Original Article

PREVALENCE OF DIABETIC RETINOPATHY AND INFLUENCE FACTORS AMONG NEWLY DIAGNOSED DIABETICS IN RURAL AND URBAN AREAS OF PAKISTAN: Data analysis from the Pakistan National Blindness & Visual Impairment Survey 2003

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ABSTRACT

Objective: To estimate the prevalence of diabetic retinopathy among newly diagnosed adult diabetics from the data set of Pakistan National Blindness survey 2003.

Methodology: We analyzed the data collected from the Pakistan National Blindness Survey, a population based survey with regards to diabetic retinopathy and its risk factors. Descriptive information for each of the variable was derived and distribution was assessed by simple tabulation and cross tabulation. We used Odds Ratio (using Mantel-Haenszel technique) and 95% confidence interval to assess association between the variables.

Results: Among the 16507 subjects (95.3% response rate) 660 (4%) were found to be diabetic. Out of these, one hundred one (15.3%) had diabetic retinopathy. We found a low prevalence of diabetic retinopathy (0.6%) among the subjects aged 30 and above. The risk of diabetic retinopathy was higher in urban diabetic subjects (OR 2.7, with 95% CI 1.08-4.1) as compared to rural areas of Sindh. In addition it was higher in hypertensive (OR 2.77 with 95% CI 1.0-4.1) and in obese (OR 2.2 with 95% CI 1.7-4.2) as compared to subjects with normal body mass index (BMI). The prevalence of blindness in diabetic subjects was 5.9%. There were three hundred forty four (52%) subjects with diabetes with normal vision, 149(22%) subjects were with moderate visual impairment, thirty six (5.9%) subjects were blind and twenty two (3.3%) subjects were with severe visual impairment. About 214 diabetics have hypertension (32.4%), one hundred forty one (21.3%) diabetics are obese.

Conclusion: Our study data suggests lower prevalence of Diabetic Retinopathy as compared to other part of the region. There is great need to collect and monitor epidemiological data at district hospital level in order to develop a national annual retinal screening program for diabetic patients in Pakistan.

KEY WORDS: Visual Acuity (VA), Diabetic Retinopathy (Dr), Body Mass Index (BMI), Hypertension.

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INTRODUCTION

Pakistan is the sixth most populous country in the world and second in the Islamic world.[1] It is situated in the Eastern Mediterranean Region of the World Health Organization (EMRO, WHO). Approximately 67% of total population lives in rural areas with literacy rate (defined as age 15 and over and can read and write their names) of 48.2%.

According to World Health Organization estimates, there are 177 million diabetics in the world.[2] One in 20 of world's adult population now suffers from diabetes.[3] At least one in ten deaths among adults between 35 and 64 years old is related to diabetes.[4] It is estimated that by the year 2030, diabetic population of the world will double; with the greatest relative increase occurring in the Middle Eastern crescent, sub Saharan Africa and India.[5] The global increase of diabetes is attributed to longevity, obesity, change in life style, unhealthy diet, better diagnostic facilities and health care.[6] In developed countries, most of the diabetics are above the age of retirement (65 years). In developing countries, diabetes frequently affects younger people.[7] The number of diabetics is estimated to increase by 150% in the developing countries within next 25 years.[8] Diabetes is also expected to increase in Pakistan. According to Pakistan National Diabetes Survey,[9] Pakistan ranks 8th highest worldwide in the prevalence of diabetes. A diabetic can have a serious eye disease and not even know about it until irreversible vision loss has occurred.[10,11]

Like other developing countries, diabetic eyecare services in Pakistan are concentrated in the urban areas and most of the services for diagnosis and treatment of diabetic eye problems are provided by the private sector. Awareness about the available services and indeed, about diabetes and its complications itself, is also lacking. It is estimated that 6.2 million people in Pakistan have diabetes, representing 8.5% of the total adult population. This is expected to rise to 11.6 million by 2025.[12] In Pakistan, only 33% to 44% of known diabetic patients have correct knowledge of diabetes and its complications.[13,14] A survey of Pakistani physicians (of an average experience of 13.5 years) about their knowledge of diabetes revealed that only 62% knew about diabetes and its complications.[15] There are several known risk factors for the onset and progression of diabetic eye disease, like duration of diabetes[14,15] hyperglycemia, hypertension, pregnancy,[16,17] smoking, BMI/Obesity.[18] The diabetic retinopathy can be delayed by controlling all or some of these risk factors. Keeping all the above facts in mind we decided to analyse the Data of Pakistan National Blindness and Visual Impairment Survey[19] for Diabetic Retinopathy.

