabetic clinic, no data could be linked to the person it was obtained from. No informed consent form was signed.

Results

Of the total 168 participants (137 women and 31 males), 164 were diagnosed with type 2 and 4 with type 1 diabetes. The 4 patients with diabetes type 1 were excluded, leaving a number of 164 patients (134 females (81.7%), 30 males (18.3%)). Number from each clinic: Huruma OPD 5 (3.0%), Huruma Diabetes/Hypertension (D/H) clinic 47 (28.7%), Keni D/H clinic 28 (17.1%), Kirwa D/H clinic 22 (13.4%), Tarakea D/H clinic 30 (18.3%) and Karume D/H clinic 32 (19.5%). Of the patients included 95.1% had medication for diabetes mellitus and 97% stated that they followed the prescription given by their physician.

Table 1: The age of the population is presented below

Age		Frequency	Percent
Valid	21–40	14	8,5
	41–60	83	50,6
	61–80	58	35,4
	>80	6	3,7
	Unknown	3	1,8
	Total	164	100,0

Table 2: Mean SBP, DBP, BMI and WC of all the participants.

	N	Minimum	Maximum	Mean	Std. Deviation
Mean systolic blood pressure (mmHg)	164	108	255	158,57	28,034
Mean diastolic blood pressure (mmHg)	164	69	137	95,35	12,712
Random blood glucose (mmol/L)	162	3,9	29,6	12,111	5,8234
Body Mass Index (kg/m2)	163	16,0	41,0	25,963	4,5595
Waist circumference (cm)	164	62	120	93,01	10,503
Valid N (listwise)	161				

Of the participants, 71.3% had a random blood glucose (RBG) value of more than 7.5mmol/L and 54.5% hade RBG above 10mmol/L. The mean value of waist circumference (WC) among the females was 92.45cm (SD 10.7) and 95.53cm (SD 10.5) among the males. The females had a WC of 92.45cm while the males measured 95.53cm. 64% of the females had a WC above 88cm, and 20% of the males had a WC above 102 cm.

T-test was performed for BMI, waist circumference, RBG, SBP and DBP in the dichotomized groups (RBG below and above 10 mmol/L and SBP below and above 140 mm Hg) without any significant differeces between any of the groups.

Table 3: Mean values of the patients, separated into two groups using random blood glucose (RBG) value above/below 10 mmol/L.

RBG <>10		Body Mass Index (kg/m2)	Waist circumference (cm)	Mean systolic blood pressure (mmHg)	Mean diastolic blood pressure (mmHg)
<10	Mean	26,58	95,21	161,85	96,41
	N	71	71	71	71
	Std. Deviation	4,671	10,316	29,927	13,695
=>10	Mean	25,49	91,33	156,06	94,54
	N	92	93	93	93
	Std. Deviation	4,439	10,386	26,387	11,920
Total	Mean	25,96	93,01	158,57	95,35
	N	163	164	164	164
	Std. Deviation	4,559	10,503	28,034	12,712

Table 4: Mean values of the patients, separated into two groups using mean systolic blood pressure (MSBP) value above/below 140mmHg.

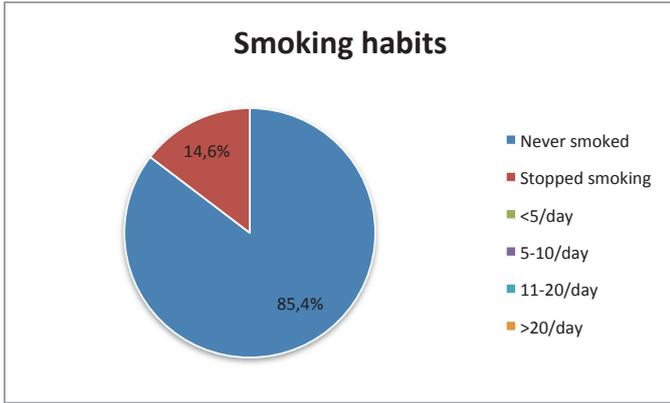| MSBP140		Body Mass Index (kg/m2)	Waist circumference (cm)	Random blood glucose (mmol/L)
<140	Mean	25,04	89,74	13,10
	N	46	46	44
	Std. Deviation	4,858	10,684	5,745
=>140	Mean	26,32	94,29	11,74
	N	117	118	118
	Std. Deviation	4,406	10,194	5,834
Total	Mean	25,96	93,01	12,11
	N	163	164	162
	Std. Deviation	4,559	10,503	5,823

