Original Article

Risk factors associated with Type 2 Diabetes Mellitus at Kibuye Referral Hospital, Rwanda- A case control study

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Abstract

Background
Type 2 Diabetes Mellitus (T2DM) is increasing globally, being among the leading cause of premature mortality. If no bold actions are taken, nine in ten persons diagnosed with diabetes will have T2DM by 2025.

Objectives
 This study aims at assessing socio-demographic characteristics and identify lifestyle factors associated with T2DM at Kibuye Referral Hospital.

Methods
Hospital-based case control study design was used. Food frequency, and global physical activity questionnaires adapted from WHO were used. SPSS v 23 was used for all research analysis. Descriptive statistics were used to summarize categorical variables with help of frequencies and percentages. Binary logistic regression was used to identify the factors associated with T2DM by computing odds ratio with corresponding 95% confidence interval. Logistic regression models using multivariate analysis with a significance level of 5% was used to establish the independent risk factors of T2DM by controlling the confounding variables.

Results
Smoking, level of physical activity, low level of dietary diversity were associated with T2DM. The likelihood of developing T2DM among smokers was about 9 times more [AOR= 8.9; 95%CI=2.84-27.86; p<0.001] compared to non- smokers. Respondents with low level of physical activities were 8.1 times more likely to get T2DM than those with high or moderate physical activities [AOR= 8.1; 95%CI= 2.90-22.79; p<0.001]. Similarly, respondents with low level of dietary diversity score were 6 times more likely to developT2DM [AOR= 6.03; 95%CI= 1.67-21.80; p=0.006] compared to those with high level of dietary diversity score.

Conclusion
Lifestyle factors that showed strong association with T2DM can all be modified by public health interventions that are promoting physical activity, healthy lifestyle, and dietary diversity.

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Keywords: Type 2 diabetes mellitus, associated risk factors, case, control

Introduction

Globally, the increase of diabetes in the last decades is having global impact, especially in sub-Saharan Africa, which faces challenge in the battle against the NCDs consisting of paucity of research and financials, among others. T2DM is the mostly prevalent form of diabetes and represents 85% of diabetes subjects. However, it is increasing more rapidly, becoming the leading cause of premature mortality globally.[1] The recent scientific evidence projected that by 2025, T2DM will represent 90% of all forms of diabetes, with resultant infinite economic consequences on many nations. The latest scientific evidence provided that more than 425 million in Africa have T2DM and it is anticipated to increase to 629 million by 2050. In Africa, this rise will not only be a result of increased incidence, but also that Africa lacks a well pooled analyzed population surveys, and a great proportion of undiagnosed population.[2] Africa demonstrates a high prevalence T2DM with 4.9% of general population, with disparities for different countries.

Several studies reported risk factors that influence the likelihood of one's to develop T2DM. A study conducted in South Africa revealed that physical inactivity is linked to a 15-20-fold risk of acquiring many NCDs including T2DM.[3] while unhealthy dietary behaviors and lifestyle behavior such as smoking strongly influence the likelihood of developing T2DM.[4]

The recent study conducted in UK demonstrated that T2DM will continue to increase if not bold interventions are not taken into consideration. Consequently, cost-effective public health interventions such as relative weight loss efforts, improved dietary intake, reduced physical inactivity, quitting smoking, and avoiding excessive drinking of alcohol containing beverages are the first front responsive actions towards prevention and elimination of T2DM.[5]

It is apparent that globally research was conducted on T2DM prevalence and determinants though there is little, or no information from some parts of the world on the modifiable risk factors such as lifestyle, behaviors and socio-demographic associated with T2DM especially in rural Rwanda Kibuye Referral Hospital where this study was conducted.

Methods

Study design
A Hospital based case control study design was adopted. The study was conducted at Kibuye Referral Hospital, located in Western province

Participants
Patients attending noncommunicable disease (NCD) clinic (cases) and patients attending outpatient department (OPD) (controls, excluded those having any form of diabetes) from January to December 2020, were considered for this study. Cases were T2DM patients, with a laboratory diagnosis of greater than 126 mg/dL (7.0mm/L) of blood glucose for a sample taken an 8 hour overnight fast. Selected case participants were patients diagnosed using Fasting Plasma Glucose Test among patients consulting Kibuye Referral hospital, under follow up in NCD clinic and diagnosed at least one-month prior data collection, either sex, with or without osmotic symptoms of diabetes (polyuria, polydipsia, thirst, body weight loss), all religions and residence. The hospital NCD clinic is currently following up 125 T2DM patients at the end of 2020. Controls were patients consulting out-patient department and diagnosed for any cause other than diabetes. They were not having a history of diabetes or taking any diabetes medication, such as oral antihyperglycemic agents or insulin; either sex, religions and residence were considered. Matching criteria were age (accepted age range: +/-2 years), sex, and income category (Ubudehe category). For each case, one control was selected (Matching ratio 1:1).

