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Dietary factors associated with glycemic status among adults living with Type II Diabetes in Fako Division, Cameroon

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ABSTRACT

Introduction: Diabetes mellitus is the most common metabolic disease that has recently been proposed as a health priority worldwide. **Objective:** To assess the influence of food security, food choices, and nutritional status on glycemic control among adults living with Type 2 Diabetes. **Methods:** A cross-sectional study design was used to select adults from two health facilities during their scheduled hospital visit. Data collection was done from November 2022 to March 2023 using a questionnaire comprising sociodemographic characteristics, nutritional status, food security, and dietary diversity sections. Data was analyzed using SPSS version 27.0. Both bivariate and multivariate analyses were done to determine the factors associated with poor glycemic control. **Results:** The study included 299 respondents, and findings found that 77.9% of respondents had a poor fasting blood glucose level, while 22.1% had a good fasting blood glucose level. Respondents living in households with ≤4 family members were about two times more likely to have a poor fasting blood glucose compared to their counterparts living in households with more than 4 family members (aOR: 1.83, 95% CI: 1.02-3.28, p=0.042). However, food insecurity, poor dietary diversity, and high body mass index were found not to be significantly associated with poor fasting blood in the study area (p>0.05). **Conclusion:** Most persons living with type II diabetes had poor glycemic control. Food security and dietary diversity were not found to influence the management of fasting blood glucose. However, small family size was the major determinant of the management of fasting blood glucose amongst adults.

Keywords: nutritional assessment; Diabetes Mellitus, type 2; dietary patterns; food security; blood glucose.

INTRODUCTION

Type 2 diabetes is a chronic condition that has become increasingly prevalent over the last few decades. This condition consists of high levels of glucose (sugar) in the blood, which might contribute to serious health complications unless managed effectively. One of the key aspects of managing type 2 diabetes is maintaining a healthy and balanced diet. Nutritional intake is critical for patients with type 2 diabetes as it affects their blood glucose levels, weight management, and overall health[1].

Diabetes mellitus is an ancient disease cited by both Egyptians and the Greeks around the1500 before Christ[1]. Type II diabetes mellitus may account for 90 to 95% of all diagnosed cases of diabetes[2]. Previous evidence has ranked diabetes mellitus among the top ten epidemics in the North Africa and Middle East region[3], while the Western Pacific islands dominate the list due to ethnicity and changing lifestyles[4]. Findings from sub-Saharan Africa recommend that a greater proportion of essential services for diabetes care and diagnosis remain unmet[5]. These include access to screening for complications, counselling, and medicines. Many low-income countries are already overloaded with health care systems and multiple competing health care issues.

Risk factors of this type II diabetes are numerous and range from genetic to environmental factors, including family history, age, overweight or obesity (especially intra-abdominal obesity), and physical inactivity[6,7]. Adiposity and a sedentary lifestyle are prevailing risk factors for type II diabetes[8]. Insufficient proper health education, limited health care personnel, and health clinics put patients at an increased risk of diabetes complications. Prevention remains costly, and some countries, especially the developing countries, rely on international assistance to implement screening and education[5].

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Food insecurity has primarily been linked to undernutrition, but contextualizing it with diet-related non-communicable diseases (NCDs) in Cameroon, such as type 2 diabetes mellitus (T2DM), has not been made clear. More specifically, people diagnosed with T2DM living in urban areas of Cameroon may experience food insecurity due to competing priorities such as a high health expenses and high cost of living, which compromise dietary diversity, increase use of coping strategies, amount of food consumed, and nutritional quality of the diet both at household and individual levels. This dietary behavior and self-care management may be more problematic among food-insecure and diverse individuals living with T2DM[9-11].

