Research Paper

Assessment of Patients' Knowledge of Diabetic Eye Complications at Selected Health Facilities in the Tema Metropolis, Ghana

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ABSTRACT
Introduction: Diabetes prevalence has been rising more rapidly in the middle- and low-income countries. The leading causes of blindness secondary to diabetes are diabetic retinopathy, cataracts, and glaucoma. A cross‑ sectional survey was carried out to assess the knowledge level of diabetic patients on diabetes and its eye complications in selected health facilities within the Tema Metropolis in the Greater Accra Region of Ghana.
Methods: A total of 422pretested structured questionnaires were systematically administered to interview diabetic patients at Tema General Hospital, Tema Polyclinic and Manhean Health Centre. Data were collected on respondents' socio-demographic characteristics, knowledge of diabetic status, knowledge of diabetic eye disease and referral rate for eye examinations.Univariate analysis was applied to establish the frequency and percentage distributions of the responses. Chi-square (χ^2) and Fisher's exact tests were employed to determine the factors associations. Regression analysis was used to predict the strength of the associations. The threshold for statistical significance was set at a p-value less than 0.05.
Results: A few (3.86%) of diabetic patients did not know that they had diabetes. Knowledge of diabetic ocular complications was low, and only 77(18.60%) of the patients knew two or more of the ocular complications of diabetes. Knowledge of diabetic ocular complications was significantly associated with age group (p=0.019), educational level (p<0.001), marital status(p=0.002), occupation (p=0.001), ethnicity (p=0.030), income level (p<0.001) and residence (p=0.008). Majority of the interviewees (63.04%) had a history of an eye examination. Only 57.33% of them were referred for the eye examination by the doctor managing diabetes.
Conclusion: Knowledge of diabetic eye complications is low among diabetic patients. Most of the referrals for eye exams are done by their physicians managing diabetes. Policies by the government are required to decrease the incidence of diabetes. Also, healthcare authorities are required to intensify the education on diabetic eye complications and early referral for an eye examination.
Key Words: Diabetic retinopathy, Eye Complication, Knowledge, Tema, Ghana.
Subject: Public Health

I. INTRODUCTION

Diabetes mellitus (DM) is a chronic disease caused by inherited and/or acquired deficiency in insulin production by the pancreas, or by the ineffectiveness of the insulin produced. Such a deficiency results in increased concentrations of glucose in the blood, which damage many of the body's systems, particularly the blood vessels and nerves. There are two main forms of diabetes mellitus, namely,*type 1* and *type 2*. Type 1 diabetes (formerly known as **Insulin-Dependent**) occurs when the pancreas fails to produce insulin essential for survival. This form develops most frequently in children and adolescents but is being increasingly noted later in life. Type 2 diabetes (formerly named **Non-Insulin Dependent**) results from the body's inability to respond appropriately to the action of insulin produced by the pancreas.[1]

Type 2 diabetes is much more common and accounts for around 90% of all diabetes cases worldwide. It occurs most frequently in adults but is being noted increasingly in adolescents as well.[1] The worldwide prevalence of diabetes in the year 2000 among adults age 20 years and above was estimated to be about 171 million and expected to be higher than 342 million by 2030.[2] Much of this increase will occur in developing countries and will be due to population growth, ageing, unhealthy diets, obesity and sedentary lifestyles.[1]The

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prevalence of diabetes among older adults in Ghana was 3.95% in 2016.[3]Diabetic patients suffer systemic complications, including eye disorders.[4]It is estimated that 4.51 million of the diabetic population in sub-Saharan Africa have one form of ocular complications due to diabetes.[5]The leading causes of blindness secondary to diabetes are diabetic retinopathy, cataracts, and glaucoma.[6]

People living with diabetes are about 25 times more likely to become blind than the normal population.[7] The incidence of vision loss or blindness due to ocular complications of diabetes raises sufficient public health concern, with diabetic retinopathy alone responsible for 12,000 to 24,000 new cases of blindness yearly in the United States.[8] Diabetic patients are required (due to their condition's disposition) to have sufficient knowledge regarding their illness toexhibit a positive attitude to health care. Despite the increased tendency of blindness, studies have shown that most diabetic patients do not often seek the recommended ocular examinations (such as regular dilated fundus examination) aimed at preventing visual impairment and blindness.[9] Patients in Ghana are no exception to this worrying global public health menace.

