EFFECT OF SMOKING ON BLOOD GLUCOSE TOLERANCE AND MICROALBUMINURIA AMONG SMOKERS IN TIKO HEALTH DISTRICT

ABSTRACT

Cigarette smoking is one of the most important modifiable risk factor for diabetes. Cigarette smoking is linked to vascular damage, endothelial dysfunction, and activation of the blood-clotting cascade. It is not unusual that the combined harmful effect of elevated blood glucose and cigarette smoking accelerates vascular damage in people with diabetes, and smoking significantly increases the risk of micro and macrovascular complications in patients with type 2 diabetes mellitus. Environmental tobacco smoke has been linked to a higher risk of ischaemic heart disease. Diabetes mellitus is also linked to an increase in mortality and morbidity. The effect of smoking among diabetics remains controversial with several studies showing no relationship between smoking and risk of diabetes. This study was aimed surving the effect of smoking on blood glucose and albuminuria among smokers in Tiko Health District. This was an investigative study which lasted for a period of six months from January, 2022 to June 2022 with a sample size of 88 participants. The acutest@ Micro albumin urine reagents strips were used to test for micro albuminuria using the urine samples obtained. The fasting blood glucose was measured using plasma following the manufacturer procedure.

From the results obtained from this study, the prevalence of prediabetes and diabetes among smokers in Tiko community was 35.2% and 10.2% respectively and the prevalence of albuminuria among smokers in Tiko community was 11.4%. There was no association between certain parameters such as body mass index, consumption of alcohol, age and the onset of diabetes among study participants. In conclusion, smokers in Tiko municipality are reported to be affected by both prediabetes and diabetes alongside the presence of albumin in urine.

Keywords: ***prediabetes, diabetes, albuminuria, smokers, Tiko***

Introduction

“Smoking as a mode of consumption is most commonly used for tobacco, mainly in the form of burnt tobacco and predominately cigarettes. Although the rate of cigarette smoking is decreasing in several countries, it remains a serious threat to public health worldwide, particularly in central and south-east Asia as well as in Eastern Europe with the world’s largest number of smokers” [1, 2]. “The World Health Organization (WHO) estimates that by 2050 there will be one and a half billion smokers globally” [3]. “Between 2010 and 2018, Cameroon smoking prevalence remained stable at around 17.5 % .The devastating negative impact of cigarette smoking on health is well known, causing a wide range of diseases and disorders throughout every organ and system in the human body” [4, 5]. “The risks of developing cardiovascular diseases, cancer and chronic obstructive pulmonary diseases (COPD) are strongly correlated with the amount of daily consumption of cigarettes and the overall duration of smoking; prolonged smoking avoidance decreases these risks” [6–8]. “In addition to the smoking epidemic, another devastating pandemic looms: diabetes mellitus (DM). Since 1980,the number of adults with DM worldwide has quadrupled, exceeding 400 million people with a prognosis of nearly 650 million in the year 2040” [9, 10]. “The United States Surgeon General's report recently documented a 40% increase in the risk of type 2 diabetes mellitus(T2DM) among cigarette smokers compared with nonsmokers, based on a systematic review and meta-analysis of 46 prospective studies, and concluded that cigarette smoking is a cause of T2DM” [11].

“The dramatic increase of DM prevalence represents a formidable challenge to public health. DM is characterized by a chronic hyperglycemia that causes irreversible damage to the blood vessels and consequently leading to macrovascular and microvascular complications of the

