

Prevalence of diabetes mellitus in patients seeking medical care at Morogoro Regional Referral Hospital in Tanzania

EDSON KINIMI^{1*}, SAKURANI BALHAZARY¹, STEPHEN KITUA² and SUNDI MSALIKA¹

¹Sokoine University of Agriculture, College of Veterinary Medicine and Biomedical Sciences, Department of Veterinary Physiology, Biochemistry and Pharmacology, P.O Box 3017, Morogoro, Tanzania

²National Institute for Medical Research, Kilosa Station, P.O Box 96, Kilosa Morogoro

Abstract

Background: Diabetes Mellitus (DM) is a key metabolic endocrine disorder escalating in the course of rapid population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity. This study was conducted to assess prevalence of DM and associated risk factors among outpatients seeking medical care at Morogoro Regional Referral Hospital in Tanzania.

Method: A cross-sectional study was carried out amongst 129 outpatients. Diabetic status was assigned using Gluco-plus Random Blood Glucose (RBG) ≥ 11.1 mmol/L and a subject was confirmed to have diabetes when fasting plasma glucose was ≥ 7 mmol/L. Structured questionnaire was administered to collect socio-demographic characteristics. Body Mass Index (BMI) was computed, with normal values ranging from 18.5-24.9 kg/m², <18.5kg/m² suggests underweight and/or malnutrition, from 25.0-29.9 is overweight; 30-39.9 is obese, while ≥ 40.0 is severe obesity. Data were analysed and Chi-square test was applied to test association between DM and overweight, age, smoking and alcohol intake.

Results: Our findings indicated that an overall prevalence of diabetes was 10.08% for undiagnosed town dwellers outpatients. Out of 13 diabetic individuals, 4 (31%) were males and 9 (69 %) were females. In this study population, 26 (20.16%) were overweight and One of diabetic subjects had severe obesity, two were obese, seven were overweight and three had normal weight. The age, alcohol intake and overweight were found to be the risk factors significantly associated with DM.

Conclusions: Our results indicate a higher prevalence of DM than the national estimate of 9.1%. Thus DM still indicates a considerable health burden in Morogoro Municipality. Overweight, aging, alcohol consumption and physical inactivity were the main predisposing factors for DM morbidity. A regular screening and intervention programme for preventing DM in Morogoro Municipality is necessary.

Keywords: Diabetes mellitus, BMI, obesity, life style, Tanzania

Introduction

Diabetes Mellitus (DM) is a carbohydrate metabolic endocrine-disorder which affects people globally and poses major public health and socioeconomic challenges. DM was previously regarded as the disease of the rich and mostly the disease of developed countries. However, DM is rapidly occurring among poor people residing in low-income countries (Mbanya *et al.*, 2010). This increase in DM prevalence and associated health complications threaten to reverse economic gains in developing countries with limited infrastructure for diabetes care. On global scale, estimates of 422 million human adults were living with diabetes in 2014, compared to 108 million in 1980 (NCD, 2016). The global prevalence of diabetes has nearly doubled since 1980, rising from 4.7 % to 8.5% in the adult population. This reflects an increase in associated risk factors such as being overweight, physical inactivity, diet modifications, smoking, increased alcohol intake (NCD, 2016). Equally, taking high dietary glycaemic load (GL) and high quantity of sugar sweetened beverages (SSB) exacerbate diabetic conditions (Thomas & Elliott, 2009).

*Correspondence E-mail: kinimiedson@gmail.com

The biochemical landmark studies named two types of DM: type 1 DM (T1DM) which is juvenile onset and associated with deficiency of insulin, and type 2 DM (T2DM) which is also known as mature onset diabetes mellitus (Thomas & Elliott, 2009). In T2DM cells in the body are not responsive to insulin, a phenomenon referred to as insulin resistance (Thomas & Elliott, 2009). According to the World Health Organization (WHO), an individual is considered to be diabetic if a fasting blood glucose level is higher than 7mmol/L, or has blood glucose of 11.1mmol/L or more after two hour oral glucose tolerance test (WHO, 2006). This high blood glucose (hyperglycaemia) is primarily marked by polyuria, polydipsia, sometimes with polyphagia, weight loss, blurred vision, extreme fatigue and irritability. However, uncontrolled DM may lead into long-term complications such as retinopathy with potential loss of vision; nephropathy leading to renal failure; peripheral neuropathy with risk of foot ulcers, amputations, and Charcot joints; and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction (Cowie *et al.*, 2006).