METHODOLOGY

Methodology used in survey: The sample size was calculated by assuming blindness prevalence at 1.78% in persons aged 30 years and older with 0.3% random sampling error precision and a designed effect of 2.0 with 95% confidence interval. The sample size was sixteen thousand six hundred based on these values.

Multi-stage stratified cluster random sampling, with probability proportional to size (PPS) was adopted for the selection of a cross sectional, national representative sample of adult population. A total of 221 clusters sample were collected. Of these, 112 were rural clusters (consisting of a village). The urban cluster comprised of a street block. The rural cluster area consisted of one hundred subjects and urban cluster area consisted of fifty subjects. Data were collected by three ophthalmic teams. After taking oral informed consent from each subject, personal and demographic data were obtained before the eye examination by a trained interviewer. A trained ophthalmic nurse took distance visual acuity from each subject with reduced logarithm of minimum angle of acuity (log MAR) tumbling "E" chart which was used separately for each eye at four meters and one meter.

Based on visual acuity presentations, the subjects were marked as RED card if their present visual acuity is less than 6/12 in either eye or marked as GREEN card if their visual acuity is less than 6/12 in the better eye. Subjects with green card were discharged after taking refraction, biometry and undilated fundus examination. If there was any pathology detected they became red cards. Those with red card underwent detailed slit lamp anterior and posterior segment examination, digital photography. Visual fields were recorded and any retinal pathology was noted.

Definition used in Ophthalmic Examination during Survey: Blindness was defined as best corrected visual acuity of less than 3/60 in the

better eye. Low vision was defined as best corrected visual acuity of less than 6/18 but equal to or better than 3/60 in the better eye. The low vision was divided in two categories 1=Moderate visual impairment: defined as visual acuity of less than 6/18 to 6/60 and category 2 = severe visual impairment: a visual acuity of less than 6/60 and up to 3/60. Near normal visual acuity was defined as with the best corrected visual acuity of less than 6/12 but equal to or better than 6/18 in better eye.

Diabetes were defined as any subject with random blood glucose level higher than 11.0mmol/l (Random blood glucose level was tested by One touch Basic Plus Glucometer, life scan Deutschland G.m.b.H., Neckargemund, Germany). They asked for any positive history of diabetes and also measured height and weight of the subjects.

Diabetic retinopathy was divided into three categories, Non-Proliferative, Proliferative and Maculopathy.

Definitions used for analysis:

Diabetes Mellitus:- For the purpose of our analysis diabetes was defined as, "the blood sugar level higher than 140mg/dl with or with out positive family history or having ophthalmoscopic findings of diabetic retinopathy.

Hypertension:- For the purpose of analysis Hypertension is defined as a systolic blood pressure of more than 160mmHg and the diastolic blood pressure of 90 mmHg.

BMI:- BMI is weight in kilograms divided by the square root of height in meters.

Statistical Method: We analyzed the national data collected from the survey as outlined above with regards to diabetic retinopathy and its risk factors. The data analysis is performed with STATA version 9.0. Descriptive information for each of the variable is derived and distribution is assessed by simple tabulation, cross tabulation. We used Odds Ratio by using Mantel-Haenszel technique and 95% confidence interval to assess association between the variables.

For the purpose of analysis we categorized visual acuity, age and BMI in to following categories:

1. Visual Acuity Category one= Normal (6/12 or better), Category two = Near Normal (between 6/12 and 6/18), Category three = Moderate visual impairment (between 6/18 and 6/60), Category four = Severe visual impairment (between 6/60 and 3/60), Category five = Blind (less than 3/60).
2. AGE Age group one = 30-39 years, Age group two = 40-49 years, Age group three = 50-59 years, Age group four = 60-69 years. Age group five = 70-70+ years.
3. Hypertension O = subjects with no hypertension 1= subjects with hypertension
4. BMI BMI of 0 = Lean , BMI of more than 0 / less than 25 = Normal , BMI of more than or equal to 25 = Overweight, BMI of more than 30 = Obese.

RESULTS

Response rate: There were total seventeen thousand three hundred eleven (17311) subjects in data set with age of 30 and above. Out of these, sixteen thousand five hundred seven (16,507) subjects were responders and remaining eight hundred four subjects were non responders. There were various reasons for non responders. These included 72.9% being out of town, 17.2% refusing to be examined, 1% being disabled and forty four (0.5%) subjects with no particular reason were recoded as others. This left us with 16507 subjects for analytical purposes. Of these six hundred sixty (4%) subjects were found to be diabetic.