disease" [12]. "Public health policies and programs must address the main modifiable risk factors for DM to prevent its onset and delay the development of its complications. Cigarette smoking is one of the most important modifiable risk factor for DM" [13]. "Exposure to cigarette smoke is associated with vascular damage, endothelial dysfunction and activation of the blood-clotting cascade" [14], so "it is not at all surprising that the combined harmful effects of elevated blood glucose with cigarette smoking accelerates vascular damage in people with diabetes who smoke. Quitting smoking substantially reduces this risk" [16]. "Even as reducing exposure to cigarette smoke is an imperative for public health, it is even more so for patients with DM, as reflected in most clinical guidelines" [17]. "Smoking is a major cardiovascular risk factor and cause of death" [18]. "Environmental tobacco smoke exposure alone has also been reported to be associated with an increased risk of ischaemic heart disease" [19]. "Diabetes mellitus is also associated with an increased mortality and morbidity" [20]. "However, whether smoking increases the incidence of diabetes remains controversial. Several earlier prospective studies showed no relationship between smoking and risk of diabetes" [21]. "More recently, evidence has accrued suggesting a positive association between smoking and the risk of diabetes in both men and women" [23].These reports are confined to white people [24]. There is little or no information about the prevalence of prediabetes and diabetes among smokers in Cameroon [25]. This sought to generate statistical information on the prevalence of prediabetes and diabetes among smokers in Tiko community

2.0 METHOD

2.1 Study area and setting

This study was carried out in Tiko a rural community found in Fako division in Southwest Region of Cameroon with approximately 134,649 inhabitants with several ethnic groups and predominantly Bakerians. The active smoking population is approximated at about 20,000 inhabitants.

