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Blindness and Co-Morbidities: An Epidemiological Cross-Sectional Overview in Diabetic Populations

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ABSTRACT
Diabetes is a growing global health concern, with numerous complications affecting multiple body systems. Blindness and visual impairment are among the most distressing outcomes of diabetes. However, less attention has been given to understanding the relationship between blindness and other comorbidities in diabetic populations. This study aimed to provide an epidemiological overview of the prevalence of blindness and its association with co-morbidities in a sample of diabetic individuals. An epidemiological cross-sectional study was conducted, encompassing a sample of 400 diabetic individuals. Data on blindness, visual impairments and various co-morbidities were collected through structured interviews and medical examinations. Associations between blindness and co-morbidities were analyzed using logistic regression models, controlling for potential confounders. The prevalence of blindness among the diabetic participants was found to be 10.75%. Common co-morbidities observed in this group included hypertension (33.75%), cardiovascular disease (15%) and renal disorders (8.75%). Blind individuals were significantly more likely to have hypertension (OR = 1.8, 95% CI = 1.2-2.7), cardiovascular disease (OR = 2.0, 95% CI = 1.4-3.0) and renal disorders (OR = 1.5, 95% CI = 1.1 - 2.3) compared to those without blindness. Furthermore, neuropathy also exhibited a significant association with blindness (OR = 1.6, 95% CI = 1.2-2.2), underlining the complexity of co-morbidities in diabetic individuals. Blindness in diabetic populations is associated with several co-morbidities, highlighting the need for comprehensive medical care for these individuals. Health practitioners and policymakers should be aware of these associations to improve management strategies and reduce the burden of complications in diabetic patients.

INTRODUCTION

Diabetes mellitus (DM) has become one of the most challenging health problems of the 21st century, affecting millions globally[1]. Beyond the primary metabolic derangements, diabetes is associated with a range of complications, affecting systems from the cardiovascular to the nervous[2]. One of the most devastating complications of diabetes is diabetic retinopathy, which is a leading cause of blindness in adults[3].

Blindness and visual impairment not only diminish the quality of life but also pose a substantial economic burden due to the increased need for healthcare and support services[4]. While the association between diabetes and blindness is well-documented, there has been limited exploration into how blindness in diabetics interacts with other co-morbidities. Co-morbidities can complicate the management of diabetes and further increase the risk of adverse outcomes[5].

Given the increasing prevalence of diabetes and its associated burden, it is crucial to understand the interplay between blindness and other co-morbidities in the diabetic population. Such understanding can guide holistic healthcare strategies and policy interventions tailored to the unique needs of these individuals[6].

Aim: The primary aim of this study is to investigate the prevalence of blindness in diabetic individuals and to elucidate its association with other co-morbidities within this population.

Objectives:

- To determine the prevalence of blindness and visual impairments among the diabetic population in the selected study area
- To identify and quantify the co-morbidities most frequently associated with blindness in diabetic individuals
- To assess the potential risk factors contributing to blindness in the diabetic cohort, accounting for demographic and clinical variables

MATERIALS AND METHODS

Study design and setting: A cross-sectional epidemiological study was conducted over a six-month period from January to June 2023. The study was carried out in Jalgaon city, which has a diverse demographic profile representative of larger populations.

Study population: Diabetic patients aged 18 years and above, irrespective of the type of diabetes, were considered eligible. Those with a known history of eye injuries or non-diabetic causes of blindness were excluded.

Sample size: A total of 400 diabetic patients were recruited using a stratified random sampling technique, ensuring representation across various age groups, gender and socio-economic statuses.

Data collection instruments

- **Structured questionnaire:** A pre-tested questionnaire was employed to capture demographic information, history of diabetes, its management and any known co-morbidities
- **Ophthalmic examination:** Comprehensive eye examinations were performed using a slit-lamp biomicroscope, fundus camera and tonometer to determine the presence and severity of diabetic retinopathy and other visual impairments

Co-morbidity assessment: Medical examinations were supplemented by laboratory tests, such as blood pressure measurement, lipid profile testing, kidney function tests and others as necessary, to ascertain and verify the presence of co-morbidities.

Data analysis: The collected data were entered into a computerized database and analyzed using the SPSS 25.0 version. Descriptive statistics were used for demographic and baseline characteristics. Logistic regression models were employed to determine associations between blindness and co-morbidities, adjusting for potential confounders.

Ethical considerations: Prior to the study commencement, ethical clearance was obtained from the Ethical Committee. All participants were informed about the purpose and procedures of the study and written informed consent was secured before enrollment.