Medical management of type II diabetes comprises monitoring blood glucose and treatment with the use of medications. Nutritional management is as vital as medical management, and it includes lifestyle modification to improve levels of blood glucose, lipids, or lipoproteins and blood pressure. In addition, nutrition education, energy restriction to enhance weight loss, and monitoring of blood glucose to make adjustments in medications or food[12]. Also, the International Diabetes Federation (IDF) and the American Diabetes Association (ADA) guidelines approve the use of insulin only or combined with other glucose-lowering drugs (GLDs) when persons with Type 2 diabetes are unbalanced, with signs and symptoms of acute decompensation, including dehydration, acute weight loss, acute illness, very high glucose levels, and presence of ketones. Basal insulin would be given, and it can be temporary. Most insulin procedures start with 0.2 units/kg and titrate once or twice weekly at 1 to 2 units every time to obtain a required fasting blood glucose of 3.9 to 7.2 mmol/L (70 and 130 mg/dL)[13].

Dietary management is critical for the prevention of diabetes mellitus, managing existing conditions, and the onset of the development of related complications[14]. Evaluation of the quality of food eaten by a person living with diabetes is useful for the development of an effective diabetes

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management intervention, which entails an appropriate assessment of their dietary status, mainly for secondary and tertiary prevention to reduce the progression of diabetes complications[7,15]. Better dietary status is associated with several protective effects towards health outcomes[3].

Though preceding studies have examined food security and diabetes self-management, these studies have frequently not had adequate numbers of very-low-food-secure participants to permit adequate analysis by severity of food insecurity.

This study aims to assess the influence of food security, dietary diversity, and nutritional status on the management of type II diabetes mellitus among patients with diabetes in two health facilities in Fako Division.

METHODS

Study area, design, and population

This study was carried out in Buea and Limbe Regional Hospitals. Buea is situated in Fako Division between the latitude 4º 14 north of the equator and longitude 9º 23 east of the Greenwich Meridian. Buea Regional Hospital is about 2 km away from the Mile 17 motor park. It is situated precisely between the delegations of education and the army barracks, along the highway to the Bokwango neighborhood.

Regional Hospital Limbe is a 200-bed hospital located in the Southwest Region of Cameroon and is the main referral public hospital for the region. These hospitals have an established diabetes unit and a diabetologist who is a resident at both hospitals, during clinic days, which are on Tuesdays and Thursdays, patients come for routine visits where they are educated about diabetes, dietary management, and self-care. Their blood glucose level is examined, and medications are prescribed by the diabetologist.

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A cross-sectional study was conducted from November 2021 to August 2022 at the Buea and Limbe Regional Hospital with diabetes patients. The number of patients who had received treatment for more than six months at the two health facilities met the inclusion criteria where the patient. Therefore, an exhaustive sampling method was used to sample all participants attending the selected health facilities. However, a minimum sample size of 299 was calculated using the formula $n = Z^2 \times P(1-P) / d^2$, where: n = minimum sample size, z = confidence value =1.96 for a 95% confidence interval, p= the prevalence of key indicators of diabetes from a study[16] done in Center and North-west region =8% and 5% of precision with an additional 49 participants for attrition. Ethical clearance was obtained from the Institutional Review Board of the University of Buea (No: 2021/1467-05/UB/SG/IRB/FHS), Cameroon, and all participants provided written informed consent before enrollment in the study.

Data collection and procedure

The data collection tool used for this study was a semi-structured questionnaire, consisting of the following parts: socio-demographic data, Anthropometric measurements, Dietary assessment, and Household food security, used to collect data from November 2022 to March 2023. The interviewer presented him/herself to the participant, explained the aim of the study, and obtained informed consent. All participants were informed about the nature and purpose of the study. A pre-tested structured interview questionnaire was used to collect data. It consists of the following: socio-demographic data, anthropometric measurements (weight and height, BMI), dietary assessment using a 24-hour food recall, and household food security.

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Sociodemographic data, which include information about the general characteristics of the study sample, including age of the patient, marital status, educational level, income level, household size, duration of type II diabetes mellitus, etc.

