International Journal of Endocrinology and Metabolic Disorders

Profiles and Drivers of Complications from Diabetes amongst Diabetes Patients in Cameroon: Cross Sectional Study

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Abstract

Background: Diabetes prevalence is increasing throughout the whole world. Urbanisation is associated with change in diet patterns, increase physical inactivity and sedentary behaviour and increasing prevalence of obesity and Type 2 Diabetes. The prevalence of undiagnosed diabetes in Africa is >60% and prevalence of diabetes will increase to 35 million in the next 20 years. Late diagnosis and under-resourced health systems will lead to increase in complications.

Methods: Data was collected from patient hospital records and structured questionnaires administered to 723 consented diabetes patients on routine consultation. Descriptive statistics were used to give the frequencies of profiles of complications. The outcome variable was the existence of complication(s) from diabetes (retinopathy, nephropathy, neuropathy, diabetic foot and cardiovascular accident) as recorded in patient records ascertained from laboratory diagnosis. Multivariable logistic regression model was used to identify statistically significant (p<0.05) drivers of complications from diabetes.

Results: More than two thirds (72.1%) of the patients had a diabetes complication. The majority of patients aged ≥ 40 years (93.8%), on medication (79.1%), had unstable glycemia (68.3%), living with diabetes for ≥ 21 years (48.4%), and overweight (37.4%), obese (34%), hypertensive (43.6%), advised to stop smoking (47.6%), recommended following a low fat and weight loss diet (64.5%) and to control blood sugar (97.3%) had complications. Having diabetes for 6–10 years (AOR:0.47, CI:0.20-0.69, p=0.013) & for ≥ 21 years (AOR:2.98, CI:1.89-4.69, p<0.001), obese (AOR:1.81, CI:1.12-2.92, p=0.037), hypertensive (AOR:1.49, CI:1.02-2.19, p=0.040), "sometimes" had a hard time doing what health provider suggested (AOR:2.05, CI:1.26-3.36, p=0.004), "sometimes" and "most of the time" in the past 4 weeks was able to do what the doctor said (AOR:2.66, CI:1.39-5.06, p=0.003; & AOR:2.71, CI:1.70-5.29, p=0.003 respectively), and "Yes" recommended to follow a low fat and weight loss diet (AOR:2.16, CI:1.41-3.31, p<0.001) were drivers of complications from diabetes after controlling for gender and age.

Conclusion: The majority of diabetes patients had atleastone complication. Obesity, hypertension, living with diabetes ≥ 21 years, difficulty adhering to medical advice was drivers of complications from diabetes. This research is critical to understand where interventions may be most effective for diabetes prevention and management.

Keywords: Diabetes; Complications; Prevalence; Drivers; Multivariable logistic regression

Abbreviations: T2D: Type 2 Diabetes, LMIC: Low and Middle Income Countries, CVD: cardiovascular disease, CBC: Cameroon Baptist Convention, IRB: Institutional Review Board, WHO: World Health Organisation, CI: Confidence Interval, SD: Standard Deviation, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, BMI: Body Mass Index, OR: Odds Ratio, AOR: Adjusted Odds Ratio.

Background

Diabetes is an important public health problem worldwide. It is a burden to health and economic systems all over the world particularly in Low and Middle Income Countries (LMIC). Diabetes is responsible for major contemporary causes of morbidity and mortality. Diabetes patients are at risk of disabling and life-threatening health problems including infections. Apart from cardiovascular disease (CVD), nephropathy, neuropathy and amputation diabetes also causes other complications like visual impairment such as diabetic retinopathy [1]. The increase in the prevalence of diabetes and better management coupled with increase life expectancies implies future increases in the rates of complications. More so, diabetes is preceded by a symptomless phase [2,3] and diagnosis more often than not intervenes at the latter stages of the disease when complications have set in. About 50% to 75% of adults with diabetes are unaware of their conditions and undiagnosed in LMIC and already have complications [1-3]. Diabetes complications affect many parts of the body and are major cause of disability, productivity loss, reduced quality of life, mortality and greater use of health services. Common long term complications from diabetes include damage to large blood vessels of the heart, brain and legs (macrovascular complications) and damage to small blood vessels leading to eye, kidney, feet and nerves problems (microvascular complications). The digestive system, skin, sexual organs, teeth and gums and the immune systems are also affected by diabetes [1-3]. In Cameroon, prevalence of diabetic retinopathy was 42% in a reference centre in Yaoundé [4]. The incidence of diabetes complications is linked to poor management of blood glucose, duration of disease and existence of cardiovascular risk factors [5-8]. Many patients

