Original Research Article

An Evaluation of the Occurrence and Contributing Factors of Diabetic Retinopathy in a Population-based Study

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Abstract:
Introduction:
India is projected to become the world's diabetic epicentre, with a drastic increase in diabetes cases expected by 2030. Diabetic retinopathy (DR) is a significant complication, affecting a substantial proportion of diabetics. Distinct clinical variations exist between Indian and European populations with diabetes, necessitating comprehensive epidemiological studies to understand the occurrence and contributing factors of DR in India.
Objective:
This study aimed to conduct a comprehensive evaluation of the occurrence and identify the key contributing factors of diabetic retinopathy in a population-based setting.
Methods:
A cross-sectional population-based study was conducted, involving individuals with diabetes. A representative sample was drawn using a multistage sampling technique. Clinical assessments, interviews, and medical record reviews were used to collect data on demographics, diabetes history, blood glucose levels, blood pressure, lipid profile, genetic history, lifestyle factors, and comorbidities. Statistical analysis, including multivariate regression models and subgroup analyses, was performed to identify key contributing factors.
Results:
Demographic characteristics revealed a diverse population, with a mean age of 55.3 years. The prevalence of diabetic retinopathy was 66.0%, with mild nonproliferative DR being the most prevalent stage (20.3%). Significant associations were found between diabetic retinopathy and factors such as age, duration of diabetes, blood glucose levels, systolic blood pressure, family history of DR, physical inactivity, and hypertension. Subgroup analyses revealed increasing prevalence with age.
Conclusion:
This study provides valuable insights into the occurrence and contributing factors of diabetic retinopathy in a population-based setting. The findings underscore the need for targeted intervention strategies to manage diabetic retinopathy and its associated risk factors effectively. Healthcare professionals and policymakers can use this information to develop tailored preventive measures and improve diabetic retinopathy management in the Indian population.

1. Introduction

India is poised to take on the title of being the world's diabetic epicentre. In the year 2000, the World Health Organization (WHO) reported that 31.7 million individuals in India were affected by diabetes mellitus (DM). However, projections indicate that this number will surge significantly to a staggering 79.4 million by the year 2030, making it the highest number of diabetes cases in any nation globally. Alarmingly, almost two-thirds of all Type 2 diabetics and nearly all Type 1 diabetics are expected to develop diabetic retinopathy (DR) over time, as suggested by multiple studies [1,2,3]. Several epidemiologic studies have provided valuable information on the prevalence of DR in Western countries that is useful for identifying subgroups at risk and for the planning of public health policies.(4)

Moreover, type 2 diabetes among Indians exhibits notable distinctions compared to Europeans in various aspects. Notably, it tends to manifest at a younger age [5], and obesity is less prevalent among Indian populations [6]. Additionally, genetic factors seem to exert a stronger influence on the development of diabetes [7]. Given these clinical variations and the escalating prevalence of diabetes in India [8], it becomes imperative to conduct thorough epidemiological studies on diabetes-related complications within this demographic.

Several risk factors have been identified for the development and progression of diabetic retinopathy. Firstly, the duration of diabetes plays a crucial role, as individuals with a longer history of diabetes are at a higher risk of developing retinopathy. Poorly controlled blood glucose levels over time are strongly associated with an increased risk of diabetic retinopathy. Additionally, high blood pressure and hypertension can exacerbate the condition, as they put additional strain on the delicate blood vessels in the retina. Other risk factors include dyslipidaemia (abnormal lipid levels), obesity, and a sedentary lifestyle. Genetics also play a role, as individuals with a family history of diabetic retinopathy may have an elevated risk. Moreover, certain ethnic groups, such as South Asians and Hispanics, have shown a higher predisposition to diabetic retinopathy. To mitigate the risk of diabetic retinopathy, early diagnosis, vigilant blood glucose control, blood pressure management, and regular eye screenings are crucial components of a comprehensive diabetes management plan.

The significance of this study lies not only in its scientific contributions but also in its potential to bring about positive changes in the lives of individuals living with diabetes and diabetic retinopathy, ultimately alleviating the burden of this vision-threatening complication on society at large.

Objective

To conduct a comprehensive evaluation of the occurrence and identify the key contributing factors of diabetic retinopathy in a population-based setting.

2. Material and Methods

Study Design: This research employed a cross-sectional population-based study design to comprehensively evaluate the occurrence and identify the key contributing factors of diabetic retinopathy in patients presenting to private hospital (Jyot Sarthi Eye Hospital, pohri bypass road, Shivpuri).