Demography of subjects in the sample: Among the responders, there were 8766 (53.12%) females and seven thousand seven hundred forty one (46.90%) were males. About eleven thousand eighty four (67.15%) subjects belonged to rural area and five thousand four hundred twenty three (32.85%) were from urban areas.

Diabetics with diabetic retinopathy: Of the 660 diabetic subjects in the data set, one hundred one had signs of diabetic retinopathy on fundal examination. Fifty six (55.4%) were female and forty five (44.5%) were male. Of the 101 subjects with diabetic retinopathy, sixty two (61.3%) subjects were from Punjab, sixteen (15.8%) from province of Sindh, one (0.1%)

Table-I: Visual Loss due to Diabetes

Anatomical Location	*Pathology due to Diabetes*
Cornea	Epithelial erosions, Infective Keretitis
Iris	New vessels & Neovascular Glaucoma
Lens	Early cataract
Retinal Vessels	Venous Occlusion, Arterial Occlusion, Ocular Ischemic Syndrome
Vitreous	Vitreous Hemorrhage
Retina	Macular edema, Macular ischemia, Macular traction, Exudative maculopathy, Macular Detachment, Tract ional Rhegmatogenous Retinal Detachment
Optic Nerve	Diabetic Papillopathy, Anterior ischemic optic neuropathy.

from Balouchistan, twenty (3.1%) from NWFP and one (0.1%) from Azad Kashmir (Pie Chart 1). Fifty eight (57.4%) subjects with diabetic retinopathy belonged to rural area and forty three (42.5%) to the urban area. Of the subjects with diabetic retinopathy, thirty one had normal vision, twenty two had near normal vision, 35 had moderate visual impairment, five had severe visual impairment and eight were blind (Table-III). Of the subjects with diabetic retinopathy, five (0.08%) were in age group one (n=5995), 22 (0.13%) were in age group two (n=3589), 29 (0.16%) were in age group three (n=2870), 27 (0.16%) were in age group four (n=2345), and 18 (0.18%) were in group five (n=1748) (Table-IV). There were 35 hypertensive and 16 obese subjects with diabetic retinopathy in data set.

Prevalence of diabetic retinopathy: Over all prevalence of diabetic retinopathy is 0.6%. The province wise prevalence of diabetic retinopathy is 0.4% in Sindh, 0.7% in Punjab, 0.8% in NWFP, 0.1% in Balouchistan, 0.4% in Azad Kashmir. The prevalence of diabetic retinopathy is higher in females (0.64%) than in males (0.58%) and lower in rural (0.38%) than urban areas (1.08%). The prevalence of blindness in subjects with diabetic retinopathy was 7.9%. Prevalence of diabetic retinopathy according to visual acuity category wise is 0.25% in group one, 1.49% in group two, 1.69% in group three, 2.10% in group four, 1.44% in group five.

Table-II: Age and sex distribution

Age groups	*Sex*		*Total*
	Male (%)	*Female (%)*	
30-39	2498 (41.94%)	3457 (50.62%)	5955
40-49	1974 (55.10%)	1615 (44.99%)	3589
50-59	1451 (50.55%)	1419 (49.44%)	2870
60-69	1120 (47.76%)	1225 (52.23%)	2345
70-70+	764 (43.70%)	984 (65.29%)	1748

According to age, prevalence of diabetic retinopathy is higher at 1.16% in subjects with age 60-69 than other age groups in the data set. It is 0.08% in age group 30-39 years, 0.61% in age group 40-49 years, 1.02% in 50-59 age groups and 1.00% in age group 70 and over. Prevalence of diabetic retinopathy among diabetic patients was 15%. It is higher at 0.95% in hypertensive subjects than non hypertensive (0.5%). Its prevalence is higher at 1.09% in obese subjects compared to the prevalence in lean subjects at 0.51%, normal subjects at 0.48% and in over weight subjects at 0.48%.

Odds Ratio for diabetic retinopathy: The risk of diabetic retinopathy was lower in male diabet-

Table-III: Province wise distributions of diabetic patients with retinopathy
Province wise prevalence of diabetes and diabetic retinopathy (DR).

