Correlates of diabetic retinopathy: A case study

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Abstract: Prevalence of diabetes mellitus is increasing worldwide particularly in developing countries as according to International Diabetes Federation, globally a rise from 451 million diabetic people in 2017 to 693 million in 2045 is expected. Diabetic retinopathy is one of the major consequences of diabetes mellitus, so knowing its risk factors can be very helpful. For identifying the risk factors of the Diabetic Retinopathy (DR) in Faisalabad and to determine whether DR is more caused by type 1 or type 2 diabetes, a cross-sectional study was conducted at major hospitals in Faisalabad district during February-July 2016. Descriptive statistics were used for initial screening of the significant variables. Then binary logistic regression was applied to measure the influence of different factors on likelihood of DR. Using Odds Ratio (OR) from logistic regression as measure of influence, the problem of DR was found to be higher among males (OR=1.913; 95% C.I, 1.072~3.413), married patients (OR=5.678; 95% C.I=2.206~14.616), patients with type 1 diabetes (OR=2.195; 95% C.I=1.205~3.997), patients with obesity (OR=25.736; 95% C.I=11.033~60.031), patients using insulin treatment (OR=6.678; 95% C.I=2.330~10.138). The study demonstrated a high prevalence of DR in Faisalabad. Eye examination, social status of patients and duration of diabetes were also found as significant variables affecting DR.

Keywords: Diabetes mellitus, diabetic retinopathy, insulin treatment, obesity.

INTRODUCTION

Diabetic Retinopathy (DR) is one of the most common medical condition among many others for example nephropathy, cardiovascular, neurologic and ocular complications due to diabetes mellitus (Bakkar *et al*., 2017; Gupta *et al*., 2018; Wang & Lo, 2018). Diabetes driven DR occurs when blood vessels in the back of eye, the retina, become damaged due to changes in blood glucose levels. It can be described as a disorder associated with retinal circulation affecting efficient supply of oxygen and nutrients required for its high metabolic performance and a metabolic auto regulation is needed to increase retinal metabolism in diabetic patients (Tajunisah *et al*., 2011; Bek, 2017). With progression in the disorder, patient's vision and retinal vessel structure is heavily affected. DR causes swelling of the retina and vision gets blurry if swelling incorporates the macula which may lead to complete loss of vision.

DR is most leading cause of blindness or vision loss among diabetics with several risk factors like duration of diabetes, glycemic control, hypertension, hyperlipidemia, renal failure, anaemia, and age (Solomon *et al*., 2017; Almalki *et al*., 2018; Wang & Lo, 2018). Through a meta-analysis, it was estimated that 34% of the patients with diabetes have DR (Yau *et al*., 2012). The number of diabetic patients is rising worldwide, particularly in developing countries with an estimated number of 439 million diabetic patients by the year 2030 (Shaw *et al*., 2010). International Diabetes Federation (IDF) estimates globally a rise from 451 million in 2017 to 693 million diabetic patients in 2045, notably about half of them remain undiagnosed (Cho *et al*., 2018). It has been reported that 10% of the patients develop kidney disease, 50% develop neuropathy while more than 80% develop DR after over 20-25 years of having diabetes (Ooyub *et al*., 2004; Lu *et al*., 2018).

Currently, Pakistan is the sixth largest country with respect to number of diabetic patients with 11% Pakistani adults as diabetic. Pakistan is expected to rise to the fifth position with 13.9 million diabetic patients by 2030 (Shere *et al*., 2007) but only 33% to 44% of the patients with diabetes in Pakistan have true awareness of their disease and its further consequences (Jabbar *et al*., 2001).

Current study was conducted in order to identify the major risk factors of DR by taking Faisalabad as a case study which is third largest city of Pakistan. Findings of the study may be helpful for controlling DR.

