Diabetes and Hyperglycaemia: A cross-sectional study investigating proportions, risk factors and knowledge of disease among HIV positive and Outpatients at Kibosho Hospital, Tanzania

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Programme in Medicine

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1. ACRONYMS AND ABBREVIATIONS

NCD	Non-communicable disease
CVD	Cardiovascular disease
DM	Diabetes Mellitus
T1DM	Diabetes Mellitus type 1
T2DM	Diabetes Mellitus type 2
HG	Hyperglycaemia
HIV	Human immunodeficiency virus
PLHIV	People living with HIV
ARV	Antiretroviral drug
ART	Antiretroviral therapy
HAART	Highly active antiretroviral therapy
RBG	Random Blood Glucose
FBG	Fasting Blood Glucose
OGTT	Oral Glucose Tolerance Test
SBT	Systolic Blood Pressure
DBT	Diastolic Blood Pressure
CTC	Care and Treatment Centre
OPD	Outpatient Clinic
HDI	Human Development Index
WHO	World Health Organization

2. ABSTRACT

"Diabetes and Hyperglycaemia: A cross-sectional study investigating proportions, risk factors and knowledge of disease among HIV positive and Outpatients at Kibosho Hospital, Tanzania"

Degree Project, Programme in Medicine,
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BACKGROUND

Non-communicable diseases (NCDs) are increasing worldwide and are responsible for seven out of ten deaths each year. Some of the NCDs are asymptomatic even though they are health threatening. Detection, screening and treatment are key components of the global response to NCDs. People living with HIV (PLHIV) on antiretroviral treatment (ART) have been suggested to have an increased risk of developing NCDs like diabetes (DM).

AIM

The primary aim of this study was to investigate the proportions of DM and hyperglycaemia (HG) among PLHIV and patients visiting the Outpatient Department at Kibosho Hospital. Secondary aims were to investigate knowledge, treatment, adherence to treatment, education and complications secondary to DM.

METHODS

This was a cross-sectional study taking place at Kibosho Hospital, Tanzania for eight weeks. We used a structured questionnaire was used in combination with measurements of weight, height, waist circumference, blood pressure and blood glucose.

RESULTS

After exclusion, 390 participants remained for analyse. The proportions of DM (4.0%) and HG (1.7%) were lower among PLHIV compared to other studies in the field. Overweight,

hypertension and abdominal obesity were more common among patients visiting the Outpatient Department. Risk factors associated with DM was age (OR 1.03; 95 % CI 1.02-1.1) and with HG hypertension (OR 3.66; 95 % CI 1.63-9.03). We also found "higher-than-optimal" mean FBG at both facilities which was associated with hypertension (B = 2.25; 95 % CI 0.88 – 3.62), smoking (B= -0.87; 95 % CI (-)1.58 – (-)0.17) and female gender (B= -1.65; 95 % CI (-)3.26 – (-)0.04). PLHIV were less adherent to DM medications compared to ART and suffered from multiple and severe complication secondary to DM. Half of the participants did not know any DM risk factor.

CONCLUSIONS

The proportion of DM among PLHIV was lower than expected and when compared to other studies in the field. However, the small number of PLHIV with diagnosed DM makes it hard to draw conclusions whether HIV infection and ART are associated with DM, but our general findings support the importance of screening for NCDs in the community.

Keywords: "Diabetes", "HIV", "Hyperglycaemia"

3. BACKGROUND

3.1 THE GLOBAL BURDEN OF NON-COMMUNICABLE AND COMMUNICABLE DISEASES

Non-communicable diseases (NCDs) are a worldwide threat to the public health and are responsible for seven out of ten deaths globally each year. Translated into numbers, this correlates to 41 million deaths. Even though the NCDs are more common in older people, 15 out of 41 million deaths occur in the ages between 30 and 69 (1). The World Health Organization (WHO) estimates that the economic loss due to premature death caused by NCDs will reach seven trillion USD in 2030 (2). Another threat to the worlds young population and the global health are communicable diseases such as malaria and human immunodeficiency virus (HIV). Thanks to the HIV/AIDS Programme, there has been a massive reduction in new HIV infections and within seven years the incidence in the East and Southern Africa has decreased with 30 %. Although HIV remains Africas most significant public health challenges the situation is referred to as stabile. In contrast, the WHOs Annual Report from 2017 showed an increase of NCDs (3). Due to nutritional transition to a modern diet consisting of processed food, almost all countries in the Middle East and north Africa have faced a shift in burden of disease from communicable to non-communicable (4).

3.2 NON-COMMUNICABLE DISEASES

NCDs are the result of a combination of physiological, environmental, genetical, and behavioural factors and tend to be chronic or of long duration and medications are often needed to control the diseases (1). Risk factors for developing NCDs can be divided into modifiable behavioural, metabolic, hereditary, and socioeconomic. Examples of behavioural risk factors are tobacco use, physical inactivity, harmful use of alcohol, and an unhealthy diet including access salt, fat, and sugar. Metabolic risk factors are high blood pressure,

overweight and obesity, hyperglycaemia (HG=high blood sugar levels), and hyperlipidaemia (high blood lipids). Poverty is closely linked to NCDs and people who are living in a socioeconomical disadvantaged environment have an increased risk of being exposed to tobacco, harmful air pollution, and unhealthy diet (1, 5). The majority (85 %) of the 15 million premature deaths in NCDs occur in low- and middle-income countries (1).

Among the NCDs, cardiovascular diseases (CVDs) such as myocardial infarction and stroke causes the highest number of deaths per year (17.9 million) and diabetes mellitus comes in fourth place with 1.6 million deaths per year (1).

3.3 Diabetes Mellitus

Diabetes mellitus (DM) is a chronic disease that is characterized by elevated levels of blood glucose. It occurs either when the pancreas does not produce insulin hormone (type 1/T1DM) or when the cells in the body are unable to use the insulin that the pancreas produces (type 2/T2DM) (6). T2DM accounts for 90 % of all DM worldwide (7). T1DM is more often diagnosed in younger ages and because of its severity patients are dependent on lifelong insulin treatment for survival. Today, the cause of T1DM is unknown and cannot be cured (6). The development of T2DM is strongly connected to behavioral and metabolic risk factors and can be prevented with physical exercise, healthy eating, no smoking, and by controlling blood pressure and blood lipids (6). Age and pregnancy are also risk factors for developing T2DM.

The aim of treatment of DM is to achieve and maintain normal blood glucose levels and thereby to prevent progress of the disease, acute and long-term complications, and premature death. Glucose levels depend on several factors such as food intake, duration of diabetes, conditions such as infection and inflammation, age, co-morbidities, physical activity, and medications (8). Normal random blood glucose for the majority of healthy individuals is 4.0-11.1 mmol/l (8). Both T1DM and T2DM are progressive diseases and without correct

treatment complications will occur. The treatment of T1DM is dependent on life-long insulin injections and the primary treatment of T2DM are lifestyle changes in combination with antidiabetic pills. In some cases of severe or badly controlled T2DM, insulin is needed (6). As lifestyle advice, reduction of body weight and abdominal fat are essential to prevent and control DM (9).

3.4 Availability and Cost of Medicine

Availability and cost of medicines like insulin and metformin are problematic in low-and middle-income countries. Because of this, prevention of DM is most important to maintain a good public health. In WHOs Non-communicable Disease Country Capacity Survey from 2015, 117 Member States were asked to rate the availability of essential DM medicines and basic technologies in public funded pharmacies. In the African WHO Region, only 40 % of the countries had Insulin available in 50 % or more of the public facilities or pharmacies. In the American and European WHO Regions the availability of insulin was more than double. For oral DM medications, approximately 50 % of the countries in the African WHO Regions reported a availability in 50 % or more of the public facilities and pharmacies (10). Another problem is the storage of insulin, because it needs to be kept in a fridge until use. In 2017, 65 % of the households in Tanzania had access to electricity (11).

3.5 The Metabolic Syndrome

Dysfunctional insulin production or increased insulin resistance is a mandatory component in the metabolic syndrome, which is a cluster of overweight, hypertension, and elevated blood lipids (10). The underlying cause is not fully clarified, but central obesity and insulin resistance are significant risk factors. Excess of abdominal fat has been proven to alone be superior to BMI in order to indicate risk of T2DM and metabolic syndrome (9). Abdominal fat can easily be measured by the waist circumference or waist-hip ratio and what is

considered to be increased circumference depends on ethnicity and gender (7, 9). Other factors that may have effect on the development of the metabolic syndrome are hormonal changes, inflammatory and proinflammatory conditions, ageing, and lack of physical activity (7). Nowadays, women living in Middle East and north African regions suffers the highest risk of metabolic diseases globally. The risk for men in this aspect was ranked in second place globally (4).

