

random plasma glucose ≥ 11.1 mmol/L. 2) >30 yrs old and 3) provided informed consent to participate in the study.

Patients were interviewed during their routine clinic review visit by the diabetes physician specialist using a questionnaire to capture information on demographics, age of initial diagnosis of diabetes, duration of diabetes diagnosis and diabetic related complications were extracted from their clinic folders. Diabetic complications that were considered in this study were cerebrovascular conditions, renal impairment, cardiovascular conditions, peripheral neuropathy, diabetic foot diseases, erectile dysfunction (in men) and eye problems. Cerebrovascular conditions considered were transient ischemic attack (TIA) and stroke; renal disease included acute kidney disease, chronic kidney disease and end-stage renal disease; cardiovascular conditions were heart failure; foot diseases consisted of foot ulcer and amputation; eye problems included retinopathy, cataracts, blindness, glaucoma, blurry vision. In this study, hypertension was considered as a co-morbid condition and not a complication. The diagnosis of diabetic complications was obtained from patients medical charts/folders with no additional clinical assessments performed.

2.1 Statistical Analysis

Descriptive analysis of the data was done using SPSS version 19 (SPSS Inc, Chicago, IL). Inferential statistics using non-parametric chi square and Cramer's v tests were used to assess any associations in categorical and ordinal data. Two-tailed tests were performed with the significance level at 0.05.

2.2 Definitions Used for Specific Variables

- Retinopathy/cataracts/glaucoma: was diagnosed by an ophthalmologist specialist and documented in their medical folders.
 - Diabetic neuropathy: were diagnosed by presence of abnormal 10g monofilament test.
- Renal impairment/disease includes patient with documented abnormal eGFR.

3. Results

3.1 Characteristics of Respondents'

A total of 548 respondents were recruited in the study (156 (28.5%) males and 392 (71.5%) females with majority within 50-59 and 60-69 age groups. The highest educational level attained by the respondent's were middle/Junior High School (35.8%), followed by Senior High School (20.4%). The illiteracy rate was high at 20.6%. The predominant ethnic group was Fante (73.8%), followed by Twi (13.4%). Majority (91.3%) were Christians. About 30.0% reported petty trader as their occupation and 26.6% were retired. Majority (64.2%) reported being married (Table 1).

3.2 Duration of diabetes

Majority (41.8%) of the respondents reported duration of their illness between one and five years and 34.7% have had it between six and ten years (Table 2).

3.3 Prevalence of Chronic Complications

Table 3 presents the prevalence of the diabetes-related chronic complications in relation to duration of diagnosis of diabetes. Majority of the respondent's (61.4%) suffered from at least one diagnosed chronic complication and 38.6% from two or more complications. In this study, hypertension was treated as a co-morbid condition and not a complication. The prevalence of diagnosed hypertension among the respondents' was 96.2%.

The prevalence of cerebrovascular, renal impairment, cardiovascular, peripheral neuropathy, diabetic foot diseases, eye diseases and erectile dysfunction were 6.5%, 2.0%, 3.8%, 60.4%, 4.9%, 58.6% (blurry vision excluded) and 31.0% respectively. The most prominent cardiovascular condition in this study was congestive heart failure (3.8%). Cerebrovascular conditions included 26 cases of stroke and 10 cases with TIA. A total of 30 respondent's suffered from foot complications with majority 21 cases (70.0%) with foot ulcers and 6 (20.0%) who have undergone amputation.

A total of 214 respondents suffered from eye complications, with the most prominent conditions being cataract (24.4%), followed by glaucoma (9.1%). Prevalence of diagnosed retinopathy was 1.9% in this study. Majority 134 (64.1%) of the respondent's with complaints of blurry vision are those who have not had a formal evaluation and diagnosis by an ophthalmologist, therefore was not included in the analysis. About 48 (31.0%) of the male respondent's reported symptoms of erectile dysfunction.

3.4 Association between chronic complications and duration of diagnosis of diabetes

Table 3 shows the distribution of complications in relation to duration of diabetes. The table shows some of the prevalence of the complications significantly increased with disease duration including Cardiovascular conditions ($p=0.000$), peripheral neuropathy ($p=0.000$), eye disease ($p=0.008$) and erectile dysfunction ($p=0.008$). Cerebrovascular disease, renal impairment, foot disease were not significantly associated with duration of illness.

