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Prevalence and risk factors of diabetic retinopathy in a rural population of South India

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Abstract The purpose of this study is to study the prevalence and associated risk factors of diabetic retinopathy (DR) in type 2 diabetics in a rural setup by means of outreach screening camps. A total of 1270 diabetic patients were enrolled into the study from outreach screening camps conducted in rural areas of Kolar district by Sri Devaraj Urs Medical College attached to Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka. Detailed history with reference to age, duration of diabetes, hypertension, smoking and alcohol consumption was taken. Detailed ocular examination was done. Prevalence and associated risk factors were noted. Among the 1270 diabetic patients who were screened, 235 (18.5 %) patients had evidence of diabetic retinopathy. This included 167 (71.1 %) patients with mild to moderate non-proliferative diabetic retinopathy (NPDR), 41 (17.4 %) patients with severe NPDR, 19 (8.1 %) patients with proliferative diabetic retinopathy (PDR) and 60 (4.7 %) patients with maculopathy. The independent risk factors of DR which were statistically significant were older age (76.6 %), longer duration of diabetes (54.5 %), alcohol consumption (6.4 %), family history of diabetes (43 %) and insulin intake (27.7 %). Diabetes and its related complications are no longer restricted to the urban and the rich, with studies proving that prevalence rates are almost equivalent to urban population; strategies for prevention, early diagnosis and treatment need to be planned and implemented at the earliest if the burden of diabetic blindness is to be tackled effectively.

Keywords Type 2 diabetes mellitus · Diabetic retinopathy · Risk factors · Rural population

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Introduction

Diabetic retinopathy (DR) is a well-recognized complication of diabetes mellitus. The World Health Organization (WHO) estimates that diabetic retinopathy is responsible for 4 % of the 45 million cases of blindness. According to the latest WHO report, India has 31.7 million diabetic subjects and the number is expected to increase to 79.4 million by 2030 [1]. Patients with type 2 diabetes, unlike those with type 1, frequently have significant retinopathy at first diagnosis due to a time lag between onset and clinical diagnosis. Although the pathogenesis of retinopathy in diabetes is still not fully understood, a number of risk factors have been identified including hypertension, poor glycemic control and increasing duration of diabetes.

In India, diabetic retinopathy is the 6th cause of blindness. Recent epidemiological studies have provided valuable information on the prevalence of DR in the urban south Indian population [2–4]. However, there are very few data on the prevalence of DR in rural population, where 72 % of India′s population lives. Although prevalence rates of diabetes are lower in rural areas, the absolute number of people with diabetes is actually higher (23 million) compared to urban areas (17.9 million). Screening for diabetes and its complications is hardly ever done in rural areas. Such areas have additional challenges such as the lack of awareness due to illiteracy and limited access to specialized health-care facilities, which, even if available, would be largely unaffordable due to the prevailing poverty. This results in a large burden of undiagnosed diabetes and its associated complications due to delayed diagnosis and/or improper treatment [5]. Once vision has been lost due to diabetic retinopathy, it usually cannot be restored, although some forms of retinopathy can be treated by complex vitreo retinal surgery. Therefore, this study is aimed at studying the prevalence and associated risk factors of diabetic retinopathy in type 2 diabetics in a rural setup by means

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of outreach screening camps. Targeting the modifiable risk factors aggressively and regular screening may help to plan better strategies addressing diabetes and diabetic retinopathy care.

Materials and methods

Study design A prospective observational clinical outreach study involving rural type 2 diabetics was undertaken to study the prevalence of diabetic retinopathy and its associated risk factors.

This study was conducted by a team of ophthalmologists from Sri Devaraj Urs Medical College attached to Sri Devaraj Urs Academy of Higher Education and Research and R.L. Jalappa Hospital from January 2009 to June 2011 in peripheral health centres of Kolar district, Karnataka. The peripheral health centres included were those in Kolar district, and they were identified by the department of community medicine. The patients included were those attending these outreach screening camps. A total of 1270 type 2 known diabetics were included in this study and subjected to various examination techniques.

