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EVALUATION OF COMMON CATARACT TYPES IN PATIENTS WITH DIABETES MELLITUS: A CROSS-SECTIONAL SURVEY AT TERTIARY CARE SETTINGS

Original Research

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder that predisposes individuals to a range of systemic and ocular complications. Among these, diabetic eye diseases such as cataracts, retinopathy, diabetic macular edema, and corneal changes are significant causes of visual impairment. With the global prevalence of type 1 and type 2 diabetes continuing to rise, the incidence of diabetic cataracts is also expected to increase. Early identification of the most prevalent cataract types in diabetics is crucial for timely intervention and prevention of vision loss.

Objective: To evaluate the common forms of cataract among patients with diabetes mellitus and assess their association with lifestyle and systemic risk factors.

Methods: A descriptive cross-sectional study was conducted on 380 diabetic patients recruited through convenience sampling. Participants were examined at the Ophthalmology and Visual Sciences Department of Dow University of Health Sciences, Ojha Campus, and Dr. Ruth Pfau Civil Hospital, Karachi, between January and April 2025. Inclusion criteria comprised patients with type 1 or type 2 diabetes, while exclusions included neurological disorders, congenital or traumatic cataracts, prior intraocular surgery, gestational diabetes, and secondary causes of diabetes. Visual acuity was tested with a Snellen chart, cataracts were classified via slit-lamp examination (TopCon SL-3C, VOLK 90D lens), blood glucose was measured with a glucometer, and anterior chamber and fundus were evaluated using an ophthalmoscope. Data entry and analysis were performed with Microsoft Excel and SPSS version 26.

Results: The median age was 59 years (range: 52–65), with 207 males (54.5%) and 173 females (45.5%). Type 2 diabetes was predominant (91.1%), while 8.9% had type 1 diabetes. Controlled diabetes was present in 78.2%, and uncontrolled in 21.8%. Nuclear sclerotic cataract was most frequent (55%), followed by posterior subcapsular (23.7%) and cortical cataract (15.8%). Combination forms were less common, including PSCC with nuclear (2.6%), PSCC with cortical (2.4%), and cortical with nuclear (0.5%). Significant associations were observed between cataract type and uncontrolled diabetes ($p=0.006$), unregulated diet ($p<0.001$), lack of physical activity ($p<0.001$), stress ($p<0.001$), and uncontrolled hypertension ($p=0.02$). Non-proliferative diabetic retinopathy was observed in 1.6% of cases and showed a significant association with cataract type ($p<0.001$).

Conclusion: Nuclear sclerotic cataract was the most common form in diabetic patients, particularly in those with uncontrolled diabetes and hypertension. Lifestyle factors such as poor dietary regulation, lack of exercise, and stress further amplified cataract risk. Effective management of glycemic status and hypertension, combined with lifestyle modification, is vital to reducing the burden of cataracts in diabetic populations.

Keywords: Cataract, Diabetes Mellitus, Diabetic Retinopathy, Hypertension, Lifestyle, Risk Factors, Visual Acuity.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or a combination of both (1). Beyond abnormal glucose regulation, it is associated with widespread disturbances in protein, lipid, and carbohydrate metabolism, contributing to progressive multisystem complications. Long-term consequences of uncontrolled diabetes include nephropathy, neuropathy, and retinopathy, while systemic comorbidities such as peripheral artery disease, cerebrovascular disease, obesity, erectile dysfunction, cardiovascular disease, cataracts, and non-alcoholic fatty liver disease are also prevalent (2-4). Of particular concern are the ocular manifestations of diabetes, which encompass cataract formation, diabetic retinopathy, macular oedema, tear film instability, and corneal morphological changes, collectively contributing to significant visual impairment (5). Global epidemiological projections underscore the urgency of this health challenge. By 2030, an estimated 439 million individuals are expected to be living with diabetes, and due to aging populations and improved life expectancy, prevalence rates are anticipated to rise by more than 33% by 2050 (6). The rising burden of diabetes amplifies the risk of cataract formation, a condition long recognized as a major cause of vision loss among diabetic patients. Evidence from cohort studies, such as Janghorbani and Amini's evaluation of 3,888 type 2 diabetes patients in Iran, demonstrates a substantial incidence of cataract development, with 33.1 cases per 1000 person-years observed during an average follow-up of 3.6 years (7-9). These findings highlight diabetes as an independent risk factor for cataractogenesis. Although the link between diabetes and cataract development is well acknowledged, uncertainties remain regarding the most common morphological subtypes and their clinical course in diabetic populations. While cortical cataracts are frequently reported to be predominant, especially with worsening glycemic control, variability across studies has left the issue unresolved. Basic and analytical epidemiological studies continue to support the mechanistic connection between hyperglycemia and lens opacity, yet the natural history and precise patterns of cataract progression in diabetics are insufficiently documented (10-12). Given the escalating prevalence of diabetes and its ophthalmic complications, early recognition and targeted management of cataract subtypes in affected individuals are critical. Identifying the most frequent morphological forms may not only enhance diagnostic precision but also guide personalized counseling, preventive measures, and optimized surgical interventions. This study is therefore designed to evaluate the prevalent forms of cataracts among diabetic patients, with the objective of generating evidence that can improve patient care, inform clinical decision-making, and ultimately reduce the burden of avoidable blindness.

