Prevalence of Diabetic Retinopathy and Its Associated Factors Among Diabetic Patients at Debre Markos Referral Hospital, North-west Ethiopia, 2019.

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Keywords: Diabetes mellitus; Diabetic retinopathy; associated factor, Ethiopia

Posted Date: May 5th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-26218/v1>

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Abstract

Background

Diabetic retinopathy is a well-known sight-threatening microvascular complication of diabetes mellitus. Currently 93 million people live with diabetic retinopathy worldwide. There are insufficient studies addressing on the prevalence of diabetic retinopathy and underlying risk factors in Ethiopia.

Objective

To assess prevalence of diabetic retinopathy and its associated factors among diabetic patients on follow up at Debre Markos Referral Hospital, North-West Ethiopia, 2019.

Methods

Institutional based cross-sectional study was conducted among 302 participants at Debre Markos Referral Hospital. They were selected through systematic sampling technique and those with mature cataract and critically ill were excluded. The necessary data were extracted from medical records by using pre-tested checklist. Blood pressure, weight, height and visual acuity tests were assessed. Retinal examination was performed through slit lamp biomicroscope and binocular indirect ophthalmoscope. Data were entered to epi-data 3.1 version. The data were exported into Statistical Package for Social Science (SPSS version 20) program for analyses. Binary logistic regression with 95%CI was used for analyses. A variable had p-value < 0.25 in the bivariable logistic regression was entered to multivariate logistic regression. Finally, variables with p-value < 0.05 in the multivariable logistic regression were considered as statistically significant.

Result

There were 302 participants included in this study, out of which 57(18.9%) had diabetic retinopathy. Among DR patients, three-fourth (75.4%) had pre-proliferative type of diabetic retinopathy. Four in ten (37.7%) of diabetic patients had visual acuity problem. Poor glycaemic control (AOR(95% CI: 4.58(1.86,11.31), having more than 10 years diabetic duration (AOR(95% CI: 3.91(1.86,8.23), body mass index > 25 kg/m²(AOR(95% CI: 3.74(1.83,7.66), and hypertension (AOR(95% CI: 3.39(1.64,7.02) were significantly associated factors with diabetic retinopathy.

Conclusion

About one fifth of DM patients had diabetic retinopathy. Diabetic retinopathy was significantly associated with glycaemic control, hypertension, body mass index and duration of illness. Routine assessment and

early control of those associated factors may be important to reduce both the prevalence and impact of diabetic retinopathy as evidenced in the current study.

Background

Diabetic Retinopathy (DR) is a well-known sight-threatening microvascular complication of diabetes mellitus(1–3). It is characterized by varying degrees of microaneurysm, hemorrhage, hard exudate, cotton wool spot, venous change, and new vessel formation involved in the peripheral, macula, or both part of retina (4–7). Globally, approximately 95 million (35.4%) of diabetic patients had diabetic retinopathy. Out of which one-third had vision-threatening diabetic retinopathy with 7.6% of macular edema (8,9). Global annual incidence of diabetic retinopathy was range from 2.2% to 12.7% and progression was ranging from 3.4% to 12.3 %. The progression to proliferative diabetic retinopathy was higher in individuals with mild disease than in individuals with no disease at baseline (10).

Global prevalence of blindness is estimated to be 1.5 billion out of which 0.4 million is due to diabetic retinopathy. Even though blindness and visual impairment was reduced globally, blindness due to diabetic retinopathy was increased from 0.2 million to 0.4 million and moderate to severe visual impairment was increased from 1.4 million to 2.6 million from 1990 to 2015 respectively (11). However, combination of social, nutritional and medical supports was taken to prevent or stop progress of diabetic retinopathy, still it is a global issue because of epidemic rise of DM and the risk of visual loss is 25 times more in diabetes. Screening and treatment of DR is more challenging in developing countries due to lack of cost and skilled human power (6,8,12). More than \$3190 cost lost for screening and treatment of diabetic retinopathy per quality-adjusted life-year-individual. But financial loss due to social and blindness were not estimated (13).

