

Frequency of Diabetic Macular Edema (DME) in Diabetic Patients and Comparison of Various Systemic Parameters that Increase its Risk with and without Diabetic Macular EDEMA

Bushra^{1*}, Bibi Rafeen Talpur¹, Rameesha¹, Abdul Fattah¹

ABSTRACT

OBJECTIVE: To determine the frequency of DME in diabetic patients presenting for ophthalmology assessment and to compare systemic parameters that contribute to the development of DME between patients with DME and those without DME.

METHODOLOGY: This cross-sectional study was conducted at the Sindh Institute of Ophthalmology and Visual Sciences in Hyderabad, Pakistan, from January to June 2024. A total of 118 diabetic patients were assessed for the presence of DME using optical coherence tomography. Patients with and without DME were assessed for various systemic parameters. Among these, quantitative systemic parameters were compared among patients using the Mann-Whitney U test, while qualitative systemic parameters were compared using the chi-square test.

RESULTS: Median age was 35.50 (9.00) years. There were 82 (69.50%) males and 36 (30.50%) females. Median BMI was 30.15 (6.02) kg/m². Median duration of diabetes was 5.00 (2.00) years. DME was present in 34 patients (28.80%). Upon comparison of systemic parameters, it was found that there was a significant difference between patients with and without DME in low-density lipoprotein levels ($p = 0.005$), glomerular filtration rate ($p = 0.024$), and the frequency of co-existing hypertension ($p < 0.001$).

CONCLUSION: In this study, DME was found in nearly one-third of patients, underscoring its significant burden in the local diabetic population. It was also observed that elevated LDL, reduced GFR, and co-existing hypertension were significantly associated with DME, while other systemic parameters showed no significant differences.

KEYWORDS: Diabetes Mellitus, Macular Edema, Optical Coherence, Tomography.

INTRODUCTION

Diabetes mellitus (DM) leads to oedema of the macula, a condition known as diabetic macular oedema (DME), which is amongst the leading causes of visual impairment worldwide^{1,2}. Uncontrolled DM leads to upregulation of vascular endothelial growth factor (VEGF), which increases vascular permeability and the breakdown of the blood-retinal barrier, thereby causing fluid build-up in the macula, i.e., DME, which is detected on optical coherence tomography (OCT)^{3,4}. Globally, the prevalence of DME has been reported at 4.07% among the diabetic population⁵. In Pakistan, the exact prevalence of this condition is unknown. Still, according to a study with a large sample size in Pakistan, it was reported that among DM patients, DME prevalence was 30.5%.⁶ Conversely, in one study conducted on DM patients of Romania, it was observed that DME prevalence was only 15.3%.⁷

When it comes to systemic parameters comparison between DM patients with and without DME, it has

been observed that various factors may not have any difference, including body mass index (BMI), smoking, history of hypertension, glycosylated haemoglobin and total cholesterol levels, while for some other variables, there could be a significant difference between these patients, including use of anti-hyperlipidaemic medication and glomerular filtration rate⁸.

DME is a vision-threatening condition that has the potential to cause permanent blindness. When previous trends are analyzed, there is a significant disparity in reported DME prevalence (ranging from 5.47% global prevalence to 30.5%), and there is limited recent data on comparisons of various systemic parameters between patients with and without DME in the current local demographic. For this purpose, it is essential to determine the burden of this ocular condition in the diabetic population of the local community whilst focusing on various systemic parameters associated with this serious diabetic complication. For this purpose, the present study is being conducted to determine the frequency of DME in diabetic patients presenting for ophthalmology assessment and to compare systemic parameters that contribute to DME development between patients with DME and those without DME. Results from this study would help identify patients with DME, along with the assessment of various parameters that can potentially increase the likelihood of its development.