METHODS

The study was designed as a descriptive cross-sectional investigation and was conducted in the Ophthalmology and Visual Sciences Department of Dow University Hospital, DIMC, and the Ophthalmology and Visual Sciences Department of Dr. Ruth Pfau Hospital (Civil Hospital), DMC, over a period of four months from January to April 2025. A total of 380 diabetic patients were enrolled. The sample size was determined using OpenEpi version 3, with the calculation based on a reported prevalence of cataracts among diabetic patients of 54.43% (6). A non-probability convenience sampling technique was applied for participant recruitment. Sociodemographic details of the study subjects were retrieved from hospital record files. After obtaining written informed consent, each participant underwent a thorough ophthalmic evaluation, which included visual acuity testing, cataract assessment, and systemic evaluation of glycemic status. For ocular assessment, visual acuity was measured using a Snellen chart (optotype-based). Cataracts were assessed through slit-lamp biomicroscopy (TopCon SL-3C with VOLK 90D lens), and the anterior segment was further examined using a direct ophthalmoscope. Pupillary dilation was achieved using 1% Mydriacyl (tropicamide) eye drops to allow detailed lens and fundus examination. Blood glucose levels were checked with a standardized glucometer (On Call EZ2). A structured, researcher-administered questionnaire was used to collect additional clinical and demographic information (13-15).

The study included only patients with a confirmed diagnosis of diabetes mellitus (either type 1 or type 2). Patients with neurological disorders, previous cataract surgery, a history of intraocular surgical procedures, lens-related pathologies other than cataract, gestational diabetes, or any reported syndromic disorders were excluded. This strict inclusion and exclusion ensured the reliability of the findings and minimized potential confounding factors. Data entry and analysis were carried out using Microsoft Excel and SPSS version 26. Quantitative variables, such as age, HbA1c level, and duration of cataract, were expressed as mean ± standard deviation, while categorical variables, including gender, type and status of diabetes, visual acuity, drug history, hypertension, fundus findings, and cataract

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type, were summarized as frequencies and percentages. Ethical approval for the study was obtained from the Ethical Review Committee of Dow University of Health Sciences, Karachi. Permission for data collection was granted by the Department of Ophthalmology and Visual Sciences of Dow University of Health Sciences. Written informed consent was obtained from all participants before their inclusion, and patient confidentiality was strictly maintained throughout the study.