DR is the leading cause of new cases of blindness in middle-aged and elderly population in the Asia-Pacific. It has been estimated the sources of 51% blindness and 56% visual impairment from global prevalence but awareness of DR among diabetic patients ranged from 28% to 84% (14). In Africa, DR was ranged from 7.0 to 62.4% out of which 15% had severe form DR. Ethiopia is one of among the top four countries with the highest (3.8%) adult diabetic population in Sub-Saharan Africa, but still no sufficient studies, screening guidelines, standard referral criteria and retinal photocoagulation (15,16). Therefore, the aim of this study was to identified prevalence and determinants of diabetic retinopathy among diabetic patients in the study area.

Methods

Study design, setting and study population

Institution -based cross-sectional study was conducted at Debre Markos Referral Hospital, Debre Markos, Northwest Ethiopia from April 1-30/ 2019. Debre Markos is a town in Amhara region, and found 300 km

away from Addis Ababa, the capital city of Ethiopia. All diabetic patients fulfilling the inclusion criteria during the study period were included in this study.

Sample size determination

The required sample size for the study was computed by **Epinfo** using single population proportion formula with the following assumptions: taking 95% confidence interval (CI), 5% margin of error, and 41.4% proportion (P) of DR which was taken from a study conducted in Jimma University Specialized Hospital (17). In addition, correction formula was applied since the source populations were less than 10,000 and 10% non-response rate was considered. Accordingly, a total of 302 study participants were included in this study.

Sampling technique and procedures

Systematic random sampling method was used to select study participants. Less than three years diabetic follow up for type I diabetes mellitus were excluded. Debre Markos Referral hospital diabetic follow-up clinic provides service from Monday up to Friday every week. There are a total of 2018 DM patients currently attending follow up at Debre Markos Referral Hospital. Every 3rd patients were systematically selected from the sampling frame to get a sample size of 302. Patient's registry book was used as a sampling frame.

Operational definition

Diabetic retinopathy: On the retinal camera examination the presence of microaneurysm, hemorrhage, exudate, cotton wool spot, intra-retinal microvascular abnormalities, vein beading and/or new blood vessels at least one of the eyes.

Pre-proliferative DR: - On the retinal camera examination the presence of microaneurysm, cotton wool spot, hemorrhage, vein beading, exudate and/or intra-retinal microvascular abnormalities

Poor glycemic control: - Average of six consequents follow up fast blood sugar greater than 130 mg/dl.

Data collection technique and procedure

Data were collected using semi-structured questionnaire, standard stadiometer, digital weight scale, android digital sphygmomanometer, Snellen chart, slit lamp bio microscopy and binocular indirect ophthalmoscope. Blood pressure was measured by using android digital sphygmomanometer through keeping the respondent in a seating position. If a systolic blood pressure is 140 mm Hg or more and/or a diastolic blood pressure is 90 mm Hg or more two consecutive measurements apart from four hours and ongoing treatment with antihypertensive drugs taken as hypertensive respondent. Height was measured with a moveable headboard (stadiometer) and recorded to the nearest 0.1 centimeter. Weight was measured by digital weight scale and recorded to the nearest 0.1 kg (18).

Visual acuity test was tested separately at 6 meters in well-illuminated area by using Snellen chart. The participant's vision was too poor to read any letters on the chart at 6 meters, then counting finger, hand movement and light perception consequently was done (19). Slit lamp biomicroscope (HAAG Streit Bern 90032742, Swiss Made) and binocular indirect ophthalmoscope (HEINE EN53®, Germany) involved for assessment of retina. Dilation of the participants pupil with 1% tropicamide were done before retinal examination. Fine and short beam size with small pinpoint of light was used to good illumination. Anterior segment examination was carried out by using a slit lamp and posterior segment examination was carried out by using a binocular indirect ophthalmoscope (20,21).