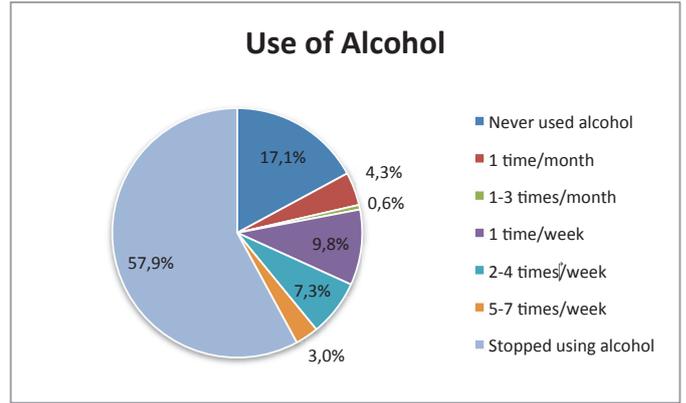**Figure 1: Self-reported smoking habits.**

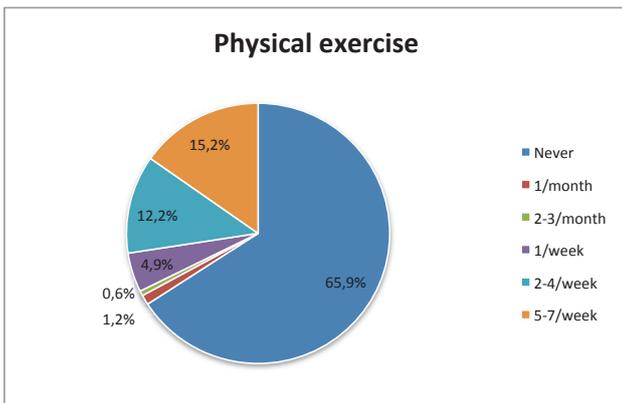**Figure 2: Self-reported use of alcohol.**

Figure 3: Self-reported quantity of physical exercise (30 minutes of moderate physical activity or 15 minutes of heavy physical activity).
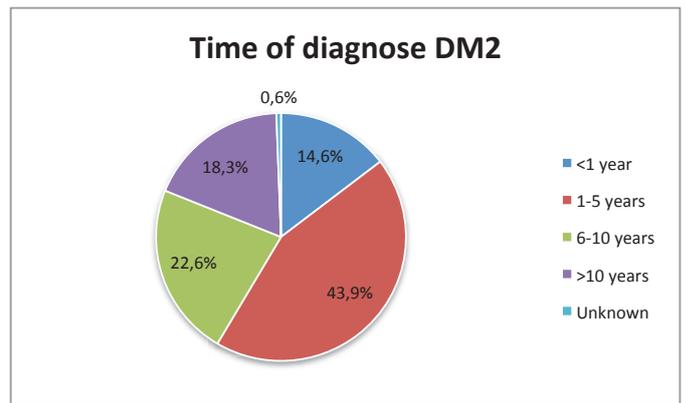