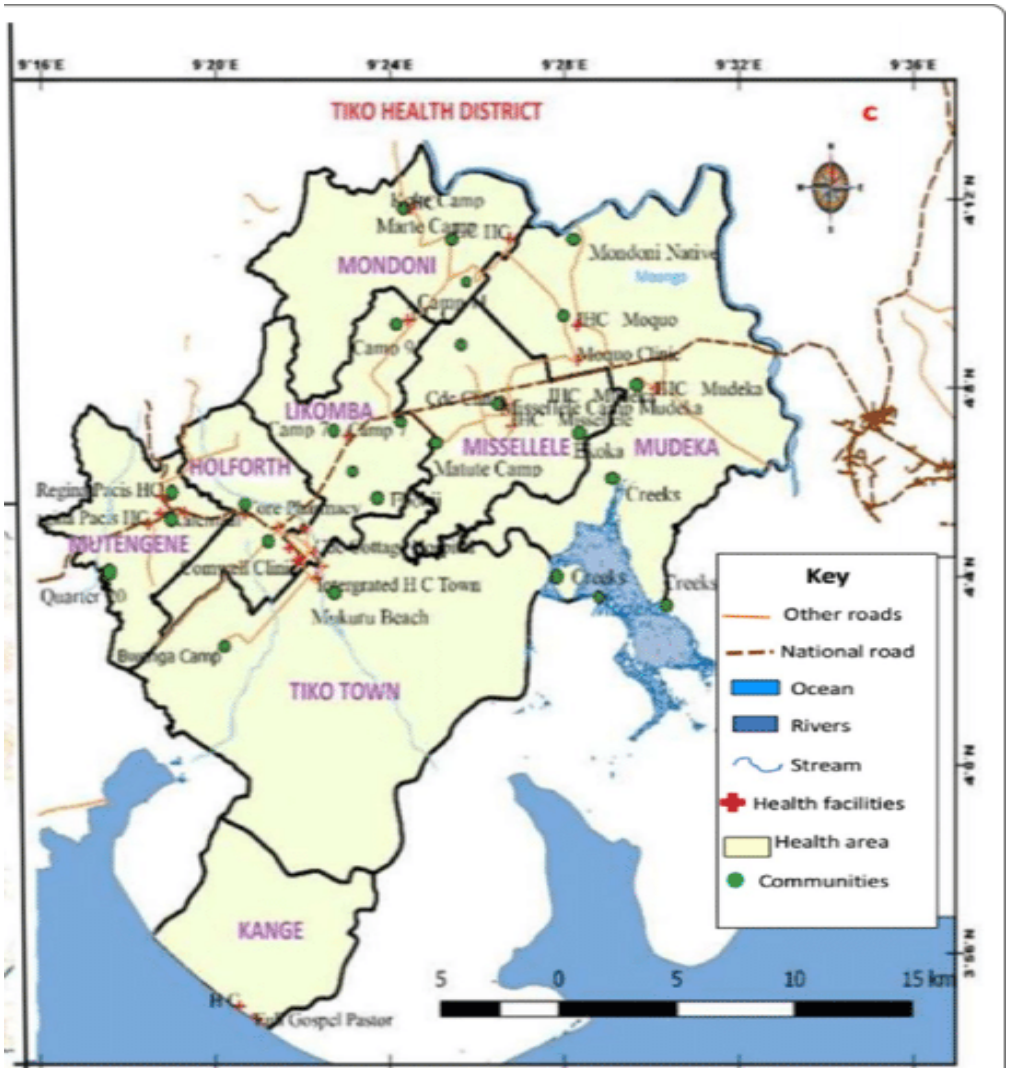

Figure 1: The map of Tiko Health district (MINSANTE, 2021)

2.2 Study design and duration

This study was a community based cross-sectional study which lasted for six months, from January-June, 2022.

2.3 Study population and sampling

This study was made up of smokers in Tiko community as well as individuals who had a history of smoking and had stopped. A total of 88 participants were recruited to take part in this study using the convenient sampling technique.

2.4 Eligibility criteria

- **Inclusion and exclusion criteria**

The study recruited participants with history of long term smoking and who accepted to participate while those with long term history of smoking and on diabetic drugs were excluded from the study.

2.5 Data collection and sampling techniques

The tests carried were oral glucose tolerance test (OGTT) and micro albuminuria test. For the OGTT the recruited participants were informed on how to prepare for the test. The test was performed after three days of normal carbohydrate intake and physical activity and after eight hours of fasting. No smoking was allowed during the test. The participant's blood sample was

taken prior to the test, and they were asked to drink a liquid containing 75g of glucose. The blood samples was taken every 60 minutes in a period of 3 hours and placed in a sodium fluoride test tube also a sterile urine container was given to the participants to provide first morning urine sample .The samples were transported to CDC central clinic diagnostic laboratory where it was centrifuged using electronic centrifuge set to run at a revolution of 3500 rev/mins for 5 minutes to obtain plasma and sediments respectively.

2.6 Sample analysis

In the laboratory, acutest@ Micro albumin urine reagents strips were used to test for micro albuminuria using the urine samples obtained. The glucose test kit reagent was removed from the refrigerator and allowed to attain room temperature. The fasting blood glucose was measured using plasma by following the manufacturer's instructions. The fasting blood glucose was estimated using a spectrophotometer.

2.7Data Analysis

The data collected was keyed into Microsoft excel and transported to Statistical Package for Social Sciences (SPSS) version. 21 and using Chi-square test of association, univariate and bivariate analysis and results were generated and represented on tables and charts.

3.0 RESULTS

3.1 Biochemical and anthropometric characteristics.

In this study, 88 participants were selected with a minimum age of 21 years and a maximum age of 68 years. The mean age was 41.22±9.3 years and the median age of 40.5 (IQR: 35.2-44.7). The 2 hours post glucose load concentration (blood sugar concentration) ranges from 103 to 283 mg/dL with a mean of 149.6±34.29mg/dL and a median value of 137 (IQR:132-150). The BMI

value of participants ranges from 17 to 47 Kg/m^2 with a mean value of 29.7±5.99 Kg/m^2 and median BMI of 29 (IQR: 26-34). The mean bottle of alcohol consumed per month ranges from 0-9 bottles and the mean weekly bottles consumed was 2.7±2.8 bottles and the median mean weekly bottles consumed was 1 (IQR: 0.25-4).