Therefore, this project aimed to ascertain patients' knowledge of ocular manifestations of diabetes to determine if this is the barrier to seeking recommended eye examination among the diabetic population in Tema.

II. METHODS

2.1Profile of Study site
The Tema Health Metropolitan was previously made up of Tema West, East, and Central Health Districts until a recent detachment of Tema West Health Metropolis. It is one of the 16 districts of the Greater Accra Region, located in the south-eastern part of Ghana. It is a vibrant commercial and industrial city, about the only well-planned city in the country. It has a large harbour, one of the world's biggest man-made harbours, the main sea-port entry to Ghana. The estimated 2015 population of Tema Metropolis was 341,045 (as projected from the 2010 National Population and Housing Census), making it the second largest-populated of the 16 districts in the Greater Accra Region, after Accra Metropolis.[10] The Greenwich Meridian (longitude zero) passes through the Metropolis and situated only about 5^0 N from the Equator. Tema Metropolis is considered as being the city in the center of the world.Tema was commissioned by Ghana's first president, Dr. Kwame Nkrumah, and grew rapidly after the construction of a large harbour in 1961. It is now a major trading center, with numerous industries that produce aluminium, refined petroleum, chemicals, food products, and building materials.

Tema Polyclinic is the prime health facility in the Tema West Metro. It was established in 1962 as a Municipal Health Centre and was later upgraded to a Polyclinic in 1982. It is located in a suburb of the metropolis referred to as Community 2.[11] Additionally, Tema General Hospital, the prime facility of Tema Central Sub-Metro is located at Community 12 and was established between 1954 and 1957. It offers both General and Specialist care services in all the major clinical disciplines including Internal Medicine, General Surgery, Paediatrics, Obstetrics and Gynaecology, Dental and Eye care, etc.[12] The Manhean Health Centre, the main facility in Tema East, was initially constructed as a health post in the 1970s.[13] It is located on the Eastern sector of the fishing harbour and serves as the Sub-Metropolitan district health centre.[14]

2.2 Study Method and Design
A cross-sectional study design was employed for the study. The study was conducted between January and May 2020 with a quantitative approach that provided the option to examine the relationship between variables.

2.3 Study population.
Diabetic patients who visited the Tema Polyclinic, Manhean Health Centre and Tema General Hospital from January to May, 2020 represented the study population.

2.4Sampling technique
A multi-stage sampling technique was employed in selecting the study participants. Initially, the prime health facilities in the three (3) Sub-Metropolis, namely, Tema General Hospital, Manhean Health Centre and Tema Polyclinic,were selected. Systematic sampling was then used to select the study participants from the three facilities using the estimated daily sample size for each facility as the skip interval. The average daily attendance at the diabetic clinics of Tema General Hospital, Manhean Health Centre and Tema Polyclinic was in the ratio 4:3:2. This was used to allocate the sample size for each facility proportionately. The sample size for each facility was then divided by the number of data collection days to get the daily sample size.

2.5 Sample size
The sample size was calculated based on previous research findings on the knowledge of diabetes and its associated ocular manifestations by diabetic patients at Korle-Bu Teaching Hospital, using a 50% prevalence rate.[4] The sample size was calculated using the Cochran's formula[15] as shown below;

$$n = \frac{Z^2 \times pq}{e^2}$$

Where,

n = sample size.

Z = the z-score that corresponds with 95% confidence interval which is 1.96

p = proportion of diabetic patients with knowledge on diabetic eye disease which is 50% or 0.50

q = Proportion of diabetic patients with no knowledge on diabetic eye disease which is equal to 1-***p***. That is, 100-50% = 50% =0.5

e = Margin of error set at 5% (0.05)

Therefore,

$$n = \frac{(1.96)^2 \times (0.5 \times 0.5)}{(0.05)^2} \cong 384$$

A 10% non-response rate resulting in about 38 respondents was added to the minimum sample size to get 422 participants. Of the total 422 questionnaires administered, 414 were completed and included in data analysis. One hundred and eighty-five (185) participants were selected from Tema General Hospital, 137 from Manhean Health Centre and 92 from Tema Polyclinic.