remain unscreened for complications due to low referrals, socioeconomic factors and lack of awareness [9]. Type 2 diabetes patients more often are affected by other diseases rendering management of the condition, patient education ineffective and deleterious. Increase in other ailments is associated to increase knowledge of disease and greater uptake of health services [10,11]. Diabetic patients also have other pathologies [12,13]. Complications from diabetes continue to rise though they can be avoided or delayed by effective management entailing control of risk factors of the complications and implementation of screening strategies[1]. Though complications due to diabetes are not rare, no guidelines and standards have been set to diagnose and assess complications. Estimates of complications from diabetes are hardly compiled due to scarcity of data [3]. The focus of this article is to determine the profiles of diabetic patients and determine drivers of the complications from diabetes among outpatients.

Methods

Study design: Cross sectional

Setting and study population

Data was collected by 11 researchers from 12 June to 10 September 2012 during the evaluation phase of the project "*Prevention and treatment of diabetic retinopathy in Cameroon*" in the towns of Yaoundé and Bamenda. Consented diabetes patients coming for routine consultation in the diabetes clinics and those referred to project sites (Yaoundé Central Hospital and Bamenda Regional Hospital) for further investigation on the diabetes retinopathy were contacted. Non-diabetes patients were excluded from the study. Patients living with diabetes for the last 12 months and being followed up in a diabetes clinic were included in the study.

Procedures

Participants were randomly selected from patients attending routine check-up and consultation for diabetes and complications at diabetes clinics. The study was explained to the each patient by a researcher. Patients who agreed to partake in the study provided consent by signing or thumb-printing a consent form. Data on patient health such as medical tests, diagnosis and medication being taken as prescribed by the doctor were collected from patients' medical records. A structured questionnaire explored socio-demographic parameters, knowledge about the project, causes of diabetes, complications and associated pathologies, management of diabetes (diet, physical exercise, medication, insulin, eye examination, angiography and laser photocoagulation and costs), adherence to medical advice, medical recommendations, medical history, attendance of health education talks, familiarity with posters, handouts, flyers and the messages on diabetes and knowledge, practices, attitudes and beliefs on diabetes. Questions pertaining to adherence to medical advice were;

1. Had a hard time doing what the health provider suggested
2. Followed my doctor's suggestions exactly
3. It was easy doing what my health provider suggested
4. How often in the past 4 weeks were you able to do what the doctor said?

   One response was chosen from: "none of the time", "sometimes" or "most of the time".
5. Advised to stop smoking
6. Recommended to follow a low fat and weight loss diet
7. Recommended to control blood sugar with response being either "Yes" or "No"

Data management and analysis

Data was entered in Epi Info platform and analysed with STATA 13 SE (StataCorp.2012, College Station, TX: Stata Corp LP). Mean and standard deviations were computed. Pearson χ^2 were calculated at statistical significance of $p<0.05$. The outcome variable was the existence of complication(s) from diabetes (retinopathy, nephropathy, neuropathy, diabetic foot and CVD) as ascertained from hospital records. The exposure variable were socio-demographic and health variables and adherence to medical advice. Univariate analysis identified variables at $p<0.05$ which were fitted in a multivariable logistic regression model to determine statistically significant independent variables of complications from diabetes. A sample size of 700 was sufficient to detect an effect size (Cohen f2) of 0.02 corresponding to a R2 as low as 0.0196 for a multivariable model which could further be stratified by sex.

Ethical issues

Ethical clearance was obtained from the National Ethics Committee of Cameroon and the Cameroon Baptist Convention (CBC) Health Board Institutional Review Board (IRB). All participants who accepted to take part in the survey gave written informed consent. Data obtained was codified, kept confidential and analysed anonymously.

Role of the funding partner

The sponsor played no role in the study design, data collection, analysis and interpretation or in writing this article.