3.2 Socio-demographic and lifestyle characteristics

In this study, majority of the participants were between the age group 41 to 50 years and majority (63.6%). Majority consumed between 2 to 4 bottles of alcoholic drink per week while most (44.3%) were obese.

Table 1: Description of Socio-demographic and lifestyle characteristics

Variable	Frequency (n=88)	Percentages (%)
Age group		
21-30	11	12.5
31-40	33	37.5
41-50	34	38.6
51-60	4	4.5
≥61	6	6.8
Marital status		
Married	56	63.6
Single	32	36.4
Alcohol consumed per week		
0	22	25.0
1	23	26.1
2-4	22	25.0
≥5	21	23.9
Weight category		
Underweight (<18.5kg.m^2)	1	1.1
Normal (18.5-24.9kg/m^2)	15	17.0
Overweight (25.0-30kg/m^2)	33	37.5
Obesity (>30kg/m^2)	39	44.3

3.2 Prevalence of prediabetes and Diabetes mellitus

Out of the 88 participants selected for this study, 31 were prediabetics while 9 were diabetics given a prevalence of prediabetes and diabetes of 35.2% and 10.2% respectively. Results are summarized in Figure 2.

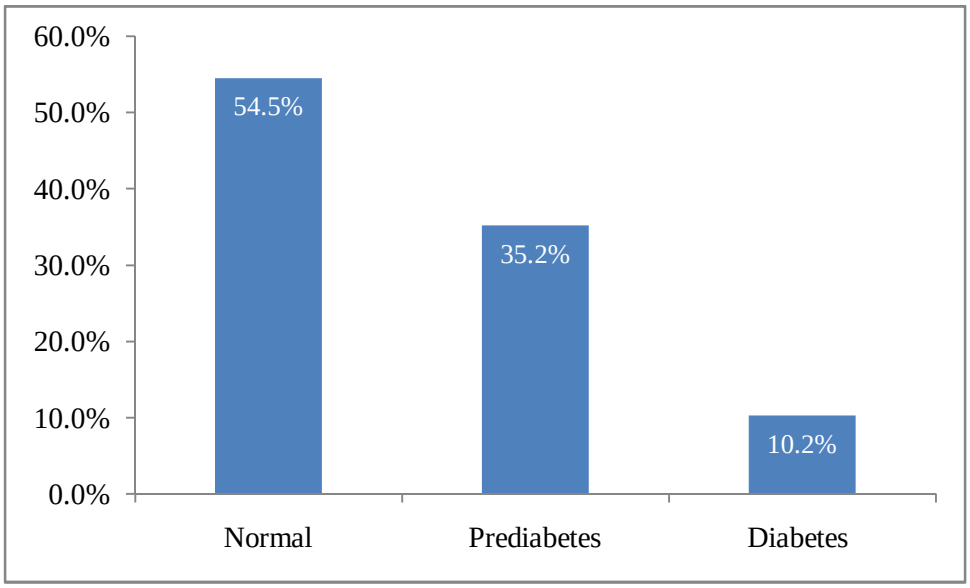

Figure 2: Prevalence of pre-diabetes and diabetes

3.2 Prevalence of Micro albuminuria

Out of the 88 participants selected for this study, 10 had test positive for urine albumin given a prevalence of albuminuria of 11.4%. Results are summarized in Figure 3.