2.6 Data Analysis.
Statistical data analysis was conducted using the STATA statistical software package (*StataCorp.2007. Stata Statistical Software. Release 14. StataCorp LP, College Station, TX, USA*). Univariate analysis was applied to establish the frequency and percentage distributions of the responses. Chi-square (χ^2) tests were employed to determine the level of association of selected variables with patients' awareness of diabetics and its ocular complications. Regression analysis of demographic and diabetic awareness characteristics was used to predict the likelihood of awareness of diabetes and its eye complications in some participants compared to particular participants. The threshold for statistical significance was set at a p-value less than 0.05.

2.7 Ethical Consideration.
Ethical approval for the study was obtained from the Ethical Review Committee of Ensign College of Public Health and Ghana Health Service Ethical Review Committee. Administrative permission was also sought from the management of the health facilities before the commencement of the study. Privacy and confidentiality were maintained during data collection. No personal identifiers like names of patients were recorded. Written informed consent was obtained from the individual respondents before interviewing them. The participants were assured of confidentiality regarding the information collected and had the option to opt-out of the study at any time.

III. RESULTS

3.1 Demographic characteristics of the respondents
Of the total 422 questionnaires administered, 414 were completed and included in data analysis yielding a response rate of 98.1%.The mean age of the diabetic patients in this study was 59.63 ± 11.39 years. A higher proportion [215 (51.93%)] of them were between the ages of 41 and 60 years at the time participating in the study.Among them were morefemales [242 (58.45 %)] than males [172 (41.55 %)]. One hundred and thirty-eight [138(33.33%)] had no formal education. Out of the total respondents, 272 representing 65.70% were married, 247(59.66%) were self-employed, 197 (47.58%) were Akans while 387 (93.48%) were Christians. The majority [403 (97.34%)] of the diabetic patients had active National Health Insurance Schemes (NHIS), 180 representing 43.48% of the total respondents reported having an income of less than GH₵500.00 while 160(38.65%) reported living within the Tema East enclave of the Metropolis[Table1].

Table 1: *Demographic characteristics of the respondents*

Variable	Frequency	Percentage (%)
Age group		
≤40	19	4.59
41-60	215	51.93
61-80	180	43.48
Gender		
Male	172	41.55
Female	242	58.45

Education

None	138	33.33
Primary	65	15.70
JHS	77	18.60
SHS/Tech/Voc	74	17.87
Tertiary	60	14.49
Marital Status		
Single	34	8.21
Married	272	65.70
Widow/Separated/Divorced	108	26.09
Employment Status		
Self-employed	247	59.66
Government worker	27	6.52
Pensioner	34	8.21
Unemployed	76	18.36
Other	30	7.25
Ethnicity		
Akan	197	47.58
Ewe	102	24.64
Ga/Dangme	81	19.57
Other	34	8.21
Religious Beliefs		
Christian	387	93.48
Muslim	25	6.04
Other	2	0.48
NHIS status		
Active	403	97.34
Not active	11	2.66
Income		
< 500 GH₵	180	43.48
500-1,000 GH₵	163	39.37
>1,000 GH₵	71	17.15
Residence		
Tema East	160	38.65
Tema Central	60	14.49
Tema West	136	32.85
Ashaiman	37	8.94
Other	21	5.07

3.2 Response of diabetic patients on eye examination

A few [16 (3.86%)] of them did not know they had diabetes when asked of their status (Table 2). The participants were asked whether they knew three common eye complications of Diabetes and whether the disease condition could cause those complications. Again, they were asked whether diabetes could cause any eye disease and if so, they were offered the opportunity to write them out. A score of 1 was awarded to each correct answer without repetition to attain a minimum total of 4. Individuals who scored below two (2) were ranked as having low knowledge, while those who scored two (2) or more had high knowledge (Table 3). In general, the majority [337(81.40 %)] of the diabetic patients demonstrated low knowledge of diabetic eye complications.