3.6 Complications of Diabetes and Hyperglycemia

Long term complications due to elevated levels of blood glucose are retinopathy, neuropathy, nephropathy, decreased wound healing, amputation, and premature death directly or indirectly by increased risk of CVD (10). In 2012, DM caused 1.5 million deaths directly and additionally 2.2 million deaths by increasing the risk of myocardial infarction and stroke (10, 12). Even patients with higher-than-optimal glucose levels, but below levels of DM, suffer an increased risk of developing CVD (13). Long-term complications and premature deaths secondary to DM are preventable, without major costs for the individuals and society. Screening is an effective way to identify individuals with high risk of developing diabetes and accessibility to treatment with good adherence are necessary to prevent progress of disease.

3.7 Africa and United Republic of Tanzania

The United Republic of Tanzania is located by the coastline in Sub-Sharan Africa, East region and in 2018, the population was 56.3 million (14). According to The Human Development Index (HDI), which is a composite statistic of life expectancy, income per capita, and education, Tanzania is considered to be a low human development country. Poverty is specially common among Tanzanian women as a result of low education and non-income-generating activities such as agriculture and household chores (15). When it comes to life

expectancy, Tanzania's most significant health problem and threat to survival among young are the communicable diseases malaria and HIV (15).

3.8 HIV-INFECTION

HIV was first isolated in 1983 and was then identified as the causative agent of AIDS. The first antiretroviral drug (ARV) came 1987, but the real revolution in HIV treatment came in the middle of the 1990s, when various ARVs were used in combination (16). According to the latest data from 2017 there are 36.9 million people living with HIV (PLHIV) globally, among whom 22 million are on ART. The most affected areas are low- and middle income countries, particularly Sub-Saharan Africa (SSA) (17). In the United Republic of Tanzania, the prevalence of HIV in 2018 was 4.6 % (18).

3.9 THE LINK BETWEEN HIV-INFECTION AND DIABETES MELLITUS

PLHIV are getting older because of ART and non-development of AIDS (19). Since ageing is a risk factor for NCDs, DM among PLHIV are increasing as well. The total prevalence of both types of DM in Tanzania in 2016 was 4.3 % (20). There are studies presenting a higher frequency of DM among PLHIV on ART (15-18%) compared to healthy uninfected individuals (21-23).

However, evidence of HIV-infection and ART as independent risk factors for T2DM are in conflict (19) and studies have shown mixed results (21). In studies showing a higher prevalence of T2DM in PLHIV, multiple risk factors associated with development of DM are seen more frequently in HIV-positive patients. Because of that, HIV-infection has been neglected as an independent risk factor (21, 24).

3.10 Kilimanjaro Region and Kibosho Hospital

The Kilimanjaro region is one of 26 regions in Tanzania, located in the northern part at the border to Kenya. When it comes to health care, Kilimanjaro is considered to be one of Tanzania's most developed regions. Thanks to the attraction Mount Kilimanjaro and the fertile landscape surrounding the mountain, tourism and agriculture are two major sources of income to individuals living in the region. Kibosho Hospital is located in Moshi rural area and in 2018 the assigned catchment included 273 507 people. Hospital clinics of certain interest are the Care and Treatment Clinic (CTC) and the Outpatient Department (OPD). The CTC are responsible for patients who needs regular follow up due to diseases like HIV/AIDS and tuberculosis. Planed follow up, prescription of ART, worsened health status or other medical situation requiring medical assistance are the most common reason for encounter. PLHIV with good response to ART and without additional health issues are considered as stabile and thereby committed to smaller health centers. The regional HIV-prevalence is estimated to 3-5 % (25). The OPD is the largest clinic at Kibosho Hospital and responsible for pre- and postoperative care, regular follow up and newly added medical conditions of varying emergency. Because of hard terrain and poor infrastructure in the hospital surroundings very few patients with emergent or poor health condition reaches the hospital by their own. This leads to a reduction of emergency cases visiting the OPD.

4. SPECIFIC OBJECTIVES

The primary objective of this study was to determine the proportion of DM and HG and associated risk factors for DM among PLHIV and Outpatients attending at Kibosho Hospital. As second objective, to assess the knowledge of disease, education, treatment, adherence to treatment, and complications among participants with diagnosed DM. As a third objective, we wanted to investigate knowledge of risk factors for DM among all the participants.

5. MATERIALS AND METHODS

5.1 STUDY DESIGN

The study was a cross-sectional study that took place at Kibosho Hospital, Tanzania between the 7th of October and 29th of November 2019. To bring power to the study a sample size of 360 was demand and carried out with simplified sample size calculation with a precision level of 5 % and an estimated number of 5500 patients visiting the two facilities. Our aim was to enroll 400 patients in total to secure margin. PLHIV were recruited from CTC. Recruitment of Outpatients from OPD were not dependent on HIV-status and could be both HIV-positive and HIV-negative. Data was collected Monday to Friday between 8.00 am-13.00 pm. Inclusion criteria were 18 years or older and ongoing ART for PLHIV.

We used a semi-structured questionnaire and capillary blood glucose sampling at both facilities. Responsible for blood glucose sampling and questionnaire at the CTC was Dr. Eileen Lirhunde. At the OPD, participants were recruited in the triage and all patients received oral information about the study. Free blood glucose test was offered as a screening for DM and HG. When a patient agreed to participate, he or she was brought into a quiet and separated consultation room where we measured the blood glucose and asked the questions. To minimize bias, one nurse was responsible for the questionnaire and plasma glucose

sampling at the OPD. Weight, height, blood pressure, and pulse rate were measured in the triage. Participants were interviewed while they were waiting to meet the physician in charge at the OPD. Patients were anonymized with ID- numbers before the interview, and data was recorded without connection to their personal identity.

The questionnaire (attached in appendix) consists of both validated questions (26, 27) and self-designed ones to match our objectives. The original questionnaire was written in English by Linda Degeryd and Greta Guidotti and was then translated in written form into Swahili by Dr. Eileen S. Lirhunde, who also served as translator at the CTC. The questionnaire was read out to the patient in Swahili and answers were translated into English and recorded by Linda Degeryd or Greta Guidotti, who attended all the interviews. The questionnaire included general questions about age, gender, and lifestyle. HIV-status, time since HIV-diagnosis, time on ART, and adherence to ART were asked to PLHIV. All patients were asked about risk factors for DM and what they thought were normal levels of blood sugar. If a patient had a diagnosed DM, more detailed questions followed. Specific diabetes questions included awareness of DM-type, time since diagnose, treatment, adherence to treatment, reason for non-adherence, use of glucose meter in the home, diabetic education, medical history and knowledge of diabetes complications.

5.2 Measurements and Definitions

DM was defined as diagnosed type 1, type 2, or a history of gestational diabetes. Hyperglycemia was defined as non-diagnosed diabetes with a random blood glucose (RBG) ≥ 11.1mmol/l or a fasting glucose (FBG) ≥ 7.0 at the time of enrolment. Fasting was defined as ≥ 10 h since the last meal or sweetened drink. Water, tea, and coffee without sugar or milk were considered non-sweetened (28). The capillary glucose meter GlucoPlus was used to analyze capillary blood glucose levels. The machine was calibrated in the hospital laboratory.

During time of data collection, the two glucose meters were calibrated week number 1, 4, and 8. Margin of error was ± 0.3 mmol/l. From the weight and height BMI was calculated and values ≥ 25 was defined as overweight, and ≥30 as obesity (9). Waist circumference was measured with patients standing in upright position. Place of measurement was midpoint, between the top of the iliac crest and the lower margin of the last palpable rib in the mid axillary line. Increased waist circumference was defined as ≥ 102 cm for men and ≥ 88 cm for women (9). Among patients with a systolic blood pressure ≥130 mmHg and/or a diastolic pressure ≥80 mmHg, a second blood pressure was measured after a rest for 10-15 minutes while answering the questionnaire. Mean blood pressure was calculated from the two measurements. Hypertension was defined as set diagnose from a health professional or SBP ≥ 140 mmHg or DBP ≥ 90 mmHg at the time of enrolment. Physically active was defined as any bodily movement that requires energy expenditure for at least 30 minutes most days of the week (total ≥ 150 minutes/week) (29, 30). Subgroups of physical activity are physical work, active transport, house chores, and exercise. Exercise was defined as planned, structured, repetitive activities like jogging, gym, ball sports etc. Smoking was divided into non-smoker, current smoker previous smoker. Adherence to ART and DM medicines was defined as self-reported “always remember to take my medicines” in combination with 0 missed pills the last week.

5.3 Statistical Methods and Variables

Outcomes and dependent factors were DM, HG, FBG, and RBG. Research variables and independent factors were age, gender, BMI, waist circumference, hypertension, smoking, and physically active (minutes/week). Descriptive statistics were used to investigate the proportions of DM and hyperglycemia, the knowledge of disease, education in DM, treatment, adherence, and complications secondary to DM. Paired sample T-test was used to

investigate the difference in mean value of FBG/RBG between PLHIV and Outpatients. Simple linear regression was carried out to investigate the relationship between independent factors and dependent factors FBG/RBG. Logistic regression was used to investigate the relationship between independent factors and dependent factors DM and hyperglycemia. Correlation was made with non-parametric Spearman analysis. Insignificant variables got a second chance to prove its effect in all regression analysis.