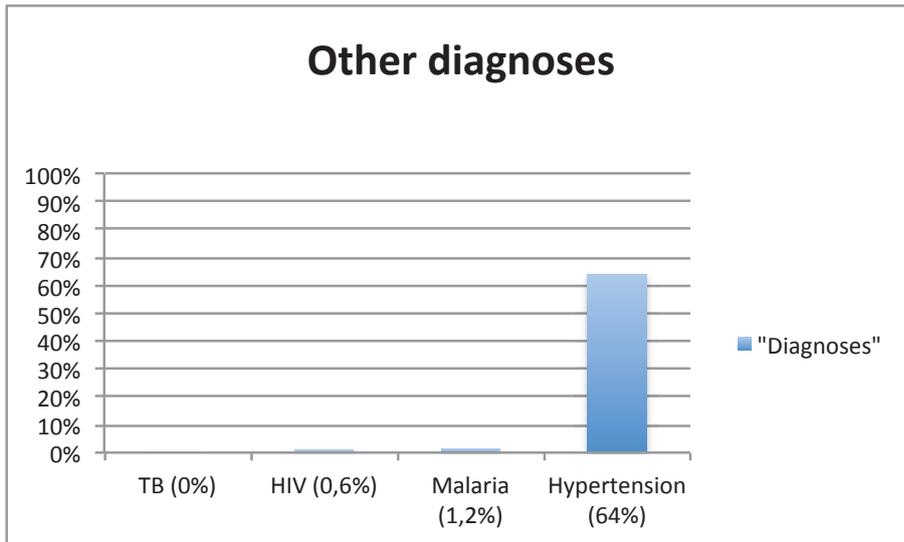**Figure 4: Self-reported time since the patients were diagnosed with diabetes mellitus type 2.**

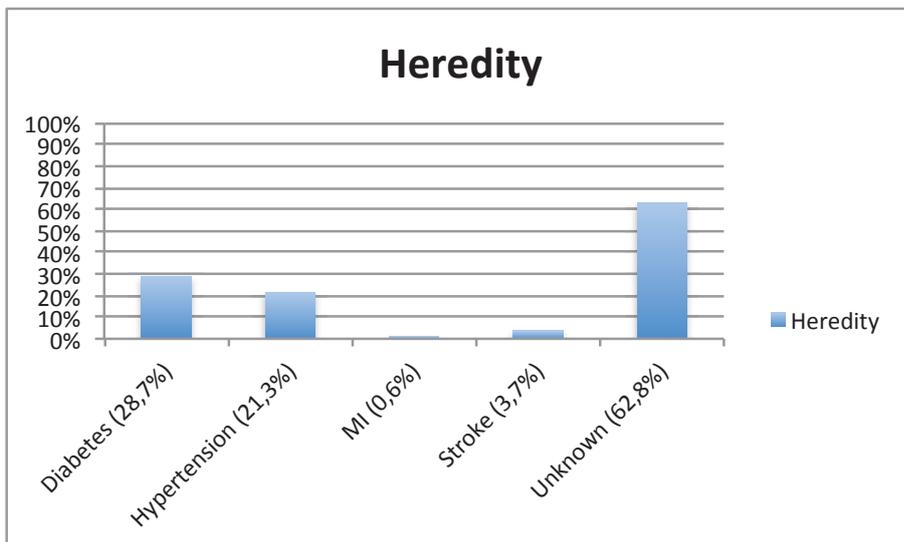**Figure 5: Self-reported other diagnosed conditions except DM type 2.**

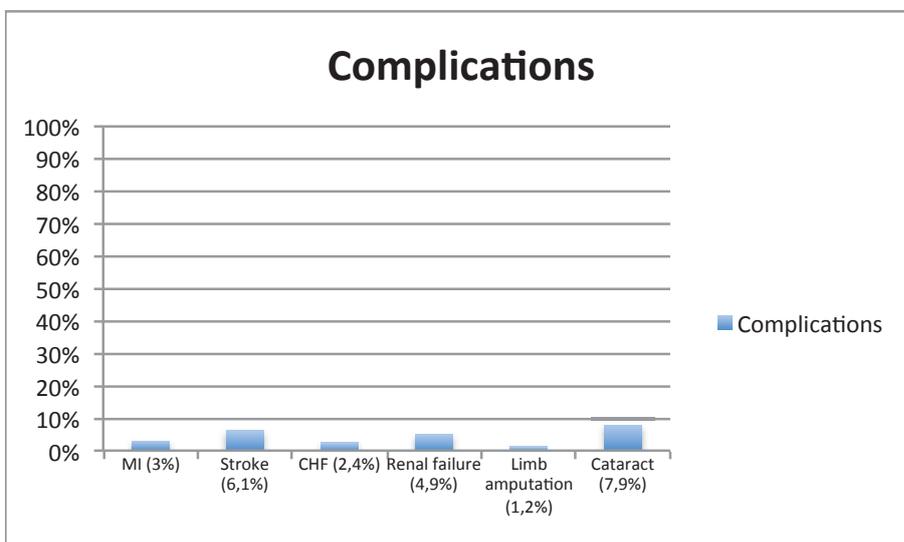**Figure 6: Self-reported heredity (parent or sibling).**

Figure 7: Self-reported diagnosed complications.

