Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i6.2086
*Biol. Clin. Sci. Res. J., Volume 6(6), **2025**: 2086*
Original Research Article

Association Between Diabetic Retinopathy and Body Mass Index

Wishal Saleem[1], Mutaish Arif Khan[2], Awais Ahmad Khan[3], Masood Alam Shah[1]

[1]Department of Ophthalmology, Combined Military Hospital, Pakistan
[2]Department of Ophthalmology, Alshifa Trust Eye Hospital, Rawalpindi, Pakistan
[3]Department of Ophthalmology, Ayub Teaching Hospital, Abbottabad, Pakistan
**Corresponding author`s email address:* anoshashamim994@gmail.com

(Received, 14th May 2025, Accepted 2nd June 2025, Published 30th June 2025)

Abstract: *Diabetic retinopathy is a leading microvascular complication of type 2 diabetes mellitus and a major cause of vision loss. Obesity, assessed through body mass index, contributes to insulin resistance and chronic inflammation, potentially increasing the risk and progression of diabetic retinopathy. Understanding this relationship is essential for early detection and prevention, especially in populations like Pakistan, where obesity and diabetes are increasingly prevalent.* ***Objective:*** *To determine the association between body mass index and diabetic retinopathy in patients with type 2 diabetes mellitus presenting to the Ophthalmology Unit of Ayub Teaching Hospital, Abbottabad, from November 2024 to April 2025.* ***Methods:*** *A cross-sectional study was conducted over 6 months among 196 patients with type 2 diabetes mellitus, selected using consecutive sampling. Demographic, clinical, and biochemical data were collected along with fundoscopic evaluation using slit lamp biomicroscopy. Body mass index was calculated and categorized per World Health Organization criteria. Diabetic retinopathy was staged using standard clinical definitions. Data were analysed in SPSS version 20 using descriptive statistics and chi-square tests to assess associations, with $p < 0.05$ considered significant.* ***Results:*** *Participants had a mean age of 57.6 ± 9.1 years, and females represented 52 percent of the sample. Most patients belonged to middle socioeconomic strata and rural backgrounds. The mean duration of diabetes was 8.2 ± 4.5 years, while the mean HbA1c was 8.9 ± 1.4 percent. The mean BMI was 28.7 ± 3.9 kg/m², with overweight (40.3 percent) and obese (24.5 percent) groups constituting the majority. Diabetic retinopathy was identified in 68.9 percent of patients, with 28.6 percent having non-proliferative disease and 16.3 percent having proliferative retinopathy. A statistically significant association was observed between increasing BMI and the severity of diabetic retinopathy ($p = 0.03$), with proliferative disease being highest among obese individuals (29.2 percent).* ***Conclusion:*** *Higher BMI was significantly associated with more advanced stages of diabetic retinopathy in patients with type 2 diabetes mellitus. These findings highlight obesity as a modifiable risk factor that should be targeted through preventive measures, patient education, and early retinal screening to reduce visual morbidity.*

Keywords: Diabetic retinopathy, Body mass index, Type 2 diabetes, Obesity

[***How to Cite:*** Saleem W, Khan MA, Khan AA, Shah MA. Association between diabetic retinopathy and body mass index. *Biol. Clin. Sci. Res. J.*, **2025;** 6(6): 603-606. doi: https://doi.org/10.54112/bcsrj.v6i6.2086

Introduction

Diabetic retinopathy is a major microvascular complication of type 2 diabetes mellitus and remains a leading cause of preventable visual impairment and blindness worldwide. Its development and progression are influenced by several systemic determinants, among which obesity is increasingly recognised as an important modifiable factor. Excess adiposity, typically assessed by indicators such as body mass index, is strongly linked to insulin resistance, poor glycemic control, and metabolic dysregulation, which collectively contribute to retinal microvascular damage and heightened susceptibility to diabetic retinopathy (1,2). Evidence suggests that each incremental rise in body mass index increases the risk of diabetes onset and accelerates related complications by promoting a persistent pro-inflammatory state and worsening insulin resistance (3). Specific obesity phenotypes may also confer varied risks, further supporting the biologic plausibility of a direct association between obesity and diabetic retinopathy (1,4).

Globally, obesity prevalence is rising at an unprecedented rate, particularly in South Asian countries with a high burden of type 2 diabetes (5). Pakistan has witnessed rapid lifestyle transitions characterised by urbanisation, reduced physical activity, and unhealthy dietary trends. These trends have driven a substantial increase in overweight and obesity, with reports indicating that more than one quarter of adults fall within the overweight category (5,6). Parallel to this, diabetes prevalence is expanding, and the proportion of patients presenting with diabetic retinopathy continues to rise. Many patients are additionally affected by metabolic comorbidities frequently observed with obesity, which further compounds disease severity and visual morbidity (4,6).