¹Department of Ophthalmology, Sindh Institute OF Ophthalmology & Visual Sciences (SIOVS) Hyderabad
Correspondence: pg.bushra@siovs.edu.pk

doi: 10.22442/jlumhs.2026.01411

Received: 28-10-2025

Revised: 13-04-2026

Accepted: 15-04-2026

Online First: 01-06-2026



METHODOLOGY

This cross-sectional study was conducted at the Sindh Institute of Ophthalmology and Visual Sciences, Hyderabad, from January to June 2024, following approval of the research proposal by CPSP (Ref. #: CPSP/REU/OPL-2022-169-2538; dated 10/01/2024). The WHO sample size calculator was used to calculate a sample size of 118, with a 95% confidence interval, an absolute precision of 6.5%, and an anticipated DME frequency of 15.3%⁸. The sample selection process used non-probability consecutive sampling. Before inclusion, it was ensured that all patients provided written informed consent, using a predesigned pro forma.

Patients aged between 18 and 65 years, of either gender, who had diabetes (defined as having HbA1C% $\geq$ 6.5%) or were taking anti-diabetic medications for $\geq$ 12 months and were referred to the ophthalmology outpatient department by physicians for ophthalmology screening and assessment were included. Patients having ocular opacification (like dense cataract) that interfered with the reliability of optical coherence tomography (OCT) imaging, blind patients since birth, other retinopathic or maculopathic anomalies, congenital structural abnormality of the eye and those with a previous history of intervention for diabetic retinopathy were excluded.

Baseline characteristics, including age (in years), gender, and duration of diabetes, were documented after OCT was performed to make a diagnosis of DME by the presence of retinal swelling, sub-retinal fluid and cystoid macular oedema on OCT in diabetic patients with central subfield thickness of $\geq$ 250 μ m. After this, patients with DME and those without DME were assessed for various systemic parameters including body mass index (BMI), glycosylated haemoglobin (HbA1C%), lipid profile [total cholesterol (TC), triglycerides (TG), high-density lipids (HDL) and low-density lipids (LDL)], co-existing hypertension, use of anti-hyperlipidaemic medication, smoking and glomerular filtration rate (GFR). GFR was measured using the Modification of Diet in Renal Disease (MDRD) equation.

All collected data were entered and analyzed using SPSS version 30.0.0. Descriptive statistics were collected for qualitative and quantitative variables. Qualitative variables (gender, presence/absence of DME, co-existing hypertension, use of anti-hyperlipidaemic medication and smoking) were measured in terms of frequency and percentage. Quantitative variables (age, BMI, duration of diabetes, HbA1C%, TC, TG, LDL, HDL and GFR) were measured as median interquartile range (IQR) since all of these were found to be not normally distributed. Frequency of DME was stratified by age, gender, and

duration of disease to account for effect modifiers. After post-stratification, the Chi-square test was used to assess significance. To compare BMI, HbA1C%, lipid profile, and GFR between patients with and without DME, we used the Mann-Whitney U test. To compare co-existing hypertension, use of anti-hyperlipidaemic medication and smoking between patients with and without DME, the chi-square test was used. A p-value $\leq$ 0.05 was considered significant.

RESULTS

In this study, 118 patients were included. Median age was 35.50 (9.00) years. Of these, 82 (69.50%) were male, and 36 (30.50%) were female. Median BMI was 30.15 (6.02) kg/m². Median duration of diabetes was 5.00 (2.00) years. Patient demographics are given in **Table I**:

Table I: Patient demographics (n = 139)

Demographic variable	Median IQR; n (%)
Mean age	35.50 (9.00) years
Age group	
18-40 years	77 (65.30%)
41-65 years	41 (34.70%)
Gender	
Male	82 (69.50%)
Female	36 (30.50%)
Median BMI	30.15 (6.02) kg/m ²
Mean duration of diabetes	5.00 (2.00) years
Duration of the diabetes group	
< 5 years	48 (40.70%)
$\geq$ 5 years	70 (59.30%)

BMI = Body mass index

Among 118 patients, 34 (28.80%) had DME, while 84 (71.20%) did not. Stratification of DME frequency by confounding variables, including age, gender and duration of diabetes, is given in **Table II**:

Comparison of systemic parameters that have the potential to increase the risk of developing DME among patients with and without DME is given in **Table III**:

Table II: Stratification of DME frequency by confounding variables (n = 118)

Age stratification			
	18-40 years (n = 77)	41-65 years (n = 41)	p-value
DME	22 (28.57%)	12 (29.27%)	0.937†
Gender stratification			
	Male (n = 82)	Female (n = 36)	p-value
DME	26 (31.71%)	8 (22.22%)	0.295†
Stratification by duration of diabetes			
	< 5 years (n = 48)	$\geq$ 5 years (n = 70)	p-value
DME	17 (35.42%)	17 (24.89%)	0.190†

† = Chi-square test; DME = Diabetic macular oedema

Table III: Comparison of systemic parameters of patients with and without DME (n = 118)

Parameter	DME (n = 34)	No DME (n = 84)	p-value
HbA1C%	10.40 (0.85)	10.20 (1.80)	0.466 *
TC (mg/dl)	216.50 (64.25)	191.00 (61.75)	0.058 *
TG (mg/dl)	221.50 (10.00)	222.00 (10.00)	0.560 *
LDL (mg/dl)	190.50 (49.50)	180.00 (47.75)	0.005 *
HDL (mg/dl)	38.50 (15.50)	41.00 (27.50)	0.166 *
GFR (ml/min/1.73m ²)	78.00 (16.75)	92.00 (20.50)	0.024 *
Coexisting hypertension	23 (67.65%)	22 (26.19%)	< 0.001†
Use of anti-hyperlipidaemic medication	16 (47.06%)	31 (36.90%)	0.308†
Smoking	19 (55.88%)	32 (38.09%)	0.077†

* = Mann Whitney U-test; † = Chi-square test

HbA1C% = Glycosylated haemoglobin, TC = Total cholesterol, TG = Triglycerides, LDL = Low density lipids, HDL = High density lipids, GFR = Glomerular filtration rate, DME = Diabetic macular oedema

DISCUSSION

Diabetes is a highly prevalent condition not only on a global scale but also in Pakistan, affecting a major proportion of the population.⁹ This multi-system disease can lead to significant damage to vision due to ophthalmological complications, which can range from mild, asymptomatic and non-proliferative disease of the retina to a much more advanced condition like DME^{9,10}. The effective management of this common morbidity is of utmost importance, since if this is not managed properly. The glycemic control stays poor for an extended period of time, which can lead to irreversible loss of the ability to see, resulting in significant deterioration of the general life quality of the ailing patients^{11,12}. The present study thus focused on determining the frequency of this serious ophthalmologic complication of DM and on assessing differences in systemic parameters among patients with and without this complication of DM.

In the present study, the frequency of diabetic patients who were diagnosed with DME through OCT was 28.8%. This percentage represents that a significant proportion of patients who have diabetes can develop this vision-threatening condition, thereby exhibiting a high burden not only on the DME but also the high likelihood of encountering a high burden of patients who may develop irreversible blindness.

In comparison, a study was conducted among patients with diabetes in Ethiopia. They found that the frequency of this retinal pathology in their study population was 25.8%.¹³ This proportion of was comparable to the DME frequency of the present study.

Contrary to the present study's finding of a high frequency of DME, a large-scale meta-analysis

examined the frequency of this complication by pooling data from 7 previously published studies. After detailed analysis, they reported a global DME frequency of only 5.47%, much lower than in the current study¹⁴. Similarly, one study was conducted in the Pakistani diabetic population. In this study, they found that the frequency of the same retinal pathology, the focus of the present study, was 13%, still lower than the DME frequency reported in the present study¹⁵. Although the exact reason for this difference of the DME frequency between the present and past studies could not be determined, several factors were hypothesized to have caused it. The primary reason for this difference in the DME frequency was considered to be differences in the sample sizes of the aforementioned studies, which can directly influence the frequency percentage: if a sample size is large, even a relatively larger number can yield a lower frequency. In contrast, with a small sample size, even a smaller number of patients can yield a higher frequency. In addition, the demographics of the studied populations may have contributed to differences of DME frequency between the current and previously conducted studies.