Name of Province	*n (%)*	*Total No: with*		*Prevalence*	
		Diabetes	*DR*	*Of Diabetes(%)*	*DR inDiabetic patients (%)*
Punjab	8710 (52.7)	436	62	5	14.2
Sindh	3664 (22.2)	121	16	3.3	13.2
NWFP	2652 (16.0)	88	21	3.3	23.8
Balouchistan	945 (5.7)	04	01	0.4	25
Azad Kashmir	248 (1.5)	07	01	2.8	14.2
Federal	94 (0.5)	03	00	3.1	00
Northern Areas	194 (1.1)	01	00	0.5	00
Total	16507	660	101		

ics (OR 0.90, 95% CI 0.613-1.348) as compared to female diabetics. It was about 13 times higher in diabetics of age group 50-60 as compared to younger diabetics. In the data set 1455 subjects were obese. Out of these, 141 had diabetes and 16 subjects had diabetic retinopathy. The risk of diabetic retinopathy was almost two time higher in obese (OR 2.2, with p value of 0.01 and 95% CI1.17-4.29). A total of 214 persons with diabetes had associated hypertension including 35 persons with diabetic retinopathy. The odds of diabetic retinopathy increase about two fold in patients with hypertension as compared to non-hypertensive (OR 1.913, p=0.03 95 %CI 1.22-2.78). Odds of having diabetic retinopathy increase two times in urban diabetic subjects as compared to rural diabetic subjects (OR 2.77, with p-value of 0.00 and 95% CI 1.08-4.12).

DISCUSSION

Diabetic retinopathy is one of the diseases in which definitive preventive measures can lead to delayed onset, progression and complications of the disease. Diabetes is a major public health problem in the world. There is no available curative treatment for this costly disease. It is costly in terms of loss of quality of life,[20] loss of life, economic burden on the community[21] and on the family of the diabetic patient and on the health sector.[22-26]

King[27] estimates a high prevalence of diabetes by 2025. This is a matter of great concern considering the potential for blindness due to diabetic retinopathy. This was the reason why we decided to analyze the recently conducted Pakistan National Survey into the Causes of Pakistan Blindness and Visual Impairment in 2003.[19] The strength of our study is in an excellent response rate (95.3%), methodology used for sampling, experienced ophthalmic team, adhering strictly to the clinical protocol.

There are, also certain limitation in our study. For example, the survey relied only on capillary blood glucose level for the diagnosis of diabetes and did not perform fasting blood glucose level or glycosylated hemoglobin measurements (diagnostic bias). They asked verbally for the diabetes so this may lead to information bias (selection bias). Also three different survey teams were used in different provinces of Pakistan to record the clinical findings. Thus, there is a chance of inter-observer bias. Finally, the chances of diagnostic vogue bias for diabetic retinopathy are present in our study. Thus, because of these factors, we may have underestimated the prevalence of diabetes (3.99%) in Pakistan.

According to this dataset, the overall prevalence of diabetes mellitus was 4.0%, the highest being in the province of Punjab (5%) followed by Sindh, NWFP and Federal territory with prevalence of 3.3, 3.3 and 3.1% respectively, the lowest being in province of Balouchistan with a prevalence of 0.4% followed by Northern areas and Azad Kashmir with prevalence of 0.5 and 2.8% respectively (Table-I). It is our view that this difference may be due to sample size bias, better awareness and with better available diagnostic facilities in the provinces with higher prevalence of diabetic retinopathy. Further, the lower prevalence of diabetic retinopathy in Balochistan may be due to non-awareness among the community for diabetes and also due to barriers in that province for service uptake. We found low prevalence of diabetic retinopathy in all provinces of Pakistan (Table-I). This suggests that diabetic retinopathy carries less priority than other commoner causes of blindness in Pakistan, like refractive errors and cataract.

In this survey we also found more diabetics in urban areas than in the rural areas. This may be because the urban population has more access to diagnostic facility as compared to rural subjects. Other reason may be the life style (like less physical activity than those in rural areas) and dietary habits. We found higher prevalence of diabetes among the females (4.1%) than males (3.2%) in our analysis. This may have been because of higher number of female participants (53.1%) than male participants (46.9%). The other reason for higher prevalence in females may be less opportunity for physical activity (sports) and low literacy rate among females as compared with males. Prevalence of diabetes is higher in subjects above 60 years

of age. This may be because of the duration of diabetes. We found 5.9% prevalence of blindness among the diabetic subjects.

In this analysis, we found an overall prevalence of diabetic retinopathy to be 0.6% and 15.7% in diabetic subjects. It was higher in females (8.4%) than males (6.96%), higher in urban (8.7%) than in rural areas (6.5%). This may be because of the methodology used in the survey for detection of diabetes.

CONCLUSION

Our study data suggests a lower prevalence of Diabetic Retinopathy. With the number of diabetics on the rise and the increasing life expectancy among the diabetics, collecting and monitoring epidemiological data at district hospital level becomes increasingly important to be able to develop a national annual retinal screening program for diabetics in Pakistan.

As the new therapies for Diabetic Retinopathy and its associated complications emerge, we need to develop trained personnel at all levels for providing high quality affordable diabetic eye care services at their door step.

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