6. ETHICS

Ethical considerations follow the guidelines issued by the World Medical Association Declaration of Helsinki and the Universal Declaration of Human Rights. An ethic approval was made by the director of Kibosho Hospital through an ethical committee at Kilimanjaro Christian Medical Centre in Moshi. To minimize burden for the patients, the plasma glucose samples were collected by experienced staff at the hospital. All participants received oral information about the study and were also informed that participation was voluntary. Participants were free to stop the interview and withdraw their data at any time.

Blood glucose level and blood pressure was recorded on an information sheet which was given to all participants (attached in appendix). The sheet also included the normal ranges of blood sugar and blood pressure and information regarding prevention against DM and hypertension through regular exercise, healthy diet, non-smoking and avoiding harmful alcohol consumption. When hyperglycemia was found, the physician in charge was informed and Kibosho Hospital was responsible to arrange follow up with oral glucose tolerance test (OGTT) with 2-h plasma glucose (2-h PG) to confirm DM diagnosis.

7. RESULTS

7.1 CHARACTERISTICS OF THE PARTICIPANTS

In total, 5492 patients visited the two facilities during our eight weeks of data collection. We interviewed 400 patients and 10 were later excluded because of underage, unknown HIV-status, pregnancy and uncomplete measurements. Among the remaining 390 participants, 217 were recruited from the OPD and 173 from the CTC (Fig. 1). All patients recruited from the OPD were HIV- negative.

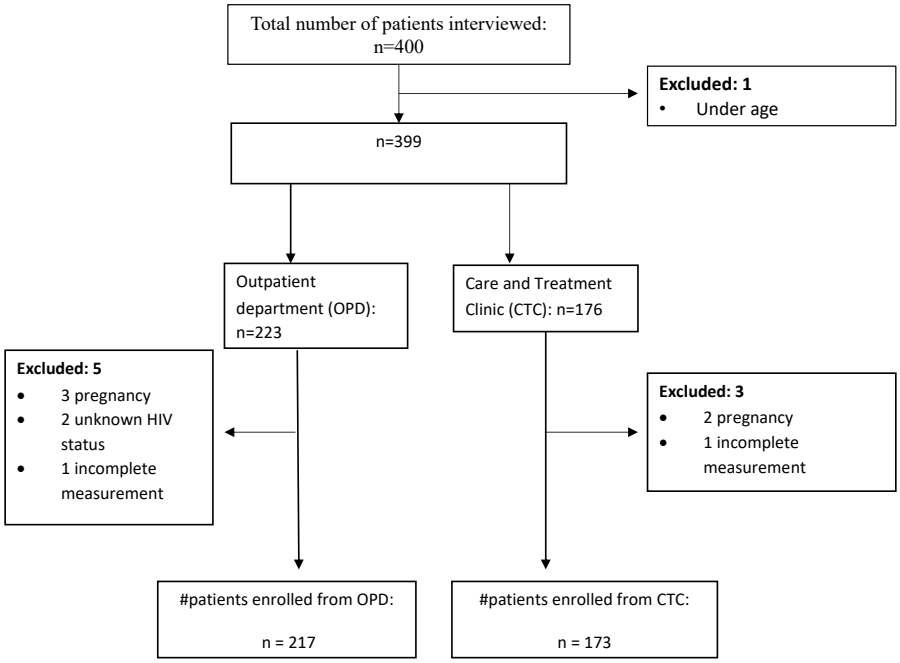

Figure 1. Schematic presentation of the participant selection process.

The majority of the participants were 45-54 years old (27.9%) and 69.5% were women (Table 1). There were 44.4% PLHIV among the participants. Christian (94.6%) was the dominating religion and most common tribe was Chagga (87.2%).

Table 1. Socio-demographic characteristics of the participants (n = 390).

Variables	n	%
Age in years		
[Mean; SD]	**[49; 15]**	
18-24	33	8.5
25-34	40	10.3
35-44	71	18.2
45-54	109	27.9
55-64	78	20.0
65^{+}	59	15.1
Gender		
Male	119	30.5
Female	271	69.5
HIV status		
Positive	173	44.4
Negative	217	55.6
Religion		
Christian	369	94.6
Muslim	21	5.4
Ethnicity		
Chagga	340	87.2
Pare	19	4.9
Others	31	7.9

Characteristics of PLHIV (n = 173) and Outpatients (n = 217) are shown in table 2. Female gender dominated both groups and the mean age among Outpatients was 50 years compared to 47 in PLHIV. Outpatients had a higher proportion of hyperglycemia (2.8 %), DM (7.4 %), hypertension (35.0 %), increased waist circumference (47.0 %), overweight (32.7 %) and obesity (20.3 %) compared to PLHIV. There was no significant difference in proportions of DM and HG between groups. HIV negative individuals were older and had in average lived with DM for longer time (6.1 years) compared to PLHIV. SBP and DBP were higher among uninfected participants with a mean difference of 7 mmHg for both values between groups. Among uninfected 85 % were physically active compared to 75 % among PLHIV.

The mean time with HIV infection was 7.3 years and all PLHIV received ART with a mean treatment time of 6.3 years. Mean CD4 cell count was 434 cells/ mm^3.

Table 2. Characteristics of people living with HIV (PLHIV) and Outpatients (n=390).

Variables	PLHIV (n=173)	Outpatients (n=217)
DM diagnose, n (%)	7 (4.0)	16 (7.4)
Years with DM*	3.5 (3.5)	6.1 (4.6)
Hyperglycaemia, n (%)	3 (1.7)	6 (2.8)
Female gender, n (%)	110 (63.6)	161 (74.2)
Age *	47 (12.0)	50 (18.0)
Increased waist circumference, n (%)	52 (30.0)	101 (47.0)
Overweight, n (%)	34 (19.7)	71 (32.7)
Obese, n (%)	23 (13.3)	44 (20.3)
Hypertensive, n (%)	30 (17.0)	76 (35.0)
Mean SBP, mmHg *	121 (21.0)	128 (19.0)
Mean DBP, mmHg *	74 (13.0)	81 (11.0)
Current smoker, n (%)	14 (8.1)	4 (1.8)
Previous smoker, n (%)	29 (16.8)	13 (6.0)
Physically active, n (%)	130 (75.0)	184 (85.0)
Years with HIV infection *	7.3 (4.4)	N/A
On ART, n (%)	173 (100.0)	N/A
Years with ART *	6.3 (3.9)	N/A
CD4 cell count cells/mm^3 *	434 (257)	N/A

** = values are presented as [mean; SD]*
DM = diabetes mellitus
SBP = systolic blood pressure *DBP = diastolic blood pressure*
ART= antiretroviral therapy *N/A = non-applicable*

7.2 Proportions of DM and HG

Among all 390 participants the proportion of DM were 5.9%, were 5.4 % had current DM and 0.5 % reported DM during pregnancy. The proportion of HG among undiagnosed individuals was 2.3%. Among participants with diagnosed DM 43% were hyperglycaemic at the time of enrolment.

7.3 Proportions of DM and HG in PLHIV and outpatients

Among Outpatients the proportion of DM was 7.4% and among PLHIV 4.0%. Even the proportion of HG was higher among Outpatients (2.8%) compared to PLHIV (1.7%). (Fig.2)

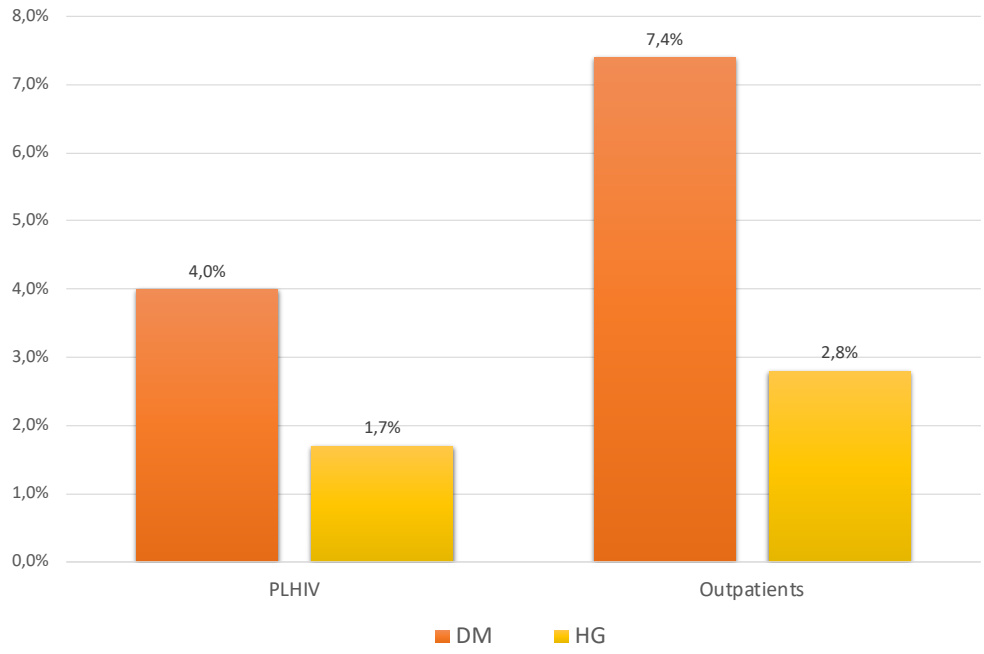

Figure 2. Proportions of diabetes (DM) and hyperglycaemia (HG) among people living with HIV (PLHIV) and Outpatients (n=390).