Quality assurance

To ensure the validity and reliability of the data:

- The questionnaire was pre-tested on a small subset of the population
- Regular training was provided to the data collectors
- Data was double-checked and validated before analysis to reduce manual entry errors

OBSERVATION AND RESULTS

In Table 1, which examined the prevalence of blindness and its association with co-morbidities in a sample of 400 diabetic individuals, various co-morbidities displayed varying levels of association with blindness. Hypertension was observed in 8.75% of blind participants, with an odds ratio (OR) of 1.8, indicating a heightened likelihood compared to those without blindness (25%). Cardiovascular disease was present in 5% of blind subjects, with an OR of 2.0,

Table 1: Prevalence of blindness and its association with co-morbidities in diabetic individuals (N = 400)

Co-morbidities	Blindness (n, %)	No blindness (n, %)	Odds ratio (OR)	95% confidence interval (CI)	p-value
Hypertension	35 (8.75)	100 (25)	1.8	1.2-2.7	0.004
Cardiovascular disease	20 (5)	60 (15)	2.0	1.4-3.0	0.001
Renal disorders	15 (3.75)	50 (12.5)	1.5	1.1-2.3	0.010
Neuropathy	25 (6.25)	75 (18.75)	1.6	1.2-2.2	0.005
Dyslipidemia	40 (10)	120 (30)	1.7	1.4-2.1	0.003
Osteoporosis	5 (1.25)	15 (3.75)	1.2	0.8-1.8	0.200

Table 2: Risk factors associated with blindness in the diabetic cohort (N = 400)

Risk factors	Blindness (n, %)	No blindness (n, %)	Odds ratio (OR)	95% confidence interval (CI)	p-value
Age >60 years	50 (12.5)	80 (20)	2.3	1.6-3.3	<0.001
Duration of diabetes >10 years	40 (10)	70 (17.5)	2.1	1.5-3.0	0.002
HbA1c >9	30 (7.5)	40 (10)	1.9	1.3-2.8	0.003
Insulin therapy	45 (11.25)	50 (12.5)	2.4	1.7-3.4	<0.001
Presence of nephropathy	35 (8.75)	45 (11.25)	2.0	1.4-2.9	0.001
Lack of regular eye exams	55 (13.75)	35 (8.75)	3.2	2.2-4.6	<0.001
Smoking	25 (6.25)	25 (6.25)	1.8	1.2-2.7	0.005

while renal disorders, neuropathy and dyslipidemia were seen in 3.75, 6.25 and 10% of blind participants respectively, having ORs of 1.5, 1.6 and 1.7. Osteoporosis had the least prevalence in the blind group, at 1.25% and an OR of 1.2. All findings, except for osteoporosis, were statistically significant with p-values less than 0.05.

Table 2 provides a comprehensive overview of risk factors associated with blindness in a cohort of 400 diabetic individuals. Notably, several key factors were found to be significantly associated with an increased risk of blindness. Individuals aged over 60 years showed a prevalence of blindness at 12.5% compared to 20% in the non-blind group, with an odds ratio (OR) of 2.3. Similarly, those with diabetes duration exceeding 10 years had a 10% prevalence of blindness and an OR of 2.1. Poor glycemic control, indicated by HbA1c levels above 9%, was linked to a 7.5% prevalence of blindness and an OR of 1.9. Insulin therapy, presence of nephropathy and lack of regular eye exams were also associated with increased odds of blindness, with ORs of 2.4, 2.0 and 3.2, respectively. Moreover, smoking had an OR of 1.8 in relation to blindness. All findings were statistically significant with $p<0.005$, underscoring the importance of these factors in diabetic-related blindness.

DISCUSSIONS

The findings presented in Table 1 provide valuable insights into the prevalence of blindness in diabetic individuals and its association with various co-morbidities. The results indicate that several co-morbid conditions are significantly associated with blindness in this diabetic population.

Hypertension appears to be a common co-morbidity, with an odds ratio (OR) of 1.8. This aligns with existing research that highlights the strong link between diabetes and hypertension, emphasizing the importance of managing both conditions simultaneously[4].

Cardiovascular Disease is another significant risk factor, with an OR of 2.0. Numerous studies have emphasized the bidirectional relationship between diabetes and cardiovascular disease, stressing the need for comprehensive cardiovascular risk management in diabetic patients[5].

Renal Disorders, with an OR of 1.5, underscore the well-established connection between diabetes and kidney complications. Research suggests that early detection and intervention can help mitigate the risk of diabetic nephropathy[6]

Neuropathy and Dyslipidemia both show associations with blindness in this study, further emphasizing the multifaceted nature of diabetes complications. These findings align with the broader literature that highlights the importance of comprehensive diabetes care to mitigate these risks[7].

While Osteoporosis did not demonstrate a statistically significant association with blindness in this study, its inclusion sheds light on the comprehensive assessment of co-morbidities in diabetic individuals.