RESULTS

The study included 380 participants with a median age of 59 years (range: 52–65). Of these, 207 (54.5%) were male and 173 (45.5%) were female. Among the participants, 34 (8.9%) were diagnosed with type 1 diabetes mellitus and 346 (91.1%) with type 2 diabetes mellitus. The majority, 297 (78.2%), had controlled diabetes, whereas 83 (21.8%) had uncontrolled diabetes. In terms of disease duration, 42 (11.1%) had diabetes for one year, 34 (8.9%) for 1.5–3 years, 102 (26.8%) for 3–5 years, and 202 (53.2%) for more than 10 years. Regarding treatment modalities, 270 (71%) were using oral hypoglycemic agents, 75 (19.7%) were on insulin therapy, and 35 (9.2%) were receiving both. A family history of diabetes was reported in 107 (28.2%) participants. Lifestyle assessment revealed that 155 (40.8%) followed dietary control measures, while 225 (59.2%) did not. A total of 127 (33.4%) reported engaging in physical exercise, and 109 (28.7%) experienced stress, while 271 (71.3%) did not. Hypertension was observed in 215 (56.6%) individuals, of whom 96 (25.3%) had controlled hypertension and 118 (31.1%) had uncontrolled hypertension, while 165 (43.4%) had no hypertension. Ocular assessment showed that 208 (54.7%) had a history of ocular medication, whereas 172 (45.3%) had none. Diabetic retinopathy was infrequent, with only 6 (1.6%) having non-proliferative diabetic retinopathy, while no cases of proliferative diabetic retinopathy or advanced diabetic eye disease were detected. All patients were free from hypertensive retinopathy, including central and branch retinal vein or artery occlusion. Cataract assessment demonstrated that nuclear sclerotic cataract was the most common type, observed in 209 cases (55%). Posterior subcapsular cataract was identified in 90 cases (23.7%), while cortical cataract was found in 60 cases (15.8%). Less frequent combinations included PSCC with nuclear sclerosis in 10 cases (2.6%), PSCC with cortical changes in 9 cases (2.4%), and cortical with nuclear changes in 2 cases (0.5%). Visual acuity results indicated that for the right eye, 249 (65.4%) had 6/6–6/18 vision, 76 (20%) had 6/24–6/60, and 55 (14.4%) had 5/60–1/60. For the left eye, 246 (64.6%) had 6/6–6/18 vision, 84 (22.1%) had 6/24–6/60, and 50 (13.1%) had 5/60–1/60. Statistical analysis using chi-square testing revealed that diabetes status, dietary habits, physical activity, stress, hypertension control, and diabetic retinopathy were significantly associated with different cataract types. In contrast, drug history, family history, and overall hypertension presence did not show significant associations.

Table 1: Distribution of Sociodemographic and Categorical Variable among Study Participants

Variable		**No. and %**
Gender	Male	207 (54.5)
	Female	173 (45.5)
DM	Type 1	34 (8.9)
	Type 2	346 (91.1)
Status	Controlled	297 (78.2)
	Uncontrolled	83 (21.8)
Duration	1 year	42 (11.1)
	1.5-3 years	34 (8.9)
	3-5 years	102 (26.8)
	>10 years	202 (53.2)
Drug History	Medicine	270 (71)
	Insulin	75 (19.7)
	Both	35 (9.2)

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Variable		**No. and %**
Family member with diabetes	Yes	107 (28.2)
	No	273 (71.8)
Diet	Yes	155 (40.8)
	no	225 (59.2)
Physical activity exercise	Yes	127 (33.4)
	No	253 (66.6)
Stress	Yes	109 (28.7)
	No	271 (71.3)
Hypertension	Positive	215 (56.6)
	Negative	165 (43.4)
Status HTN	Controlled	96 (25.3)
	Uncontrolled	118 (31.1)
	None	166 (43.7)
Medication	Yes	208 (54.7)
	No	172 (45.3)
DR	NPDR	6 (1.6)
	PDR	0 (0)
	ADED	0 (0)
	NONE	374 (98.4)
HTN Retinopathy	CRVO	0 (0)
	BRVO	0 (0)
	CRAO	0 (0)
	BRAO	0 (0)
	None	380 (100)

Table 2: Distribution of the study participants based on the type of cataract

Diagnosis	**Type of Cataract**	**No. and %**
Cataract	PSCC	90 (23.7)
	Nuclear Sclerotic Cataract	209 (55)
	Cortical Cataract	60 (15.8)
	PSCC + nuclear	10 (2.6)
	PSC + cortical	9 (2.4)
	Cortical + nuclear	2 (0.5)
Visual Acuity		
Right eye Pin-hole	(6/6-6/18)	249 (65.4)

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Diagnosis	Type of Cataract	No. and %
	(6/24-6/60)	76 (20)
	(5/60-1/60)	55 (14.4)
Left eye Pin Hole	(6/6-6/18)	246 (64.6)
	(6/24-6/60)	84 (22.1)
	(5/60-1/60)	50 (13.1)

Table 3: Chi-Square Association of Different Types of Cataracts with Study Variables