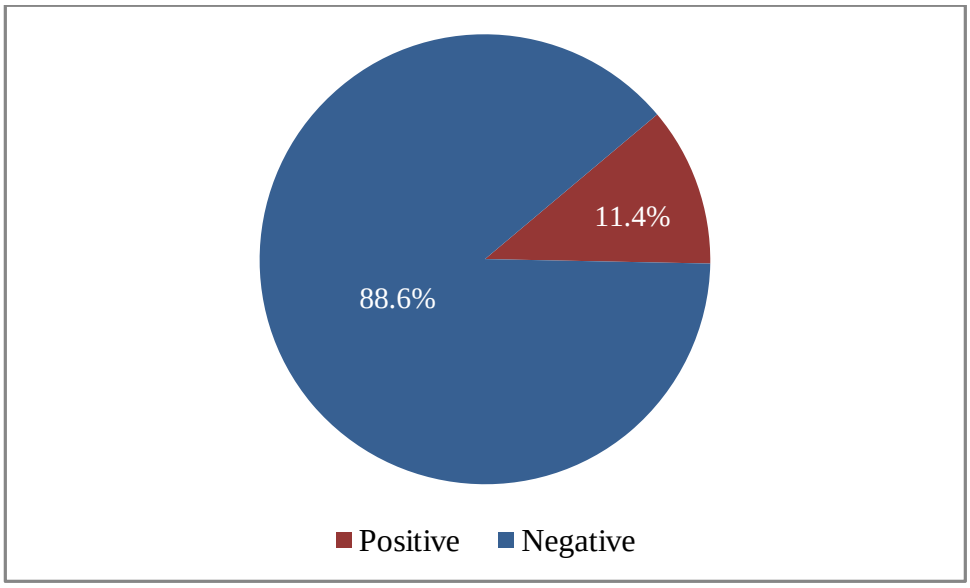

Figure 3: Prevalence of Micro albuminuria

3.3 Relationship between Age, BMI, Number of alcohol bottles consumed and Blood Glucose concentration

No coherent pattern was observed between Age, BMI and Number of alcohol bottles consumed per week with Blood glucose concentration as seen in Figure 4.

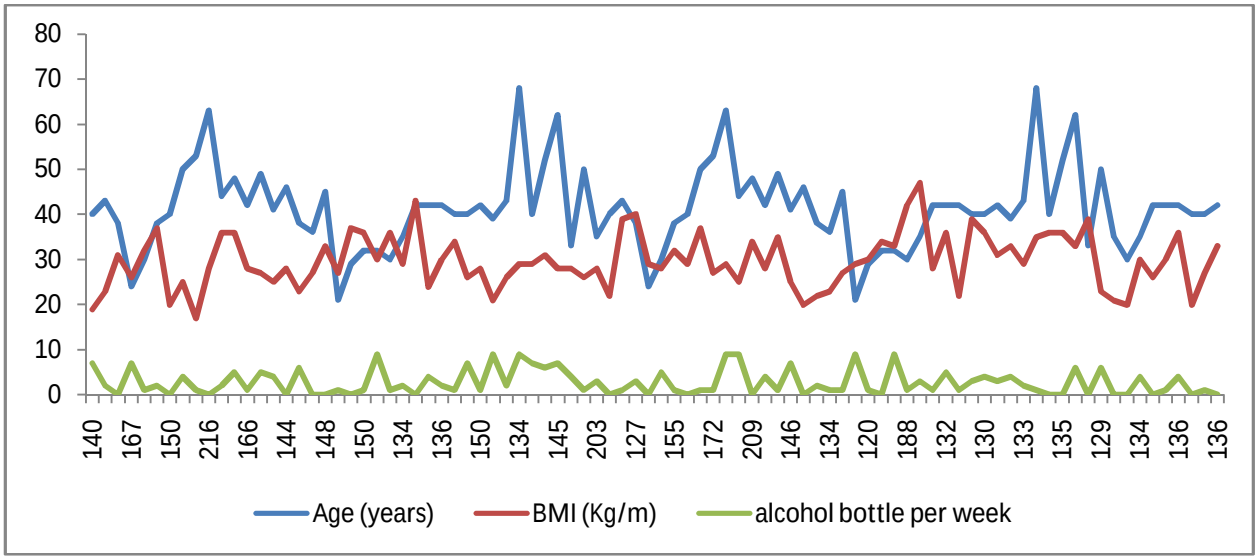

Figure 4: Relationship between Age, BMI, Number of alcohol bottles consumed and Blood Glucose concentration