Detailed history regarding the duration of diabetes, hypertension, smoking, alcohol consumption, family history and any other relevant information were recorded by means of a standard questionnaire. Capillary blood by pin-prick method was obtained, and random blood glucose was determined. A cutoff value of 200 mg/dl was taken to detect new cases. Cases with borderline values were referred to base hospital and subjected to further investigations. Patients who were already on treatment or had a letter from their physician were treated as known diabetics. Hypertension was defined as a systolic blood pressure of more than 140 mmHg and/or diastolic blood pressure of more than 90 mmHg. Regarding smoking data collected, it focused on if the subject was a current smoker or not.

Patients were subjected to detailed medical examination. A thorough ocular examination by a retinal specialist was done. Visual acuity estimation was done with the Snellen's chart. Anterior segment evaluation and posterior segment evaluation with dilated pupils by direct and indirect ophthalmoscopy were done.

Signs of DR including the presence of even one microaneurysm within the arcades, dot or blot haemorrhages, hard exudates, cotton-wool spots, intra-retinal microvascular anomalies (IRMA), venous beading, neo-vascularization of the disc (NVD) or elsewhere (NVE), vitreous haemorrhages with or without fibrovascular proliferation and evidence of tractional retinal detachment were looked for. DR was classified for each eye as no retinopathy (level 1), mild-moderated non-proliferative DR (NPDR, levels 1.5–3), severe NPDR (levels 4–5) and proliferative DR (PDR, levels 6–7) based on the modified classification method, as described by Klein et al. [6].

Patients with hazy media or in which clear fundal details could not be ascertained were excluded from the study. Those who required further investigations like fluorescein angiography or laser treatment were referred to the base hospital and treated free of cost. All patients were counselled as to their diet and lifestyle by a qualified dietician.

Statistical analysis Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean±SD (min–max), and results on categorical measurements are presented in number (%). Significance was assessed at 5 % level of significance. Student's *t* test has been used to find the significance of study parameters on continuous scale between two groups. Levene's test for homogeneity of variance has been performed to assess the homogeneity of variance. Chi-square/ Fisher's exact test