Data quality management

The questionnaire was translated into local language (Amharic) from its English version then back to English with the guidance of ophthalmologist. Training was provided for the data collectors for one day on how the data should be obtained and recorded. Pre-test was done on 16 DM patients at Fenoteslam General Hospital before the actual data collection time in order to see the validity of the instrument, to estimate the time needed to collect data, and to modify the questionnaire accordingly. Data collectors were supervised while collecting the data by the principal investigator and technical support was provided accordingly. Data were checked daily for completeness and consistency throughout the data collection period.

Data processing and analysis

Completeness and consistency of data collection forms were examined during data management, storage, cleaning and analysis. After data were entered to epi Data 3.1 version, it was exported into Statistical Package of Social Science (SPSS) version 20 for analysis. Data were checked, cleaned, coded, merged, and categorized before analyzed. Continuous variables were expressed in terms of mean $\pm$ standard deviation while categorical variables were expressed in proportion. Descriptive statistics and cross tabulation were done for each independent variable. Binary logistic regression with 95% confidence interval was used to assess the association of variables with diabetic retinopathy. A variable had p-value <0.25 in the bivariable logistic regression was entered to multivariate logistic regression. Backward stepwise logistic regression was used for multivariable binary logistic analysis. In the multivariable logistic regression p-value <0.05 was considered as a significant associated variable with diabetic retinopathy. Finally, the results were summarized and presented by text, tables, charts, and graphs.

Results

Socio demographic characteristics of the respondents

A total of 302 diabetic patients were included in the current study with 99.6 % response rate. The respondents mean age was 41.20 (± 14.20) years. Two-third (67.5%) of the respondents were males. Half (54%) of the respondents were more than 40 years old. Two-third (65.6%) and three-fourth (76.2%) of respondents were married and urban dwellers respectively. Even though one-third (37.4%) of the

respondents had family history of diabetes mellitus, only 5.30 % of them developed diabetic retinopathy. Half (45.0%) of respondents had college education and one-third (35.1%) of respondents were governmental or non-governmental employers (Table 1).

Behavioral, clinical and diabetic care characteristics of the respondents

The prevalence of cigarette smoking and alcohol consumption habit of the respondents were 1(0.3%) & 53(17.5%) respectively. Four in ten (37.1%) of the respondents had duration of diabetes greater than ten years. The mean body mass index was $23.79(\pm 2.6)$ kg/m². Three-fourth (72.2%) of the respondent's body mass index were normal and one-fourth (25.8 %) were overweight/obese. One-fourth (23.18%) of respondents had history of hypertension. The mean fast blood glucose level was 131.06 (± 26.79) mg/dl and half (50.3%) of the respondents had good glycemic control. More than half (55.6%) of respondents use oral anti-glycemic agents while 43.4% of respondents take insulin for their treatment. About 184 (60.92%) of respondents were visiting health institution every month and one in four (39.08%) were visiting health institution every two months for diabetic follow up (Table 2 & Figure 1).

Prevalence of Diabetic Retinopathy

Among three hundred and two participants, 57(18.9%) had diabetic retinopathy. Three-fourth (75.4%) of DR patients had non- proliferative while one-fourth (24.6%) of DR patients had a proliferative type of diabetic retinopathy. Four in ten (37.7%) of the respondents had visual acuity problem and three-fourth (86%) of DR respondents had visual acuity problem (Figure 2).