Study Variables		Types of Cataracts						p-Value
		PSCC	nuclear sclerotic cataract	cortical cataract	PSCC + nuclear	PSCC + cortical	Cortical + nuclear	
DM	Type 1	9 (10)	17 (8.1)	7 (11.7)	0 (0)	1 (11.1)	0 (0)	0.8
	Type 2	81 (90)	192 (91.9)	53	10 (100)	8 (88.9)	2 (100)	
				-88.3				
	Gestational	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Status of diabetes	Controlled	61 (67.8)	170 (81.3)	52	5 (50)	8 (88.9)	1 (50)	0.006
				-86.7				
	Uncontrolled	29 (32.2)	39	8 (13.3)	5 (50)	1 (11.1)	1 (50)	
			-18.7					
Duration	1 year	8 (8.9)	22	7 (11.7)	3 (30)	1 (11.1)	1 (50)	
			-10.5					
	1.5-3 years	17 (18.9)	10 (4.8)	5 (8.3)	1 (10)	1 (11.1)	0 (0)	
	3-5 years	27 (30)	50	19	4 (40)	2 (22.2)	0 (0)	
			-23.9	-31.7				
	>10 years	38 (42.2)	127 (60.8)	29	2 (20)	5 (55.6)	1 (50)	
				-48.3				
Drug History	Medicine	61 (67.8)	150 (71.8)	46	4 (40)	7 (77.8)	1 (50)	0.5
				-76.7				
	Insulin	19 (21.1)	40	10	3 (30)	2 (22.2)	1 (50)	
			-19.1	-16.7				
	both	10 (11.1)	18 (8.6)	4 (6.7)	3 (30)	0 (0)	0 (0)	
	4	0 (0)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	
Family Member	Yes	28 (31.1)	51	17	5 (50)	5 (55.6)	1 (50)	0.1
			-24.4	-28.3				

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Study Variables		**Types of Cataracts**						**p-Value**
		PSCC	nuclear sclerotic cataract	cortical cataract	PSCC + nuclear	PSCC + cortical	Cortical + nuclear	
	No	62 (68.9)	158 (75.6)	43	5 (50)	4 (44.4)	1 (50)	
				-71.7				
Diet	Yes	60 (66.7)	61	24 (40)	3 (30)	5 (55.6)	2 (100)	<0.001
			-29.2					
	No	30 (33.3)	148 (70.8)	36 (60)	7 (70)	4 (44.4)	0 (0)	
Physical Activity exercise	Yes	49 (54.4)	47	16	7 (70)	7 (77.8)	1 (50)	<0.001
			-22.5	-26.7				
	No	41 (45.6)	162 (77.5)	44	3 (30)	2 (22.2)	1 (50)	
				-73.3				
Stress	Yes	41 (45.6)	44	13	6 (60)	4 (44.4)	1 (50)	<0.001
			-21.1	-21.7				
	No	49 (54.4)	165 (78.9)	47	4 (40)	5 (55.6)	1 (50)	
				-78.3				
Hypertension	Positive	57 (63.3)	112 (53.6)	35	6 (60)	3 (33.3)	2 (100)	0.3
				-58.3				
	Negative	33 (36.7)	97	25	4 (40)	6 (66.7)	0 (0)	
			-46.4	-41.7				
Status of HTN	Controlled	32 (35.6)	43	12 (20)	5 (50)	2 (22.2)	2 (100)	0.02
			-20.6					
	Uncontrolled	24 (26.7)	69 (33)	23	1 (10)	1 (11.1)	0 (0)	
				-38.3				
	None	34 (37.8)	97	25	4 (40)	6 (66.7)	0 (0)	
			-46.4	-41.7				
Medication	Yes	56 (62.2)	107 (51.2)	36 (60)	5 (50)	2 (22.2)	2 (100)	0.09
	No	34 (37.8)	102 (48.8)	24 (40)	5 (50)	7 (77.8)	0 (0)	
DR	NPDR	0 (0)	1 (0.5)	2 (3.3)	2 (20)	1 (11.1)	0 (0)	<0.001
	PDR	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
	ADED	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
	NONE	90 (100)	208 (99.5)	58	8 (80)	8 (88.9)	2 (100)	
				-96.7				
HTN Retinopathy	CRVO	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.001
	BRVO	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	