7.4:1 RISK FACTORS ASSOCIATED WITH DM

When the relationship between DM and present risk factors was investigated, age was significant in its relationship to DM (*P = 0.045)* with an odds ratio of 1.034 (Exp(B)) (Table 3). Increased waist circumference was insignificant in its relationship to DM (*P = 0.055*). Insignificant variables not shown in the table are hypertension, smoking, physical inactivity, and gender. BMI was excluded because of correlation with waist circumference.

Table 3. The association between variables age and increased waist circumference and dependent factor diabetes mellitus.

Model		B	95% Confidence interval for B	Sig.	Exp(B)
(1)	Age	0.034	1.02 – 1.1	0.045*	1.034
	Increased waist circumference	0.987	1.02 – 6.13	0.055*	2.683

**Significant level p < 0.05*

7.4:2 RISK FACTORS ASSOCIATED WITH HG

When the relationship between HG and risk factors was investigated, hypertension was significant in its relationship to HG (*p = 0.01)* with an odds ratio of 3.657 (Exp(B)). Insignificant variables not shown in the table are age, HIV-status, smoking, physical inactivity, and gender. BMI was excluded because of correlation with waist circumference (Table 4).

Table 4. The association between variable hypertension and dependent factor hyperglycaemia.

Model		B	95% Confidence interval for B	Sig.	Exp(B)
(1)	Hypertension	1,297	1,63 – 9,03	0,01*	3,657

**Significant level P < 0.05*

7.7 KNOWLEDGE OF DISEASE AND DM EDUCATION

To investigate knowledge of disease among participants with DM (n = 23), we asked *"Which type of DM do you have?"*. The majority (87%) did not know their DM type while 9% answered DM during pregnancy and 4% answered T2DM.

Furthermore, we asked "*Have you been educated in our DM by health professionals and if YES, what was it regarding?* Education had been given to 21 DM patients and the education consisted of information about diet/weight (95.2%), body exercise (57.1%), treatment (medications) (33.3%), glucose meter (23.8%), preventing complications (14.3%), and others (9.5%) like care of wounds and feet (Fig. 3).

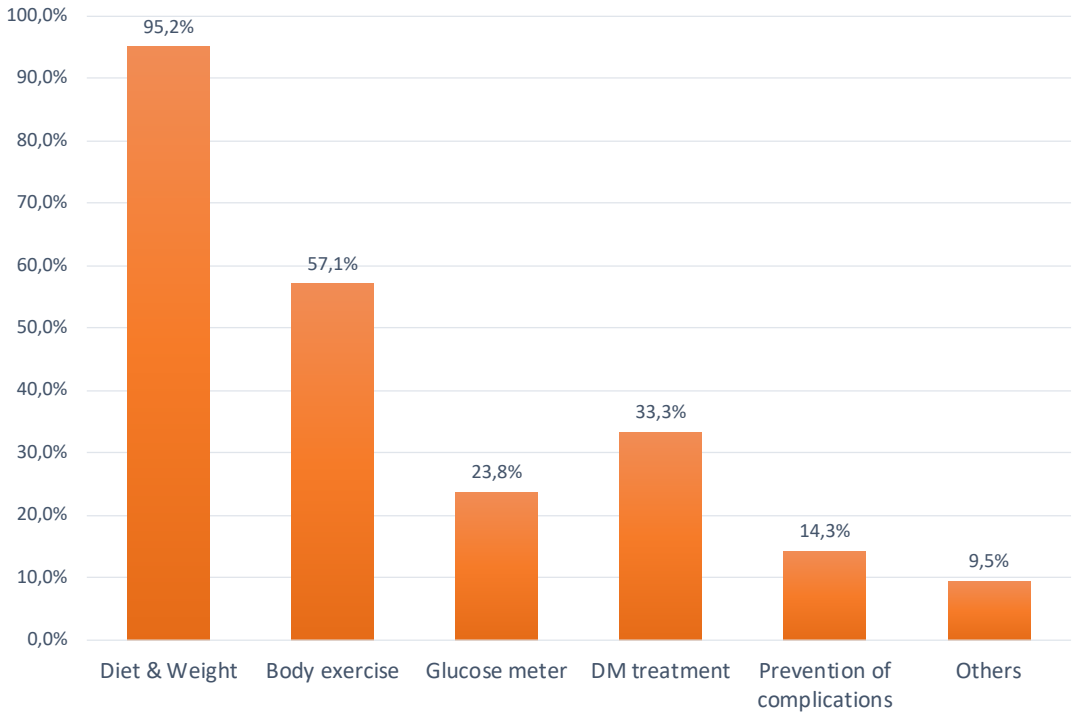

Figure 3. Multiple answer question regarding diabetes-education from health professional to participants with diabetes (n=21). Education in DM-treatment (DM=diabetes mellitus) concerned diabetic medications and "Others" were care of wounds and feet.

7.8 DM TREATMENT AND ADHERENCE

Treatment and adherence to treatment were investigated among DM patients (n = 23). The majority (65.2%) was treated with only pills and 13.0% used pills in combination with diet and exercise. Diet and exercise were also used together with insulin (4.3%) or as single treatment (4.3%). Thirteen percent did not have any treatment at all and (Fig. 4).

Among Outpatients, 68.8% reported "good adherence" to DM medications and among PLHIV 57.1%. Outpatients also reported a higher proportion of "no good adherence" (18.8%) but among PLHIV there, 28.6% did not take medications at all (Fig. 5).

Reason for not good adherence was "I forgot", "I only take medicines when blood sugar is high", or "I only take medicines when I have symptoms". Reasons for "not taking medications" was "I do not need them" or "I do not believe in the effect of medications".

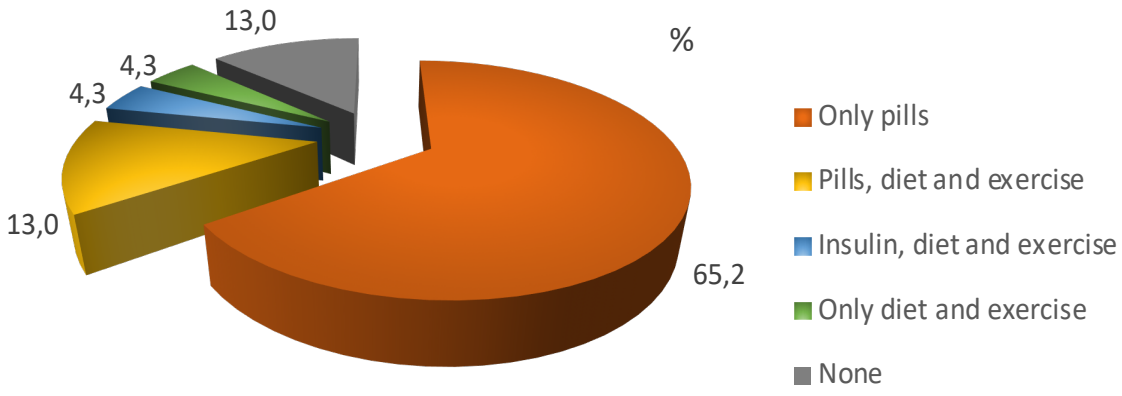

Figure 4. Treatment among participants with diabetes diagnosis (n = 23). The patients with no treatment had history of gestational diabetes (n = 2) and preferred natural medicines (n = 1).

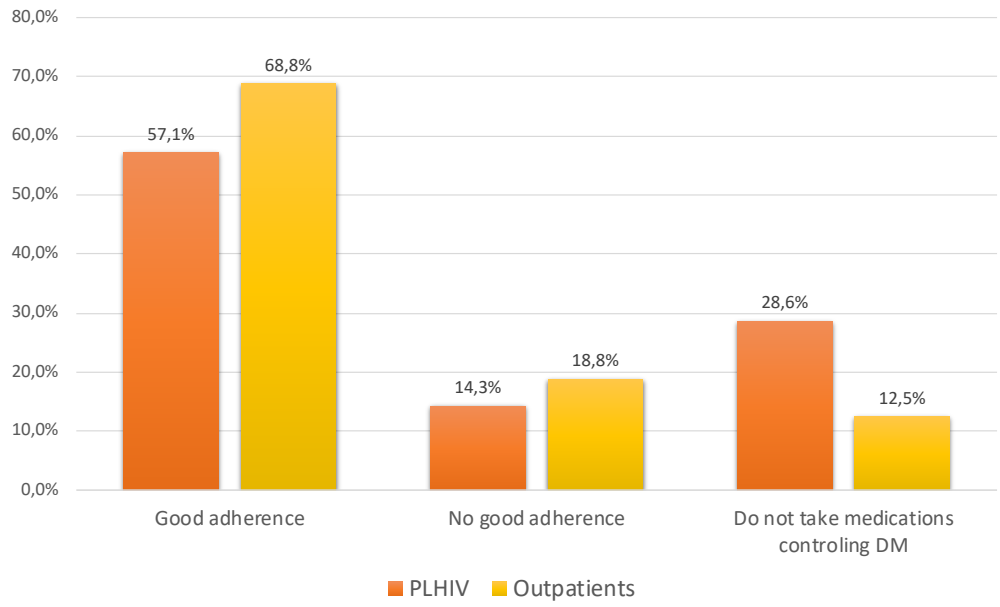

Figure 5. Adherence to diabetic treatment among people living with HIV (PLHIV) and Outpatients. DM= diabetes mellitus.