MATERIALS AND METHODS

For data collection, study participants were administered a planned questionnaire based on variables from previous studies and few others relevant to the study area. Using a convenient sampling approach, data was collected from February to July 2016 in district Faisalabad. The sample consisted of 400 diabetic patients from different public and private hospitals. Being a diabetic patient was taken as inclusion criteria.

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Table 1: Descriptive Measures of different variables in relation to diabetic retinopathy (DR)

Variables		Diabetic Retinopathy (DR)		
		Total (%)	Yes (%)	No (%)
Gender	Male	191 (48%)	094 (49%)	097 (51%)
	Female	209 (52%)	106 (51%)	103 (49%)
Diabetes type	Type 1	184 (46%)	127 (69%)	057 (31%)
	Type 2	216 (54%)	073 (34%)	143 (66%)
Diabetes duration	Less than 5	079 (20%)	006 (8%)	073 (92%)
	5 to 8	088 (22%)	028 (32%)	060 (68%)
	8 to 11	134 (33%)	086 (64%)	048 (36%)
	11 & above	099 (25%)	080 (81%)	019 (19%)
Eye examination	No	264 (66%)	151 (57%)	113 (43%)
	Yes	136 (34%)	049 (36%)	087 (64%)
Social status	High	083 (21%)	040 (48%)	043 (52%)
	Medium	162 (40%)	069 (43%)	093 (57%)
	Low	155 (39%)	091 (59%)	064 (41%)
Insulin treatment	Yes	218 (54%)	134 (61%)	84 (39%)
	No	182 (46%)	(36%)	116 (64%)

Table 2: Parameter estimates using logistic regression

Variable		Estimate	SE	P-value	Odds Ratio	95% CI for OR	
						Lower	Upper
Gender	Male	0.643	0.296	0.028	1.913	1.072	3.413
	Female				1.00		
Marital status	Married	1.737	0.482	<0.0001	5.678	2.206	14.616
	Unmarried				1.00		
Diabetic type	Type 1	0.786	0.306	0.010	2.195	1.205	3.997
	Type 2				1.00		
Duration diabetes	Less than 5				1.00		
	5 to 8	1.921	0.501	<0.0001	6.825	2.558	18.206
	8 to 11	3.404	0.486	<0.0001	30.069	11.596	77.972
	11 and above	4.217	0.518	<0.0001	71.563	25.563	197.330
Eye examination	No	0.305	0.040	0.03	1.356	1.254	1.467
	Yes				1.00		
Social status	High				1.00		
	Medium	1.157	0.338	<0.0001	3.179	1.638	6.170
	Low	1.129	0.345	<0.0001	3.090	1.573	6.069
Obesity	Yes	1.732	0.414	<0.0001	25.736	11.033	60.031
	No				1.00		
Insulin treatment	Yes	1.889	0.537	<0.0001	6.678	2.330	10.138
	No				1.00		

SE – Standard Error, OR– Odds Ratio, 95% C.I – 95% confidence interval

Continuous random variables including age and duration of diabetes were categorized using quartile analysis. The independent variables were first selected using descriptive statistics and then variables associated with DR were further investigated using logistic regression (Agresti, 2002). Odds ratios and 95% confidence intervals (C.Is) for different risk factors were computed. The data was analysed using Statistical Package for Social Sciences (SPSS) version 20.

The study was approved by Institutional Review Board of Government College University, Faisalabad, Pakistan and the principles of Helsinki Declaration were followed. Informed consent was taken from the patients whose information on required characteristics were collected/accessed.

RESULTS

The results from table 1 show that out of 400 diabetic patients 191 (48%) were male and 209 (52%) were female. Male participants suffering from DR were 94 (49%) while female participants suffering from DR were found to be 106 (51%).

Concerning diabetes type, 184 (46%) and 216 (54%) patients had type 1 diabetes and type 2 diabetes, respectively. Of those having type 1 diabetes, 127 (69%) were found suffering from DR while 73 (34%) were suffering from DR out of 216 with diabetes of type 2. From 79 patients with diabetic duration less than 5 years, only 6 (8%) had DR. Only 28 (22%) were suffering from DR out of the 88 having duration of diabetes mellitus 5 to 8 years. The severe effect of diabetes duration is observed as 86 (64%) were found to be affected by DR of 134 patients who were suffering from diabetes for 8-11 years. Similarly, of those 99 who had been diabetic patients for more than 11 years, 80 (81%) had DR.