Discussion

The mean values of random blood glucose (RBG), mean diastolic blood pressure (MDBP), mean systolic blood pressure (MSDP), body mass index (BMI) and waist circumference (WC) all placed themselves in the range considered above normal. After dichotomization based on RBG below or above 10 mmol/L the BMI, WC, MSBP and MDBP turned out lower in the group with higher RBG. After dichotomization based on MSBP above or below 140mmHg, both WC and BMI turned out higher while RBG turned out lower among the patients with MSBP>140mmHg. The results indicate a low degree of physical exercise with 66% reporting no physical activity at all. Only 15% were active 5-7 times/week, which is equivalent to the recommendations from WHO (42), which means that 85% of the participants could be regarded as physical inactive. Furthermore 64% were diagnosed with hypertension and the mean systolic blood pressure was 159 mmHg. The habits of alcohol use and smoking were not alarming with 58% reporting that they stopped using alcohol and 85% stated that they never smoked.

Physical inactivity among type 2 diabetics has been documented worldwide, why the results of 66% physical inactive in this analysis are not surprising. Moreover, the number would be significantly higher, 85% if you choose the WHO guidelines as the definition. An American trial including almost 1,500 diabetes type 2 patients found that 31% did not preform any physical exercise, and an additional 38% performed less physical activity than the guidelines suggested (43). On the other hand, a Nigerian study from 2014, indicating a somewhat more active lifestyle with a prevalence of

physical inactivity of 31% (44). The importance of physical activity for type 2 diabetes patients is well documented and it has been shown to reduce cardiovascular events as well as all-cause mortality (45).

Regarding the high prevalence of hypertension in the examined group, it has been documented in previous surveys as well. However, studies from the African region show a great variance in the coexistence of hypertension and diabetes, varying from 9,7% in Nigeria to 70,4% in Morocco (46). Research from a high-income country reported that 40% of the included diabetes patients had a systolic blood pressure above 140 mmHg (47) and another American survey described a 75% coexistence of diabetes and hypertension (48). However, the scientific evidence of benefits from tight blood pressure control is extensive, regarding diabetic associated complications and deaths (49, 50).

The mean value of random blood glucose (RBG) was 12.1 mmol/L and 54.5% had a RBG above 10 mmol/L, which has have been suggested as an acceptable glycemic control (21). A British investigation present a mean random blood glucose value of 13.0 mmol/L among the patients with diabets type 2 using oral hypoglycaemics drugs (21). Another analysis suggest a target RBG value of ≤ 7.5 mmol/L (51), which only 28.7% of the patients in this examination presented. The same analysis, conducted in Zambia, reported a mean RBG of 8.0 mmol/L among the type 2 diabetics (51). Hence, the RBG result from this study place itself in between the two surveys.

The results of the patients in this trial were dichotomized into two groups based on value of RBG above or below 10 mmol/L. The result differentiated from the expectations, since both BMI, waist circumference and blood pressure were higher among the group with lower RBG. These results are very difficult to explain. The long distance covered on foot to reach the clinic as well as the fact that some of the patients did not eat prior to the clinic may contribute to influence the value of RBG. It may also show the inadequacy of the RBG test or could just be a consequence of the small study group, i.e. a chancefinding.

Furthermore, the data was divided in a similar way, but using a value of 140 mmHG of mean systolic blood pressure as a cut point. The value 140mmHg was used according to present systolic blood pressure goal of <140 mm Hg (27). This showed that the patients with blood pressure above 140 also had higher BMI (26 kg/m^2 compared to 25 kg/m^2 in the group with lower systolic blood pressure) and waist circumference (94cm compared to 90cm in the group with lower systolic blood pressure), but lower RBG (11mmol/L compared to 13mmol/L). The low value of RBG in this group, is as discussed above hard to explain.