7.9 Adherence to ART

Among PLHIV, 91% were adherent to ART (n = 173). Reasons for non-adherence were travel, ran out of medicines because of blocked roads due to bad weather conditions, could not afford the transport or too weak to get to the hospital.

7.10 Complications secondary to DM

Participants with DM were asked *"Has your doctor told you that you have complications from your DM?"* and 12 out of 23 responded YES. Among PLHIV, neuropathy was the most common complication (57%) followed by retinopathy (43%) and 14% had history of amputation due to DM. Among the uninfected individuals, 38% reported retinopathy, 31% neuropathy, and none had a history of amputation. (Fig.6)

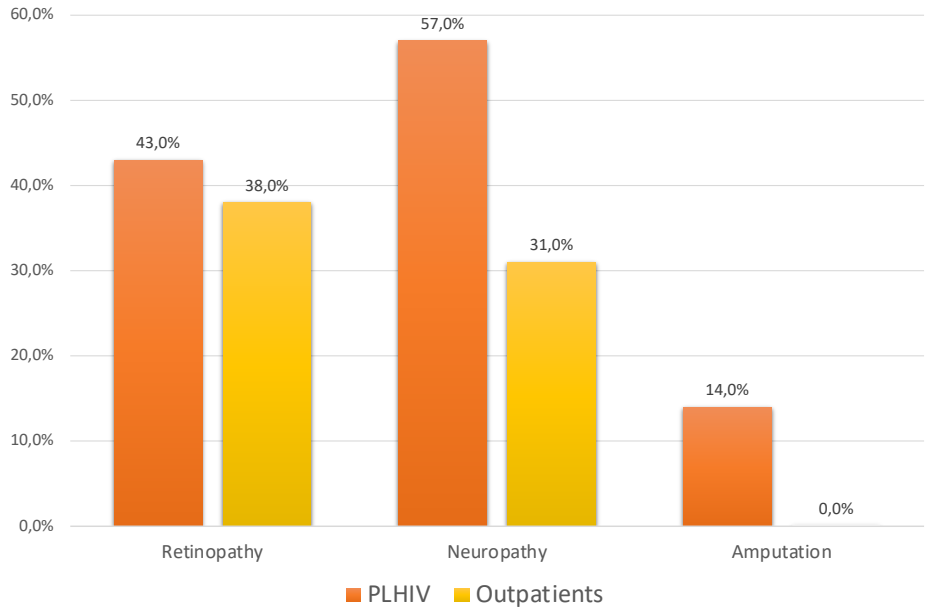

Figure 6. Self-reported complications secondary to diabetes among people living with HIV (PLHIV) and Outpatients.

7.11 KNOWLEDGE OF RISK FACTORS FOR DM

All patient responded to the open question *"Do you know any risk factors for developing DM?"* (n = 390). The most common answer was "do not know" (51.3%) followed by unhealthy diet (40.5%), "others" (14.6%), body inactivity (8.2%), overweight/obesity (7.7%), family history of DM (4.4%), high blood pressure (1.5%), tobacco use (1.3%), DM during pregnancy (<1 %), and waist circumference (<1%). Responses recorded as "other" was alcohol, pancreatic disease, and chronic diseases (Table 8).

Table 8. Multiple answer question regarding knowledge of risk factors for diabetes mellitus (DM) (n = 390).

Responses to risk factors	Frequency	Percent
Unhealthy diet	158	40.5
Body inactivity	32	8.2
Overweight/obesity	30	7.7
Family history of DM	17	4.4
High blood pressure	6	1.5
Tobacco use	5	1.3
DM during pregnancy	3	0.8
Waist circumference	1	0.3
Others*	57	14.6
Do not know	200	51.3

** Responses in combination with others was alcohol, pancreatic disease and chronic diseases like HIV and cancer.*

7.12:1 ADDITIONAL FINDINGS- MEAN DIFFERENCE OF GLUCOSE VALUE (FBG/RBG) IN PLHIV AND OUTPATIENTS

There was a significant difference in mean FBG between Outpatients and PLHIV ($p = 0.011$). The mean FBG among PLHIV was 5.12 mmol/l and among Outpatients 6.68 mmol/l. The mean difference in FBG between groups was 1.56 mmol/l (Table 5).

Table 5. Mean random blood glucose (RBG) and mean fasting blood glucose (FBG) among people living with HIV (PLHIV) and Outpatients (n=390).

		Mean			
Glucose status	Overall	PLHIV	Outpatients	Mean difference	P-value
RBG	6.01	5.95	6.04	0.09	0.724*
FBG	5.79	5.12	6.68	1.56	0.011*

**Significant level p=<0,05*

7.12:2 VARIABLES ASSOCIATED WITH FBG

There was a significant relationship between variables hypertension, gender and smoking and dependent factor FBG (*p = 0.001*, *p=0.044 and p=0.016 respectively)*. Hypertension was positive associated to FBG (B = 2.07) while smoking and gender were negative associated (B= -0.87 and B= -1.65, respectively). Insignificant variables not shown in the table are age, physically active and increased waist circumference. BMI was excluded because of correlation with waist circumference (Table 6).

Table 6. The association between variables hypertension, smoking and gender and dependent factor fasting blood glucose.

Model		B	95% Confidence Interval for B	Sig.
(1)	(Constant)	7.65	6.76 – 9.08	0.000*
	Smoking	-0.87	(-)1.58 – (-)0.17	0.016*
	Female gender	-1.65	(-)3.26 – (-)0.04	0.044*
	Hypertension	2.25	0.88 – 3.62	0.002*

**Significant level P<0,05*

7.12:3 VARIABLES ASSOCIATED WITH RBG

Hypertension, increased waist circumference, and physical activity were all significant in their relationship to RGB (*p = 0.001, 0.001, and 0.021 respectively*). Both hypertension and increased waist circumference were positive in their association with RBG (*B = 0.90 and B = 0.85 respectively*) and physical activity had a protective and negative association with RBG (B = -0.708). Insignificant variables not shown in the table are age, smoking, and gender. BMI was excluded because of correlation with waist circumference (Table 7).

Table 7. The association between variables hypertension, increased waist circumference, physical activity and dependent factor random blood glucose.

Model		B	95% Confidence Interval for B	Sig.
(1)	(Constant)	6.01	5.40 – 6.60	0.000*
	Hypertension	0.90	0.35 – 1.44	0.001*
	Increased waist circumference	0.85	0.35 – 1.35	0.001*
	Physically active	-0.71	(-)1.30 – (-)0.11	0.021*

**Significant level p<0,05*

8. DISCUSSION

8.1 PRIMARY FINDINGS

The total proportions of DM and HG among participants in this study were 5.9% and 2.3%, respectively. As expected, the proportion of DM was higher compared to older population based studies from SSA (4-4.9%) (31, 32) since this study was hospital based and NCDs are increasing worldwide. In 2016, the prevalence in the Kilimanjaro region (Moshi urban and rural areas) was similar (5.7 %) (25). The study from 2016 conducted a randomized household survey and used a mobile research team to collect their data during 2014-2015. Because of this, one might expect a bigger difference in proportions of DM (0.2%). This could be explained by different criteria for the DM-group. In the study from 2016, HbA1c was used as a diagnostic tool and describes average blood sugar for the past two to three months. We used current DM or history of gestational DM as criteria and undiagnosed participants with newly discovered high FBG/RBG were referred to as hyperglycaemic. According to American Diabetes Association FBG, 2-h PG value during a 75-g OGTT and HbA1c are equally appropriate as diagnostic tool and can be used both for screening and diagnose. Although, it should be mentioned that the different tools not necessarily detect diabetes in the same individuals (33). For example, HbA1c is inappropriate for diagnosis of newly onset T1DM, gestational DM, and patients with symptoms of DM for less than two months. This means that our proportion of 5.9 % might be higher after follow-up of hyperglycaemic participants and that prevalence reported in the study from 2016 might be underestimated.