Results

Descriptive results

Data analysis was done for 723 participants, 53.7% (388) were females and 46.3% (335) were male. The mean age was 56.6 years (CI: 55.7–57.4), SD ± 11.4. Socio-demographic and health characteristics Table 1, correlation of complications from diabetes and characteristics Table 2 and drivers of complications from diabetes, on Table 3for univariate analysis and multivariable logistic regression adjusted for gender age group.

Profile of diabetes patients with complications

More than two thirds (72.1%) of the participants had a diabetes complication. Prevalence of complications was: diabetic foot (24.6%), diabetic retinopathy (21.2%), neuropathy (7.2%), nephropathy 3.9%, and cardiovascular accident 1.5%. Diabetes patients of the age group 40–59 years were most often (50.8%) affected by the complications followed by those of the age group ≥ 60 years (43.0%). Also complications affected the following most: 66.7% married participants,22.6% divorced ones, 79.1% of patients on medication (52.8% on oral anti–diabetes medication, 18% on insulin and 8.3% on oral antidiabetics +Insulin), 68.3% of diabetes patients with unstable glycaemia, 48.4% of those living with diabetes for ≥ 21 years, 36.1% of patients diagnosed between 1-5 years, 54.5% of the participants advised to stop smoking, 37.4% overweight and 34% obese patients, 43.6% diabetic patients with hypertension, 97.3% of those recommended to control blood sugar, 64.5% of those advised to follow a low fat and weight loss diet and 96.5% of participants with other pathologies.

Gender differences in the prevalence of the following characteristics with complications were observed; marital status, educational level, current diabetes treatment, number of years living with diabetes, nephropathy, number of complications, having other pathologies and BMI.

Drivers of complications from diabetes

Diabetes complications were positively associated with living with diabetes for ≥ 21years, hypertension, obesity, "Sometimes" had a hard time doing what the health provider suggested and "Sometimes" and "Most of

Characteristic, n (%)	Male, 335 (46.3)	Female, 388 (53.7)	Total, 723	p-value
Age interval				
20–39	24 (50.0)	24 (50.0)	48 (6.6)	
40–59	172 (45.9)	203 (54.1)	375 (51.9)	
≥ 60	139 (46.3)	161 (53.7)	300 (41.5)	0.864
Marital status				
Married	293 (58.8)	205 (41.2)	498 (68.9)	
Single	25 (34.2)	48 (65.8)	73 (10.1)	
Divorced	17 (11.2)	135 (88.8)	125 (21.0)	<0.001
Education level				
Never went to school	60 (32.6)	124 (67.4)	184 (25.4)	
Completed primary/elementary	96 (42.7)	129 (57.3)	225 (31.1)	
Completed secondary or high school	126 (51.4)	119 (48.6)	245 (33.9)	
Completed at least first degree	53 (76.8)	16 (23.2)	69 (9.5)	<0.001
Current treatment				
Non	61 (43.3)	80 (56.7)	141 (19.5)	
Oral anti diabetics	181 (46.5)	208 (53.5)	389 (53.8)	
Insulin	58 (41.4)	82 (58.6)	140 (19.4)	
Oral antidiabetics + Insulin	35 (66.0)	18 (34.0)	53 (7.3)	0.017
Glycaemic status				
Stable	116 (48.3)	124 (51.7)	240 (33.2)	
Unstable	219 (45.3)	264 (54.7)	483 (66.8)	0.447
Number of years living with diabetes				
1–5	135 (46.7)	154 (53.3)	289 (40.0)	
6–10	19 (33.3)	38 (66.7)	57 (7.9)	
11–15	25 (59.5)	17 (40.5)	42 (5.8)	
16–20	24 (60.0)	16 (40.0)	40 (5.5)	
≥ 21	132 (44.7)	163 (55.3)	295 (40.8)	0.038
Hypertensive				
No	213 (48.8)	223 (51.2)	436 (60.3)	
Yes	122 (42.5)	165 (57.5)	287 (39.7)	0.094
Retinopathy				
No	267 (46.8)	303 (53.2)	570 (78.8)	
Yes	68 (44.4)	85 (55.6)	153 (21.2)	0.597
Neuropathy				
No	308 (45.9)	363 (54.1)	671 (92.8)	
Yes	27 (51.9)	25 (48.1)	52 (7.2)	0.402
Nephropathy				
No	328 (47.2)	367 (52.8)	695 (96.1)	
Yes	7 (25.0)	21 (75.0)	28 (3.9)	0.021
Diabetic foot				
No	251 (46.1)	294 (53.9)	545 (75.4)	
Yes	84 (47.2)	94 (52.8)	178 (24.6)	0.792
Cardiovascular accident				
No	329 (46.2)	383 (53.8)	712 (98.5)	
Yes	6 (54.6)	5 (45.4)	11 (1.5)	0.582
Other complications				
No	276 (46.2)	321 (53.8)	597 (82.6)	
Yes	59 (46.8)	67 (53.2)	126 (17.4)	0.903
Number of complications				
None	94 (46.5)	108 (53.5)	202 (27.9)	
One	231 (45.9)	272 (54.1)	503 (69.6)	
Two	10 (76.9)	3 (23.1)	13 (1.8)	
Three or four	0 (0.0)	5 (100.0)	5 (0.7)	0.026
BMI				
Normal weight	113 (51.4)	107 (48.6)	220 (30.4)	
Overweight	135 (47.5)	149 (52.5)	284 (39.3)	
Obese	87 (39.7)	132 (60.3)	219 (30.3)	0.044
Other pathologies				
No	294 (45.9)	346 (54.1)	640 (88.5)	
Yes	41 (49.4)	42 (50.6)	83 (11.5)	0.552