BMI placed the study cohort in the range of overweight. Since normal BMI is considered 20-25 kg/m^2 this place the study population just slightly above the level considered to be normal, but it is considerably better than the results from a large American trial on multiple ethnic groups which reports a mean BMI of 33.5 kg/m^2 (52). A Middle-Eastern investigation presented results more similar to this study with a mean BMI of 27.9 kg/m^2 (53). Concerning waist circumference (WC), 64% of the

females in this trial had a WC above 88cm, which is consistent with substantially increased risk of metabolic complications according to a WHO report (54). An Italian survey published an even higher proportion, 79% of the females had a WC above 88cm (55). Similar results was published from a analysis on Trinidad where 75% of the females had a WC above 89cm (56). An american investigation from 2010 found that the mean WC value among women with type 2 diabetes was 105.1 cm (57).

Smoking cigarettes was not a substantial burden according to the results from this trial. None of the patients were current smokers and as much as 85% had never smoked. This differs substantially from the majority of other published material. A recently published longitudinal analysis of the Swedish national diabetes register (NDR), reported that over 20% of the patients were smokers (58). An investigation on 887 patients with diabetes type 2 from Pakistan presented results with 78.3% reporting that they never smoked, 9.0% were ex-smokers and 12.7% were smokers (59). A newly published examination from Iran reported 24.2% of the males and 5% of the females as smokers (60). Although, a study on patients with type 2 diabetes from Ghana found that 3% of the patients were smokers (61).

Limitations

This survey has some limitations. First, the amount of included participants was limited, and especially there was an uneven participation of male patients attending the clinic. Although, the amount of men included were representative to the amount of men registered at the clinic. Anyhow, the disparity and low number of participants make it impossible to make any analyses comparing the results in a gender aspect. The possible explanations for the difference is discussed later on under personal reflections.

Since it was impossible to analyze HbA1c values, only random blood glucose (RBG) could be used. Hence, it is difficult to evaluate the control of blood glucose. The clinics started in the morning and some of the patients had been told not to eat breakfast before leaving home, and the majority of patients had a long walk prior attending the clinics. Both these factors may contribute to a low blood glucose value. Blood pressure were measured after minutes of rest and in a sitting position. The values from our measurements often exceeded the values from the clinic personal, which might indicate that stress or anxiety about the situation influenced the results. It should also be stated that our measurements sometimes also were a lot higher than the result from the clinic nurse.

The weight and waist circumference were measured on a dressed patient, since it often took place in a public area and with two patients in the room simultaneously. Needless to say, this affected those values.

Furthermore, the language skills in English of the interpreters used, were not perfect, which may influence the questionnaire answers about physical exercise. This may also be the case regarding the question about compliance (i.e. if they follow the physician's suggestions), where all of the patients answered full compliance. Also, the fact that they were answering this question in front of us, may be a factor. The question concerning smoking habits could have been asked differently. Only cigarettes were included and no other form of tobacco use. Other forms of tobacco use, such as chewing tobacco is widely used, but were not included in this study. Neither was passive smoking. Moreover, the question about complications only included diagnosed complications. Hence, symptoms of complications, even with a high probability of a complication, were not included.

Another factor affecting the results, is that the included patients, i.e. the patients attending the clinic, were the ones healthy enough to do so. This leaves us with a healthy population with diabetes since no in-patients were included. Accordingly our sample is not representative for all the diabetes patients.

Personal Reflections

The obvious discrepancy in numbers between registered females and males at the diabetes clinic is a topic that needs further discussion, since the prevalence between the sexes do not differentiate in Tanzania (1). When addressing the matter with the AMOs (Assistant Medical Officer) responsible for the clinics, several potential explanations came up. Compared to females, males are more commonly working

outside the home, and in addition to this they are working far from home. Consequently their ability to attend the clinic is limited. It is also believed that men seek health care later, and first after suffering from severe symptoms. Moreover, the doctor in charge at Huruma hospital proposed that females are more open to education, and that men often goes to the "local healer" and are treated with herbs. More physical demanding work, ignorance and poverty, due to expenditure on alcohol are other factors that were suggested. The result of this may need to be investigated in future trials. Are there numerous undiagnosed males with diabetes out there, and if so, is this disparity reflected inversely when looking at complications to diabetes at the emergency ward? The fact that men at a greater extent are smokers and drink alcohol may support this theory.