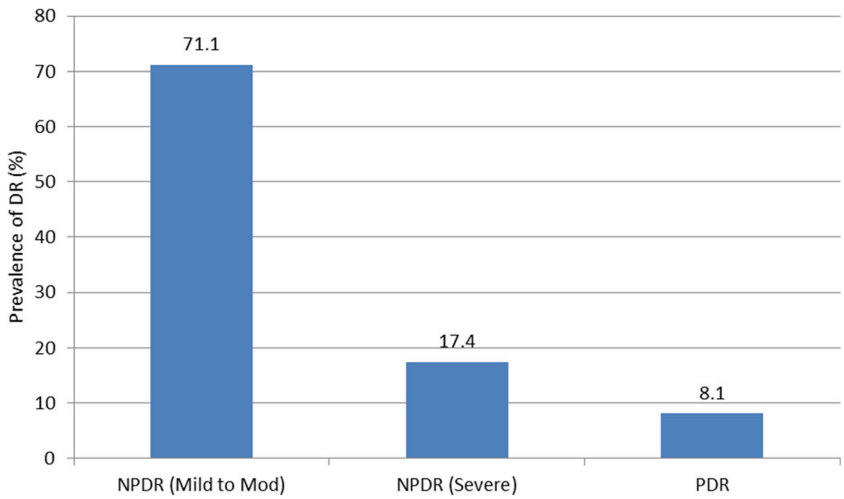

Fig. 1 Prevalence of DR in our study

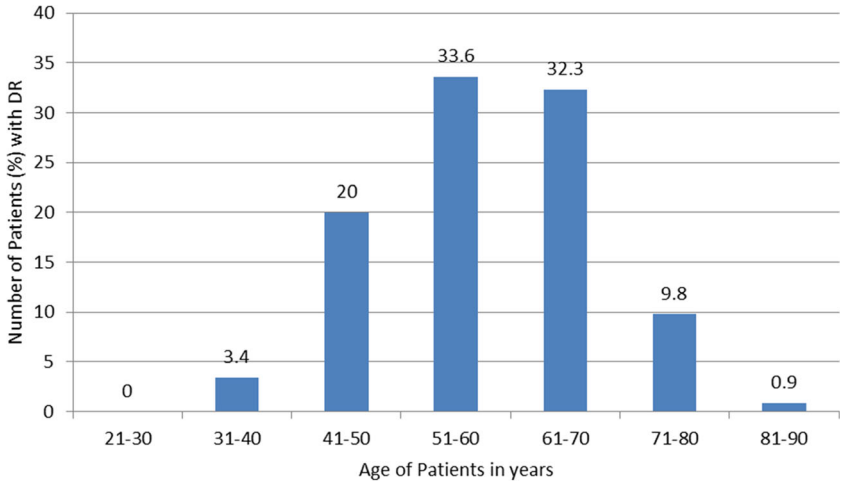

Fig. 2 Age of patients and DR

has been used to find the significance of study parameters on categorical scale between two or more groups. Multivariate logistic regression analysis was performed to predict the prevalence of diabetic retinopathy.

Results

Out of 1270 diabetic patients, 235 (18.5 %) patients had diabetic retinopathy. The mean age of the diabetics with DR was 58.63±9.98 years. The mean age of onset of diabetes among those who had DR was 48±11.30 years. Male female distribution among patients with diabetic retinopathy was 66 and 34 % (P=0.702). Ophthalmic examination revealed that 235 patients had some form of diabetic retinopathy including 167 (71.1 %) patients with mild to moderate non-proliferative diabetic retinopathy (NPDR), 41 (17.4 %) patients with severe NPDR, 19 (8.1 %) patients with proliferative diabetic retinopathy (PDR) and 60 (4.7 %) patients with maculopathy (Fig. 1).

The details of prevalence in different age groups are shown in Fig. 2. This shows that maximum number of patients (65.9 %) in the age group of 51–70 years had evidence of retinopathy.

In our study, the prevalence of diabetic retinopathy was maximum (35.7 %) when the age of onset was in the 41–50 age group (Fig. 3). The mean duration of diabetes in patients with diabetic retinopathy was 10.52±7.54 years compared to those without DR which was 7.06±6.91 years (P<0.001). Figure 4 shows details of retinopathy according to duration of diabetes. DR was seen in 38.8 % of the patients who had diabetes >10 years.

Systolic blood pressure was in the range of 140–159 mmHg for 27.2 % of patients with diabetic retinopathy (P=0.007). Of the diabetic subjects with retinopathy when compared with subjects without DR, 42.9 % of patients had family history of diabetes (P=0.002), 48.9 % had hypertension (P=0.19), 6.4 % were smokers (P=0.297) and 6.4 % were alcoholics (P=0.005). Multivariate logistic regression model was used to estimate the quantitative effect of each significant risk factor associated with diabetic retinopathy (Table 1).