Associated factors for Diabetic Retinopathy among DM patients

In the bivariable logistic regression p-value <0.25 were entered to multivariable logistic regression. Glycemic control, hypertension, BMI and duration of illness had statistically significant association with diabetic retinopathy. The odds ratio developing diabetic retinopathy among those had poor glycemic control were about five times more likely (AOR (95% CI: 4.58 (1.86,11.31) than those having good glycemic control. The odds ratio developing diabetic retinopathy in hypertensive patients were three times (AOR (95% CI: 3.39 (1.64,7.02) more likely chance than non-hypertensive patients. The odds ratio developing diabetic retinopathy among overweight/obese respondents were about four times more likely (AOR (95% CI:3.74 (1.83,7.66) than those having normal bodyweight. The odds ratio developing diabetic retinopathy among patients who had more than ten years diabetic illness were four times more likely risk (AOR (95% CI: 3.91 (1.86,8.23) than those had counterpart (Table 3).

Discussion

The finding of the current study showed that, one in five (18.9% (95%CI (14.5,23.3) of diabetic patients had diabetic retinopathy. This is consistent with studies conducted in Brazil 15% (22), India 21.2% (23) and Meta Analyses in China 18.45% (24). However, it is higher than studies conducted in Beijing 8.1% (25) and Arbamnech General Hospital 13% (26) but lower than studies conducted in Armenia 36.2% (27),

Zimbabwe 28.4% (28), Khartoum 82.6% (29) and Jimma in Ethiopia 41.4 % (30). This discrepancy among studies might be due to variation in genetic, methodology, setting, DR risk comorbidities, diagnostic method, quality of care and health seeking behavior among the study participants. In our study, among DR patients three-fourth (75.4%) had non-proliferative type of diabetic retinopathy. This is lower than study results in India 85.3% (30), Armenia 90.2% (27) but higher than the studies in southern Iran 56.9% (31) and Khartoum 51.7% (29). This variation might be due to quality of care given for diabetic patients and diagnostic method. Four in ten of (37.7%) respondents had visual acuity problem and more than three-fourth (86%) of DR patients had visual acuity problem. This was higher than a study conducted at Nobel Medical College in Biratnagar 24.6% (32). This variation might be due to quality of care given for diabetic patients and life style. In the multivariate logistic regression model glycemic control, hypertension, body mass index, and duration of illness were significantly associated with diabetic retinopathy. In this study, the odds ratio developing diabetic retinopathy among those had poor glycemic control were about five times more likely chance (AOR (95% CI: 4.58 (1.86,11.31) than those having good glycemic control. This result is in line with a systematic review in China (24), Southern Iran (33), Tanzania (34) and Jimma University Hospital(30). The possible mechanism might be poor glycemic control causes vascular cell apoptosis by abnormal glucose metabolism, activation of protein kinase C, formation of advanced glycation end product, and increased production of reactive oxygen species (35–37). The odds ratio developing diabetic retinopathy among hypertensive patients were three times (AOR (95% CI: 3.39 (1.64,7.02) more likely chance than non-hypertensive patients. This is consistent with studies conducted in Beijing (25), Tanzania (34), Kenya (38), Khartoum (29), Arbamech General Hospital (26), and Jimma University Hospital (30); but inconsistent with studies conducted in Iran (33). This discrepancy among studies might be due to methodology, confounding effect, variation of self-care practice and variation of hypertensive prevalence among studies. There also exists association between duration of diabetes and diabetic retinopathy in our finding. The odds ratio developing diabetic retinopathy among patients who had more than ten years diabetic illness were four times more likely risk (AOR (95% CI: 3.91 (1.86,8.23) than those had counterpart. This finding is in line with studies conducted in Armenia (27), Beijing (25), Iran (31), Kenya (38), Tanzania (34), Zimbabwe (28), Khartoum (29), Arbamech General Hospital (26) and Jimma University Hospital (30).

The odds ratio developing diabetic retinopathy among overweight/obese respondents were about four times more likely chance (AOR (95% CI:3.74 (1.83,7.66) than those having normal bodyweight. This result is in line with the studies conducted in America (39), Iran (31) and Beijing (25); but inconsistent with the studies in Croatia(40), and Minnesota(41). The possible reasons of this discrepancy among studies might be due to methodological differences, differences in study participants, lack of comprehensive anthropometric measurements, and confounding effect; but being overweight/obese causes increasing blood viscosity, oxidative stress, vascular growth factors, leptin, cytokines, and intracellular adhesion molecule-1 which leads to diabetic retinopathy (42,43). Fasting blood sugar was used to assess glycemic control due to the lack of facilities to do HbA1c in the study area was our limitation.