3.5 Association between chronic complications among different socio-demographic groups

Table 4 shows the prevalence of chronic T2DM complications by demographic variables. The prevalence of complications among male respondent's was significantly higher than in females notably in foot disease ($p=0.030$) and eye disease ($p=0.021$). The prevalence of complications also varied significantly between different age groups with cardiovascular conditions ($p=0.000$), renal impairment ($p=0.042$), peripheral neuropathy ($p=0.000$), foot disease ($p=0.027$), eye disease ($p=0.026$) and erectile dysfunction ($p=0.000$) with most of the complications between the 50-59 and 60-69 age groups. There was no statistically significant association between chronic complications and educational level except with erectile dysfunction ($p=0.000$). Also only cardiovascular disease ($p=0.001$) and erectile dysfunction ($p=0.000$) were significantly associated with occupation.

Table 1: Demographic characteristics of subjects and gender differences

Variable	Male	Female	Total (%)
	N (%)	N (%)	
Age			
30-39	5 (21.7)	18 (78.3)	23 (4.2)
40-49	24 (25.8)	69 (74.2)	93 (16.8)
50-59	48 (26.2)	135 (73.8)	183 (33.1)
60-69	46 (28.7)	114 (71.3)	160 (28.9)
70-79	28 (48.4)	49 (51.6)	77 (13.9)
80+	5 (41.7)	7 (58.3)	12 (2.2)
Educational Status			
None	4 (3.5)	110 (96.5)	114 (20.6)
Primary	11(21.2)	41 (78.8)	52 (9.4)
Middle/JSS	60 (30.3)	138 (69.7)	198 (35.8)
SHS/Vocational	42 (37.2)	71 (62.8)	113 (20.4)
Tertiary	32 (50)	32 (50.0)	64 (11.6)
Postgraduate	7 (58.3)	5 (41.7)	12 (2.2)
Ethnicity			
Fante	110 (27)	298 (73.0)	408 (73.8)
Twi	26 (35.1)	48 (64.9)	74 (13.4)
Ewe	7 (31.8)	15 (68.2)	22 (4.0)
Hausa	7 (20.6)	27 (79.4)	34 (6.1)
Nzema	2 (28.6)	5 (71.4)	7 (1.3)
Others(awutu, efutu, etc)	4 (50.0)	4 (50.0)	8 (1.4)
Religion			
Christian	146 (29.0)	359 (71.0)	505 (91.3)
Muslim	10 (20.9)	38 (79.1)	48 (8.7)
Occupation			
Fishmonger	1 (3.8)	25 (96.2)	26 (4.7)
Farmer	20 (34.5)	38 (65.5)	58 (10.5)
Petty trader	11 (6.6)	155 (93.4)	166 (30.0)
Civil servant	41 (46.0)	48 (54.0)	89 (16.1)
Retired	52 (35.4)	95 (64.6)	147 (26.6)
Fisherman	2 (100.0)	0 (0.0)	2 (0.4)
Other	29 (44.6)	36 (55.4)	65 (11.8)
Marital Status			
Single	6 (19.4)	25 (80.6)	31 (5.6)
Married	137 (39.6)	218 (61.4)	355 (64.2)
Divorced	6 (7.8)	71 (92.2)	77 (13.9)
Widowed	7 (7.8)	83 (92.2)	90 (16.3)

Table 2: Duration of DM of respondents

Duration of DM (yrs)	Frequency	Percent (%)
< 1	40	7.2
5-Jan	231	41.8
10-Jun	192	34.7
15-Nov	50	9
>15	40	7.2