Since direct communication between the patients and myself were limited, most of the communication was done through the nurse and misunderstandings are an obvious risk. This has probably not affected the results since it was a multiple-choice questionnaire, but more importantly it makes it difficult to guarantee that all patients understood the purpose of the study and that it was voluntary to participate.

The adverse effects of high alcohol consumption seem to have been addressed by the physicians, since many answered that they quit drinking after receiving their diagnose. Although, the nature of why high alcohol consumption is harmful may be discussed. It occurred to us after a conversation with one of the attending doctors, that it is the combination of the drugs and alcohol that is harmful and some of the patients skip their dose of medication the days they are drinking alcohol.

When spending time in Tanzania, it is inevitable to neglect the extensive multitude of commercials, especially from Coca Cola. Moreover, it is more expensive to buy a bottle of water, than a bottle of soda. Hence, everywhere you go, sodas are consumed in a vast quantity. Research supports the assumption that high soda consumption could yield a higher incidence of cardiovascular risk factors and consequently additional risk of cardiovascular events (62). Furthermore, the shops in Rombo district, where the survey took place, have a wide range of unhealthy products containing lots of sugar and fat, but limited amount of healthy alternatives.

Conclusions and Implications

Given the limited period of time since the diabetes clinics were founded, they had developed considerably. Although, there are still obstacles to overcome. There is a great need for improvements regarding physical activity. The majority of patients are able to walk, and 30 minutes of walking everyday would implicate a huge improvement for most of the individuals in the study group. Likely, this would also have beneficial effects on public health and might help to lower e.g. BMI, blood pressure and waist circumference.

The answers about tobacco and alcohol consumption were impressive. With almost 60% of the patients answering that they stopped using alcohol after they had been diagnosed with diabetes, pinpoint the good work of the clinic staff.

The mean systolic blood pressure was high among the participants and given the associated risks, this should be given a high priority on the clinics. Could it be an outcome of bad adherence (even though 100% of the patients answered they followed doctors prescriptions)? Clinic staff indicated that compliance is a significant problem.

Random blood glucose, which is used at the clinic has obvious limitations, and makes it hard for the attending physician to interpret. In the future, there might be room in the budget to invest in HbA1c-instrument. This could make a substantial difference in regulating and controlling the blood glucose.

The absence of males attending the clinic leaves unanswered questions that needs further work. If there are a lot of undiagnosed men with diabetes, special efforts need to be made to reach out to them before complications occur. But if the proportion of female attending the clinic reflects the numbers in the villages, this differentiates from the rest of the Tanzanian population. Anyhow, the gender differences in prevalence attending the clinics needs to be investigated and addressed. Moreover, looking at the in-patients with diabetes would be interesting. What is the cardiovascular profile among them and what is the proportions of males and females.

Populärvetenskaplig sammanfattning på svenska

Diabetes typ 2 är en högst allvarlig sjukdom som orsakar ett dödsfall var sjätte sekund. Sjukdomen ökar också världen över och 80% av patienterna med diabetes typ 2 bor i låg- och medelinkomstländer. Studier tyder på att ca 50% av patienterna med diabetes dör i hjärt-kärlsjukdom, såsom hjärtinfarkt och stroke. Det är därför avgörande att minska dess största riskfaktorer; högt blodtryck, rökning, högt blodsocker (diabetes), fysisk inaktivitet och övervikt. Eftersom det är känt att dessa riskfaktorer inte bara samvarierar, utan också potentierar varandra måste man behandla på bred front samtidigt för att minska den totala risken.