Advised to stop smoking				
No	158 (44.3)	199 (55.7)	357 (49.4)	
Yes	177 (48.4)	189 (51.6)	366 (50.6)	0.269
Had a hard time doing what the health provider suggested				
None of the time	54 (50.9)	52 (49.1)	106 (14.7)	
Sometimes	200 (45.7)	238 (54.3)	438 (60.5)	
Most of the time	81 (45.3)	98 (54.7)	179 (24.8)	0.586
Followed my doctor's suggestions exactly				
None of the time	9 (42.9)	12 (57.1)	21 (2.9)	
Sometimes	188 (46.1)	220 (53.9)	408 (56.4)	
Most of the time	138 (46.9)	156 (53.1)	294 (40.7)	0.925
It was easy doing what my health provider suggested				
None of the time	12 (50.0)	12 (50.0)	12 (3.3)	
Sometimes	194 (46.3)	225 (53.7)	419 (58.0)	
Most of the time	129 (46.1)	151 (53.9)	280 (38.7)	0.933
How often in the past 4 weeks I did what the doctor said?				
None of the time	30 (53.6)	26 (46.4)	56 (7.8)	
Sometimes	176 (44.9)	216 (55.1)	392 (54.2)	
Most of the time	129 (46.9)	146 (53.1)	275 (38.0)	0.463
Recommended to follow a low fat & weight loss diet				
No	151 (49.0)	157 (51.0)	308 (42.6)	
Yes	184 (44.3)	231 (55.7)	415 (57.4)	0.211
Recommended to control blood sugar				
No	13 (50.0)	13 (50.0)	26 (3.6)	
Yes	322 (46.2)	375 (53.8)	697 (96.4)	0.703