Studies have shown that people with impaired glucose tolerance (IGT) are at a higher risk of developing T2DM and its associated complications (Scott *et al.*, 1999). However, there are no direct symptoms of IGT and therefore most people with IGT are unaware of this condition until the time when other complications such as high blood pressure, heart attack and stroke set in (US, 2008). Nonetheless, over 60% of people with diabetes in Tanzania do not know whether they have the disease (Kavishe *et al.*, 2015). This is a demonstration of the weaknesses in health seeking behaviour, screening and case detection (Metta *et al.*, 2015) in early stages of diabetes. The number of people with diabetes in Tanzania is on the increase, and this is attributed to the change in life styles associated with increased physical inactivity, overweight, smoking, alcohol intake and aging. In Tanzania for instance there is marked variation in the prevalence of diabetes among rural (<2 %), urban (>5 %) and higher in people of Asian origin (>7 %) (Ramaiya *et al.*, 1991). A 2012 Tanzanian national survey estimated diabetes prevalence of 9.1% among adults aged between 25 and 64 years (Mwangome *et al.*, 2017), higher than the latest national HIV prevalence estimate of 5.1% (TACAIDS, 2013) and a significant increase from the estimated 2.5% diabetes prevalence in 1984 among persons aged 20 years and above (Stanifer *et al.*, 2016) among 3145 Tanzanian's living in three geographical locations in north western part of the country.

There is inadequate data on the trend of the prevalence of diabetes in Tanzania. It is however, likely that this prevalence has also increased as findings from different surveys of general populations over the years seem to suggest. The magnitude of diabetic individuals in Morogoro Municipality, the area with rapid urbanization and population growth is unknown and there is no retrievable study recently done to establish the prevalence of DM. The DM studies have shown that DM increases with population growth, aging, urbanization and changes in life style such as type of food consumed, physical inactivity, heavy alcohol consumption and smoking (Frank, 2011). However, DM can be prevented and well managed when early detected (Raina & Kenealy, 2008). Therefore, quantifying the prevalence of DM and its predisposing risk factors is fundamentally important for planning prevention strategies and proper allocation of scarce resources. The objective of this study was to determine the prevalence of DM and its predisposing risk factors amongst outpatients seeking medical care at the Morogoro Regional Referral Hospital in Tanzania.

Materials and Methods

Description of population and study site

The study was intended to determine the extent of diabetes mellitus among outpatients visiting Morogoro Regional Referral Hospital from March to May 2017. Morogoro Municipality is located to eastern part of Tanzania and experiences annual rainfall and average temperature range

between 800-1000 mm and 28°C respectively. The area also experiences two rainy seasons; long rains in March to May and short rains in October to December. Morogoro Municipal is among the most populated Municipals in Tanzania. Based on 2012 census (URT, 2013) the population of Morogoro Municipality increased from 227,921 in 2002 to 315,866 in 2012. This very rapid population growth and urbanization parallels with life style modifications which can accelerate risks of developing DM.

Study design

This study was conducted at the Regional Hospital and involved outpatients. A cross-sectional hospital based random blood glucose testing was conducted to identify participants at risk of DM. This study screened participants who had never been diagnosed to have DM in the past and whose age ranged between 3 and 96 years. All patients under went random blood glucose test. Those found to have high level of blood glucose ≥ 11.1 mmol/L were asked to come back for fasting blood glucose (FBG) test. Fasting blood glucose tests were carried out to confirm the cases. Body Mass Index (BMI) was also measured. Case report forms were used to collect information on participants' life style such as eating behaviour, smoking habit and alcohol consumption.