Studien är genomförd på ett sjukhus och fyra omgivande vårdcentraler på landsbygden i norra Tanzania. Endast patienter med bekräftad diagnos av diabetes typ 2 inkluderades och detta efterhand som de besökte diabeteskliniken. Ett frågeformulär angående bland annat livsstil, ärftlighet, samsjuklighet, komplikationer och följsamhet fylldes i av patienterna med hjälp av två sjuksköterskor, vilka också fungerade som tolkar. Dessutom mättes blodsocker, blodtryck, vikt, längd och midjeomfång.

Bland de 164 undersökta patienterna med diabetes typ 2 i denna studie visade det sig att 85% inte nådde upp till WHO:s rekommendationer för fysisk aktivitet. Dessutom var deltagarnas genomsnittliga blodtryck, blodsocker och kroppsmasseindex (BMI) högre än vad som anses normalt. Det ska dock också tilläggas att rökning och alkoholkonsumtion, vilka båda också är kända riskfaktorer, inte var ett stort problem i regionen.

Populärvetenskaplig sammanfattning på svenska

41

Deltagarna bestod till 82% av kvinnor, vilket överensstämmer med könsfördelningen på diabetesklinikerna i regionen. Totalt i Tanzania är dock förekomsten av diabetes typ 2 lika mellan könen. Det finns ingen enkel förklaring till könsskillnaden på diabeteskliniken, men tänkbara orsaker skulle kunna vara att männen är mindre benägna att söka sjukvård eller att de arbetar på andra platser och därför inte kan närvara. Huruvida om männen är mer frekvent drabbade av komplikationer till diabetes skulle kunna vara intressant att studera i framtiden.

Resultaten ger en fingervisning om var resurser behöver sättas in. Ökad fysisk aktivitet, samt ett minskat sockerintag skulle vara två viktiga livsstilsförändringar i denna population. Om det är så att en mängd män med odiagnostiserad diabetes finns i distriktet är det också av högsta vikt att nå ut till dessa, innan de drabbas av komplikationer.

Acknowledgement

Without these people this study would not have been possible. I would like to address the following my deepest gratitude:

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Questionnaire

1. Gender

Male   Female

☐   ☐

2. Age (yrs)

0-20   21-40   41-60   61-80   >80

☐   ☐   ☐   ☐   ☐

3. Smoking habits (number of cigarettes)

Never smoked   Stopped smoking   Less than 5/day   5-10/day

☐   ☐   ☐   ☐

11-20/day   More than 20/day

☐   ☐

4. Use of alcohol

Never used alcohol   Stopped using alcohol   Less than once/month

☐   ☐   ☐

1-3 times/month   Once/week   2-4 times/week   5-7 times/week

☐   ☐   ☐   ☐

5. Do you suffer from any of the following conditions?

Tuberculosis   HIV   Malaria   Diabetes   High blood pressure

☐   ☐   ☐   ☐   ☐

6. If you have a diagnose of diabetes, when were you diagnosed?

Less than a year ago   1-5 years ago   6-10 years ago   More than 10 years ago

☐   ☐   ☐   ☐

7. Do you have any medication for diabetes?

Yes   No

☐   ☐

8. If you have high blood pressure, when were you diagnosed?

Less than a year ago   1-5 years ago   6-10 years ago   More than 10 years ago

☐   ☐   ☐   ☐

9. Do you have any medication for hypertension?

Yes   No

☐   ☐

10. Do you follow the ordination of medicine for diabetes/hypertension?

Yes   No   Do not have medication for diabetes or hypertension

☐   ☐   ☐

11. Do you have or have had any of the following conditions?

Myocardial infarction   Stroke   Heart failure   Renal failure

☐   ☐   ☐   ☐

Limb amputation   Cataract

☐   ☐

12. Physical activity (30 minutes of moderate exercise)

Never   Less than once/month   1-3 times/month

☐   ☐   ☐

Once/week   2-4 times/week   5-7 times/week

☐   ☐   ☐

13. Do either your parents or siblings suffer from or have had the following conditions?

Diabetes   High blood pressure   Myocardial infarction   Stroke   No/Do not know

☐   ☐   ☐   ☐   ☐

Thank you so much for helping us with our study! We are very grateful!