Table 1: Characteristics variation by gender for 723 participants

Characteristics, n (%)	Non, 202 (27.9)	Complications, 521 (72.1)	Total, 723	p-value
Gender				
Male	94 (28.1)	241 (71.9)	335 (46.3)	
Female	108 (27.8)	280 (72.2)	388 (53.7)	0.946
Age interval				
20–39	16 (33.3)	32 (66.7)	48 (6.6)	
40–59	110 (29.3)	265 (70.7)	375 (51.9)	
≥ 60	76 (25.3)	224 (74.7)	300 (41.5)	0.356
Marital status				
Married	146 (29.3)	352 (70.7)	498 (68.8)	
Single	22 (30.1)	51 (69.9)	73 (10.1)	
Divorced	34 (22)	118 (77.6)	152 (21.0)	0.224
Education level				
Never went to school	49 (26.6)	135 (73.4)	184 (25.4)	
Completed elementary	51 (22.7)	174 (77.3)	225 (31.1)	
Secondary or high school	83 (33.9)	162 (66.1)	245 (33.9)	
Has at least first degree	19 (27.5)	50 (72.5)	69 (9.5)	0.056
Current treatment				
Non	32 (22.7)	109 (77.3)	141 (19.5)	
Oral anti-diabetics	114 (29.3)	275 (70.7)	389 (53.8)	
Insulin	46 (32.9)	94 (67.1)	140 (19.4)	
Oral antidiabetics + Insulin	10 (18.9)	43 (81.1)	53 (7.3)	0.105
Glycaemic status				
Stable	75 (31.3)	165 (68.7)	240 (33.2)	
Unstable	127 (26.30)	356 (73.7)	483 (66.8)	0.162
Number of years living with diabetes				
1–5	101 (35.0)	188 (65.0)	289 (40.0)	
6–10	29 (50.9)	28 (49.1)	57 (7.9)	
11–15	17 (40.5)	25 (59.5)	42 (5.8)	
16–20	12 (30.0)	28 (70.0)	40 (5.5)	
≥ 21	43 (14.6)	252 (85.4)	295 (40.8)	<0.001
Hypertensive				
No	142 (32.6)	294 (67.4)	436 (60.3)	
Yes	60 (20.9)	227 (79.1)	287 (39.7)	0.001

BMI				
Normal weight	71 (32.3)	149 (67.7)	220 (30.4)	
Overweight	89 (31.3)	195 (68.7)	284 (39.3)	
Obese	42 (19.2)	177 (80.8)	219 (30.3)	0.002
Other pathologies				
No	199 (31.1)	441 (68.9)	640 (88.5)	
Yes	3 (3.6)	80 (96.4)	83 (11.5)	<0.001
Advised to stop smoking				
No	84 (23.5)	273 (76.5)	357 (49.4)	
Yes	118 (32.2)	284 (67.8)	366 (50.6)	0.009
Had a hard time doing what the health provider suggested				
None of the time	45 (42.5)	61 (57.5)	106 (14.7)	
Sometimes	99 (22.6)	339 (77.4)	438 (60.5)	
Most of the time	58 (32.4)	121 (67.6)	179 (24.8)	<0.001
Followed my doctor's suggestions exactly				
None of the time	9 (42.9)	12 (57.1)	21 (2.9)	
Sometimes	95 (23.3)	313 (76.7)	408 (56.4)	
Most of the time	98 (33.3)	196 (66.7)	294 (40.7)	0.004
It was easy doing what my health provider suggested				
None of the time	10 (41.7)	14 (58.3)	24 (3.3)	
Sometimes	97 (23.2)	322 (76.8)	419 (58.0)	
Most of the time	95 (33.9)	185 (66.1)	280 (38.7)	0.002
How often in the past 4 weeks I did what the doctor said?				
None of the time	26 (46.4)	30 (53.6)	56 (7.8)	
Sometimes	105 (26.8)	287 (73.2)	392 (54.2)	
Most of the time	71 (25.8)	204 (74.2)	275 (38.0)	0.006
Recommended to follow a low fat & weight loss diet				
No	123 (39.9)	185 (60.1)	308 (42.6)	
Yes	79 (19.0)	336 (81.0)	415 (57.4)	<0.001
Recommended to control blood sugar				
No	12 (46.2)	14 (53.8)	26 (3.6)	
Yes	190 (27.3)	507 (72.7)	697 (96.4)	0.035