Table 2: *Awareness of Diabetes*

Variable	Frequency	Percentage
Do you know whether you have Diabetes or not?		
Yes	360	86.96
No	54	13.04
Do you have Diabetes?		
Yes	398	96.14
No	16	3.86

Table 3: *Response of Diabetic patients on Diabetic eye complications*

Variables (N=414)	Yes n(%)	No n(%)
Do you know Diabetic Retinopathy?	60(14.49%)	354(85.51%)
Do you know Glaucoma?	207(50.00%)	207(50.00%)
Do you know Cataract?	240(57.97%)	174(42.03%)
Can Diabetes cause any eye complication?	214(51.69%)	200(48.31%)
Asked among those reporting only awareness		
Preprinted eye complications participants selected from	Can Diabetes cause Diabetic Retinopathy? (n=60)	58(96.6701%)
	Can Diabetes cause Glaucoma? (n=207)	87(42.03%)
	Can Diabetes cause Cataract? (n=240)	119(49.58%)

Eye complications participants wrote themselves (n=214)	Diabetic Retinopathy	1(0.47%)
	Glaucoma	35(16.36%)
	Cataract	33(15.42%)
	Poor vision	8(3.74%)
	Blindness	28(13.08%)
	Don't know	109(50.93%)

3.3 Bivariate analysis of demographics on knowledge level of diabetic eye complications

Table 4 below illustrates the association between the respondents' selected socio-demographic characteristics and their knowledge level of Diabetic eye complications. It was observed from the gathered data that participants' knowledge of diabetic ocular complications wassignificantly associated with their age group, educational level, marital status, occupation, ethnicity, income level and place of residence. However, the awareness and knowledge of diabetic ocular complications wereinsignificantly associated with gender, religious beliefs, NHIS status and awareness of being diabetic at a set level of significance of 0.05.

Table 4: *Bivariate analysis of demographics characteristics on knowledge level of diabetic eye complications*

Demographic characteristics (N=414)	Knowledge Level of diabetic eye complication		P-value
	Low n=337(%)	High n=77(%)	
Age group (years)			**0.019***
<40	19(5.64)	0(0.00)	
41-60	166(49.26)	49(63.64)	
61-80	152(45.10)	28(36.36)	
Gender			0.123
Male	134(39.76)	38(49.35)	
Female	203(60.24)	39(50.65)	
Educational level			**<0.001***
None	115(34.12)	23(29.87)	
Primary	60(17.80)	5(6.49)	
JHS	69(20.47)	8(10.39)	
SHS/Tech/Voc	60(17.80)	14(18.18)	
Tertiary	33(9.79)	27(35.06)	
Marital status			**0.002***
Married	220(65.28)	52(67.53)	
Single	21(6.23)	13(16.88)	
Widow/Separated/Divorced	96(28.49)	12(15.58)	
Occupation			**0.001***
Self-employed	201(59.64)	46(59.74)	
Government worker	14(4.15)	13(16.88)	
Pensioner	28(8.31)	6(7.79)	
Unemployed	67(19.88)	9(11.69)	
Other	27(8.01)	3(3.90)	
Ethnicity			**0.030***
Akan	149(44.21)	48(62.34)	
Ewe	86(25.52)	16(20.78)	
Ga/Dangme	72(21.36)	9(11.69)	
Other	30(8.90)	4(5.19)	
Religious Beliefs			0.509
Christian	316(93.77)	71(92.21)	
Muslim	20(5.93)	5(6.49)	
Other	1(0.30)	1(1.30)	
NHIS status			0.971
Active	328(97.33)	75(97.40)	
Not active	9(2.67)	2(2.60)	
Income level			**<0.001***
<GH500.00	146(46.95)	34(33.01)	
GH500.00-GH1,000.00	132(39.17)	31(40.26)	
>GH1,000.00	47(13.95)	24(31.17)	
Residence			**0.008***
Tema East	139(41.25)	21(27.27)	
Tema Central	52(15.43)	8(10.39)	
Tema West	102(30.27)	34(44.16)	
Ashaiman	25(7.42)	12(15.58)	
Other	19(5.64)	2(2.60)	
Diabetes Status			0.051
Yes	321(95.25)	77(100.00)	
No	16(4.75)	0(0.00)	

Statistically significant effect at a 95% Confidence Interval.

3.4 Multivariate Logistic Regression model for relevant demographic variables

There was a noticeable increase in the likelihood of an individual gaining higher knowledge of eye complication resulting from being diabetic with increased formal education. Respondents with a tertiary level of education were 4.2 times more likely to attain higher knowledge on the disease complication compared to their counterparts with no formal education after adjusting for all other covariates in the model. Also, the unmarried diabetic patients compared to their reported married counterparts were 3.2 times more likely to have high knowledge on the health effect of the disease condition holding all other variables constant.