Data collection and analysis

A standardized questionnaire researcher-administered was used to collect all data of respondents, 94 cases in NCD clinic, and 94 patients in OPD department for controls. Food frequency (FFQ) adopted from FAO, and global physical activity (GPA) and Alcohol use disorder identification test (AUDIT) questionnaires adapted from WHO were used to collect information on lifestyle factors such as types of food and frequency, level of physical activity, and alcohol consumption level.

The SPSS v 23 were used to analyze the collected data. Descriptive statistics were used to summarize categorical variables with help of frequencies and percentages. Binary logistic regression was used to identify the factors associated with T2DM by computing odds ratio with corresponding 95% confidence interval. Logistic regression models using multivariable analysis with a significance level of 5% was used to establish the independent risk factors of T2DM by controlling the confounding variables.

WHO AUDIT score were used to determine level of drinking alcohol. Three parameters generated by the researcher including frequency of drinking alcohol, number of drinks per occasion and frequency of six or more drinks on one occasion were used to know the level. After aggregating and converting into percentage, respondents were categorized as High alcohol user (<50%), Moderate (25-50%), Low (1-24%) and None (0.0%).

Similarly, the level of physical activities was assessed using five indicators generated by the researcher, including work involve vigorous intensity activity, work involving moderate intensity activity, vigorous intensity sports fitness or leisure activities, moderate intensity sports fitness or leisure activities and use of bicycle to or from work. A score 1 was given for Yes and score 0 for No. After aggregating and converting into percentage, respondents were categorized as Low level (<50%), Moderate (50-69%) and High (70% and above).

The researcher used FFQ to assess dietary diversity score using 10 different food groups. A score 1 was given for Yes and score 0 for No as indicated in Appendix 6. Those who scored 7 and below were categorized as low or inadequate food diversity and those who scored greater than 7 were grouped as adequate or high dietary diversity.

Ethical approval

Ethical clearance was granted by the Institute of post Graduate Studies and Research of MKU (REF: MKU04/PGS&R/0534/2021) and Kibuye Referral Hospital (No 14/338/HOP1-1/021). Participants were formally informed on voluntary participation and were briefed about study and the questionnaire. Furthermore, they were informed about their rights to withdraw from the study at any time. In addition, participant's records were kept anonymous.

Results

A total number of 188 were recruited, comprising 94 cases and 94 controls, with a response rate of 99%. There were significant differences between level of education and T2DM. The odds of developing T2DM were 4.89 times more among respondents with no formal education compared to those with secondary and above [COR= 4.89; 95%CI=1.86-12.86; p=0.001]. History of blood pressure was also significantly more among cases than controls (p<0.001), but the odds ratio could not be calculated due to zero distribution. However, there was no significant association among the other socio-demographic factors.

Socio-demographic factors associated with T2DM at Kibuye Referral Hospital

The overall smoking was 16% and it was more among cases (26.6%) compared to controls (5.3%). The frequency of alcohol consumption in the last one month was assessed where 8.5% of the cases used to drink four or more times in a week while there was none among controls. Those who drank alcohol greater than six per occasion was slightly higher among cases (4.3%)

than controls (3.2%). Similarly, those who never drunk greater than six per one occasion were more in cases (93.3%) compared to controls (91.5%). After computing overall score by considering the aforementioned 3 parameters, high alcohol consumption was more among the cases (8.5%) compared to controls (4.3%).

Table 1. Socio-demographic factors associated with T2DM at Kibuye Referral Hospital

Variables	Case (n=94)		Control (n=94)		COR	95%CI		p value
	n	%	n	%		Lower	Upper	
Religion								
Catholic	49	52.1	58	61.7	Ref			
Protestant	33	35.1	30	31.9	1.30	0.70	2.43	0.407
Muslim and others	12	12.8	6	6.4	2.37	0.83	6.77	0.108
Level of education								
No formal education	43	45.7	22	23.4	4.89	1.86	12.86	**0.001**
Primary	43	45.7	52	55.3	2.07	0.83	5.16	0.119
Secondary and above	8	8.5	20	21.3	Ref			
Marital status								
Single	14	14.9	15	16.0	Ref			
Married	64	68.1	68	72.3	1.01	0.45	2.25	0.984
Divorced/widow	16	17.0	11	11.7	1.56	0.54	4.49	0.411
Occupation								
Famer	56	59.6	47	50.0	1.19	0.52	2.75	0.681
Merchant	11	11.7	13	13.8	0.85	0.28	2.52	0.764
Government employed	6	6.4	10	10.6	0.60	0.17	2.10	0.425
Casual employee	7	7.4	10	10.6	0.70	0.21	2.37	0.566
Unemployed	14	14.9	14	14.9	Ref			
History of blood pressure								
Yes	19	20.2	0	0.0	UD	-	-	**<0.001**
No	75	79.8	94	100.0	Ref			

COR=Crude Odds Ratio; CI= Confidence Interval; UD= Undefined

Lifestyle factors associated with T2DM at Kibuye Referral Hospital

A score assessment was used to determine the overall level of physical activities using the five indicators such as work involving vigorous intensity activity, work involving moderate intensity activity, vigorous intensity sports fitness or leisure activities, moderate intensity sports fitness or leisure activities and use of bicycle to or from work. After converting the aggregate into percentages, most of the respondents from both groups (78.7%) scored low level of physical activities and this was more among the cases (93.6%) than controls (63.8%).