Table 3: Distribution of complications in relation to duration of DM

Variable	Duration of DM (yrs)					Total (%)	P-value	Cramers' V
	<1	5-Jan	10-Jun	15-Nov	>15			
Cerebrovascular:								
Stroke	1	12	11	1	1	26 (72.2)	0.401	0.087
TIA	0	3	3	3	1	10 (27.8)		
Nephropathy:								
Renal impairment	1	4	5	1	0	11 (100.0)	0.13	0.106
Cardiovascular:								
Hypertension	22	193	161	44	37	457 (96.2)	0	0.177
Heart failure	1	6	10	1	0	18 (3.8)		
Peripheral:								
Neuropathy	12	127	126	38	30	333 (100)	0	0.229
Foot diseases:								
Foot ulcer	0	6	10	3	2	21 (70.0)		
Amputation	0	3	1	1	1	6 (20.0)	0.489	0.083
Foot ulcer	0	2	0	0	1	3 (10.0)		

Eye Conditions:							
Retinopathy	0	0	2	2	0	4 (1.9)	
Cataracts	2	18	19	8	4	51 (24.4)	0.008
Blindness	0	0	0	0	1	1 (0.5)	
Glaucoma	1	3	8	4	3	19 (9.1)	
Blurred vision	9	53	50	12	10	134 (64.1)	
Erectile dysfunction:							
(in males)							0.008
Yes	3	18	11	6	10	48 (31.0)	
None	6	46	34	14	7	107 (69.0)	

Table 4: Distribution of chronic complications among different socio-demographic groups

Variable	Cerebro-vascular N (%)	Cardiovascular N (%)	Renal disease N (%)	Neuropathy N (%)	Foot disease N (%)	Eye condition N (%)	Erectile dysfunction N (%)
Gender							
Male	13 (8.3)	131 (84.0)	3 (2.0)	86 (55.1)	14 (9.0)	61 (91.1)	48 (31.0)
Female	23 (5.3)	344 (86.7)	8 (2.0)	247 (62.2)	16 (4.0)	153 (38.5)	-
P-value	0.486	0.414	0.815	0.125	0.03	0.021	0
Cramer's V	0.051	0.056	0.027	0.065	0.127	0.155	0.996
Age							
30-39	0 (0.0)	11(2.4)	1 (9.1)	13 (2.4)	0(0.0)	5 (2.3)	5 (3.2)
40-49	1 (2.8)	69 (15.2)	0 (0.0)	93 (17.3)	3 (10.0)	26 (12.1)	23 (14.8)
50-59	13 (36.1)	150 (33.0)	7(63.6)	183 (34.0)	7(23.3)	69 (32.2)	48 (31.0)
60-69	17 (47.2)	140 (30.8)	2 (18.2)	160 (29.7)	9 (30.0)	63 (29.4)	46 (29.7)
70-79	3 (8.3)	73 (16.1)	0 (0.0)	77 (14.3)	9 (30.0)	40 (18.7)	28 (18.1)
80+	1 (2.8)	11 (2.4)	1 (9.1)	12 (2.2)	0(0.0)	7 (3.3)	5 (3.2)
P-value	0.319	0	0.042	0	0.027	0.026	0
Cramer's V	0.149	0.278	0.177	0.25	0.174	0.167	0.317
Education							
None	10 (8.8)	100 (87.7)	5 (4.4)	78 (68.4)	7 (6.1)	52 (45.6)	3 (2.6)
Primary	3 (5.8)	45 (86.5)	1 (2.0)	29 (55.8)	3 (5.8)	28 (53.8)	6 (11.5)
Middle/JSS	13 (6.6)	172 (86.9)	2 (1.0)	115 (58.1)	12 (6.1)	69 (34.8)	20 (10.1)
SHS/Vocational	9 (8.0)	96 (85.0)	2 (1.8)	38 (59.4)	5 (4.4)	37 (32.7)	13 (11.5)
Tertiary	4 (6.3)	52 (81.3)	1 (1.6)	5 (41.7)	2 (3.1)	24 (37.5)	5 (7.8)
Post- graduate	0 (0.0)	10 (83.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (33.3)	1 (8.3)
P-value	0.733	0.916	0.472	0.331	0.707	0.406	0
Cramer's V	0.086	0.065	0.098	0.102	0.084	0.097	0.25
Occupation							
Fishmonger	2 (7.7)	21 (80.7)	1 (3.8)	15 (57.7)	3 (11.1)	10 (38.0)	0 (0.0)
Farmer	1 (1.7)	48 (82.7)	1 (1.7)	39 (67.2)	3 (5.1)	25 (43.1)	7 (12.1)
Petty trader	13 (2.8)	135 (81.3)	5 (3.0)	101 (60.8)	7 (4.2)	57 (34.3)	3(1.8)
Civil servant	5 (3.4)	72 (80.9)	1 (0.1)	50 (56.2)	2 (2.2)	27 (31.4)	1 (1.2)
Retired	11 (7.5)	143 (99.3)	3 (2.0)	90 (61.2)	10 (6.8)	68 (46.2)	3 (2.0)
Fisherman	0 (0.0)	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	1 (50.0)	1 (50.0)
Others	6 (9.2)	55 (84.6)	0 (0.0)	37 (56.9)	5 (7.7)	25 (38.5)	6 (9.2)
P- value	0.778	0.001	0.897	0.932	0.932	0.559	0
Cramer's V	0.086	0.17	0.065	0.065	0.078	0.101	0.339