Among Outpatients, the proportions of DM and HG was 7.4% and 2.8 %, respectively and among PLHIV 4.0 % and 1.7 %. All PLHIV with DM were diagnosed with DM after being diagnosed with HIV and initiation of ART. Since Outpatients were actively seeking health

care and do not represent a proper HIV negative control group, we cannot compare the results. Furthermore, CVDs are probably over-represented among the Outpatients and an important reason for visiting the hospital. But we can compare our low proportion of DM among PLHIV to other studies, since they are conducted at special HIV clinics. Higher prevalence of T2DM among PLHIV on ART has been reported in several studies (21-24). Two of them are cross-sectional studies from Tanzania and England (18% and 15%, respectively) (22, 23). In the Tanzanian study, ART naïve PLHIV had significantly lower prevalence of T2DM compared to PLHIV on ART. The difference in prevalence could not be explained by obvious cofounders like age, waist-hip ratio, or BMI nor by ART or duration of ART (23). One explanation to our low proportion might be geographic differences and lower rates of risk factors with possible potentiating effect of ART. The theory of metabolic changes due to ART has been described in previous studies and relies on excess of body fat distributed to the abdominal area (34). PLHIV on ART in our study tended to have lower numbers of risk factors like overweight and obesity compared to participants in other studies which might explain the difference in results. But there are also studies suggesting that highly active ART has no effect on glucose metabolism (FBG and insulin sensitivity) but are associated with development of DM risk factors (35). Because of the study method, we cannot draw conclusions about the chain of events since that would demand following participants over time, from ART naïve to long time with ART.

We found significant relationships between age and DM (OR = 1,034) and hypertension and HG (OR = 3,657). Age and hypertension are well established risk factors for DM and significant associations have been reported in previous studies as well (24). Even though several lines of evidence suggest abdominal obesity as a strong risk factor there was no significant association to DM or HG.

Discussing variables without significant association relationship to DM and HG, is possible that our sample size lacks the power to truly investigate if PLHIV on ART suffers from an increased risk of developing DM as suggested by bigger studies (21, 23, 24). There is also a risk of losing shades by grouping scale variables into nominal variables which could have given us more associated risk factors. Further analysis could be run on the material to investigate separate risk factors impact om DM development among PLHIV without transforming them into category groups.

More than half (57%) of the DM patients in this study were hyperglycaemic at the time of enrolment. Treatment targets in DM varies between individuals and are dependent on age, time with DM and co-morbidities. Previous research has shown poor achievements of treatment targets (40-53%) among individuals with T2DM and are associated with long time of DM (36). Many patients reported non-adherence to DM medicines in the morning because of planned hospital visits, which could be one reason for HG among DM patients. This was not a recommendation from the doctors, but they recognised the phenomenon and the importance of informing patients to take the medicines as usual. Other reasons could be poor adherence or insufficient treatment or doses, which were not thoroughly investigated in this study. Among the undiagnosed patients, 11 (3%) were hyperglycaemic at the time of enrolment which supports the importance of screening.

Almost all (21/23) patients had been educated in DM by health professionals with “diet and weight”, “body exercise”, and “DM treatment” being the most common education topics. Despite this, very few patients were aware of the different types of DM and a minority (3/23) knew their DM type. Poor knowledge regarding DM type is presented in other studies as well (25). Two of them responded history of gestational DM and had no current DM-treatment. Regarding the question about which treatment, they were on, 19 were treated with pills which indicates T2DM and one with insulin who probably had T1DM. We found low rates of DM

awareness among participants from both facilities, even though one might think that regular healthcare visits would lead to better knowledge among PLHIV. Similar low awareness rates have been seen in other studies from Africa and indicates that patients need to be more included in their health situation and receive information repeatedly (23). Among DM patients treated with pills, the most common drugs were metformin and glibenclamide as single or combination treatment which corresponds to the national treatment guidelines (29). A minority (4/23) used "diet and exercise" in addition to medical treatment and one used "diet and exercise" as only treatment with satisfying effect on blood glucose levels. When we asked about blood sugar testing at home, one third (8/23) had a glucose meter of their own. Remaining ones tested blood glucose levels at the hospital between once a month to twice a year. The most likely explanation to this is that the majority (20/23) had T2DM which usually does not need daily blood glucose testing. It could also be a question of cost, since all material and medicines are private funded.

PLHIV were more adherent to ART (91%) than to DM medications (57.1%) and one third of the HIV-positive participants with DM did not take any DM medicines at all. One possible reason for the difference in adherence to ART compared to DM-medications among PLHIV is the cost. ART is for free while pills, insulin, and equipment for home testing are self-funded. Even though no one answered that they could not afford their medications, we still consider the cost as one reason for low adherence to DM medications. This because economic situation is a delicate subject to discuss and self-reported answers may underestimate the truth. This was also confirmed by the doctors working at Kibosho Hospital who daily struggled with patients who could not afford investigations or treatments. Misunderstanding and/or lack of information between patients and physicians might also contribute to low adherence and few patients were aware of that DM is a chronic disease and that correct treatment with good adherence is important to avoid long-term complications.

Awareness of complications was self-reported, and eight Outpatients and four HIV-positive patients had been told that their complications were secondary to DM. PLHIV in general had more than one complication and more severe complications (amputation). Since the risk of developing complications secondary to DM increases with time, one might expect that PLHIV had lived with DM longer. On the contrary, the mean time with DM was shorter among PLHIV compared to Outpatients (3.5 vs. 6.1 years). Possible reasons for multiple and more severe complications among PLHIV are lower adherence to DM-medicines, more severe DM (T1DM) and the fact that two out of seven did not use medicines to control their DM. A weakness in the questionnaire is that we did not ask about income generative work or employment which makes it impossible to make a statement about the socioeconomic status among PLHIV.

Half (51%) of the participants did not know any risk factor for DM. The second most common answer (41%) was “unhealthy diet” such as sugar and fat and the third most common answer was “others” in combination with alcohol. Body inactivity and overweight/obesity had a respondent rate of 8.2% and 7.7%, respectively. Very few (< 1%) were aware that age and abdominal obesity are risk factors for DM. More than half of the participants did not know any risk factor, which was an unsatisfying result. This identify an important information gap to fill in order to prevent DM and prediabetic states. Lifestyle intervention has been proven effective in order to prevent DM among patients with impaired fasting glucose and resulted in a 43% lower incidence of DM compared to the control group during a 20 years period (37).

8.2 ADDITIONAL FINDINGS

” Higher-than-optimal” mean FBG were measured at both facilities which is a risk factors for developing CVDs (13). Individual levels of FBG > 4.9 mmol/l has showed a continuous association with ischemic heart disease and stroke (38). Among Outpatients, mean FBG was 6.68 mmol/l which is, as an individual value, referred to as prediabetes (FBG 5.6-7.0 mmol/l). A meta-analysis published in Lancet 2006 reported that people living in SSA had the lowest levels of mean fasting plasma glucose among all 52 countries included in the study. The mean for men and women, age-standardized by sex and region, were 5.13 and 5.15 mmol/l, respectively. No information about HIV infection was mentioned in the characteristics of participants (13). These values are in line with our findings of mean FBG among PLHIV (5.12 mmol/l) for both genders. However, since this was a hospital-based study we cannot compare the high mean FBG among Outpatients with the values from the meta-analysis which was population based. But importance of prevent and control DM by lowering FBG still remains because of the increased risk of stroke and ischemic heart disease (39). Living in rural areas makes it hard for patients to reach the hospital by their own and bad infrastructure makes the transport of patients in need of acute management problematic. Because of this, disability or death are common outcomes of severe stroke or ischemic heart disease.

To investigate specific variable associated to FBG, a linear regression analysis was made. The analysis presented a significant association between FBG and hypertension (B = 2.25; 95 % CI 0.88 – 3.62), smoking (B= -0.87; 95 % CI (-)1.58 – (-)0.17) and female gender (B= -1.65; 95 % CI (-)3.26 – (-)0.04). Prevention of hypertension in order to lower FBG and prevent CVDs is clinically relevant while promote smoking to prevent high FBG would only be harmful. Discussing the protective effect of female gender, higher levels of FBG among men has been reported in previous studies conducted in the Kilimanjaro region, especially those living in urban areas (40). However, to prevent development of DM in both genders is to be

recommended since women suffers an increased risk of developing DM during pregnancy and after regression of gestational DM (41).

Variables associated with RBG were hypertension (B=0.90; 95 % CI 0.35-1.44), increased waist circumference (B=0.85; 95 % CI 0.35-1.35) and physical activity (B= -0.71; 95 % CI (-)1.30 – (-)0.11). Even though RBG is a minor predicative variable than FBG, all these findings are in line with recommendations how to prevent and control DM and are clinically relevant in order to prevent CVD as discussed above. Increased waist circumference and hypertension had an elevated effect on RBG and physical activity was protective by lowering the RBG.

8.3 STRENGTHS AND LIMITATIONS

There are some strengths and limitations in this study. One strength is the number of participants included in the study which gave the analysis power to investigate our objectives. Second, we had the same interviewers during the entire period of data collection and to minimize bias between facilities Linda and Greta switched facilities day by day.