Study Population and Sample Size: The target population consisted of individuals with diabetes residing in the defined geographical area. A representative sample was drawn from this population using a multistage sampling technique. Firstly, a list of all eligible individuals with diabetes was obtained from healthcare facilities, diabetes clinics, and community health centers within the region. Next, a random sampling approach was applied to select

participants for inclusion in the study. The sample size was determined based on statistical considerations, aiming for a sufficient number of subjects to ensure statistical power while maintaining feasibility. A prior power analysis was performed to calculate the required sample size, considering an estimated prevalence of diabetic retinopathy and the desired level of precision.

Data Collection: Data collection was carried out through a combination of clinical assessments, interviews, and medical record reviews. Trained healthcare professionals conducted comprehensive eye examinations, including fundus photography, to detect and grade diabetic retinopathy in the study participants. Additionally, information regarding demographics, diabetes history (including age of onset and duration of diabetes), blood glucose levels, blood pressure, lipid profile, genetic history, lifestyle factors (such as physical activity and dietary habits), and comorbidities were gathered through structured interviews and medical record reviews.

Data Analysis: Statistical analysis was performed using appropriate software packages. Descriptive statistics were used to summarize the characteristics of the study population and the prevalence of diabetic retinopathy. To identify key contributing factors, multivariate regression models were employed, taking into account potential confounding variables. Subgroup analyses were conducted to explore variations in diabetic retinopathy occurrence across different demographic and clinical subgroups.

3. Results

Table 1: Demographic Characteristics of Study Participants

Variable	Mean (SD) / n (%)
Age (years)	55.3 (10.2)
Gender	Male: 320 (48.5%)
	Female: 339 (51.5%)
Education Level	Primary: 123 (18.7%)
	Secondary: 301 (45.6%)
	Tertiary: 235 (35.7%)

Table 1 presents the demographic characteristics of the study participants. The mean age was 55.3 years with a standard deviation of 10.2. Of the participants, 48.5% were male, and 51.5% were female. In terms of education level, 18.7% had a primary education, 45.6% had a secondary education, and 35.7% had a tertiary education.

Table 2: Prevalence and Grading of Diabetic Retinopathy

Diabetic Retinopathy Stage	Number of Participants
No Diabetic Retinopathy	435 (66.0%)
Mild Nonproliferative DR	134 (20.3%)
Moderate Nonproliferative DR	72 (10.9%)
Severe Nonproliferative DR	11 (1.7%)

Diabetic Retinopathy Stage	Number of Participants
Proliferative DR	7 (1.1%)

Table 2 presents the prevalence and grading of diabetic retinopathy in the study participants. The majority, 66.0%, had no diabetic retinopathy. Among those with diabetic retinopathy, 20.3% had mild nonproliferative DR, 10.9% had moderate nonproliferative DR, 1.7% had severe nonproliferative DR, and 1.1% had proliferative DR.

Table 3: Association of Key Contributing Factors with Diabetic Retinopathy

Variable	Odds Ratio (95% CI)
Age (years)	1.07 (1.02 - 1.12)
Duration of Diabetes (years)	1.25 (1.10 - 1.42)
Blood Glucose Level (mg/dL)	1.04 (1.01 - 1.07)
Systolic Blood Pressure (mmHg)	1.09 (1.04 - 1.15)
Total Cholesterol (mg/dL)	1.03 (0.99 - 1.06)
Body Mass Index (BMI)	1.18 (1.07 - 1.30)
Family History of DR	1.78 (1.36 - 2.32)
Physical Inactivity	1.63 (1.22 - 2.18)
Hypertension	2.01 (1.54 - 2.63)

Table 3 shows the odds ratios (with 95% confidence intervals) of key contributing factors associated with diabetic retinopathy. Age (years) had an odds ratio of 1.07 (1.02 - 1.12), while duration of diabetes (years) had an odds ratio of 1.25 (1.10 - 1.42). Blood glucose level (mg/dL) had an odds ratio of 1.04 (1.01 - 1.07), and systolic blood pressure (mmHg) had an odds ratio of 1.09 (1.04 - 1.15). The odds ratio for total cholesterol (mg/dL) was 1.03 (0.99 - 1.06), and for body mass index (BMI), it was 1.18 (1.07 - 1.30). Family history of DR had an odds ratio of 1.78 (1.36 - 2.32), physical inactivity had an odds ratio of 1.63 (1.22 - 2.18), and hypertension had the highest odds ratio of 2.01 (1.54 - 2.63).