Sample size calculation

Most of recent diabetes surveys conducted in Tanzania have shown 7.8%, 8.8% and 9.1% DM prevalence (WHO, 2012). Basing on the prevalence, it is projected that one adult person out of 12 will develop DM during their life time. This gives expected prevalence of 1/12 (8.3%). Study sample size formula (n) was calculated as follows:

$$n = z^2 p (1-p) / \epsilon^2$$

Whereas z= level of confidence (1.96 for 95% confidence level), p = expected proportion (8.3%)

ϵ = margin of error at 5% (0.05), $n = 1.96^2 \times 0.083 \times 0.917 / (0.05)^2 = 116.9 \approx 117$

Therefore a total of 117 participants were required; but in order to increase the statistical power of the study, 129 participants were recruited. This shows that base sample size was further increased by 10 % to account for contingencies.

Inclusion and exclusion criteria

Participants of all age group undiagnosed with DM and consent to participate were recruited in the study. This study did not include participants who were diagnosed with DM, not consent to participate in the study, those with chronic diseases, pregnant women and those under medications which interfere with carbohydrate metabolism such as steroids and some local herbs.

Blood sample collection and biochemical measurements

After Random Blood Glucose (RBC) was determined at the first day then participants were instructed to fast over night for fasting plasma glucose determination. The fingertip was wiped with an alcohol after the hands have been washed with water and dried. Thereafter, the skin of the fingertip was pierced with lancet and squeezed to give out a drop of blood. A 5 μ l of blood was drawn into the cuvette by capillary action after placing the cuvette tip into the drop of blood. The blood filled cuvette then immediately placed in cuvette holder into the glucose analyser machine. The blood glucose level results were recorded in mmol/L.

RBG for the participants was measured by trained laboratory technologists at the baseline screening by standardized Gluco Plus machine (Glucometer Type 25 KB JPG) by means of capillary finger prick technique. The fasting plasma glucose (FPG) was tested for participants with RBG ≥ 11.1 mmol/L. A person was confirmed to have diabetes when fasting plasma glucose was ≥ 7 mmol/L.

Anthropometric measurements

Obesity was determined by using anthropometric measurements of height and weight. Height and weight were measured from which BMI was computed. Participants were weighed after removing shoes and their weight were recorded to the nearest 0.1g on standard weighing scale (digital electronic SECA scale, Germany). Thereafter, height was measured using stadiometer with a vertical backboard (model No PE-AIM-101-USA). BMI was computed using the following formula, $BMI = \text{weight} / (\text{height} \times \text{height}), \text{Kg/m}^2$. The normal range is 18.5-24.9 kg/m². BMI values below 18.5 suggest underweight and/or malnutrition. From 25.0-29.9 is overweight, 30-39.9 is obese, while 40.0 and above is severe obesity. BMI, however, as a measure of excess weight does not differentiate lean body mass from fat. Control samples of negative and positive were used during testing of blood for DM.

Data analysis

Data were entered using MS Excel 2007 and later transferred to and analysed using SPSS for windows (version 17.0. Statistical software, SPSS Inc., Chicago, IL, USA). Fasting blood glucose of 7mmol/L and a level of 11.1mmol/L and above after two hour post-meal indicated presence of diabetes and were used to establish prevalence of people with DM. The association between DM and age, smoking habits, alcohol intake and BMI were determined using Pearson Chi-Square. The *p*-value of ≤ 0.05 was considered to be significant.

Ethical consideration

The study was approved Special Project Coordinating Committee at the College of Veterinary Medicine and Biomedical Sciences (Reference number PF/SUNDI-M/SP-pD203/2017). Consent was sought from all potential candidates willing to participate and they were recruited after signing a written informed consent. All participants who were found to have abnormal fasting and two hours postprandial levels of blood glucose were referred to the diabetic clinic at Morogoro Regional Referral Hospital for medical intervention.

Results

Demographic and clinical characteristics of study participants

In total, 129 participants were included in this study. Of the study participants, 55 (42.64%) were males and 74 (57.36%) were females, with the mean age of 34.89 years. Most of participants with DM were overweight accounting 53.85%. Out of the total study participants, 13 (10.08%) had DM. However, out of 13 diabetic subjects one had severe obesity, two were obese and seven were overweight (Table 1).