Anthropometric measurement

Anthropometric measurements performed on all eligible participants included height and weight. Height was measured using the UNICEF wooden height and length boards, while the UNICEF Seca 762 classic mechanical medical weighing scale was used to measure weight to the nearest 0.1 kg. Nutritional status was assessed by body mass index (BMI) calculated as weight/(height)^2 and categorized according to WHO standards 2020. Definition of underweight (BMI $\leq$18kg/m^2), normal range (BMI =18.5 – 24.9 kg/m^2), overweight (BMI =25 – 29.9 kg/m^2), and obese (BMI = $\geq$30 kg/m^2).

Dietary diversity

Participants were asked to enumerate all the foods eaten both at home and out of the home in the 24 hours before the interview. A 24-hour dietary recall is an open-ended structured interview designed to capture information about all foods and beverages eaten by the participants in the past 24 hours. A single 24-hour recall is a reference tool to assess dietary diversity because it offers a complete and in-depth report of all foods and beverages eaten by participants, and extended reference periods may lead to less precise information due to faulty recall. According to the FAO report, there are no conventional cut-off points in terms of the number of food groups to indicate adequate or insufficient dietary diversity for HDDS or IDDS[17]. FAO guidelines were used to create the dietary diversity score of the included participants. All food types consumed were classified

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into nine food groups, namely: white tubers and roots cereals, meat, eggs, vegetables and fruits, legumes, nuts and seeds, fish and other seafood, milk and milk products, oils and fats. All food consumed in the 24 h recall by each respondent was assigned to one of the nine major food groups defined above.

Food security

The Household Food Insecurity Access Scale (HFIAS) is a 9-item questionnaire used to evaluate participants' food security status and is categorized as food secure if the participant reported 'no' to all of the items and insecure if the participant reported 'yes' to at least one of the nine items included in the food security questionnaire. Based on the HFIAS questionnaire scores, households were grouped into four groups: secure (0-1), mildly food insecure (2-7), moderately food insecure (8–14), and severely food insecure (15-27). This HFIAS questionnaire assesses whether a particular condition related to the experience of food insecurity occurred during the preceding 30 days[18].

Physical activity

Physical activity was measured using the WHO 2020 guidelines on physical activity, which considered that even those with chronic conditions and disability are required to do physical activity at least 150-300 minutes for moderate-intensity, at least 75-150 minutes for vigorous-intensity, or at least 150 minutes for moderate-to-vigorous-intensity physical activity weekly for substantial health benefits. Thus, physical activity level was classified as low, moderate, or high according to WHO guidelines.

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Blood pressure

The electronic blood pressure monitor was used to measure blood pressure on the non-dominant arm three times, with a 1-minute interval between measurements, while the participant remained in the same position after five minutes of rest in a calm atmosphere, and the mean of the scores taken was used for data analysis. Arterial hypertension was classified as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg.

Diabetes and Glycemic Control: The current study defined DM as the prescription of a hypoglycemic drug for ≥28 days within 2 years before the date of screening or fasting plasma glucose (FPG) ≥126 mg/dl at screening. The glycemic control was evaluated using the HbA1c test in combination with a consultation with the participant's physician. The DM status was grouped into two groups based on the reference of the American Diabetes Association: DM with good glycemic control (FPG≤130 mg/dl) and poor glycemic control (FPG>130 mg/dl)[9]. The blood glucose level of participants was measured using a glucometer (OneTouch Verio Reflect meter, Switzerland).

Statistical analysis

The data were coded, entered, cleaned, and analyzed using the Statistical Package for the Social Sciences computer program (SPSS, V.26.0). Descriptive statistics were presented in means, standard deviation for continuous variables, and frequencies and percentages for categorical variables in tables and figures. Also, inferential statistics made use of Pearson's chi-square test and logistic regression analyses. Pearson correlation was performed to investigate the relationship between food security and dietary diversity. Bivariate analysis was done to determine the factors associated with poor glycemic control using Pearson's chi-square. Then, the variables found as

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significant, or <0.20 in the bivariate analysis, were included in a multivariate logistic regression to establish associations between potential risk factors and poor glycemic control. Furthermore, other variables that have been scientifically proven to be associated with poor glycemic control in preceding studies were also included in the multivariate analysis, and a manual backward stepwise method was performed. In addition, the tolerance was tested for the various predictors and used to check for collinearity. The variables were statistically significant at $p<0.05$.