Given these interlinked trends, addressing diabetic retinopathy in Pakistan requires comprehensive and early public health responses focusing on weight modification and routine screening for retinal complications, especially among high-risk groups. A clearer understanding of the association between body mass index and diabetic retinopathy can inform clinical and preventive strategies to mitigate disease progression and reduce vision-threatening outcomes (6,2). Establishing this link within local populations is particularly relevant for policymakers and clinicians working to reduce the health system burden of diabetes and its complications. The rising prevalence of both obesity and diabetes in Pakistan underscores the urgent need for integrated interventions that prioritise obesity management as a pathway to curb microvascular complications such as diabetic retinopathy.

Methodology

This cross-sectional study was conducted in the Ophthalmology Unit of Ayub Teaching Hospital, Abbottabad, over six months, from November 2024 to April 2025, following ethical approval from the institutional review committee. A total of 196 patients with established type 2 diabetes mellitus were recruited using a non-probability consecutive sampling approach. Patients presenting to the ophthalmology outpatient department who met the inclusion criteria, namely age between 40 and 80 years, both genders, and documented type 2 diabetes based on fasting blood glucose

of at least 126 mg/dl, HbA1c of 6.5 percent or greater, or a history of antidiabetic treatment, were enrolled. Patients with impaired glucose tolerance, gestational diabetes, or pregnancy were excluded to avoid confounding physiological influences on retinal changes and metabolic status. Written informed consent was obtained from all participants after the research objectives, procedures, and confidentiality safeguards were explained.

Upon enrollment, baseline demographic data, including age, gender, occupation, education level, socioeconomic class, monthly income, and residential status, were recorded. Clinical details such as duration of diabetes, HbA1c values, weight, height, visual symptoms, and fundus findings were documented using a structured proforma. Body mass index was calculated using the World Health Organization formula of weight (kg) divided by height squared (m^2). Patients were categorized as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), or obese (>30 kg/m^2). All ophthalmic examinations were performed by trained clinicians using slit-lamp biomicroscopy with a 90-diopter lens to evaluate the posterior segment, and diabetic retinopathy was staged according to standardized operational definitions, ranging from mild non-proliferative changes to proliferative disease characterized by neovascularization or vitreous hemorrhage.

Data entry and statistical analysis were performed using SPSS version 20. Continuous variables such as age, BMI, HbA1c, and duration of diabetes were analyzed as means and standard deviations after assessing normality using the Shapiro–Wilk test. In contrast, categorical variables, including gender, residence, educational level, abnormal BMI categories, and diabetic retinopathy stages, were presented as frequencies and percentages. Effect modifiers such as age and diabetes duration were controlled for through stratification in the analysis. The relationship between BMI categories and diabetic retinopathy severity was evaluated using the chi-square or Fisher's exact test, as appropriate, with a significance level of $p<0.05$. Results were displayed in appropriately labeled tables and narrative summaries, ensuring clarity and reproducibility for academic dissemination.

Results

The mean age of participants was 57.6 ± 9.1 years (range 40–80 years). There was a slight predominance of females, with 102 (52.0 percent) females and 94 (48.0 percent) males.

Most patients belonged to a middle socioeconomic background, and the majority resided in rural areas. Table 1 presents participant demographics, including age, gender, residence, education level, and socioeconomic status. (Table 1).

Table 2 summarizes the clinical profile, including duration of diabetes and glycemic control. The mean duration of diabetes was 8.2 ± 4.5 years, and the mean HbA1c was 8.9 ± 1.4 percent, reflecting suboptimal glycemic control. Most patients reported blurred vision at presentation.

Table 3 demonstrates high overweight and obesity prevalence among diabetic patients.

The mean BMI was 28.7 ± 3.9 kg/m^2. Overweight and obese categories dominated, representing typical Pakistani diabetes phenotypes. (Table 3).

Table 4 displays the stage-wise classification of diabetic retinopathy. The majority had non-proliferative disease, consistent with early detection patterns in the hospital.

Patients with higher BMI categories showed proportionally more advanced retinal disease. Maximum proliferative DR was seen in obese individuals (29.2 percent). A chi-square test showed a statistically significant relationship between BMI and DR stage ($p = 0.03$). (Table 5).