3.4 Correlation matrix between Age, BMI, Number of alcohol bottles consumed and Blood Glucose concentration

No correlation was observed between Age, BMI and Number of alcohol bottles consumed per week with Blood glucose concentration (P-value: > 0.05) as seen in **Table 2**

Table 2: Correlation matrix between Age, BMI, Number of alcohol bottles consumed and Blood Glucose concentration

		Blood Glucose concentration (OGTT)
Comparing Variable	Age	0.04; (P-value: 0.7)
	BMI	0.102; (P-value: 0.3)
	Number of alcohol bottles consumed	-0.13; (P-value: 0.24)

4.5 Associated risk factors of diabetes and prediabetes

In this study there was no significant relationship between age group, marital status, alcohol consumption, and Body weight with abnormal glucose levels. However there was a significant association between Albuminuria and Abnormal glucose levels (p-value: 0.0001) as shown in Table 3.

Table 3: Association factors of diabetes and prediabetes

Characteristics	**Abnormal glucose**		**X^2 –value**	***p*-value**
	No	**Yes**		
Age group				
21-30	4 (8.3)	7 (17.5)	4.05	0.4
31-40	18 (37.5)	15 (37.5)		
41-50	22 (45.8)	12 (30.0)		
51-60	2 (4.2)	2 5.0)		
≥61	2 (4.2)	4 (10.0)		
Marital status				
Married	29 (60.4)	27 (67.5)	0.47	0.49
Single	19 (39.6)	13 (32.5)		
Alcohol consumed per week				
0	**9 (18.8)**	**13 (32.5)**	4.6	0.2

1	12 (25.0)	11 (27.5)		
2-4	16 (33.3)	6 (15.0)		
≥5	**11 (22.9)**	**10 (25.0)**		
Weight category				
Underweight	**0 (0.0)**	**1 (2.5)**	4.98	0.17
Normal	**7 (14.6)**	**8 (20.0)**		
Overweight	**15 (31.2)**	**18 (45.0)**		
Obesity	**26 (54.2)**	**13 (32.5)**		
Albuminuria				
No	**48 (100)**	**30 (75.0)**	**13.5**	**0.0001**
Yes	**0 (0.0)**	**10 (25.0)**		

4.0 Discussion

Smoking is an established major risk factor for various chronic non communicable diseases [23–25], although evidence for a relationship between smoking and diabetes remains controversial [14, 16], Majority of studies have demonstrated that smoking may increase the risk of diabetes [13–15] with some evidence pointed to a decreased risk [16, 19]. This study was aimed at determining the prevalence of prediabetes, diabetes and micro-albumiuria among smokers within Tiko Health District.

4.1 Prevalence of prediabetes among smokers in Tiko community.

With regards to the prevalence of prediabetes and diabetes, the study revealed that out of the 88 participants selected for this study, 31 were prediabetic while 9 were diabetics given a prevalence of prediabetes and diabetes of 35.2% and 10.2% respectively. These results contrary with studies by Shukri et al. 2018 in Kenya where a prevalence for pre-diabetes and diabetes were 3.1% (95% CI: 2.2, 4.0) and 2.4% (1.8, 3.0) respectively, Similarly studies by Kumar et al. 2016 in India revealed that the prevalence of prediabetes was 11.69% and diabetes was found to be 12.67% in the combined population of Chandigarh and Panchkula and studies by Jamaan et

al. 2018 in Saudi Arabia showed that the prevalence of diabetes and prediabetes among females from Al Kharj was 3.8% and 18.8%, respectively. This studies all reveals a lower prevalence of prediabetes and diabetes as compared to our study, this disparity in result may be due to the fact that the participants used in the present study were all smokers and several cohort studies in Korea have reported that smoking was associated with an increased risk for the development of diabetes as evident by a study carried by Cho et al. [6] who "followed 4,041 men for 4 years in rural and urban settings in Korea, and found that past and current smokers had a significantly increased risk for type 2 diabetes, and the risk increased with the number of cigarettes smoked".