First limitation, we were not able to use Outpatients as a control group, even though, they all were HIV negative. This since the proportions of DM and HG probably most likely are higher in this group compared to a randomized control group outside the hospital. Instead, the Outpatients were used to compared adherence and complications secondary to DM and knowledge of risk factors. The second limitation is the small number of HIV positive participants with DM which makes it hard to draw conclusions about causality. Third, self-reporting might contribute to both over-and underestimation of proportions. For adherence and physical activity, the percentage of participants with good adherence and being physically active may be overestimated. Fourth, the presence of both treating physicians and a Swedish student during the interviews may have affected the answers in both groups. Fifth, our

questionnaire was a combination between validated questions from previous studies and some new questions written by us. Unfortunately, there are gaps about socioeconomic status and education level that may had been useful in our analysis. Sixth, using a translator and not be able to understand the language which was spoken is a source of bias. Final limitation, capillary blood glucose measurement is inferior to venous blood glucose measurement.

The free glucose test is one possible bias in the recruitment process. The cost is normally 5000 Tanzanian Shilling per sample, which is comparable to five hospital travels with the local bus. This offer might have affected the will to participate.

9. CONCLUSIONS

As expected, proportions of DM and HG were higher among Outpatients and they also had higher numbers of risk factors like overweight, abdominal obesity and hypertension. The proportion of DM among PLHIV was lower compared to previous study results and could be explained by geographic differences, less risk factors and different diagnostic tools and diagnosis criterial. PLHIV seemed to be less adherent to their DM medications compared to ART which could be explained by the cost of DM medications. Poor adherence might have contributed to multiple and more severe complications secondary to DM among PLHIV. Age had a significant relationship to DM and hypertension was associated with HG. This tells us that NCDs like DM and hypertension are closely linked and are affecting each other and worthy to identify by screening.

Knowledge is necessary to encourage prevention of DMT2 and to control and reduce complications secondary to DM. This since half of the participants did not know any risk factor for DM. This study will also serve as material in the upcoming project “Know your

numbers", a screening program for HIV, hypertension and DM with the mission to reach rural areas of Kilimanjaro region. Hopefully, this report will bring knowledge and insight to the health professionals involved in the project and increased health to the people living in the catchment area of Kibosho Hospital.

10. POPULÄRVETENSKAPLIG SAMMANFATTNING PÅ SVENSKA

Diabetes är en kronisk, metabol sjukdom kopplad till stigande ålder, hereditet, övervikt, bukfetma och brist på fysisk aktivitet. Förekomsten av diabetes typ 2 ökar globalt i takt med en växande och åldrande befolkning samt en allt mer ohälsosam livsstil. Diabetes och förhöjda blodglukosnivåer ökar risken för hjärt- och kärlsjukdom och för tidig död, framför allt i låg- och medelinkomstländer. Hjärt-och kärlsjukdom och den smittsamma sjukdomen HIV är idag de största hoten mot folkhälsan och överlevnaden i Sub-Sahara Afrika. Den här studien syftar till att undersöka hur vanligt diabetes och förhöjda blodsockernivåer var bland patienter som besökte Kibosho Sjukhus, Tanzania. Vi ville också undersöka kunskap, behandling, följsamhet till behandling och komplikationer sekundära till diabetes bland deltagarna med diagnostiserad diabetes. Vi var också intresserade av den allmänna kunskapen om riskfaktorer för diabetes. Detta undersöktes under åtta veckor i en tvärsnittsstudie genom att samla in data från 400 patienter. Ett frågeformulär läses upp för studiedeltagarna på swahili och vikt, längd, midjemått, blodtryck och blodsockervärden mättes. Bland deltagarna rekryterades 44 % från HIV-kliniken och förekomsten av diabetes och förhöjda blodsockervärden jämfördes med tidigare studier inom fältet. HIV-positiva hade en lägre förekomst av diabetes och förhöjda blodsockervärden jämfört med HIV-positiva från tidigare studier och vi tror att detta beror på lägre förekomst av riskfaktorer så som övervikt, bukfetma

och högt blodtryck bland våra studiedeltagare. HIV-positiva med diabetes hade i regel mer än en komplikation och mer komplicerade komplikationer sekundära till sin sjukdom. Vi tror att detta beror på bristande följsamhet till diabetesmedicinering som i sig beror av kostnaden för DM-medicinerna. Denna tanke grundar sig i att HIV- positiva hade mycket god följsamhet till sina kostnadsfria HIV-mediciner. Den generella kunskapen om riskfaktorer för diabetes var låg och behöver förbättras genom utbildning och repetitiv information till patienter och allmänheten för att förhindra utveckling av diabetes och progress av sjukdomen.

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13. APPENDIX

PATIENT QUESTIONNAIRE

Questionnaire for patients treated at Kibosho Hospital

Information about the study

We are two medical students from Sweden working on a research project supported by the University of Gothenburg. Our names are Linda Degeryd and Greta Guidotti and we are conducting a study about diabetes and high blood pressure. The aim of this study is to investigate if diabetes and high blood pressure are more common among people living with HIV compared to uninfected individuals. We will also investigate treatment, adherence to treatment, complications, risk factors and general knowledge about diabetes and hypertension.

Both people HIV-positive and HIV-negative individuals are asked to participate. You have been selected to represent people in the Kibosho area and we would very much like to hear about your current health situation. We would also like to measure your blood pressure and your blood glucose. We would also like to measure your weight, height and waist circumference.

It is voluntary to participate, and you have the right to withdraw at any time.

If you have questions or concerns after we are finished, you may contact medical student via email: linda_degeryd@hotmail.com or gusguigr@student.gu.se.

C1) Interview information

C1.1) Interview ID number (in form of 001, 002, 003...): _____

C1.2) Name of facility: _____

C1.3) Date of interview DD/MM/YYYY: _____

C1.4) Language of interview: _____

C2) Measurements

C2.1) Weight: _____

C2.2) Hight: _____

C2.3) BMI: _____ (do not calculate during interview)

C2.4) Waist circumference: _____

C2.5) Plasma glucose

C2.5.1) Random glucose (without regard to the time since the last meal): _____

C2.5.2) Fasting glucose: _____

C2.6) Blood pressure

C2.6.1) Systolic: _____

C2.6.2) Diastolic: _____

C3.1) Gender

▢ Man

▢ Woman

C3.2) If your gender is female, are you pregnant at the moment?

☐ Yes

☐ No

C3.3) How old are you? *In years*

Answer: _____

C3.4) What is your religion?

☐ Christian

☐ Muslim

☐ None

☐ Other: _____

C3.5) What is your tribe?

☐ Chagga

☐ Pare

☐ None

☐ Other: _____

C4) HIV

C4.1) What is your HIV status?

☐ HIV-positive

☐ HIV-negative

☐ Do not know.

C4.2) If your status is "Do not know", would you like to get tested for HIV? (The test is free, and it takes up to 15 minutes to get the result.)

☐ Yes

☐ No

C4.3) Result HIV-test after screening:

☐ HIV-positive

☐ HIV-negative

If your status is “HIV-negative” or “Do not know”, continue to question C5.1.

C4.4) How long ago were you diagnosed with HIV?
Answer: _____

C4.5) Are you taking ART to manage your HIV?
☐ Yes
☐ No
☐ Do not know

If NO or uncertain, continue to question C5.1.

C4.6) How long ago did you start taking ART to manage your HIV?

Answer: _____

C4.7) Do you take ART as directed?
☐ I always remember to take my ART
☐ I rarely forget to take my ART
☐ I frequently forget to take my ART

C4.8) If you frequently forget to take your ART as directed, how many pills did you miss to take last week?
☐ 0

☐ 1-2

☐ 3 or more

C4.9) If you do not take your medication as regularly, why do you not take them as directed? (Do not read answers)

☐ *I cannot afford the cost*

☐ *Medication is not easily available*

☐ *I do not like to take medications*

☐ *I only take them when I feel that I need them*

☐ *I do not like the side effects of the medication*

☐ *I prefer alternative medicine*

☐ *I forget*

☐ *I do not know*

☐ *Other reasons:* _____

C4.10) What was your latest CD4+ cell count?

Answer: _____

☐ I don´t know or remember my latest CD4+ number

C5) Blood pressure

C5.1) When was your blood pressure last measured by a health professional?

☐ Within the past 12 months

☐ 1-5 years ago

☐ Not within the past 5 years

☐ Never

☐ Do not know

C5.2) Have you been told by a health professional that you have high blood pressure or hypertension?

▢ Yes

▢ Yes, but only during pregnancy

▢ No

▢ Do not know

If NO, continue to question C5.15.

C5.3) How long ago were you diagnosed with high blood pressure or hypertension? _____

C5.4) Compared to 12 months ago, is your blood pressure:

▢ Better

▢ Same

▢ Worse

▢ Do not know

▢ I didn't get my blood pressure measurement 12 months ago

C5.5) Have you ever been told to take prescribed medicine because of your high blood pressure?

▢ Yes

▢ No

▢ Do not know

C5.6) Are you currently taking medication prescribed by a doctor to lower your blood pressure?

☐ Yes

☐ No

☐ Do not know

If NO, continue to question C5.11.

C5.7) If YES, please provide details:

Treatment/dosage: _____

C5.8) If you are treated with pills to manage your high blood pressure, do you take your medication as directed?

☐ I always remember to take my medicine

☐ I rarely forget to take my medicine

☐ I frequently forget to take my medicine

C5.9) If you frequently forget to take your medicine as directed, how many pills for high blood pressure did you miss to take this week?