Table 4: Subgroup Analysis of Diabetic Retinopathy Occurrence by Age Group

Age Group (years)	No DR (%)	Mild DR (%)	Moderate to Severe DR (%)
30 - 44	85.3	12.5	2.2
45 - 59	72.1	20.7	7.2
60 - 74	51.9	33.6	14.5
75 and above	31.8	45.0	23.2

Table 4 presents a subgroup analysis of diabetic retinopathy occurrence by age group. In the age group of 30 to 44 years, 85.3% had no diabetic retinopathy, 12.5% had mild DR, and 2.2% had moderate to severe DR. For those aged 45 to 59 years, 72.1% had no DR, 20.7% had mild DR, and 7.2% had moderate to severe DR. In the age group of 60 to 74 years, 51.9% had no DR, 33.6% had mild DR, and 14.5% had moderate to severe DR. Finally, for

those aged 75 and above, 31.8% had no DR, 45.0% had mild DR, and 23.2% had moderate to severe DR.

4. Discussion

The demographic characteristics of the diabetic retinopathy patients in this study were similar to those reported in other studies. The mean age was 55.3 years with a standard deviation of 10.2, which is comparable to the mean age of 64 years in a US study (9). Of the participants, 48.5% were male, and 51.5% were female, which is consistent with the sex distribution of diabetic retinopathy patients in other studies (9). In terms of education level, 18.7% had a primary education, 45.6% had a secondary education, and 35.7% had a tertiary education. This suggests that education level may not be a significant factor for diabetic retinopathy, as other studies have also found no association between education level and diabetic retinopathy (10).

The prevalence and grading of diabetic retinopathy in this study showed that the majority, 66.0%, had no diabetic retinopathy. Among those with diabetic retinopathy, 20.3% had mild nonproliferative DR, 10.9% had moderate nonproliferative DR, 1.7% had severe nonproliferative DR, and 1.1% had proliferative DR. These results are consistent with the global estimates of diabetic retinopathy prevalence, which range from 34.6% to 35.4% among diabetic patients (11). The distribution of diabetic retinopathy severity in this study is also similar to that reported by other studies, such as the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR), which found that 21.0% of patients with diabetic retinopathy had mild nonproliferative DR, 14.0% had moderate nonproliferative DR, 10.0% had severe nonproliferative DR, and 8.0% had proliferative DR.(12)

The odds ratios of key contributing factors associated with diabetic retinopathy in this study indicate that age, duration of diabetes, blood glucose level, systolic blood pressure, BMI, family history of DR, physical inactivity, and hypertension are all significantly associated with the presence of diabetic retinopathy. These findings are in agreement with previous studies that have identified similar risk factors for diabetic retinopathy (13). The highest odds ratio was observed for hypertension (2.01), which suggests that hypertension is a major modifiable risk factor for diabetic retinopathy. This is consistent with the results of a meta-analysis that showed that hypertension increased the risk of diabetic retinopathy by 1.9 times (14). The second highest odds ratio was found for family history of DR (1.78), which implies that genetic factors may also play a role in the development of diabetic retinopathy. This is supported by a study that reported a higher prevalence of diabetic retinopathy among siblings of patients with diabetic retinopathy than among siblings of patients without diabetic retinopathy. The other factors had odds ratios ranging from 1.03 to 1.25, which indicate moderate associations with diabetic retinopathy. These factors include age, duration of diabetes, blood glucose level, systolic blood pressure, BMI, and physical inactivity. These factors are related to the duration and severity of hyperglycemia, which is the main pathogenic mechanism of diabetic retinopathy.

5. Conclusion

In conclusion, this study provided valuable insights into the occurrence and contributing factors of diabetic retinopathy in a population-based setting. The demographic characteristics revealed a diverse study population with a mean age of 55.3 years. The prevalence and grading of diabetic retinopathy indicated that a considerable proportion (66.0%) had no

diabetic retinopathy, with mild nonproliferative DR being the most prevalent stage (20.3%). The analysis of key contributing factors revealed significant associations between diabetic retinopathy and factors such as age, duration of diabetes, blood glucose level, systolic blood pressure, family history of DR, physical inactivity, and hypertension.

Furthermore, the subgroup analysis based on age groups highlighted varying trends in diabetic retinopathy occurrence, with the prevalence increasing in older age groups. These findings underscore the importance of targeted intervention strategies for different age cohorts to effectively manage diabetic retinopathy and its associated risk factors. Overall, the study's outcomes provide essential information for healthcare professionals and policymakers to develop tailored preventive measures and improve diabetic retinopathy management in the population under investigation.

6. References

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