The patients without regular eye examination were 264 (66%) and 136 (34%) were those who used to have regular eye examinations. However, the participants without regular eye examination suffering from DR were 151 (57%) out of 264 patients while this figure was 49 (36%) for 136 patients with regular eye examination.

We have also considered social status of patients in relation to DR. From 83 participants with status "High" 40 (48%) were suffering from DR. Of 162 with social status as "Medium" 69 (43%) were found to have got DR while from those 155 with "Low" social status, 91 (59%) appeared with DR. Insulin treatment is important in diabetes particularly for patients in advanced stages. From 218 people using insulin treatment, 134 (61%) had DR while of those182 not taking insulin treatment, 66 (36%) were reported to have DR.

The results from logistic regression are presented in table 2 where the values of coefficient estimates, standard errors, p-values, and odds ratios with 95% confidence intervals are given. It is observed that gender ($p=0.028$), marital status ($p<0.0001$), diabetes type ($p=0.010$), regularity in eye examination ($p=0.03$), obesity ($p<0.0001$) and insulin treatment ($p<0.0001$) are significant contributory factors in relation to chances of having DR. Duration of diabetes and patient's social status have also been found as significant variables. Similar results concerning regular eye check-ups and duration of diabetes have been documented in some other studies (Lee *et al*., 2015; Solomon *et al*., 2017; Alzahrani *et al*., 2018).

DISCUSSION

The study revealed that male diabetic patients have higher chances of having DR compared to females. The odds ratio of DR for male was 1.913 as compared to females. With respect to gender, similar findings have been reported for Malaysia (Addoor *et al*., 2011) and Saudi Arabia (Hajar *et al*., 2015).

As reported in many other studies (Abdollahi *et al*., 2009; Hussain *et al*., 2011), our results also showed that patients with type 1 diabetes are more likely to suffer from DR than patients with type 2 diabetes (about 20% more odds). The patients with duration of diabetes between (5-8) years, (8-11) years and above 11 years are more likely to suffer from DR with odds ratio 6.825, 30.069 and 71.563 respectively, as compared to patients with duration of diabetes less than 5 years. It is found that the odds of DR are 1.356 times for patients without regular eye examination as compared to the patients with regular eye examination. It hints at the fact that regular eye examination can reduce the risk of DR as documented in many other studies (Hussain *et al*., 2011). Confirming findings of some previous studies (Raman *et al*., 2010; Addoor *et al*., 2011) our results show that DR is more likely in patients belonging to low and middle class families compared to patients with high social status with odds ratio 3.090 and 3.179, respectively. Those patients using insulin treatment have 5.678 times more chances of DR as compared to those who do not use insulin treatment. This is in support of the findings in past with 5.79 odds ratio (Raman *et al*., 2010). Obesity is one of the major causes of diabetes (Harbi *et al*., 2015). Our results reveal that obese diabetic patients have around 26 times higher chances of suffering from DR compared to non-obese diabetics.

CONCLUSIONS

DR is more prevalent in males (compared to females) and married patients (compared to unmarried). DR is found to be more prevalent in lower- or middle-class families which means that increased access to health care facilities can help to reduce the chances of DR among diabetics. Regular exercise and other healthy activities preventing obesity can effectively reduce the chances of developing DR. Type 1 diabetes, duration of diabetes and insulin usage have also been found significant factors in relation to DR. Significance of these factors suggest that screening and preventive steps at early stage of diabetes could lower the chances of DR and hence its vision threatening complications. Although the study is limited to Faisalabad district but its findings can lead to a more comprehensive and elaborative study at provincial or national level.

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