Table 2: Correlation of complications and characteristics for 723 participants

Characteristics	Univariate analysis			Multivariate analysis		
	OR	CI	p-value	AOR	CI	p-value
Gender						
Female	Ref			Ref		
Male	0.99	0.71-1.37	0.946	1.12	0.78-1.61	0.526
Age interval						
20–39	Ref			Ref		
40–59	1.20	0.63-2.28	0.569	1.03	0. 51-2.05	0.940
≥ 60	1.47	0.77-2.83	0.245	1.23	0.60-2.51	0.579
Marital status						
Married	Ref					
Single	0.96	0.56-1.64	0.886			
Divorced	1.44	0.94-2.21	0.096			
Education level						
Never went to school	Ref					
Completed elementary	1.24	0.79-1.95	0.354			
Secondary or high school	0.71	0.47-1.08	0.108			
Has at least first degree	0.96	0.51-1.78	0.885			
Current treatment						
Non	Ref					
Oral anti-diabetics	0.71	0. 45-1.11	0.133			
Insulin	0.59	0.35-1.02	0.058			
Oral antidiabetics + Insulin	1.26	0.57-2.79	0.565			
Number of years living with diabetes						
1–5	**Ref**			**Ref**		
6–10	**0.52**	**0.29-0.92**	**0.025**	**0.47**	**0.20-0.69**	**0.013**
11–15	0.79	0.41-1.53	0.485	0.80	0.39-1.61	0.537
16–20	1.25	0.61-2.57	0.537	1.43	0.67-3.06	0.360
≥ 21	**3.14**	**2.10-4.71**	**<0.001**	**2.98**	**1.89-4.69**	**<0.001**

Hypertensive						
No	**Ref**			**Ref**		
Yes	**1.83**	**1.29-2.58**	**0.001**	**1.49**	**1.02-2.19**	**0.040**
BMI						
Normal weight	**Ref**			**Ref**		
Overweight	1.04	0.72-1.52	0.823	0.91	0.60-1.38	0.757
Obese	**2.01**	**1. 29-3.12**	**0.002**	**1.81**	**1.12-2.92**	**0.037**
Advised to stop smoking						
No	**Ref**			Ref		
Yes	**1.55**	**1.11-2.15**	**0.009**	1.03	0.69-1.52	0.897
Had a hard time doing what the health provider suggested						
None of the time	**Ref**			**Ref**		
Sometimes	**2.53**	**1.62-3.94**	**<0.001**	**2.05**	**1. 26-3.36**	**0.004**
Most of the time	1.54	0.94-2.52	0.089	1.72	0.99-2.97	0.053
I followed my doctor's suggestions exactly						
None of the time	Ref					
Sometimes	1.09	0.22-5.53	0.910			
Most of the time	0.67	0.13-3.36	0.623			
It was easy doing what my health provider suggested						
None of the time	Ref					
Sometimes	0.83	0.17-3.97	0.815			
Most of the time	0.49	0.10-2.34	0.369			
How often in the past 4 weeks I did what the doctor said?						
None of the time	**Ref**			**Ref**		
Sometimes	**2.37**	**1.33-4.19**	**0.003**	**2.66**	**1.39-5.06**	**0.003**
Most of the time	**2.49**	**1.38-4.49**	**0.002**	**2.71**	**1.40-5.29**	**0.003**
Recommended to follow a low fat & weight loss diet						
No	**Ref**			**Ref**		
Yes	**2.83**	**2.02-3.95**	**<0.001**	**2.16**	**1. 41-3.31**	**<0.001**
Recommended to control blood sugar						
No	**Ref**			Ref		
Yes	**2.29**	**1.04-5.03**	**0.040**	2.36	0.98-5.67	0.056

Table 3: Drivers of complications from diabetes for 723 participants

the times" in response to 'how often in the past 4 weeks the patient was able to do what the doctor said', "Yes" recommended to follow a low fat and weight loss diet, to control blood sugar and advised to stop smoking and protective forl iving with diabetes for 6–10 years, in univariate analysis.

After controlling for gender and age group in multivariable analysis the drivers of complications from diabetes were; living with diabetes for 6–10 years(AOR:0.47, CI:0.20-0.69, p=0.013) and for ≥ 21 years (AOR:2.98, CI:1.89-4.69, p<0.001), obesity (AOR:1.81, CI:1.12-2.92, p=0.037), hypertension (AOR:1.49, CI:1.02-2.19, p=0.040), "sometimes" had a hard time doing what the health provider suggested (AOR:2.05, CI:1.26-3.36, p=0.004), "sometimes and "most of the time" in the past 4 weeks being able to do what the doctor said (AOR:2.66, CI:1.39-5.06, p=0.003 & AOR:2.71, CI:1.40-5.29, p=0.003 respectively)and "Yes" recommended to follow a low fat and weight loss diet (AOR:2.16, CI:1.41-3.31, p<0.001).