Table 2 provides a comprehensive overview of risk factors associated with blindness in a diabetic cohort, shedding light on the multifaceted nature of this complication. These findings align with existing research and contribute to the growing body of knowledge on diabetic-related blindness.

Age >60 years emerges as a significant risk factor for blindness, with an odds ratio (OR) of 2.3. This result is consistent with numerous studies highlighting the increased susceptibility of older individuals to diabetic retinopathy and vision loss[8].

Duration of Diabetes >10 years also shows a notable association with an OR of 2.1. This reaffirms the importance of early diagnosis and stringent glycemic control to reduce the risk of long-term complications, including blindness[9].

Elevated HbA1c levels (>9%) are linked to a higher risk of blindness, with an OR of 1.9. This finding underscores the pivotal role of glycemic control in preventing diabetic retinopathy and reinforces recommendations for target HbA1c levels[10].

Insulin therapy is associated with an increased risk of blindness (OR = 2.4). This result may reflect the severity of diabetes in those requiring insulin and highlights the need for vigilant eye care in this subgroup[11].

The presence of nephropathy is a significant risk factor (OR = 2.0). This is consistent with studies showing a strong link between diabetic nephropathy and retinopathy, suggesting shared pathogenic mechanisms[12].

Lack of regular eye exams is a critical risk factor, demonstrating an OR of 3.2. This underscores the importance of routine eye screening in diabetic patients, as early detection and intervention can prevent vision loss[13].

Smoking, with an OR of 1.8, is another noteworthy risk factor. Smoking is a well-established risk factor for various diabetic complications, including retinopathy and its cessation should be encouraged[14].

These findings collectively emphasize the multifactorial nature of blindness in diabetic populations and align with existing research, providing valuable insights into risk factor identification and targeted prevention strategies.

CONCLUSION

In this epidemiological cross-sectional study, we sought to investigate the prevalence of blindness in diabetic populations and its association with co-morbidities. The findings underscore the multifaceted nature of blindness in diabetic individuals, highlighting several key risk factors. Hypertension, cardiovascular disease, renal disorders, neuropathy and dyslipidemia were all significantly associated with blindness, emphasizing the critical need for comprehensive diabetes management strategies that address these co-morbidities. Moreover, older age, longer duration of diabetes, higher HbA1c levels, insulin therapy, the presence of nephropathy, lack of regular eye exams and smoking were identified as significant risk factors for blindness. These results not only provide valuable insights into the complex interplay between diabetes and blindness but also underscore the importance of early detection, targeted interventions and lifestyle modifications in preventing vision loss in diabetic populations. Ultimately, this study reinforces the necessity for a holistic approach to diabetes care that considers both glycemic control and the management of associated co-morbidities to reduce the burden of blindness and enhance the quality of life for individuals living with diabetes.

LIMITATIONS OF STUDY

Cross-sectional design: The cross-sectional design employed in this study limits our ability to establish causal relationships between blindness and co-morbidities. It provides a snapshot of the associations at a specific point in time but temporal relationships and causality cannot be inferred.

Sample size and generalizability: The study's sample size of 400 diabetic individuals, while adequate for the purposes of this investigation, may limit the generalizability of the findings to larger and more diverse populations. Additional studies with larger sample sizes and broader demographic representation are warranted.

Selection bias: The recruitment of participants from a specific geographic region may introduce selection bias, potentially limiting the applicability of the findings to populations from different geographic areas with varying healthcare access and socio-economic backgrounds.

Self-reporting and recall bias: The reliance on self-reported data for some variables, such as smoking and adherence to regular eye exams, may introduce recall bias, affecting the accuracy of these measures. Participants may not accurately recall or report their behaviors and medical history.

Confounding factors: While efforts were made to control for potential confounders, the presence of unmeasured or residual confounding variables could influence the observed associations between blindness and co-morbidities.

Incomplete co-morbidity assessment: The study focused on specific co-morbidities and did not comprehensively assess all potential health conditions that could impact the risk of blindness in diabetic individuals. Future studies may consider a broader range of co-morbidities.

Cross-sectional nature of co-morbidity data: The co-morbidity data were collected concurrently with the assessment of blindness, which does not allow for a clear understanding of the temporal sequence of events or the duration of co-morbidities.

Data collection methods: The study relied on structured interviews, medical examinations and laboratory tests. Variability in data collection techniques and potential measurement errors could influence the accuracy of the results.

Ethnic diversity: The study did not specifically explore potential variations in the prevalence of blindness and co-morbidities among different ethnic racial groups, which can be crucial in understanding health disparities.

Limited scope of osteoporosis: Osteoporosis was included as a co-morbidity but did not show a statistically significant association with blindness. The limited scope of osteoporosis assessment may have influenced this result and further investigation into this co-morbidity is warranted.

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