Furthermore, an individual in the higher socio-economic income bracket was likely to have an increased awareness level of diabetic eye disease. Participants who earned more than GH₵ 1,000.00 were twice more likely to have high knowledge in diabetic eye disease compared to those who earned below GH₵ 500.00. Finally, residents in the Ashiamanenclave were likely to have increased knowledge in diabetic eye disease. Those residing in the Tema West area of the study site were 4.3 times more likely to have high knowledge in diabetic eye complications than those residing in Tema East controlling for all other covariates[Table 5].

Table 5: *Multiple logistic regression analysis of demographic characteristics associated with knowledge level of diabetic eye complications*

Demographic characteristics N=414	COR	(95% CI)	P-value	AOR	(95% CI)	P-value
Age group (years)						
<40(*ref*)	1.0	-	-	-	-	-
41-60	1.6	(0.96, 2.68)	0.072	-	-	-
61-80	1.0	-	-	-	-	-
Educational level						
None(*ref*)	1.0	-	-	1.0	-	-
Primary	0.4	(0.15, 1.15)	0.091	0.5	(0.16, 1.40)	0.161
JHS	0.6	(0.25, 1.37)	0.213	0.6	(0.22, 1.41)	0.218
SHS/Tech/Voc	1.2	(0.56, 2.43)	0.681	1.1	(0.45, 2.72)	0.816
Tertiary	4.1	(2.08, 8.06)	<0.001*	4.2	(1.64, 10.64)	0.003*
Marital status						
Married(*ref*)	1.0	-	-	1.0	-	-
Single	2.6	(1.23, 5.57)	0.012*	3.2	(1.25, 8.05)	0.015*
Widow/Sep./Div.	0.5	(0.27, 1.04)	0.063	0.7	(0.29, 1.45)	0.293
Occupation						
Self employed(*ref*)	1.0	-	-	1.0	-	-
Government worker	4.1	(1.79, 9.21)	0.001*	0.9	(0.31, 2.83)	0.910
Pensioner	0.9	(0.37, 2.39)	0.891	1.0	(0.32, 3.35)	0.946
Unemployed	0.6	(0.27, 1.26)	0.173	0.9	(0.33, 2.23)	0.746
Other	0.5	(1.14, 1.67)	0.252	0.3	(0.07, 1.16)	0.078
Ethnicity						
Akan(*ref*)	1.0	-	-	1.0	-	-
Ewe	0.6	(0.31, 1.08)	0.085	0.6	(0.27, 1.14)	0.109
Ga/Dangme	0.4	(0.18, 0.83)	0.015*	0.3	(0.13, 0.76)	0.010*
Other	0.4	(0.14, 1.23)	0.114	0.4	(0.11, 1.27)	0.114
Income level						
<GH500.00(*ref*)	1.0	-	-	1.0	-	-
GH500.00 -GH1,000.00	1.7	(0.93, 3.05)	0.084	1.3	(0.62, 2.64)	0.504
>GH1,000.00	3.7	(1.89, 7.12)	<0.001*	2.0	(0.77, 5.33)	0.150
Residence						
Tema East(*ref*)	1.0	-	-	1.0	-	-
Tema Central	1.0	(0.42, 2.44)	0.968	0.7	(0.25, 1.76)	0.413
Tema West	2.2	(1.21, 4.02)	0.010*	1.7	(0.88, 3.41)	0.110
Ashaiman	3.2	(1.39, 7.27)	0.006*	4.3	(1.63, 11.20)	0.003*
Other	0.7	(0.15, 3.21)	0.643	0.6	(0.12, 0.43)	0.590

Statistically significant effect at a 95% Confidence Interval.

3.5 Referral rate for eye examination

Majority of the respondents [261 (63.04%)] had a history of an eye examination. About one-third [86 (32.95%)] of those who had a history of eye examination reported being referred for the further eye examination by the physician managing diabetes [Table 6].