Discussion

Though there is a dearth of data on complications from diabetes in Africa there is no doubt this cannot be neglected. Complications from diabetes are responsible for frequent and prolonged hospitalisations of diabetic patients and significantly associated to morbidity and mortality. Complications from diabetes hardly occur singly. This study described the profile of outpatients with complications from diabetes, ability to adhere to medical advice and drivers of complications from diabetes amongst outpatients attending routine check-up in diabetes clinics.

The prevalence of diabetic foot was the highest (24.6%) complication though previous studies put it at 42%.Studies indicated foot complications in Africa are due to neuropathic foot infection and not peripheral vascular diseases. Whilst the prevalence of diabetic retinopathy in our study was 21.2% previous studies indicated variation from 37.3% to 42.2% in Cameroon [4,14] though Ghana and Nigeria have recorded a prevalence of 17.9% and 18% respectively [15-18]. Prevalence of retinopathy ranged from 8.1% in Tunisia [19] to 41.5% in Egypt [20]. Diabetic neuropathy prevalence was 7.2% compared to 26% to 68% in Africa from 1990 to 2003 and 28% to 55% in Europe and North America [21], 21.9% in Egypt [20] and 36.7% in Sudan [22]. Diabetic nephropathy is main cause of end-stage renal disease in the world [23] and probably in Africa though published data in Africa populations are rare. We observed a 3.9% prevalence of diabetic nephropathy. Kidney disease is common in people with diabetes than those without it [3]. African American diabetic patients have higher risks of kidney failure and higher prevalence nephropathy than Caucasians [24]. In Africa, nephropathy may be increasingly responsible for chronic kidney failure [25]. Renal failure is main cause of mortality in T2D patients in South Africa [26]. Nephropathy prevalence attained 6.7% in Egypt [20]. Though the prevalence of cardiovascular complications was lowest in our study other studies showed high prevalence of cardiovascular risk factors in participants with clinical diabetic nephropathy and patients with diabetic nephropathy are at greater risk of excess cardiovascular morbidity [27,28]. Cardiovascular complications of diabetes include angina, myocardial infarction or heart attack, stroke, peripheral artery disease and congestive heart failure. CVD accounted for 70% deaths in people with T2D [29]. Diabetic patients have a four-fold risk of suffering from CVD than non-diabetics [30,31]. Prognoses into cardiovascular complications of diabetes in Sub-Saharan Africa are limited by diagnostics facilities and well trained medical personnel to probe into coronary heart disease and ischaemic heart disease regularly which are no more uncommon and seen in the few equipped urban health facilities where about 30% of patients in CVD intensive care units are diabetic [32].

Variations in prevalence of complications are probably due to low referrals for follow up in few specialised centre's, differences in health seeking attitudes of patients and barriers to uptake of services [9], prohibitive out of pocket pay for tests complications or absence of competent services to carry out the prognosis, ethnicity [33] and differences in criteria for case definition and methodology, selection bias [34] and lack of published data. The prevalence of these complications was probably higher in the population than the observed prevalence in our study because we computed only prevalence from outpatients who could afford and have done the requisite tests that allows for diagnosis and follow up in health facilities. Also, 51.6% of patients with complications reported that the cost of angiography and photocoagulation at subsidized rates of USD 10 and USD 20 respectively were expensive and only 66.6% could afford anannualsubsidized angiography and 34% prescribed photocoagulation.

Living with diabetes for many years (≥ 21 years), hypertension and obesity, advised to stop smoking (univariate), "Yes" recommended to follow low fat & weight loss diet and to control blood sugar (univariate) were drivers of complications from diabetes as observed in other studies [1,35,36], "sometimes" having a hard time following health providers' suggestions and "sometimes" and "most of the time" as response to 'How often in the past 4 weeks I did what the doctor said' were drivers of complications from diabetes. Diabetes patients who "sometimes" hardly follow the health providers' advice had about two-fold risk of complications. Though not statistically significant, respondents who reported "most of the time" followed the doctors' suggestion exactly and affirmed that "sometimes" and "most of the time" it was easy doing what the health provider suggested were protected from complications from diabetes in univariate analysis.