Conclusion

Our result concluded about one fifth (18.9%) of DM patients had diabetic retinopathy. Three-fourth (75.4%) of DR patients had non- proliferative while one-fourth (24.6%) of DR patients had a proliferative type of diabetic retinopathy. Poor glycemic control, hypertension, overweight, obesity, and longer diabetes duration were significantly associated factors with diabetic retinopathy. Ministry of health should establish strategies and policies to control diabetic retinopathy. Health workers also provide sustainable health information to diabetic patients on the possible risk factors to DR (hypertension, overweight/obese, and poor glycemic control) since these are the risk factors for diabetic retinopathy as evidenced the current study.

Abbreviations

AOR: Adjusted Odds Ratio

CI: Confidence Interval

OR: Odds Ratio

DR: Diabetic Retinopathy

Declarations

Ethics approval and consent to participate

Ethical clearance and approval were obtained from the Institution Ethical Review Board (IERB) of Jimma University Institute of Health. Explaining the purpose and possible benefit of the study, oral informed consent was obtained from each participant. The study participant was a child, parental written consent was obtained before the data collection. Participants' confidentiality was ensured. Study participants had right to refuse to join, ask any question or withdraw at any particular time. Respondents who were diagnosed as having retinopathy were linked to the ophthalmic clinic for further management.

Consent to publish

Not applicable.

Availability of data and materials

We have sent all the available data and we want to share the raw data as we are doing related study.

Competing interests

All the authors declare that they have no competing interests.

Funding

There was no any funding or sponsoring organization for this study.

Authors' contributions

Melkamu Tilahun wrote the proposal, participated in data collection. Melkamu Tilahun, Diriba Dereje and Teshome Gobena analyzed the data and drafted the paper. Getachew Yideg and Mengistu Wolde approved the proposal with some revisions and participated in data analysis with Melkamu Tilahun and Teshome Gobena. All the authors revised the subsequent drafts of the paper, read and approved the final manuscript.

Acknowledgements

The authors would like to thank Debre Markos Referral Hospital administration, Health workers, data collectors. We are also indebted to the study participants for their kind cooperation.

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Table 1: Socio-demographic characteristics of diabetic patients on follow up at Debre Markos Referral Hospital, North West Ethiopia, 2019

Variables (N = 302)	Diabetic Retinopathy		Total number (%)
	Yes	No	
	Number (%)	Number (%)	
Sex			
Female	23(7.62)	75(24.83)	98(32.45)
Male	34(11.26)	170(56.29)	204(67.55)
Age			
≤40 years	9(2.98)	130(43.05)	139(46.03)
>40 years	48(15.89)	115(38.08)	163(53.97)
Religions			
Orthodox	53(17.55)	226(74.83)	279(92.38)
Muslim	4(1.32)	19(6.29)	23(7.62)
Place of Residency			
Rural	8(2.65)	64(21.19)	72(23.80)
Urban	49(16.23)	181(59.93)	230(76.20)
Marital status			
Single	1(0.33)	48(15.89)	49(16.22)
Married	31(10.26)	167(55.30)	198(65.56)
Divorced	5(1.66)	11(3.64)	16(5.30)
Widowed	20(6.62)	19(6.30)	39(12.91)
Educational status			
No formal education	9(2.98)	46(15.23)	55(18.21)
Primary-level education	11(3.64)	60(19.86)	71(23.51)
Secondary -level education	2(.66)	38(12.58)	40(13.25)
College education and above	35(11.60)	101(33.41)	136(45.03)
Occupation			
Merchant	25(8.28)	83(27.48)	108(35.76)
Employee	24(7.95)	82(27.15)	106(35.10)
Farmer	8(2.65)	49(16.23)	57(18.87)
Student	0 (0)	31(10.26)	31(10.26)
Family history of DM			
No	41(13.58)	148(49.01)	189(62.59)
Yes	16(5.30)	97(32.12)	113(37.42)