Table 6: *Referral rate for eye examination*

Variables (N=414)	Yes n(%)	No n(%)
History of eye examination	261(63.04%)	153(36.96%)
Asked among only those reporting of history of eye examination (n=261)		
Referrals to the eye clinic	By Physician (Diabetes cases)	86(32.95%)
	By Nurse	19(7.28%)
	By Dietician/Nutritionist	4(1.53%)
	Other	41(15.71%)

IV.   DISCUSSION

In this study, a more significant proportion of respondents (96.14%) were aware of their diabetic status. However, the awareness level was not significantly associated with the knowledge of diabetic ocular complications (p=0.051). This finding contradicts a community-based prevalence study in Greater Accra Region, where Amoah *et al.,* (2002), established that of 300 total participants with diabetes in their study, 209 (69.7%) had no prior history of the disease.[16] In another study conducted by Mbanya *et al.,* (1997)looking at the prevalence of diabetes and impaired glucose tolerance in a rural and an urban community in Cameroon,67% of diabetic subjects in the rural area had no knowledgeprior to their participation onthe survey, compared with 57% in the urban area.[17]

Knowledge of diabetic eye complications is a necessary tool to influence eye examination seeking behaviour and the management of diabetes in general. This study showed that patients had little knowledge of the ocular complications of diabetes. Only a few (18.6%) of the participants had a high knowledge of diabetic eye complications. This isconsistent with a previous study by Obirikorang *et al.,* (2016)where only 13.1% of diabetic patients had adequate knowledge of complications of diabetics.[18]A similar survey at Korle-BuTeaching Hospital, a tertiary health facility in Ghana revealed that about half (49%) of the diabetic patients reported that the disease could affect vision.[4]On the contrary, diabetic eye complications have been reported to be higher in some Asian countries and Australia. A cross-sectional study conducted within seven regions of Oman reported of 72% knowledge level of diabetic eye complications in diabetic patients.[19] Elsewhere on the far eastern region of the Asian continent, a cohort study to identify why diabetic patients in Japan did not undergo periodic ocular examination showed that more than 98% of the patients were aware of diabetic eye disease.[20] Also, in a study eliciting knowledge of the ocular effects of diabetes among Australia's general population and the members of Diabetes Australia, it was observed that 96% of people with diabetes knew that diabetes could be sight-threatening.[21]

In this study, most diabetic patients (51.93%) were between the ages of 41–60 years with the mean age of the patients being 59.63 ± 11.39 years. This mean age was very similar to that of a similar study to ascertain the knowledge level of diabetes and its associated ocular manifestations by diabetic patients at Korle-Bu Teaching Hospital which found the mean age to be 56.98 ± 12.93 years.[4]Also, in a study to determine the awareness of ocular complications of diabetes among diabetic patients in a tertiary hospital in Western Nigeria, Bodunde *et al.,* (2014) established that the mean age of the participants was 58.53 ± 10.4 years with the majority of them between 36-60years of age.[22] These studies, among others, buttress the standpoint that the prevalence of diabetes increases with age.[16,23,24]This increase in prevalence could be attributed to several risk factors including ageing, diet, obesity and physical inactivity.[25] It is thought of that while a person ages, the possibility of him learning or knowing new things is enhanced.Nonetheless, the age group was statistically insignificant with diabetic eye disease knowledge in this current research work.This current study revealed that the association between gender and diabetic eye complication knowledge is statistically not significant (p=0.123). This fact is surprisingly the opposite of what previous studies at different jurisdictions have uncovered. Male diabetic participants were found to have adequate knowledge of diabetic complications compared to their female counterparts in a study to determine the knowledge of complications of diabetes mellitus among patients visiting the diabetes clinic at Sampa Government Hospital, Ghana.[18] These results are consistent with the findings of a study conducted among people with diabetes living in Pakistan.[26] Another study conducted in rural Northwest of Pakistan regarding knowledge of diabetes among patients showed that a high proportion of males have a better understanding of diabetes symptoms, signs, and complications than females.[27] These findings are also consistent with several other authors' findings in a descriptive cross-sectional study.[28,29]

The patient's educational level explains the knowledge level of diabetic eye complications among people with diabetes. The higher the education level of a diabetic patient, the higher his knowledge level in diabetic complications. Ovenseri-Ogbomo*et al.*(2013)reported that most (76.9%) of the diabetic patients who were knowledgeable on some ocular effects of Diabetes Mellitus had had basic education or more.[4] Also, Obirikorang *et al.*(2016), found out that all (100.0 %) participants who had completed tertiary education had adequate knowledge followed by those who had completed Senior High school (40.0 %), Junior High school (33.3 %), Basic school (22.0 %) and those who were unschooled (6.8 %) (p <0.0001).[18]These findings are not

different from what this present study found as the bivariate analysis demonstrated a statistically significant association between educational level and knowledge of diabetic ocular complications. Diabetic patients with tertiary education were 4.2 times more likely to have high knowledge of diabetic eye complications than diabetic patients with no formal education after adjusting for all other variables.