The proportion of cereals, white roots and beans/peas were slightly more among controls than among cases while there was same distribution of oil/fat between the groups. However, consumption of vitamin A rich vegetables/tubers, dark green leafy vegetables, other vegetables, vitamin A rich fruits, animal foods and milk/milk products are considerably higher among controls compared to cases.

Using the ten food groups the dietary diversity score was assessed and those who scored low dietary diversity in both groups was 11.7% with more among cases (20.2%) than among controls (3.2%). The likelihood of developing T2DM among smokers was about 9 times more [AOR= 8.9; 95%CI=2.84-27.86; p<0.001] compared to those no smokers.

Respondents with low level of physical activities were 8.13 times more likely to get T2DM than those with high or moderate physical activities [AOR= 8.13; 95%CI= 2.90-22.79; p<0.001]. Similarly, respondents with low level of dietary diversity score were 6 times more likely to developT2DM [AOR= 6.03; 95%CI= 1.67-21.80; p=0.006] compared to those with high level of dietary diversity score.

Table 2. Multivariable logistic regression for predicting risk factors of T2DM

Variables	AOR	95%CI		p value
		Lower	Upper	
Full model				
Level of education				
No formal education	1.99	0.65	6.11	0.229
Primary	1.70	0.61	4.73	0.310
Secondary and above	Ref			
History of smoking				
Yes	8.34	2.67	26.12	**<0.001**
No	Ref			
Level of physical activities				
Low (<50%)	7.63	2.67	21.84	**<0.001**
High/Moderate (50% and above)	Ref			
Dietary diversity score				
Low (≤ 7 score)	5.09	1.31	19.73	**0.019**
High (> 7 score)	Ref			
Reduced model				
History of smoking				
Yes	8.90	2.84	27.86	**<0.001**
No	Ref			
Level of physical activities				
Low (<50%)	8.13	2.90	22.79	**<0.001**
High/Moderate (50% and above)	Ref			
Dietary diversity score per week				
Low (≤ 7 score)	6.03	1.67	21.80	**0.006**
High (> 7 score)	Ref			

AOR= Adjusted Odds Ratio; CI= Confidence Interval

Discussion

In this study, among all socio demographic factors only education level demonstrated statistical significance of association with T2DM. However, the odds of developing T2DM were 4.89 times more among respondents with no formal education compared to those with secondary and above.

However, this association disappeared after controlling for all other predicting factors in multivariable analysis. This finding does not agree with the results of a case control study in Myanmar that showed a statistical significance between education level and T2DM, with lower education level (p<0.001). [6]

Findings of this study showed a causal relationship of smoking and increased risk of T2DM. Smokers were 9 times more likely to acquire T2DM compared to non-smokers. Most past literature reported relative association of smoking with T2DM, in line with this current study. The study conducted in Japan, showed a relative risk of 1.38, while a study in South Africa showed that smokers had a 45% increased risk of diabetes compared to non-smokers.[7]

The mechanism by which smoking leads to T2DM is not fully understood. The available plausible explanations are that nicotine, a bioactive ingredient in cigarette, impairs the function of pancreas thus leading to insulin resistance.[8] Other studies have indicated that insufficient physical activity is strongly associated with T2DM, as revealed too in our current study. In this study, respondents with low level of physical activities were 8.13 times more likely to develop T2DM than those with high or moderate physical activities. This finding was higher compared to the findings of the mendelian randomization study, that showed that respondents with low level of physical activity were 1.3 times more likely to develop T2DM, and a study conducted in Myanmar that showed respondents in case group showed exhibited lower level of physical activity compared to controls.[8,9]

Around the globe, current evidence has emphasized the role of healthy diet diversity to ensuring the disproportionate distribution of calories. In this study, the findings revealed a strong association between dietary diversity and T2DM, where respondents with low level of dietary diversity score were 6 times more likely to developT2DM compared to those with high level of dietary diversity score. Similarities were reported in a study conducted in Bangladesh,[10] and in an unmatched case–control study conducted in Ghana.[4] This is due to the growing shift from traditional dietary diversity to processed foods rich in added sugar, fats, and salts

as a result of urbanization where majority of population tend to imitate urban lifestyle, especially dietary patterns.

Conclusion

The findings of this study supported the evidence that there are socio demographics, and lifestyle factors associated with T2DM as many other studies have proved. The robust majority of these factors can be modified by public health interventions. These are smoking, low level of physical activity and low dietary diversity, with more than 6 odds of developing T2DM.

Conflict of interest
We declare that we have no conflict of interest.

Authors' contributions
EFM designed the study, collected, cleaned, analyzed, and interpreted the data, and wrote the first draft of the manuscript; ER contributed actively to the design of the study, analysis, interpretation, and manuscript writing. All authors read and approved the final manuscript.

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