Also, out of the 88 participants selected for this study, 10 tested positive for urine albumin given a prevalence of albuminuria of 11.4%, this study is in contrast with studies by Muhammad et al. 2014 in Egypt in which the prevalence of diabetic nephropathy in T2DM patients was 30.1%, with 25.6% having microalbuminuria and 4.5% having macroalbuminuria similar studies by Ahmad et al. reported 31.56% diabetic patients with microalbuminuria [10] and Muhammad et al. reported an overall microalbuminuria prevalence of 32.9% [11]. Additionally, a study by Anwarulla *et al*. spotted microalbuminuria in 33% of type 2 diabetics [8] furthermore within the subcontinent, a Bangladesh-based study reported a prevalence of microalbuminuria among diabetic participants of 29.72% [12] and Thakur *et al*. reported that 20% of Nepalese diabetic patients had microalbuminuria [14]. This study shows that the prevalence of microalbumuria is high among diabetics as compared to non-diabetics. These studies all reported high prevalence of microalbumuria among diabetes as compared to our study, this disparity in result may be due to the fact that a lesser number of participants (10.2%) in this study were diabetic as opposed to these studies that worked strictly on diabetic patients.

4.1.3 Correlation between socio-demographic and lifestyle characteristics with hyperglycemia.

With regards to the correlation of socio demographic and lifestyle characteristics with hyperglycemia, no correlation was observed between Age and blood glucose concentration (P-value: > 0.05), however studies by Gary et al, 2006 [6] in china observed a very clear and significant increase in plasma glucose levels with age. This finding applies to fasting; 2- hour post-prandial, as well as random plasma glucose levels, with 2-hour plasma glucose showing the strongest relationship. furthermore in a recent study done in India, Kutty et al (9) reported “lower plasma glucose levels in the young age group (20-29 years) and higher plasma glucose level in the old age group (>69 years) in women than in men. In addition, the increment of plasma glucose per decade was almost twice as high in women as in men”.

This study found no correlation between BMI and blood glucose concentration however a prospective study involving a legion of men living in Uppsala, Sweden [15] with a normal glycemic state and follow-up for development of type-2 diabetes mellitus found that the incidence of diabetes mellitus rose by a factor of twenty-two when individuals with the highest BMI were compared with those who had the lowest BMI. The difference in BMI not correlating with glucose level may be due to racial and other biological factors.

Lastly, with regards the correlation of alcohol intake and blood glucose level, this study showed no correlation pattern of alcohol intake and glucose level, however a 2016meta-analysis by Li *et al*. [16] included 26 cohort studies with 31,621 T2D cases. The authors showed that moderate alcohol consumption reduced the risk ratio to 0.8 (0.72, 0.89) compared with low alcohol consumption in men.

CONCLUSION

This was a cross-sectional study carried out in the Tiko Health District to determine the prevalence of blood glucose and microalbuminuria among smokers in Tiko community. From the findings it can be concluded that the prevalence of pre-diabetes and diabets was 35.2% and 10.2% respectively. The prevalence of albuminuria among smokers in Tiko community was 11.4%. No coherent pattern was observed between Age, BMI and Number of alcohol bottles consumed per week with Blood glucose concentration.

Ethical Approval and Consent:

Ethical clearance was obtained from the Institutional review board of Faculty of Science, University of Buea after which the ethical clearance was issued to the district medical officer Tiko (DMOT) for the approval of the project. An administrative authorization was obtained from the DMOT office and was presented to the Cameroon Development Corporation (CDC) head office Bota for authorisation to carry out the research in CDC Tiko Central Clinic Laboratory. Patients enrolled in this study were provided with a semi-structured questionnaire after obtaining their written consents and a code for each questionnaire for confidentiality was assigned.

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