Although a third of the participants (33.33%) had no formal education, they could give a range of their monthly earnings. There was a significant association between the respondents' socio-economic status and the level of knowledge of diabetic complication (p<0.001). Diabetic patients who earned more than GH₵1000.00 were 3.7 times more likely to have high knowledge in diabetic eye complications compared to those who earned below GH₵500.00 (COR = 3.7, 95% CI 1.89-7.12). However, previous studies have shown diverse stance on associations between income and knowledge of diabetic complications. A prior study by Al Shafaee*et al.,*(2008)found out that a higher household income was associated with adequate knowledge on diabetic complications.[30]Also, another study by Obirikorang*et al.,*(2016)discovered that diabetic patients irrespective of low, moderate or high economic income were significantly associated with adequate knowledge on diabetic complication compared to patients without economic income.[18] Despite these significant associations, Hoque et al. (2009) observed no significant association between patients' socio-economic income and degree of understanding for diabetic complications.[31]

This study found the residence of diabetic patients to be statistically significant with the knowledge of diabetic ocular complications. The likelihood of having a high knowledge of diabetic ocular complication increased for participants who resided in the more developed areas of Tema. Diabetic patients who lived in the Tema West were 2.2 times more likely to have a higher knowledge of diabetic ocular complications than those who resided in Tema East. The study area being an urban setting agrees with a previous study in Pakistan which indicated that Type 2 diabetic patients who were urban dwellers were more knowledgeable than their counterparts residing in the rural area.[32]However, there was no significant difference in knowledge on diabetic complications between rural and urban dwellers in a previous study at Sampa Government Hospital, Ghana.[18] This was probably because diabetes targeted education was lacking in both groups.

Regarding the risks of diabetics developing ocular complications, these patients usually require eye examination. Most of the diabetic patients (63.04%) had a history of an eye examination. Still, only about one-third of those who had a history of eye examination were referred for the eye examination. Diabetic patients are usually more conscious of their general health and therefore, pay more frequent visits to their primary diabetic physicians. This may be the reason why most (57.33%) of the patients who had undergone eye examination cited their physicians as their source of referrals to the eye clinic. The patients may also visit other health professionals such as dieticians/nutritionists and nurses who are part of the multidisciplinary diabetes management team. A few of the diabetic patients cited other health personnel as their source of referral for eye examinations. Education on diabetic eye complications could be intensified at all health settings, especially by the physicians managing diabetes due to their regular contact with the patients.

V.   CONCLUSIONS

It was noted that most diabetic patients were aware of their condition irrespective of their knowledge of its ocular complications. Previous studies on diabetes have affirmed ageing as a risk factor. This research confirmed the previous studies' findings as 51.93% of the participants were between 41-60 years, while 43.48% were beyond 60 years old. Nonetheless, only 18.6% of the participants in this study had a high knowledge of diabetic eye complications for which existing studies have found equivocal conclusions. Age group was found to be significantly associated with the knowledge of diabetic ocular complications. Attainment of formal education was also discovered to substantially influence the knowledge of diabetic eye complications, both independently and when adjusted for with other covariates. Thus, those with tertiary education were more likely to have higher knowledge than those with no formal education.

Occupation, area of residence and socio-economic income of the patients independently predicted the knowledge level of diabetic ocular complications. Being a government worker or residing at the more developed enclaves of Tema or earning higher income increased the likelihood of attaining higher knowledge. Also, marital status and ethnicity influenced the knowledge of diabetic ocular complications both independently and when all other associated variables are adjusted for. An unmarried patient was likely to have a higher knowledge compared to patients of other marital statuses or ethnic descents. However, the patients' gender, religious beliefs, awareness of diabetes and their National Health Insurance Scheme (NHIS) status were not significantly associated with the knowledge of diabetic ocular complications. Majority of the diabetic patients (63.04%) had a history of an eye examination, but only about one-third of those who had a history of eye examination were referred for the eye examination. About half of the referrals (57.33%) were done by the patients' physician managing their diabetes, while dieticians/nutritionists and nurses did a few.

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