RESULTS

Characteristics of surveyed participants

A sample of 299 participants with type II diabetes mellitus was surveyed in this study. The sample consists of 53.8% males and 46.2% females with ages ranging from 45 to 75 years. The average age of participants was 61.9±7.6 years. Furthermore, the study recorded 80.3% of the participants as married and living with their spouses, and 71.2% lived in households where two or more people worked and earned a salary for the household.

Additionally, more than two-thirds (48.5%) of the participants' households had a family size of 4-6 persons with an average of 4.4±2.0 persons, 93.7% lived in households where females make decisions about food purchase and consumption, and 44.5% of the surveyed participants had a household income level of 110,000 to 200,000 (Table 1).

Results displayed on Table 2 indicated that 77.9% participants had a poor FBG, and 31.4% had high blood pressure (HBP) stage 1. Furthermore, 53.9% were only on pills as a treatment for blood sugar control, 34.0% were on Insulin alone, 10.1% were both on pills and insulin, while 2.0% were on clinical follow-up. Further findings revealed that 89.7% had no complications due to the diabetes condition, 4.6% had stroke due to diabetes, leg ulcer (3.0%), and had gone blind

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due to the disease (0.3%). More than two-thirds (62.9%) of the participants were sedentary, and 30.1% of the participants were obese.

Household food insecurity

Regarding household food insecurity, the majority (87.3%) were food secure, while 12.7% were food insecure. Detailed findings revealed that 7.7% were moderately food insecure, mildly food insecure (4.7%), and severely food insecure (0.3%).

Dietary diversity score for participants

Participants dietary diversity was obtained using the 17 food groups (cereals, vitamin A rich, vegetables/ tubers, white tubers, dark green vegetables, other vegetables, vitamin A rich fruits, other fruits, organ meat, flesh meat, eggs, fish, legumes/nuts/seeds, milk and milk products, Oils /fats, red palm products, sweets, species/condiments) from the dietary diversity score (DDS).

The results revealed that the most consumed food groups were; fish (92.6%), other vegetables (such as tomato, eggplant, including wild vegetables, onion) (88.3%), species /condiment (81.9%), cereals (80.3%) and white tuber (78.9%), while Vitamin A rich vegetables/tubers (8.7%), eggs (10.7%), sweets (2.3%) and organ meat (0.7%) were the least consumed as depicted on Figure 1. In summary, 77.9% of the participants had a more diverse diet by consuming 6 or more food groups, 19.1% consumed 4-5 food groups, and only 3.0% consumed 1-3 food groups. The average number of food groups consumed by participants was 6.7±1.9.

Table 3 presents the glycemic control in diabetic patients in relation to selected sociodemographic characteristics using bivariate analysis. The family size was found to be significantly associated with the glycemic control in diabetic patients (p=0.036). Table 4 presents

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glycemic control in diabetic patients in relation to selected health-related factors, dietary diversity, food insecurity, and the nutritional status using bivariate analysis. None of the variables was statistically significant in the current study area ($p>0.05$).

Factors associated with the glycemic control of type II diabetes

The association between socio-demographic characteristics, health-related factors, dietary diversity, food insecurity, nutritional status, and the management of type II diabetes was performed using multivariate logistic regression. Findings revealed that only household family size was significantly associated with the management of type II diabetes. Participants living in households with ≤4 family members were about 2 times more likely to have a poor FBG compared to their counterparts living in households with more than 4 family members (aOR: 1.83, 95% CI: 1.02; 3.28, p: 0.042), as shown in Table 5.