Table 2: Behavioral, clinical and diabetic care related characteristics of the respondents at Debre Markos Referral Hospital, North West Ethiopia,

2019

Variables (N = 302)	Diabetic Retinopathy		Total Number (%)
	Yes	No	
	Number (%)	Number (%)	
Alcohol consumption			
Never drink after Dx	43(14.24)	206(68.21)	249(82.45)
Drinker	14(4.64)	39(12.91)	53(17.55)
Duration of DM illness			
≤10 years	14(4.64)	176(58.28)	190(62.92)
>10 years	43(14.24)	69(22.28)	112 (37.09)
Glycemic control level			
Good control	7(2.32)	145(48.01)	153(50.33)
Poor control	50(16.56)	100(33.11)	149(49.34)
Hypertension			
No	25(8.28)	207(68.54)	232(76.82)
Yes	32(10.60)	38(12.58)	68 (23.18)
Chronic cardiac illness			
No	49(16.22)	243(80.46)	292(96.70)
Yes	8(2.65)	2(.66)	10(3.30)
Chronic kidney disease			
No	55(18.21)	242(80.13)	297(98.35)
Yes	3(.99)	2(.66)	5(1.65)
Treatment Modality			
Oral agent alone	41(13.57)	127(42.05)	168(55.63)
Insulin alone	14(4.64)	117(38.74)	131(43.38)
Both	2(0.66)	1(0.33)	3(.99)
Follow up frequency			
Every month	29(9.60)	155(51.32)	184(60.92)
Every two months	28(9.26)	90(29.80)	118(39.07)
Routine DR eye screening			
No	31(10.26)	220(72.85)	251(83.11)
Yes	26(8.61)	25(8.28)	51(16.88)

Table 3: Multivariable analysis of socio-demographic, clinical and diabetic care and treatment modality related characteristics of diabetic patients at Debre Markos Referral Hospital, North-West Ethiopia, 2019

Variables (n = 302)	Retinopathy		COR with 95% CI	AOR with 95% CI	P-value
	Yes	No			
Age					
≤40 years	9	130	1	1	.500
>40 years	48	115	6.03 (2.83,12.83)	1.39(.532,3.65)	
Glycemic control level					
Good	7	145	1	1	.001**
Poor	50	100	10.35(4.512,23.77)	4.58(1.86,11.31)	
Hypertension					
No	25	207	1	1	.001**
Yes	32	38	6.97 (3.72,13.1)	3.39(1.64,7.02)	
Body mass index					
BMI 18.5-25kg/m2	23	195	1	1	.001**
BMI >25kg/m2	34	44	6.55 (3.52,12.204)	3.74(1.83,7.66)	
BMI < 18.5kg/m2	0	6	.000	.000	
Treatment modality					
Oral agent alone	41	127	1	1	.578
Insulin alone	14	117	0.36 (0.19, 0.69)	1.306(.51,3.35)	
Both	2	1	1.5 (0.13,16.97)	1.52(.10,22.56)	
Duration of DM					
≤10 years	14	176	1	1	.001**
> 10 years	43	69	7.83 (4.03,15.2)	3.91(1.86,8.23)	

(**) Statistically significant at p- value < 0.05

Figures

Figure 1

Percentage of body mass index among DM patients on follows up at Debre Markos Referral Hospital, North- West Ethiopia, 2019

Figure 2

Prevalence of diabetic retinopathy among diabetic patients on follows up at Debre Markos Referral Hospital, North-West Ethiopia, 2019