Upon assessment of the distribution of DME across age groups, genders, and diabetes duration, it was observed that its frequency was not affected by any of these factors ($p > 0.05$). Most importantly, the gender distribution showed a non-significant difference ($p = 0.295$); however, the proportions indicated a slight male predominance. This male predominance was similar to a study in which it was observed that this pathology affected male patients much more than females.¹⁶ Similarly, in general, it is considered that as the patient gets older, the chances of retinal diseases increase as the patient grows older^{17,18}, however, in the present study, there was no difference in DME across the age groups ($p = 0.937$). One possible reason for this finding could be the higher number of patients of present study being in the younger age group. Similarly, as diabetes duration increases, the risk of retinal damage and DME increases, as per previous literature; however, in the present study, this difference was not significant ($p = 0.190$)^{19,20}.

Upon comparison of systemic parameters, patients with DME had significantly higher LDL levels ($p = 0.005$), lower GFR ($p = 0.024$), and a higher frequency of co-existing hypertension ($p < 0.001$). In contrast, no significant difference was observed between these patients based on any other systemic parameters, including HbA1C% ($p = 0.466$), TC ($p = 0.058$), TG ($p = 0.560$), HDL ($p = 0.166$), use of anti-hyperlipidaemic medication ($p = 0.308$) and smoking ($p = 0.077$). In comparison, Shaikh et al. also compared various systemic parameters between patients with and without DME. It was found that, in terms of body mass index ($p = 0.697$), smoking ($p = 0.267$), history of hypertension ($p = 0.138$), glycosylated haemoglobin ($p = 0.326$), and total cholesterol levels ($p = 0.272$), there

was no significant difference between these patients. In contrast, in terms of use of anti-hyperlipidaemic medication ($p = 0.030$) and glomerular filtration rate ($p = 0.003$), the difference was significant, with lower frequency of use of anti-hyperlipidaemic drugs and lower GFR in patients with DME⁸. In coherence with the aforementioned findings, a study found that having higher levels of LDL increases the chances of developing eye complications in diabetic patients ($p = 0.00$)²¹. This association is likely due to endothelial damage mediated by the presence of hyperlipidaemia.²¹ Similarly, the finding that DME patients had significantly low GFR strengthens the findings of previous literature that show a strong correlation of declining GFR with worsening and progression of diabetic retinal disease ($p < 0.001$)²². Another important association in the present study was between the presence of DME and the co-existence of hypertension. In a review by Rasoulinejad, it was reported that hypertension can potentially increase the propensity to develop DME by 1.7 times²³. This association is due to the ability of hypertension to exert its own detrimental effects on the retinal vasculature and thus synergizing the diabetic damage to the retina, thereby increasing the likelihood of developing DME^{23,24}.

The present study exhibits a large proportion of patients with diabetes who have DME, which signifies the importance of frequent screening of diabetic patients for this vision-threatening complication. In addition, this study provides useful insights into systemic parameters that warrant close attention during regular follow-up care.

Several limitations were associated with the present study. The cross-sectional design did not permit causal inference. The limited sample size of 118 patients from a single centre in Hyderabad limits generalizability to larger populations, as demographics and access to healthcare vary across regions. Non-probability consecutive sampling can also lead of selection bias, as patients who visited the ophthalmology department may not be representative of the entire population of diabetic patients. Also, the use of OCT as a diagnostic tool without the support of other imaging techniques, like fluorescein angiography, may have resulted in a false detection of subtle cases or a false classification. The study also did not consider possible confounders (medication compliance, socioeconomic status, and control and duration of hypertension) that could affect systemic parameters and ocular outcomes. Lastly, the young median age of participants (35.5 years) could be a biasing factor because older groups of diabetics tend to have more ocular complications.