DISCUSSION

This study sought to investigate the influence of food security, dietary diversity, and nutritional status on the management of type II diabetes mellitus among diabetic individuals on treatment in two public health facilities in Fako Division, Cameroon. Current findings reported that most participants were male, food secure, had a diverse diet, and a sedentary lifestyle. Additionally, 30.1% of the participants were obese or overweight, 41.1%, and only 28.8% had a normal BMI. Obesity is believed to account for a higher risk of developing type 2 diabetes than those with a normal BMI.

This could be because most of the participants ate more than the daily requirements, and coupled with the fact that the majority of these participants practiced a sedentary lifestyle[19]. The

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likelihood of having diabetes or having an uncontrolled blood glucose level was two or more times higher among overweight and obese individuals than among individuals with normal BMI. These results are in line with other findings from a study carried out in Malaysia by Firouzi et al.[20] and Saudi Arabia[3] who revealed that the proportion of overweight and obesity among type II diabetes individuals was 86.5% and 72.3%, respectively. The likelihood of being diabetic or having an uncontrolled blood glucose level is two or more times higher among overweight and obese individuals than among individuals with normal BMI.

The prevalence of food insecurity among participants' households in these two health facilities was low (12.7%). For this severe food insecurity, mild food insecurity, and moderate food insecurity are 0.3%, 4.7%, and 7.7%, respectively. On the other hand, a majority of 87.3% of the households were food secure. The rather low prevalence of food insecurity in this study might be because most of the included participants are older with less financial burden, and a majority of them lived with fewer household members, thus fewer persons to feed. Their children financially support some of the participants, while others do still earn a living through salaries, pensions, farming, and grading. On the contrary, a higher prevalence of food insecurity (50.7%) was reported in the findings of Tezera et al.[21] in Ethiopia.

Food-insecure participants with T2DM were more likely to have poor glycemic control, difficulty affording the appropriate diet suitable for diabetics, and were more likely to be non-adherent to dietary counselling than their food-secure counterparts[22]. In addition, food-insecure type II diabetes individuals are unable to appropriately meet their caloric needs and weight management, which might influence their glycemic control[23,24].

The dietary diversity findings revealed that the four major classes of food eaten by the participants were fish, other vegetables (e.g., tomatoes, onions, and eggplant, including wild

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vegetables), species /condiment, cereals, and white tuber, while the least consumed food groups were Vitamin A-rich vegetables/tubers, eggs, sweets, and organ meat. A greater portion (77.9%) of participants consumed 6 or more healthy food groups, while 19.1% of the participants consumed 4-5 healthy food groups, and a few households (3.0%) consumed 1-3 healthy food groups. This implies majority of the study participants had a good, diverse diet. Findings contradict those reported in South Africa, which indicated that 70.4% of the type II diabetes individuals consumed less than 5 of the 10 healthy food groups in the past 24 hours, indicating that study participants had a low-diversity diet[25]. This might be because the majority of these participants included in this study were educated, earned a monthly income, and were knowledgeable enough on the right type of food to consume and able to afford quality food.

The present findings reported that 77.9% of the study participants had poor FBG (≥130mg/dl). The high prevalence of uncontrolled T2DM reported in this present research study is of concern and also concurs with previous studies conducted in Saudi Arabia. The findings are broadly in line with previous studies conducted in Riyadh, the capital of Saudi Arabia[3]. It reported that 74.9% of participants suffered from poor glycemic control.

Our findings did not find any significant association between dietary diversity, household food insecurity, nutritional status, and the glycemic control of type II diabetes among participants in the study area ($p>0.05$). Some studies have reported the relationship between BMI and glycemic control for persons living with T2D. In general, the percentage of participants achieving glycemic control significantly declined as BMI increased[25-27]. In addition, similar studies have reported that both food insecurity and dietary diversity are concerns among adults diagnosed with T2DM[28,29].