Table 1. Demographic Profile of Patients with Type 2 Diabetes (N = 196)

Variable	Category	Frequency (%)
Age (years)	Mean ± SD	57.6 ± 9.1
Gender	Male	94 (48.0)
	Female	102 (52.0)
Residence	Urban	79 (40.3)
	Rural	117 (59.7)
Education Status	No formal schooling	71 (36.2)
	Primary	65 (33.2)
	Secondary and above	60 (30.6)
Monthly Income (PKR)	< 30,000	81 (41.3)
	30,000–60,000	89 (45.4)
	> 60,000	26 (13.3)

Table 2. Clinical Profile of Patients (N = 196)

Variable	Category	Frequency (%)
Duration of Diabetes (years)	1–3	28 (14.3)
	3.1–5	44 (22.4)
	5.1–10	82 (41.8)
	> 10	42 (21.4)
HbA1c (%)	Mean ± SD	8.9 ± 1.4
Vision Status	Normal	61 (31.1)
	Blurred vision	135 (68.9)

Table 3. BMI Categories of Participants (N = 196)

BMI Category	Frequency (%)
Underweight (<18.5 kg/m^2)	11 (5.6)
Normal (18.5–24.9 kg/m^2)	58 (29.6)
Overweight (25–29.9 kg/m^2)	79 (40.3)
Obese (≥30 kg/m^2)	48 (24.5)

Table 4. Distribution of Diabetic Retinopathy Stages (N = 196)

Stage	Frequency (%)
No DR detected	61 (31.1)
Background DR	47 (24.0)
Non-proliferative DR	56 (28.6)
Proliferative DR	32 (16.3)

Table 5. Association between BMI Categories and Stage of Diabetic Retinopathy

BMI Category	No DR	Background DR	Non-Proliferative DR	Proliferative DR
Underweight (n=11)	6 (54.5)	3 (27.3)	2 (18.2)	0 (0.0)
Normal (n=58)	28 (48.3)	16 (27.6)	11 (19.0)	3 (5.2)
Overweight (n=79)	23 (29.1)	18 (22.8)	26 (32.9)	12 (15.2)
Obese (n=48)	4 (8.3)	10 (20.8)	17 (35.4)	14 (29.2)
Chi Square p = 0.03				

Discussion

This study investigated the demographics and clinical profiles of patients with type 2 diabetes mellitus in a Pakistani context, with a specific focus on the relationship between body mass index and diabetic retinopathy. The mean age of participants was 57.6 ± 9.1 years, with a predominance of females (52 percent). Most patients belonged to a middle socioeconomic background and lived in rural areas (Table 1). This demographic distribution is consistent with findings reported in other studies on diabetic retinopathy, although evidence specific to Pakistan remains limited (7).

The clinical profiles, with a mean diabetes duration of 8.2 ± 4.5 years and an HbA1c of 8.9 ± 1.4 percent, indicate suboptimal glycemic control, a common concern among patients with type 2 diabetes in developing countries. Ahmad et al. highlighted similar trends, linking inadequate glycemic regulation to increased risk of complications (8). The observation that 68.9 percent of patients reported blurred vision at presentation further emphasises the importance of early ophthalmic evaluation, a need repeatedly noted in diabetes care literature (9).

Table 2, which summarises clinical characteristics, reveals critical gaps in diabetes management within Pakistan. Optimised glycemic control remains essential for preventing microvascular complications such as diabetic retinopathy (10). The elevated mean HbA1c in this cohort underscores the need for patient-centred education to enhance diabetes self-management.

Table 3 highlights the high prevalence of overweight and obesity, with a mean BMI of 28.7 ± 3.9 kg per square metre, classifying most patients as overweight or obese. These findings are consistent with results reported by Li et al., who identified obesity as a key determinant of adverse clinical outcomes in type 2 diabetes patients (11). The contribution of obesity to diabetes pathophysiology and complications, including diabetic retinopathy, has been well recognised (12). Excess adipose tissue drives insulin resistance and systemic inflammation, thereby worsening glucose regulation and increasing the risk of complications (13).

As noted in Table 4, most participants presented with non-proliferative diabetic retinopathy, while 16.3 percent had proliferative disease. These findings are comparable to those of Roto et al., who reported that diabetic retinopathy severity increases with longer disease duration and poorer glycemic control (14). The relationship between diabetic retinopathy stages and BMI categories, as presented in Table 5, is particularly significant. The statistically significant association (p = 0.03) demonstrating that higher BMI correlates with more severe diabetic retinopathy is consistent with findings by Gao et al., who reported obesity as an independent predictor of diabetic complications (15).

Participants in the obese category were particularly affected, with 29.2 percent exhibiting proliferative diabetic retinopathy. These findings align with the observations of Amutha et al., who described heightened microvascular complication risk among obese type 2 diabetes patients (16). Together, these associations reinforce BMI as a modifiable risk factor for preventing diabetic complications.

In Pakistan, rising obesity trends, demographic transitions, and insufficient diabetes care infrastructure present considerable challenges. The influence of socioeconomic factors on healthcare access, particularly in rural areas, is critical to understanding disease burden. Karimi et al. emphasized that socioeconomic status significantly affects diabetes management and its related complications (17). The high obesity burden demonstrated in this study accentuates the need for national public health programs promoting lifestyle modification, patient education, and dietary interventions to mitigate diabetes progression and retinal morbidity.