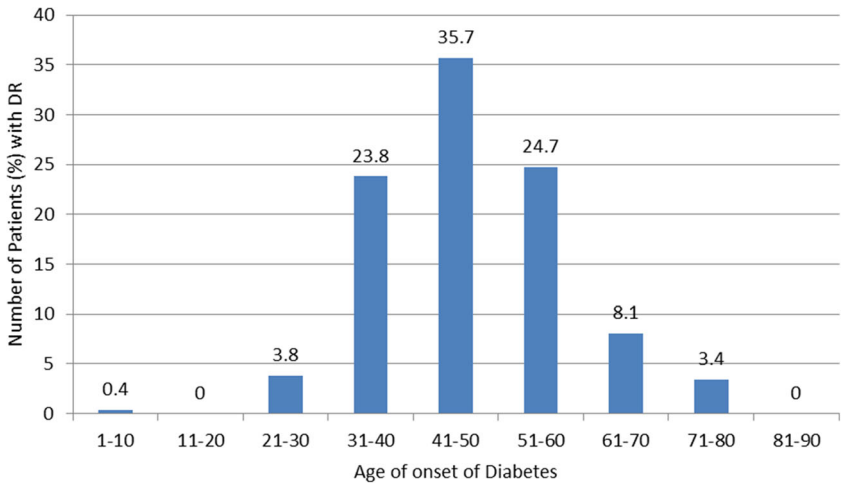

Fig. 3 Age of onset of diabetes and DR

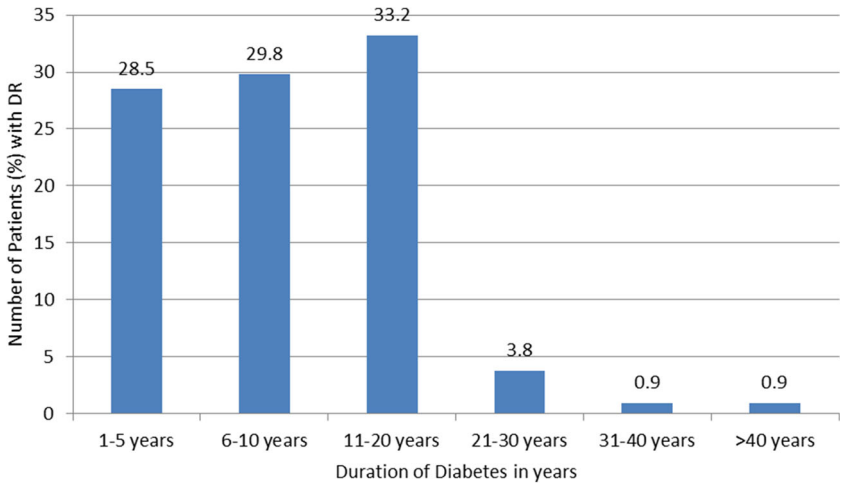

Fig. 4 Relation of DR and duration of diabetes

Discussion

With increased life expectancy, the complications due to DR lead to severe disability in old age. Moreover, growing evidence also suggests that after 15 years of diabetes, approximately 2 % of patients develop blindness, while about 10 % develops severe visual handicap [7]. The magnitude of diabetic retinopathy in rural population with diabetes needs exploration. The type, duration of diabetes mellitus, age, gender, glycemic control, systemic hypertension, body mass index, smoking, serum lipids and microalbuminuria are associated with progression of diabetes [8].

This paper presents the prevalence of retinopathy and associated risk factors in type 2 diabetic patients in a rural population in Kolar district. Studying this population provided an opportunity to compare the prevalence of DR with other rural and urban population-based studies with access to similar health-care system.

Diabetic retinopathy was present in 18.5 % of the diabetic population. This result was similar to a study conducted on a rural population by Rani et al. in which the prevalence was found to be 17.6 % [9]. The Aravind comprehensive eye study, another rural study, reported a prevalence of 10.5 % [10]. A similar large population-based study conducted in Theni district of South India reported a prevalence of 12.2 % [11]. It is of interest that the prevalence rate of diabetic retinopathy reported in our rural study is similar to the rate among urban south Indian population [2]. Two other population-based studies conducted in south India reported overall prevalence of DR as 22.4 and 26.8 % respectively [4]. However, the prevalence of DR reported in other European studies is higher, as shown in the Wisconsin study, where the prevalence was 50.3 % [2]. The reasons for these differences are not clear. The observed geographic/population variations in the prevalence of diabetic retinopathy could be due to real ethnic differences in the susceptibility to diabetic retinopathy (genetic) or due to poor control of diabetes, prevalence of hypertension and influence of socio-economical and cultural factors (environmental).