Furthermore, there was a significant association between household family size and poor glycemic control (aOR: 1.83, 95% CI: 1.02-3.28, $p=0.042$). Study participants living in households

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with household sizes of fewer than 4 persons were more likely to have poor glycemic control. These findings reveal the significance of the household context in diabetes interventions, implying that household members not targeted by diabetes interventions may also positively contribute to or undermine changes in diet management and glycemic control[30]. Comparable findings have been reported in prior randomized studies conducted in the United States of America[30,31].

Limitations and strengths of the study

The current study had several limitations that are important to note when interpreting the findings. Conclusions on the causal effect of the significant factor identified are therefore not possible given that the study used a cross–sectional study design. In addition, a substantial fraction of the data was self-reported by participants; there could be a tendency for participants to report certain aspects, such as monthly income and food consumption. Recall bias could also come into play as some participants had difficulty recalling their food consumption within the past 24hours. Therefore, three 24-hour recalls could be used in this study. The dietary diversity score was based on the minimum dietary diversity for women score, which has not been validated for men and older women.

Furthermore, some indicators of the nutritional status, such as overweight and obesity, signify a long-term cumulative process, while the dietary information obtained reflected the dietary patterns for 24 hours before the survey. However, our study included a relatively large and calculated sample size to test for associations. We used vigorous statistical methods to analyze the collected data and remain confident in the findings obtained and presented. As a strength, confounders were considered during the analysis of associated factors in the management of type II diabetes.

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Conclusion

Current findings show that a high proportion of people living with type II diabetes interviewed in urban health facilities with adequate follow-up were overweight/obese, were food secure, and had a high acceptable, diverse diet. However, the majority (77.9%) of participants had poor glycemic control. Overall, sociodemographic characteristics, dietary diversity, household food insecurity, and nutritional status were not statistically associated with the glycemic control of type II diabetes. Except for the association of small household size with increased likelihood of poor glycemic control. The study highlights the need to consider educational and dietary interventions geared to improve nutritional status and fasting blood glucose management.

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Table 1: Socio-demographic and socioeconomic Characteristics (n=299)

Variables Categories	Frequency	Percentage
Regional hospitals		
- Buea	191	63.9
- Limbe	108	36.1
Sex		
- Female	138	46.2
- Male	161	53.8
Marital status		
- Divorce	6	2.0
- Married	240	80.3
- Single	2	0.7
- Widow(er)	51	17.1
Age (years)		
- 55-64	127	42.5
- 65-74	108	36.1
- 45-54	51	17.1
- ≥75	13	4.3
Level of education		
- No formal education	15	5.0
- Primary education	12	4.0
- Secondary education	26	8.7
- Tertiary education	246	82.3
Household family size (persons)		
- 1-3	115	38.5
- 4-6	145	48.5
- ≥7	39	13.0
Household number of earning hands		
- 1	86	28.8
- 2	206	68.9
- 3	7	2.3
Who makes decisions about food purchase and consumption		
- Household head (male)	20	6.7
- Spouse (female)	279	93.7
Household income level (FCFA)		
- 110,000-200,000	133	44.5
- ≥210,000	131	43.8
- ≤100,000	35	11.7

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Table 2: Health related characteristics of participants

Variables	Frequency	Percentage
Fasting blood glucose (FBG poor = 130mg/dl)		
- Good	66	22.1
- Poor	233	77.9
High blood pressure (HBP)		
- HBP Stage 1	94	31.4
- HBP Stage 2	86	28.8
- Normal	32	10.7
- Pre-hypertensive	87	29.1
Duration of diabetes (years)		
- 1-5	172	57.5
- 6-10	97	32.5
- 11-20	29	9.7
- 21-30	1	0.3
Type of diabetes medication		
- Insulin only	101	34.0
- Insulin and pills	30	10.1
- Pills only	162	53.9
- Clinical follow-up	6	2.0
Diabetes complications		
- None	268	89.7
- Stroke	14	4.6
- Leg ulcer	9	3.0
- Blindness	1	0.3
- Others (chronic kidney disease, nerve damage, oral health, and hearing)	7	2.4
Physical activity level		
- Low (Sedentary)	188	62.9
- Moderate	111	37.1
Body mass index (BMI)		
- Normal	86	28.8
- Overweight	123	41.1
- Obese	90	30.1