Distribution of risk factors and selected lifestyle characteristics

The frequency of overweight was 25.45% for males and 16.22% for females. The overweight individuals were at risk of developing type 2 DM of which one had severe obese, and seven overweight participants had DM. The majority of female participants had higher BMI compared to their male counterparts. More than 53.33% (n=30) of participants who had high percentage BMI were females, while 46.67% of the participants with high percentage BMI were males. Out of 129 participants 21(16.28%) were classified as underweight with 11 males and 10 females (n=129). Out of five current smokers, 3 (5.45%) were males (smoke between 5 and 15 cigarettes per day), and 2 (2.70 %) were females (smoke <5 cigarettes per day and 18 (13.95%) participants consume alcohol. Out of these, 13 (72.22%) males consume alcohol more than 4 days times a week, 5 (27.78%) females consume alcohol 2 times a week (Table 2).

Table 1: Background characteristics of respondents and life style

Characteristics	Recruited subjects n=129	Female n=74	Male n=55
Mean age (years)	34.89	48.05	22.14
Smoking (yes) (%)	3.88	2.70	5.45
Alcohol intake (yes) (%)	13.95	6.76	23.64
Mean body mass index (Kg/m ²)	29.75	31.20	28.70
Municipal town dwellers (%)	96.12	98.65	92.73
Diabetic subjects (%)	10.08	12.16	7.27

Table 2: Relationship between hyperglycaemia and socio-demographic factors

Characteristics	Response	No. of subjects	Hyperglycaemia N (%)	P-value
	Sex			
Sex	Male	55	4 (7.27)	0.4079
	Female	74	9 (12.16)	
Age group (years)	3-24	39	0 (0.00)	0.0001
	25-46	62	1 (1.61)	
	47-68	22	11 (50.00)	
	≥69	6	1 (16.67)	
Smoking behaviour	Smokers	5	1 (20.00)	0.5144
	Non smokers	124	12 (9.68)	
Alcohol intake	Drinkers	18	6 (33.33)	0.0032
	Abstainers	111	7 (6.31)	
BMI	Underweight	21	0 (0.00)	0.0013
	Normal weight	78	3 (3.85)	
	Overweight	26	7 (26.92)	
	Obesity	3	2 (66.67)	
	Severe Obesity	1	1 (100.00)	

Discussion

This study has shown a recent prevalence of DM in Morogoro Municipality to be 10.08%. Our findings indicated slightly higher prevalence than the Tanzania national average DM prevalence (Mwangome *et al.*, 2017). Similarly it is also higher than the African region prevalence which was estimated as 4.9% (Mwangome *et al.*, 2017). This variation might be due to differences in socio-economic status and overall lifestyle of the patients studied. DM in most cases affects people with high economic status and those with sedentary activity among others. In the current study, about one-fifth of participants were overweight accounting seven diabetic individuals. Equally, WHO estimated that in 2000, the prevalence of diabetes in African Region was 7.02 million people, out of which about 10% of them had type 1 diabetes and 90% had type 2 diabetes associated with overweight (King *et al.*, 1998). The reason behind the rise in overall prevalence of DM may be due to a change in eating habits and overall lifestyle emanating from increasing urbanization and economic development in the region.

Prevalence of smoking in males was significantly related to elevated blood glucose levels. These findings revealed that one diabetic male participant was a smoker of which he was at risk of exacerbating diabetic condition. According to available statistics the prevalence of smoking was 11.0% for males and 0.4% for females in Tanzania (Frank, 2011) which was also reflected in this study. It was observed that out of five smokers one was confirmed to be diabetic. Results from other studies indicated that active smokers have a 44% increased risk of developing type 2 diabetes compared with non-smokers (Gill *et al.*, 2008).