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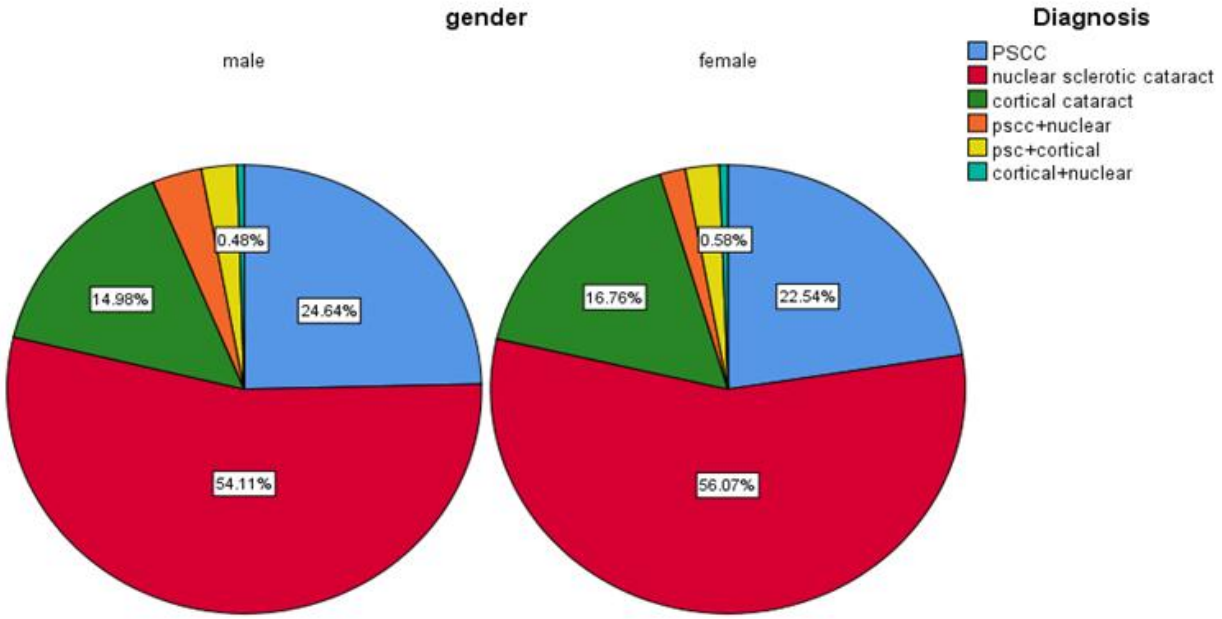
Study Variables		Types of Cataracts						p-Value
		PSCC	nuclear sclerotic cataract	cortical cataract	PSCC + nuclear	PSCC + cortical	Cortical + nuclear	
	CRAO	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
	BRAO	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
	None	90 (100)	209 -100	60 (100)	10 (100)	9 (100)	2 (100)	