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Table 3: Association of socio-demographic characteristics and glycemic control

Characteristics	FBG		Chi square	p value
	Good (<130mg/dl) n (%)	Poor (≥ 130mg/dl) n (%)		
Hospital facility			0.292	0.864
- Buea Regional Hospital	42 (14.0)	149 (49.8)		
- Limbe Regional Hospital	24 (8.0)	84 (28.1)		
Town			0.012	0.912
- Buea	42 (14.0)	150 (50.2)		
- Limbe	24 (8.0)	83 (27.8)		
Sex			1.611	0.204
- Females	35 (11.7)	103 (34.4)		
- Males	31 (10.4)	130 (43.5)		
Marital status			0.129	0.720
- Married	54 (18.1)	186 (62.2)		
- Single/Divorce/Widow(er)	12 (4.0)	47 (15.7)		
Age (years)			1.074	0.300
- 45-59	29 (9.7)	86 (28.8)		
- ≥60	37 (12.4)	147 (49.2)		
Family size			**4.396**	**0.036**
- >4 persons	32 (10.7)	80 (26.8)		
- ≤4 persons	34 (11.4)	153 (51.2)		
Educational level of the head of the household			4.745	0.191
- No formal education	2 (0.7)	13 (4.3)		
- Primary education	5 (1.7)	7 (2.3)		
- Secondary education	8 (2.7)	18 (6.0)		
- Tertiary education	51 (17.1)	195 (65.2)		
Household income level (FCFA)			0.243	0.886
- <=100,000	7 (2.3)	28 (9.4)		
- 110,000- 200,00	31 (10.4)	102 (34.1)		
- >=210,000	28 (9.4)	103 (34.4)		

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Table 4: Association of health-related factors, dietary diversity, food insecurity, and the nutritional status with glycemic control continuation

Characteristics	FBG		FBG	
	Good (<130mg/dl) n (%)	Good (≥ 130mg/dl) n (%)	Chi square	p value
Blood Pressure (BP)			1.927	0.382
- HBP stage	35 (11.7)	145 (48.5)		
- Normal	9 (3.0)	23 (7.7)		
- Pre-hypertensive	22 (7.4)	65 (21.7)		
Body Mass Index (BMI)			0.092	0.762
- Normal	18 (6.0)	68 (22.7)		
- Overweight/obese	48 (16.1)	165 (55.2)		
Duration of Diabetes			0.074	0.785
- >5 years	29 (9.7)	98 (32.8)		
- ≤5 years	37 (12.4)	132 (45.2)		
Food insecurity			2.165	0.539
- Food secure	55 (18.4)	206 (68.9)		
- Mildly food insecure	5 (1.7)	9 (3.0)		
- Moderately food insecure	6 (2.0)	17 (5.7)		
- Severe food insecure	0 (0.0)	1 (0.3)		
Dietary diversity score groups			0.317	0.854
- 1-3 food groups	2 (0.7)	7 (2.3)		
- 4-5 food groups	11 (3.7)	46 (15.4)		
- ≥6 food groups	53 (17.7)	180 (60.20)		

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Table 5: Factors associated with the glycemic control of type II diabetes