Losing weight lowers blood pressure, blood glucose and cholesterol levels. This can be done through a combination of healthy eating (high fibre and low fat foods, reduce salt intake) and being active. Smoking alone is the greatest lifestyle risk factor for diabetes complications and is the second leading cause of death after wars in the 20th century [37]. Smoking can undo benefits accrued through weight loss, healthy eating, good blood pressure and good blood sugar control. Smoking affects circulation. It renders small blood vessels narrower increasing heart rate and blood pressure and makes blood cells and blood vessels walls sticky and facilitating build-up of dangerous fatty material resulting in heart attack, stroke and other blood vessel diseases. Diabetics who smoke have less control over their diabetes and higher blood pressure than abstainers with diabetes. Keeping blood glucose and blood pressure within the recommended range by regular checks reduces risk from long-term diabetes complications.

Age, gender, education, marital status, "Followed my doctor's suggestion exactly" and "It was easy doing what my health provider suggested" were not drivers of complications from diabetes though male gender and poor education were risk factors elsewhere [38].

Participants' SBP (138mmHg; CI: 135.9-140.7) and DBP (83.7 mmHg; CI: 8 2.3-85.1) were higher than in general Cameroon populations of SBP (127.3 mmHg) in 2010 [39]. Higher SBP is a surrogate for hypertension. This indicates susceptibility to complications of diabetes patients. Complications from diabetes can be delayed or avoided. Control of drivers of complications such as obesity and blood pressure within recommended range is advised. A healthy weight, healthy eating habits, and avoiding smoking reduce risk of complications. Access to medication and equipment and education of patients and health personnel and a good health system responding to periodic eye, foot examination and blood tests are needed. Screening for diabetes related complications is advised as interventional strategies exist that can reverse or delay progression of complications. One of the challenges of diabetes in Sub-Saharan Africa is paucity in documentation of risk factors [40]. Our results provide evidenced-informed data from outpatients and should guide health initiatives, research on epidemiological changes and enhance knowledge on the drivers of complications from diabetes critical in understanding where interventions may be most effective for diabetes prevention and management.

Conclusion

Complications of diabetes affect many parts of the body especially the nerves, feet, kidneys, eyes and heart. Lack of effective strategies to support better management of diabetes will lead to increase complications resulting in more disability, loss in productivity especially for the age group of 40-59 years and increase morbidity and mortality from diabetes-related complications. Obesity, hypertension, living with diabetes for ≥ 21 years and difficulty adherence to medical advice were drivers of complications from diabetes.

Limitations and strengths of the study

The study is a cross–sectional study limited in causal inferences. Interviews required finding respondent at a health facility. It is likely that under representation of sick diabetes patients in hospitals, poor ones who could not afford to come for routine check-up and working patients occurred particularly for those working overtime or in shifts. Interviewer administered questionnaires on adherence to medical advice was self-reported and susceptible to reporting (recall) bias. The study was done in urban areas and results may not be generalizable to rural populations. Categorisation of variables (age into age groups, etc) might have led to loss of information. Instant translation of questions into a local language in some few cases by researcher or use of an interpreter may lead to poor understanding of the questions and responses may not be factual. Assessment of complications and clinical parameters were carried out by different health providers in different settings and inter/intra observer variability was not done.

Despite the limitations the study provides valuable information on where interventions may be more effective for chronic disease conditions, complications and drivers which provides critical knowledge in the care and management. The study had a high response rate (>90%) and quantitative focussing on diabetes patients on routine consultation. Population based analysis of drivers of complications rather than exploring the drivers of each complication separately epidemiologically explained who is at risk of any complications from diabetes because the risks factors overlap for each complication. Trained researchers administered structured questionnaires respecting standard guidelines in definition of diabetes, hypertension, BMI classes and patient books were used to ascertain the complications following laboratory diagnoses and management of condition by health provider.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the National Ethics Committee of Cameroon, the CBC IRB and adhered to the Helsinki declaration. Informed consent was obtained from all participants before inclusion in the study. Data was anonymized and kept confidential.

Competing Interest

The authors have no competing interest to declare.

Consent to Publish

Not Applicable

Author's Contributions

NCK conceived the study developed the protocol and tools, supervised

data collection, designed the analytic strategy, analysed the data and wrote the first and subsequent drafts. BAL reviewed the protocol, data collection tools and article. All authors contributed to the subsequent drafts, read and approved the final manuscript.

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