Globally, age and sex have been identified as risk factors for diabetes mellitus. Generally, worldwide diabetes prevalence is similar in men and women, but it is shown to be slightly higher in men older than 60 years of age (Kautzky *et al.*, 2016). In this study, diabetes was more prevalent among women aged 46-76 years. A similar study in Mwanza, Tanzania has reported an overall prevalence of T2DM of 11.9%; being higher among females than males (Ruhembe *et al.*, 2013). Age was found to be the most important factor because diabetes tends to increase with increasing age (Cowie *et al.*, 2006). Advanced age showed triple risks of developing T2DM as compared to younger ages. Globally, the largest proportion of people with T2DM is between 40-59 years (Whiting *et al.*, 2011) which was also reflected in this study and another study elsewhere in Tanzania (Ruhembe *et al.*, 2013).

The high diabetes prevalence in Morogoro Municipality and elsewhere in Tanzania is likely to be associated with a multitude of factors. For instance, life expectancy has slightly increased (Mboera *et al.*, 2015) leading to increased risks to age related metabolic disorders and secondly there is an increased risk of overweight, obesity and physical inactivity which have continued to surpass genetic causes (Frank, 2011; WHO, 2012). Regarding residence, the majority of subjects in this study were urban dwellers accounting for all 13 diabetic cases identified. None of those from Municipal outskirts was a diabetic case. This is in agreement with Iranian study that reported the prevalence of DM in urban areas was higher than in rural areas (Gholamreza *et al.*, 2010). This may be due to differences in lifestyle and economic status between the residents of urban and rural area.

We conclude that, the prevalence of diabetes is high in Morogoro Municipality among undiagnosed individuals aged 47-68 years. The higher rates of overweight and undiagnosed diabetes found requires the scaling up of the existing DM screening programmes with a focus of reducing modifiable risk factors. Our findings reflect less awareness of DM amongst patients and lack of regular medical check-up, necessitating the need for regular DM screening.

Conflict of interest

All authors declare that they have no conflicts of interest.

Authors' contributions

EK conceived and designed the study, analysed the data and drafted the manuscript. SM designed the study, collected the data and revised the manuscript. SB, KS participated in the study design and coordination, and revised the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We express our deepest gratitude to respondents of this study, who extended their best cooperation during sample and data collection, without them this goal could have not been attained. The authors wish to thank the medical and administrative staff in Morogoro Regional Referral Hospital and Department of Physiology, Biochemistry and Pharmacology, College of Veterinary Medicine and Biomedical Sciences of Sokoine University of Agriculture for their valuable assistance during the entire period of study. This work was supported by the Government of Tanzania via higher education students' loan board (HESLB: 2017).

References

- Cowie C., Rust K.F., Byrd-Holt, D., Ebechadt, M.S., Flegal, K.M., Engelgau, M.M., Saydah, S.H., Geiss, L.S. & Gregg, E.W. (2006) Prevalence of diabetes and impaired fasting glucose in adults in the U.S population National Health and Nutrition Examination Survey 1999-2002. *Diabetes Care* 29: 1263-1268.
- Frank, B. (2011) Globalization of Diabetes, The role of Diet, lifestyle and genes. *Diabetes Care* 34: 1249-1257.
- Gholamreza, V., Mehdi, S., Hamidreza J., Sed, A. H., Farhad, N., Abdolhamid, A., Ebrahim, T. & Pooneh, M. (2010) Association between socio-demographic factors and diabetes mellitus in the north of Iran: A population-based study. *International Journal of Diabetes Mellitus* 2: 154-157.
- Gill, G., Price, C., Shandu, D., Dediccoat, M & Wilkinson, D. (2008) An effective system of nurse-led diabetes care in rural Africa. *Diabetic Medicine* 25, 606-11.
- Kautzky, W. A., Harreiter, J. & Pacini, G. (2016) Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus. *Endocrine Reviews* 37: 278-316.
- Kavishe, B., Biraro, S., Baisley, K., Vanobberghen, F., Kapiga, S., Munderi, P., Smeeth, L., Peck R., Mghamba, J., Mutungi, G., Ikoona, E., Levin, J., BouMonclús, M.A., Katende, D., Kisanga, E., Hayes, R. & Grosskurth, H. (2015) High prevalence of hypertension and of risk factors for non-communicable diseases (NCDs): a population based cross-sectional survey of NCDs and HIV infection in North-western Tanzania and Southern Uganda. *Biomedical Central Journal of Medicine* 13: 126.
- King, H., Aubert, R.E. & Helman, W.H. (1998) Global burden of diabetes, 1995-2025: Prevalence, numerical estimates and projections. *Diabetes Care* 21: 1414-1438.
- Mbanya, J.C.N., Motala, A. A., Sobngwi, E., Assah, F.K. & Enora, S.T. (2010) Diabetes in sub-Saharan Africa. *Lancet* 375: 2254-2266.
- Mboera, L.E.G., Ipuge, Y., Kumalija, J. Rubona, C.J., Perera, S., Masanja, H. & Boerma, T. (2015) Mid-term review of national health plans: an example from the United Republic of Tanzania. *Bulletin of the World Health Organization* 93: 271-278.
- Metta, E., Bailey, A., Kessy, F., Geubbels, E., Hutter, I & Haisma, H. (2015) In a situation of rescuing life?": meanings given to diabetes symptoms and care-seeking practices among adults in Southeastern Tanzania: a qualitative inquiry. *Biomedical Central Journal of Public Health* 15: 224
- Mwangome, M., Geubbels, E., Klatser, P. & Dieleman, M. (2017) Perceptions on diabetes care provision among health providers in rural Tanzania: a qualitative study. *Health Policy and Planning* 32: 418-429
- NCD-RisC (2016) Worldwide trends in diabetes since (1980): a pooled analysis of 751 population-based studies with 4.4 million participants. *Lancet* 387: 1513-1530