In this study, the independent risk factors of DR which were statistically significant were older age (76.6 %), longer duration of diabetes (54.5 %), alcohol consumption (6.4 %), family history of diabetes (43 %) and insulin intake (27.7 %). According to the study by Rani et al., the risk factors associated with severity of diabetic retinopathy were longer duration of diabetes, elevated systolic BP, lower BMI and those on

Table 1 Multivariate logistic regression analysis to predict the prevalence of DR

Variables	Prevalence of DR		Univariate		Multivariate logistic regression		
	No (n=1035)	Yes (n=235)	P value	OR	P value	OR	95 % CI
Age >50 years	675 (65.2 %)	180 (76.6 %)	0.001**	1.74 (1.25–2.42)	0.025*	1.51	1.01–2.16
Duration of DM >10 years	306 (29.6 %)	128 (54.5 %)	<0.001**	2.84 (2.13–3.81)	<0.001**	2.26	1.65–3.01
Family history	334 (32.3 %)	101 (43 %)	0.002**	1.58 (1.18–2.11)	0.003**	1.58	1.16–2.15
Smoking	49 (4.7 %)	15 (6.4 %)	0.297	1.37 (0.76–2.49)	0.995	1.01	0.50–1.99
Alcohol	28 (2.7 %)	15 (6.4 %)	0.005**	2.45 (1.28–4.66)	0.008**	2.72	1.30–5.68
Hypertension	456 (44.1 %)	115 (48.9 %)	0.175	1.21 (0.92–1.61)	0.639	1.08	0.79–1.46
Insulin intake	109 (10.5 %)	65 (27.7 %)	<0.001**	3.24 (2.29–4.60)	<0.001**	2.73	1.89–3.93

*P≤0.05; **P≤0.01

insulin therapy [9]. The risk factors identified in this study have been implicated as risk factors in the development of DR in many studies: duration of diabetes [12, 13], hypertension [14], male preponderance [3, 12] and insulin intake [12, 15].

Among the patients with DR, 66 % were males and 34 % were females. In a clinic cohort in Chennai [16], DR appeared to be more prevalent in males (M/F=2:1). Similar observations were made in other studies [9]. Studies have shown varying results when predicting gender as a risk factor for developing DR.

In this study, old age (>50 years) was a risk factor associated with diabetic retinopathy. Older age has been shown to be a risk factor for DR in some studies [14]. Lack of symptoms and insidious onset of type 2 diabetes mellitus may result in the diagnosis of diabetic retinopathy at a later stage.

In India, virtually, all studies have shown an increased prevalence of DR as the duration of diabetes increased [2, 3, 17]. Our studies show a prevalence of 38.8 % after 15 years of duration of diabetes mellitus. Increased duration influencing the occurrence of diabetic retinopathy and its severity was probably related to the magnitude or prolonged exposure, or both, to hyperglycaemia coupled with other risk factors. In the study conducted by Dandona et al. in type 2 diabetes, it is reported that 87.5 % of those with >15 years of diabetes had DR compared with 18.9 % of those who had <15 years duration [3].

In the Chennai Urban Rural Epidemiology study (CURES) 4, 46.8 % of subjects on insulin therapy had DR compared with 20 % on oral hypoglycemic agents which was similar to that observed in the Andhra Pradesh Eye disease Study [3]. In our study, 27.7 % of patients on insulin had diabetic retinopathy compared to those on oral hypoglycemic agents ($P<0.005$).

A few studies have examined the effect of alcohol consumption on DR. Young et al. [18] reported heavy alcohol consumption to be a risk factor for development of DR in patients without retinopathy at baseline. In our study, history of alcohol consumption was one of the risk factors for development of DR. Hypertension has been implicated as a risk factor for development of retinopathy in many studies. However, our study did not show any association of hypertension and diabetes.

The limitation of this study was that DR grading was based on indirect ophthalmoscopy and not on fundus photography grading. Since the study was conducted by outreach screening camps, fundus photography could not be done. This could have resulted in the underestimation of the prevalence of DR.

Conclusion

Diabetes and its related complications are no longer restricted to the urban and the rich. With studies proving that prevalence rates are almost equivalent between the urban and rural, strategies for prevention, early diagnosis and treatment need to be planned and implemented at the earliest if burden of diabetic blindness is to be tackled effectively.

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