Distribution of types of cataract in type I DM and type II DM

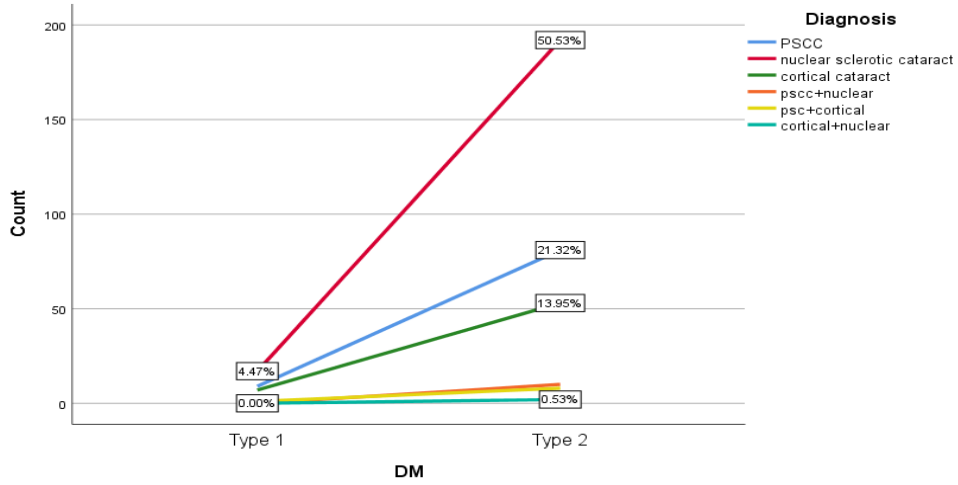


Figure 1 Distribution of Types of Cataracts in Type I DM and Type II DM

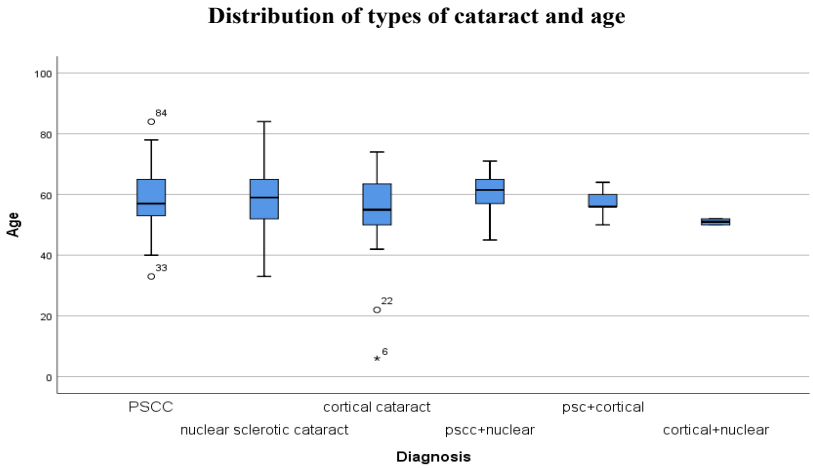


Figure 2 Distribution of Types of cataracts and Age

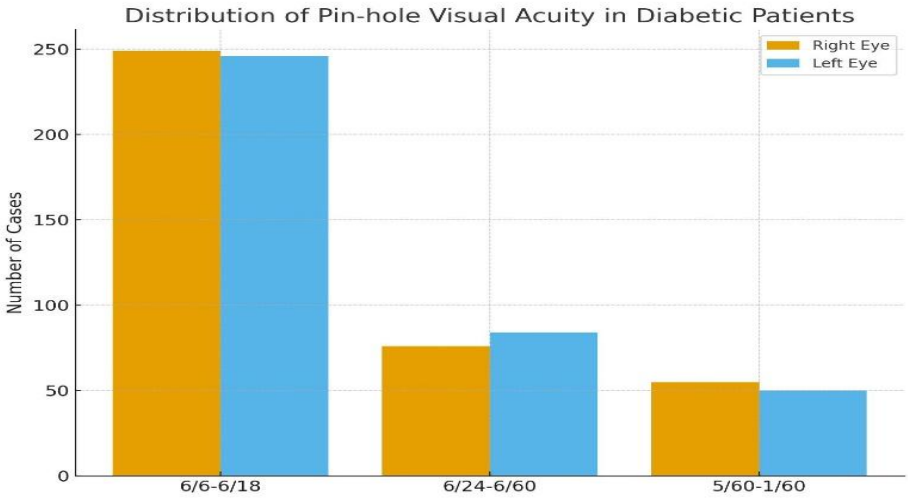


Figure 3 Distribution of Pin-Hole Visual Acuity in Diabetic Patients

DISCUSSION

The present study aimed to determine the most common forms of cataract among individuals with diabetes mellitus and to examine associated factors contributing to their development. The findings indicated that nuclear sclerotic cataract, posterior subcapsular cataract (PSCC), and cortical cataract were the predominant types in diabetic patients. Although no significant correlation was found between diabetes mellitus type and specific cataract morphology, several lifestyle and systemic risk factors including hypertension, physical inactivity, stress, and dietary habits demonstrated significant associations with cataract prevalence. This highlights the multifactorial nature of cataractogenesis in diabetics, where both intrinsic and extrinsic factors contribute to disease progression. Previous literature has consistently reported an elevated risk of cataract development in individuals with diabetes. Large population-based and multicentric studies have demonstrated a strong association between diabetes and cataracts, with variations in risk across geographical and ethnic populations (7). Several investigations confirmed that people with diabetes have a higher incidence of lens opacities compared to non-diabetics (8,9). The current findings, showing nuclear sclerosis as the most common cataract type among type 2 diabetics and cortical cataracts among type 1 diabetics, are in line with reports from studies conducted in Turkey and South Asia, which identified nuclear, cortical, and posterior subcapsular cataracts as the main morphologies linked to diabetes (11–14). These consistencies strengthen the evidence that diabetes accelerates lens aging and opacity formation, though specific morphologies may vary across populations.