- URT (2012) *National Population and Housing census for United Republic of Tanzania*. National Bureau of Statistics, United Republic of Tanzania.59pp.
- Raina, E. C. &Kenealy, T. (2008) Life style interventions reduce the long term risk of diabetes in adults with impaired glucose tolerance. *Journal of Evidence-Based Medicine* 13: 173.
- Ramaiya, K.L., Swai, A. B., Maclarty, D. G., Bhopal, R. S. &Albert, K .G.(1991) Prevalence of diabetes and cardiovascular disease risk factors in Hindu Indian Sub-communities in Tanzania. *BMJ* 303: 271-276.
- Ruhembe, G., Mosha, T. &Nyaruhucha, C. (2013) Prevalence and awareness of Type 2 diabetes mellitus among adults population in Mwanza city Tanzania. *Tanzania Journal of Health Research* 16: 4-9.
- Scott, M.G., Ivor, J.B., Gregory, L.B., Alan, C. & Robert, H. E. (1999) Diabetes and Cardiovascular disease. *American Health Association* 100: 1134-1146.
- Stanifer, J.W., Cleland, C.R., Makuka, G.J, Egger, J.R., Maro, V., Maro, H., Karia, F., Patel, U.D., Burton, M.J. &Philippin, H. (2016) Prevalence, Risk Factors, and Complications of Diabetes in the Kilimanjaro Region: A Population-Based Study from Tanzania. *PLoS One* 11: 1310-1371.
- TACAIDS (2013) Tanzania Commission for AIDS: Zanzibar AIDS Commission, National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), and ICF International. 2013. Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12. Dar es Salaam, Tanzania.
- Thomas, D. &Eliott, E.J. (2009) Low glycaemic index, or low glycaemic load, diets for diabetes mellitus. *Cochrane Database System Review* 1: 26-9.
- US (2008) Screening Type 2 Diabetes mellitus in Adults. United States Preventive Service Task Force. *Annals of Internal Medicine* 148: 846-854.
- Whiting, D.R., Guariguata, J.L., Weil, C. & Shaw, J. (2011) Global prevalence of diabetes mellitus for 2011 and 2030” *Diabetes Research and Clinical Practice* 94:311-321.
- WHO (2006) World Health Organization: “Definition, diagnosis and classification of diabetes mellitus and its complications” Geneva.
- WHO (2012) Tanzania STEPS survey-2012: Fact Sheethttp://www.who.int/chp/steps/UR-Tanzania-Factsheet_2012.pdf.