☐ 0

☐ 1-2

☐ 3 or more

If 0, continue to question C5.11.

C5.10) If you do not take your medication as regularly, why do you not take them as directed? (Do not read answers)

☐ *I cannot afford the cost*

☐ *Medication is not easily available*

☐ *I do not like to take medications*

☐ *I only take them when I feel that I need them*

☐ *I do not like the side effects of the medication*

☐ *I prefer alternative medicine*

☐ *I forget*

☐ *I do not know*

☐ *Other reasons:* _____

C5.11) Has a doctor in the past year recommended you to change your way of life, in order to lower your blood pressure?

Yes, I have been told to:

- ☐ *Eat less salt*
- ☐ *Eat less fat*
- ☐ *Eat more fruit and vegetables*
- ☐ *Maintain an appropriate body weight*
- ☐ *Exercise*
- ☐ *Quit smoking*
- ☐ *Restrict alcohol intake*
- ☐ *Less emotional stress*

☐ **No**

☐ **Do not know**

C5.12) Have you been told you have any complications of high blood pressure?

☐ Yes, I have been told I have _____.

☐ No

☐ Do not know

C5.13) Are you aware of any complications of high blood pressure? (Do not read answers)

☐ *Complications affecting the brain (stroke, headache)*

☐ *Complications affecting the heart (heart attack, heart failure)*

☐ *Complications affecting the eye (hypertensive retinopathy)*

☐ *Complications affecting the kidneys (renal failure)*

☐ *Other:*_____

☐ *I do not know any complications of high blood pressure*

C5.14) Do you have any of the following in your medical history?

☐ Stroke

☐ Heart disease (heart attack, heart failure)

☐ Hypertensive retinopathy (eye problem after being diagnosed with high blood pressure)

☐ Renal disease (kidney failure)

☐ None of the above

C5.15) Do you know any risk factors of developing high blood pressure? (Do not read answers)

☐ *Unhealthy diets (excessive salt consumption, diet high in saturated fat and trans-fat, low intake of fruits and vegetables)*

☐ *Obesity*

☐ *No regular exercise*

☐ *Tobacco*

☐ *Alcohol*

☐ *Stress*

☐ *Family history of high blood pressure*

☐ *Age over 65*

☐ *Co-existing disease (e.g. diabetes, kidney disease)*

☐ *Other:* _____

☐ *Do not know any risk factors*

C5.16) Do you know the definition of high blood pressure?

☐ Yes, it is above _____ systolic and/or _____diastolic

☐ Do not know

C6) Diabetes

C6.1) Have you been told by a health professional that you have diabetes?

☐ Yes

☐ Yes, but only during pregnancy

☐ No

☐ Uncertain

If NO, continue to question C6.17.

C6.2) How long ago were you diagnosed with diabetes? _____

C6.3) Which type of diabetes do you have?

☐ *Type1*

☐ *Type2*

☐ *Gestational (diabetes of pregnancy)*

☐ *Do not know*

C6.4) Do you test your blood sugar at home?

☐ Yes, I test my blood sugar every day, _____ times a day.

☐ Yes, I test my blood sugar every week, _____ times a week.

☐ Yes, I test my blood sugar when I get symptoms of low or high blood sugar.

☐ No, I only test my blood sugar when I am visiting the hospital, _____times a year

If "NO, I only test my blood sugar when I am visiting the hospital", continue to C6.7.

C6.5) What kind of glucose meter do you use?
Answer: _____ (e.g. capillary glucose meter)

C6.6) Has your glucose meter been tested at the lab to make sure it is accurate?
☐ Yes, date: _____
☐ No, not sure

C6.7) If you do not test your blood glucose at home, what is the reason for that?
(Do not read answer)
☐ *I have not had any directions from my doctor about testing.*
☐ *I do not have a glucose meter*
☐ *I cannot afford a glucose meter*
☐ *I am afraid of needles*
☐ *I forget*
☐ *Other:* _____

C6.8) What kind of treatment do you use controlling your diabetes?
☐ Diet and exercise
☐ Pills
☐ Insulin
☐ None

C6.9) If you are treated with pills or insulin, do you take your diabetic medication as directed?
☐ I always remember to take my insulin/pills
☐ I rarely forget to take my insulin/pills
☐ I frequently forget to take my insulin/pills

C6.10) If you frequently forget to take your medicine as directed, how many pills for high blood pressure did you miss to take this week?
☐ 0

☐ 1-2

☐ 3 or more

C6.11) If you do not take your medication as regularly, why do you not take them as directed? (Do not read answers)

☐ *I cannot afford the cost*

☐ *Medication is not easily available*

☐ *I do not like to take medications*

☐ *I only take them when I feel that I need them*

☐ *I do not like the side effects of the medication*

☐ *I prefer alternative medicine*

☐ *I forget*

☐ *I do not know*

☐ *Other reasons:* _____

C6.12) Have you been educated in your diabetes by health professional?

☐ Yes

☐ No

C6.13) If you had diabetic education, was it regarding:

☐ Diet/weight

☐ Exercise

☐ Glucose meter

☐ Pills or insulin injections

☐ Preventing complications

☐ Other _____

C6.14) Have you been told you have any complications of diabetes?

☐ Yes, I have been told I have _____.

☐ No

☐ Do not know

C6.15) Are you aware of any complications to diabetes? (Do not read answer)

☐ *Complications affecting the eyes (retinopathy)*

☐ *Complications affecting the kidneys (renal failure)*

☐ *Complications affecting the nerves and /or feet (neuropathy)*

☐ *Complications affecting wound healing (decreased wound healing)*

☐ *Complications affecting the heart and vascular system (heart attack, artery occlusion)*

☐ *Amputation of toes, foot or leg*

☐ *I am not aware of any complications to diabetes*

C6.16) Do you have any of the following in your medical history?

☐ Stroke

☐ Heart disease (heart attack, angina pectoris)

☐ Eye problems (retinopathy)

☐ Renal disease (kidney failure)

☐ Problems with nerves or/ and feet (neuropathy)

☐ Amputation of toes, feet or leg caused by necrosis (no trauma included)

C6.17) Do you know any risk factors of developing diabetes? (Do not read answer)

☐ *Age 45 or older*
☐ *Overweight or Obesity*
☐ *Increased waist circumference*
☐ *Unhealthy diet (excessive intake of sugar and/or saturated fats)*

☐ *Family history of diabetes (parent, sister or brother with diabetes)*

☐ *Diabetes during pregnancy*

☐ *Have high blood pressure or takes medicine for high blood pressure*

☐ *No regular exercise*

☐ *Tobacco*

☐ *Other:* _____

☐ *Do not know any risk factors*

C6.18) Do you know what is considered to be a normal blood glucose?

☐ Fasting glucose under: _____

☐ Random glucose, without regard since the last meal, under: _____

☐ Do not know

C7) Smoking

C7.1) Do you smoke cigarettes?

☐ Yes

☐ No, never have

☐ No, but I did smoke for _____ years in the past

If NO, continue to question C8.1

C7.2) On average, how many cigarettes do/did you smoke a day?

Number of cigarettes: _____

C7.3) How old were you when you started smoking cigarettes regularly?

Age: _____

C8) Diet

C8.1) Do you follow a particular diet?

☐ No particular diet

☐ Yes, my diet consists of: _____

If NO, continue to question C9.1

C8.2) How well do you do at following this diet?

▢ Very well

▢ Some days better than others

▢ Not very well

C9) Alcohol

C9.1) During the past month, how often have you had a drink containing alcohol?

▢ Daily

▢ Once or twice a week

▢ 3 to 4 times a week

▢ 1 to 3 times a month

▢ No

If NO, continue to question C10.1.

C9.2) During the past month, on the day that you drank alcohol, how many alcoholic drinks did you usually have altogether? (one drink= 1 glass of wine, 1 glass of beer, 1 drink of hard liquor)

▢ 1-2 drinks/day

▢ 3-5 drinks/day

▢ 6 or more drinks/day

C10) Exercise

C10.1) Do you exercise?

▢ I exercise regularly _____times a week for_____ minutes.

▢ I exercise sometimes _____times a week for_____ minutes.

▢ I don't exercise because_____

▢ I am not able to exercise because_____

If “do not exercise”, continue to question C10.3

C10.2) If you exercise, what type of exercise?

Answer: _____

C10.3) Are you physically active to/from or at work?

▢ Yes, I am physically active _____times a week for_____ minutes.

▢ No

HOW TO PREVENT DIABETES AND HIGH BLOOD PRESSURE

LIFESTYLE CHANGES:

- Eat more fruit and vegetables
- Eat less fat, salt and sugar
- Exercise daily & reduce overweight
- Stop smoking
- Drink less alcohol

KNOW YOUR NUMBERS:

Your blood pressure today was: _____mmHg

- High blood pressure is over 140/90 mmHg

Your blood sugar today was: _____mmol/l

- High blood sugar is over 11,1 mmol/l or over 7,1 mmol/l if it was 10 hours since your last meal or sweated drink