CONCLUSION

In this study, DME was found in nearly one-third of patients, underscoring its significant burden in the local diabetic population. It was also observed that elevated LDL, reduced GFR, and co-existing

hypertension were significantly associated with DME, while other systemic parameters showed no significant differences. Importantly, patient demographics (age, gender, and diabetes duration) did not significantly influence DME frequency. These results emphasize the need for routine ophthalmic screening in patients with DM. By targeting modifiable systemic risk factors, clinicians may reduce the likelihood of vision-threatening complications. Overall, the study highlights the importance of integrated diabetes care to preserve visual outcomes.

Acknowledgements: All authors are thankful to the participants and the SIOVS technical and non-technical staff

Ethical permission: College of Physicians & Surgeons Pakistan, ERC approval letter No. CPSP/REU/OPL-2022-169-2538.

Conflict of interest: There is no conflict of interest between the authors.

Financial Disclosure / Grant Approval: No funding agency was involved in this research.

Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHORS' CONTRIBUTION

Bushra: Data collection, statistical expertise

Talpur BR: Critical revision

Rameesha: Manuscript drafting

Fattah A: Manuscript drafting, assembly of data

REFERENCES

1. Kropp M, Golubnitschaja O, Mazurakova A, Koklesova L, Sargheini N, Vo TKS et al. Diabetic retinopathy as the leading cause of blindness and early predictor of cascading complications, risks, and mitigation. *EPMA J.* 2023; 14(1): 21-42. <https://doi.org/10.1007/s13167-023-00314-8>.
2. Ixamey M, Palma C. Diabetic macular edema. *Dis Mon.* 2021; 67(5): 101138. <https://doi.org/10.1016/j.disamonth.2021.101138>.
3. Singh R, Walia A, Kaur J, Kumar P, Verma I, Rani N. Diabetic retinopathy - pathophysiology to treatment: a review. *Curr Diabetes Rev.* 2025; 21(3): 58-67. <https://doi.org/10.2174/0115733998259940231105200251>.
4. Koc F, Güven YZ, Egrilmez D, Aydın E. Optical coherence tomography biomarkers in bilateral diabetic macular edema patients with asymmetric anti-VEGF response. *Semen Ophthalmic.* 2021; 36(5-6): 444-51. <https://doi.org/10.1080/08820538.2021.1907423>.
5. Teo ZL, Tham YC, Yu M, Chee ML, Rim TH, Cheung N et al. Global prevalence of diabetic retinopathy and projection of burden through 2045: systematic review and meta-analysis. *Ophthalmology.* 2021; 128(11): 1580-91. <https://doi.org/10.1016/j.ophtha.2021.04.027>.