Characteristic	n	Poor FBG (%)	aOR (95% CI)	p value
Sex of participants				
- Male	130	43.5	1.59 (0.89; 2.86)	0.120
- Female	103	34.4	1	
Household family size				
- ≤ 4	153	51.2	1.83 (1.02;3.28)	**0.042**
- > 4	80	26.8	1	
Blood pressure of participants				
- Normal	23	7.7	0.57 (0.23; 1.37)	0.207
- Prehypertension	65	21.7	0.72 (0.39; 1.34)	0.207
- HBP stage	145	48.5	1	
Food security				
- Yes	27	9.0	0.75 (0.32; 1.74)	0.500
- No	206	68.9	1	
Dietary diversity				
- 1-3 food groups	7	2.3	1.55 (0.29; 8.15)	0.608
- 4-5 food groups	46	15.4	1.38 (0.64; 2.97)	0.414
- ≥ 6 food groups	180	60.2	1	
Body mass index				
- Overweight/ obesity	165	55.2	0.77 (0.40; 1.47)	0.419
- Normal	68	22.7	1	

***n**– Frequency; FBG-fasting blood glucose; **aOR** – Adjusted Odds ratio; **CI** – Confidence Interval; 1- Reference category*

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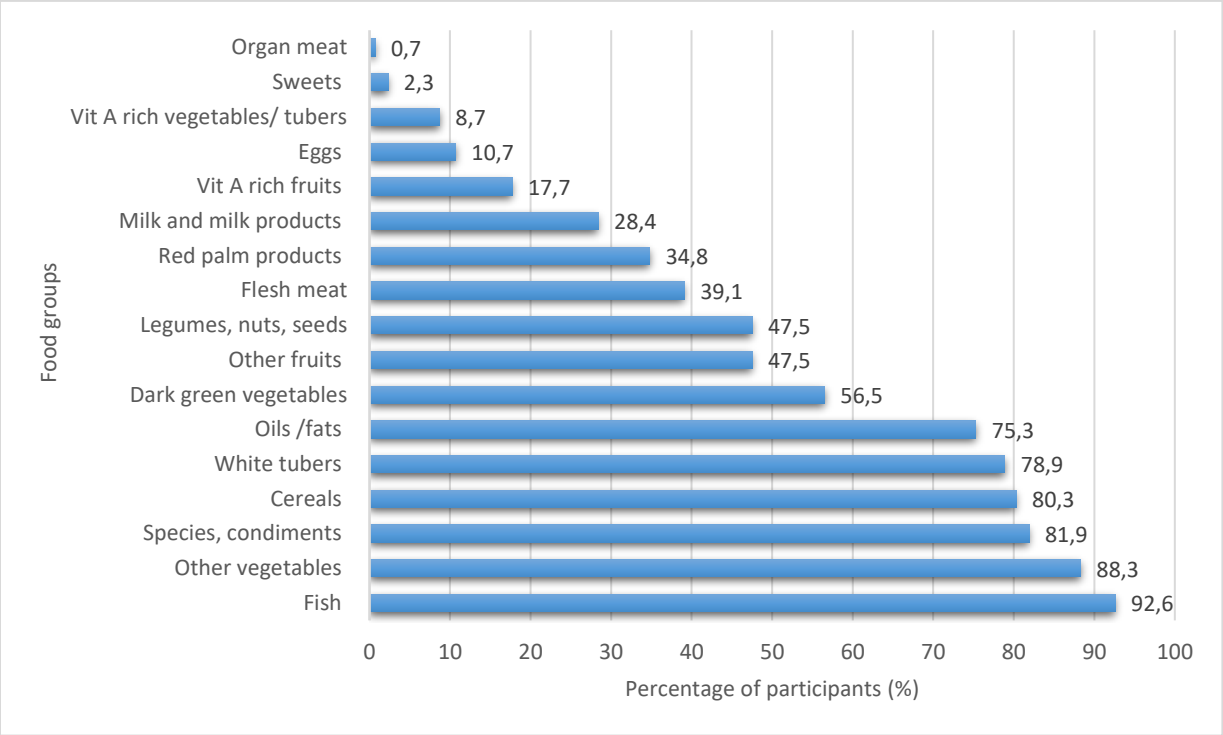

Figure 1: Food type consumed by diabetic patients (n=299)

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