The results further suggested that individuals with well-controlled diabetes were also at risk of nuclear cataract development, emphasizing that strict glycemic control, although essential, may not completely prevent lens changes. The role of duration of diabetes, widely documented as one of the most significant risk factors for cataract development (15), could not be fully explored in this study, representing a limitation. Nevertheless, the observation that cataract prevalence increased with longer disease duration is consistent with existing evidence, underscoring the cumulative impact of chronic hyperglycemia on lens proteins. Family history did not appear to significantly affect cataract formation in this cohort, contrasting with some studies suggesting a hereditary predisposition to early-onset cataracts. However, isolated case studies have shown cataract occurrence in young diabetics without a family history, reinforcing that diabetes itself can be a sufficient trigger for lens changes (16). This supports the view that genetic predisposition may play a minor role compared to metabolic and systemic influences. The association of cataracts with hypertension, diet, physical inactivity, and stress observed in this study further highlights the role of modifiable lifestyle risk factors. Evidence from prior research supports that regular exercise and balanced nutrition may reduce the risk of senile cataracts (17,18). Similarly, hypertension has been linked with an increased likelihood of lens opacity, with studies showing that blood pressure control may lower cataract risk (19). These findings point toward the need for comprehensive management approaches that extend beyond glycemic regulation alone. Diabetic retinopathy was detected in a small proportion of patients, with non-proliferative diabetic retinopathy (NPDR) being the most common. Nuclear and cortical cataracts were most frequently observed among individuals with retinopathy, though no strong statistical relationship between retinopathy and cataract type was established in this study. In contrast, other studies have identified diabetic retinopathy as an independent risk factor for cataract development (20,21). The lower prevalence of retinopathy in this cohort may explain the weaker association, though it underscores the importance of ongoing retinal screening in diabetic patients to capture early disease progression.

The findings align with hospital-based studies in South Asia that reported nuclear sclerotic cataracts as the most prevalent form in diabetics, followed by posterior subcapsular cataracts (22-24). At the same time, other investigations highlighted posterior subcapsular cataracts as the most common presentation, particularly in younger diabetics or those with type 1 diabetes, suggesting that age and diabetes type may influence cataract morphology. The present results confirm that nuclear sclerosis dominates in type 2 diabetics, especially in those with longer disease duration and poor glycemic control, while cortical cataracts are more frequent among younger type 1 diabetics. A key strength of this study was its comprehensive assessment of systemic, ocular, and lifestyle factors in a relatively large cohort, which allowed for a holistic evaluation of cataract risk in diabetics. The standardized use of slit-lamp biomicroscopy and validated clinical instruments enhanced the reliability of the findings. However, limitations include the use of non-probability sampling, which restricts generalizability, and the absence of detailed subgroup analysis by disease duration and glycemic control, which could have clarified their direct influence on cataract morphology. Moreover, the study did not evaluate the impact of biochemical markers such as HbA1c levels in relation to cataract type, which represents an area for future research. Overall, the study reinforced the established role of diabetes in accelerating cataract development, while also emphasizing the contribution of modifiable risk factors such as hypertension, poor dietary control, and physical inactivity. The results highlight the need for preventive strategies focused on early detection through routine eye examinations, strict metabolic and blood pressure control, and promotion of healthier lifestyle behaviors. Future research should employ longitudinal designs to better elucidate causal relationships between diabetes duration, metabolic control, and specific cataract morphologies, while integrating biochemical and genetic markers to provide deeper mechanistic insights.

CONCLUSION

This study concludes that nuclear sclerotic cataract emerged as the most frequent form among diabetic patients, underscoring the role of prolonged disease duration and poor metabolic control in accelerating lens changes. The findings emphasize that cataract development in diabetics is not only a consequence of hyperglycemia but is also influenced by lifestyle-related factors such as hypertension, inadequate dietary regulation, and lack of physical activity. The results highlight the need for comprehensive management strategies that combine strict glycemic monitoring with lifestyle modifications and regular ophthalmic screening to prevent avoidable vision loss and reduce the burden of diabetic eye disease.

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AUTHOR CONTRIBUTION

Author	Contribution
Anam Jamali*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Bushra Muhammad Aslam	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Fiza Muhammad Nadeem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Tehreem	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Eman Hafeez	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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