6. Mahmood T, Fahim MF, Ahsan S, Qidwai U, Memon MS. Ocular complications associated with diabetes and the risk of sustainable blindness; a real world analysis. *J Pak Med Assoc.* 2023; 73(7): 1453-6. <https://doi.org/10.47391/JPMA.8001>.
7. Ivanescu A, Popescu S, Roman D, Dragomir M, Timar R. Diabetic macular edema in the western part of Romania: screening to improve patient outcomes. *J Pers Med.* 2025; 15(3): 106. <https://doi.org/10.3390/jpm15030106>.
8. Shaikh DD, Kalhoro FA, Shaikh SP, Shaikh RD, Rath R, Shaikh TA. The frequency of diabetic macular edema and its systemic risk factors: a cross-sectional study. *Pak J Med Health Sci.* 2022; 16(02): 744-9. <https://doi.org/10.53350/pjmhs22162744>.
9. Azeem S, Khan U, Liaquat A. The increasing rate of diabetes in Pakistan: A silent killer. *Ann Med Surg (Lond).* 2022; 79: 103901. <https://doi.org/10.1016/j.amsu.2022.103901>.
10. Rani PK. Management of diabetic ocular complications: from cellular insights to community strategies. *BMC Ophthalmol.* 2024; 24(1): 151. <https://doi.org/10.1186/s12886-024-03422-9>.
11. Jeribi F, Nazir T, Nawaz M, Javed A, Alhameed M, Tahir A. Recognition of diabetic retinopathy and macular edema using deep learning. *Med Biol Eng Comput.* 2024; 62(9): 2687-2701. <https://doi.org/10.1007/s11517-024-03105-z>.
12. Zayed MG, Karsan W, Peto T, Saravanan P, Virgili G, Preiss D. Diabetic retinopathy and quality of life: a systematic review and meta-analysis. *JAMA Ophthalmology.* 2024; 142(3): 199-207. <https://doi.org/10.1001/jamaophthalmol.2023.6435>.
13. Shumye AF, Tegegne MM, Bekele MM, Woredikal AT, Eticha BL. Burden of diabetic macular oedema and its associated factors among adult patients with diabetes attending comprehensive specialized hospitals in Northwest Ethiopia, 2023: a multicentre cross-sectional study. *BMJ Open.* 2025; 15(3): e088507. <https://doi.org/10.1136/bmjopen-2024-088507>.
14. Im JHB, Jin YP, Chow R, Yan P. Prevalence of diabetic macular edema based on optical coherence tomography in people with diabetes: A systematic review and meta-analysis. *Surv Ophthalmol.* 2022; 67(4): 1244-1251. <https://doi.org/10.1016/j.survophthal.2022.01.009>.
15. Ali F, Akram SN. Frequency of diabetic retinopathy in diabetic patients in Pakistan. *J Contemp Insight Health Sci.* 2023; 1(1): 23-9. <https://doi.org/10.69591/jcihs.v1i1.5>.
16. Lin Z, Wang FH, Wen L, Wang Y, Li D, Ding XX et al. Prevalence of and risk factors for diabetic macular edema in a northeastern Chinese population. *Int J Ophthalmol.* 2022; 15(2): 320-326. <https://doi.org/10.18240/ijo.2022.02.19>.
17. Thapa R, Khanal S, Tan HS, Thapa SS, van Rens GHMB. Prevalence, pattern and risk factors of retinal diseases among an elderly population in Nepal: The Bhaktapur Retina Study. *Clin Ophthalmologic.* 2020; 14: 2109-18. <https://doi.org/10.2147/OPTH.S262131>.
18. Mortazavi A, Hashemi A, Jamali A, Hashemi H, Aghamirsalim M, Khabazkhoob M. Prevalence of retinal pathologies in people over 60 years: the Tehran Geriatrics Eye Study. *Int J Ophthalmologic.* 2024; 17(4): 721-8. <https://doi.org/10.18240/ijo.2024.04.17>.
19. Zhang D, Zhang Y, Kang J, Li X. Nonlinear relationship between diabetes mellitus duration and diabetic retinopathy. *Sci Rep.* 2024; 14(1): 30223. <https://doi.org/10.1038/s41598-024-82068-5>.
20. Chaurasia S, Thool AR, Ansari KK, Saifi AI. Advancement in understanding diabetic retinopathy: a comprehensive review. *Cureus.* 2023; 15(11): e49211. <https://doi.org/10.7759/cureus.49211>.
21. Hiran HM, Kamath A, Mendonca TM, Rodrigues GR, Nayak RR, Kamath G et al. Association of serum lipid profile and other systemic risk factors with retinal hard exudates in diabetic retinopathy. *Int Ophthalmol.* 2024; 44(1): 338. <https://doi.org/10.1007/s10792-024-03263-x>.
22. Neelamegam V, Surya RJ, Venkatakrishnan P, Sharma T, Raman R. Association of eGFR with stages of diabetic retinopathy and age-related macular degeneration in Indian population. *Indian J Ophthalmologic.* 2024; 72(7): 968-75. https://doi.org/10.4103/IJO.IJO_2558_23.
23. Rasoulinejad S A. Evaluating the risk factors of development and progression of diabetic retinopathy: a review study. *Shiraz E-Med J.* 2022; 23(5): e117171. <https://doi.org/10.5812/semj.117171>.
24. Choi J, Kim SJ, Kang SW, Son KY, Hwang S. Local ocular factors associated with the development of diabetic macular edema: an inter-eye study. *Sci Rep.* 2023; 13(1): 14868. <https://doi.org/10.1038/s41598-023-42038-9>.