4. Discussion

Considering the significant impact of chronic complications of T2DM-related morbidity and mortality, understanding the epidemiology of T2DM co-morbidities is of great importance. This study found that chronic complications are highly prevalent among T2DM patient attending a teaching hospital in Ghana.

From the study, more than half (61.4%) of the respondent's recruited in the study suffered from at least one chronic complication. Thus, chronic complications of T2DM exert a financial burden on our current healthcare system. This study also found a high prevalence of hypertension (96.2%) among the study respondents. Therefore, effective measures

for the prevention of hypertension in the general population are essential for reducing the overall morbidity due to diabetes.

The predominant chronic complications in the study were peripheral neuropathy followed by eye conditions which agrees with studies carried out in India by Mohan et al (2013) which pointed to neuropathy as the most common diabetes-related complication, but differs from studies carried out among British outpatients as well as Chinese inpatients which showed cardiovascular conditions as the predominant chronic complication of T2DM (Morgan et al, 2000; Shi et al, 2004). Another study by Zhaolan et al (2010) in china also showed cardiovascular disease as the most common diabetes-related complication. Peripheral neuropathy with a prevalence of 60.4% was high in this

study than in studies carried out in Canada, the United States and Sweden (Bruce & Young, 2008; Gregg et al, 2007; Wandell & Gafvels, 2004). The reason for the difference maybe that patients in our part of the world present late with complications at the time of diabetes diagnosis. The prevalence of foot disease was 4.9% which was lower than the 8.0% reported for the Asian-Americans (McNeely & Boyko, 2005). However, it should be noted that the criteria employed to establish foot disease differed between the two studies. In the present study, foot disease was established through a doctor's diagnosis, whereas the previously mentioned study relied on self-reported symptom (McNeely & Boyko, 2005).

Gender was found to be significantly associated with the prevalence of chronic complications with most of the complications among the 50-59 and 60-69 age groups. The higher prevalence of microvascular complications such as peripheral neuropathy among female patients corresponds to earlier findings reported in literature (Candrilli et al, 2007; Chen et al, 2008). This findings suggest that special attention to be paid to female diabetic patients with regards to the prevention and management of peripheral neuropathy. In this study, the predominant eye condition was cataract, which agrees with studies by Zhalon et al (2010). The prevalence of the studied chronic diabetic complications was found to statistically increase with age which was consistent with other studies (Morgan et al, 2000; Chen et al, 2008; Cyganek et al, 2006), and the prevalence of chronic complications such as cardiovascular condition, peripheral neuropathy, eye disease and erectile dysfunction was positively associated with the duration of diabetes. It cannot be inferred that duration of diabetes is a risk factor for chronic complications, due to limitations of a cross-sectional study. But the results point to the fact that much attention on prevention of diabetes chronic complications should be paid to diabetic patients with longer disease duration.

5. Conclusions

The present study provides estimates of the prevalence of T2DM-related complications among patients attending a teaching hospital in Ghana. A high prevalence of chronic complications was found with a predominance of peripheral neuropathy, followed by eye conditions, with cataract the most predominant eye disease. The prevalence of hypertension was very high at 97.2% among the study subjects. The association of complications with age and duration of the disease point to the need to allocate medical resources efficiently according to the local burden of disease due to T2DM complications. The study also calls for regular screening of complications to prevent its progression.

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