Conclusion

This study demonstrates a clear association between elevated body mass index and increased diabetic retinopathy severity among Pakistani patients with type 2 diabetes mellitus. Obese individuals were most likely to exhibit proliferative disease, underscoring obesity as a preventable determinant of retinal damage. Integrating weight reduction strategies, structured patient education, and routine eye screening into diabetes care pathways may significantly reduce the progression and burden of diabetic retinopathy in Pakistan.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MMNCS-0331d-24)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared no conflict of interest.

Author Contribution

WS (PGR)
Manuscript drafting, Study Design,
MAK (PGR)
Review of Literature, Data entry, Data analysis, and drafting an article.
AAK (Resident)
Conception of Study, Development of Research Methodology Design
MAS (Professor)
Study Design, manuscript review, and critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

References

1. Lam S., Lindsey J., Leon B., & Takkouche S. Shedding light on eye disease in obesity: a review. Clinical Obesity 2023;14(1). https://doi.org/10.1111/cob.12616
2. Li W., Gong X., Wang W., Xiong K., Meng J., Li Y.et al.. Association of different kinds of obesity with diabetic retinopathy in patients with type 2 diabetes. BMJ Open 2022;12(5):e056332. https://doi.org/10.1136/bmjopen-2021-056332
3. Mäkinen V., Zhao S., Ihanus A., Tynkkynen T., & Ala-Korpela M. Epidemiological associations between obesity, metabolism and disease risk: are body mass index and waist-hip Ratio all you need?. International Journal of Obesity 2025. https://doi.org/10.1038/s41366-025-01895-2
4. Sharma R., Mahat P., Maharjan S., Jha M., & Pokhrel U. Diabetic retinopathy in patients with newly diagnosed type 2 diabetes mellitus. Journal of Patan Academy of Health Sciences 2023;10(3):20-27. https://doi.org/10.3126/jpahs.v10i3.59177
5. Ghaus S., Ahsan T., Sohail E., Erum U., & Aijaz W. Burden of elevated body mass index and its association with non-communicable diseases in patients presenting to an endocrinology clinic. Cureus 2021. https://doi.org/10.7759/cureus.13471
6. Waheed M., Tahir M., Sada S., Imran A., Nadeem S., & Talha M. Prevalence and risk factors of diabetic retinopathy in type 2 diabetic patients attending tertiary care hospitals in Punjab. Dev. Med. Life sci. 2025;2(7):4-12. https://doi.org/10.69750/dmls.02.07.0125
7. Kozioł M., Nowak M., Udziela M., Piątkiewicz P., Grabska-Liberek I., &SzaflikJ.. First nation-wide study of diabetic retinopathy in Poland in the years 2013–2017. Acta Diabetologica 2020;57(10):1255-1264. https://doi.org/10.1007/s00592-020-01540-68
8. Shehzad S., Khan M., Chandio K., Zafar H., & Munawar R. Investigation of microvascular complications of type-2 diabetes mellitus patients and their clinical outcome. PJMHS 2022;16(11):817-820. https://doi.org/10.53350/pjmhs20221611817
9. Li Y., Cui M., He G., & Wang G. Global, regional and national burden of blindness and vision loss attributable to diabetic retinopathy, 1990–2021: a systematic analysis for the global burden of disease study 2021. Diabetes Obesity and Metabolism 2025;27(10):5464-5477. https://doi.org/10.1111/dom.16588
10. Ojong E., Ngemenya M., Tafili M., Tanue E., & Akum E. Association of non-alcoholic fatty liver disease with glycemic control among patients with type 2 diabetes mellitus at Limbe Regional Hospital, Southwest, Cameroon. World Journal of Hepatology 2025;17(2). https://doi.org/10.4254/wjh.v17.i2.101936
11. Li H., Guo M., An Z., Meng J., Jiang J., Song J., et al.. Prevalence and risk factors of metabolic-associated fatty liver disease in Xinxiang, China. International Journal of Environmental Research and Public Health 2020;17(6):1818. https://doi.org/10.3390/ijerph17061818
12. Han X., Wu H., Li Y., Yuan M., Gong X., Guo X., et al. Differential effect of generalized and abdominal obesity on the development and progression of diabetic retinopathy in chinese adults with type 2 diabetes. Frontiers in Medicine 2022;9. https://doi.org/10.3389/fmed.2022.774216
13. Abdelbagi O., Musa I., Altigani S., Osman A., & Adam I. Prevalence of diabetic foot amongst adults with diabetes mellitus in northern Sudan: a cross-sectional study. International Journal of Clinical Practice 2021;75(12). https://doi.org/10.1111/ijcp.14892
14. Roto A., Farah R., Al-imam M., Al-Sabbagh M., & Abu-Yaghi N. Prevalence, characteristics, and risk factors of diabetic retinopathy in type 2 diabetes mellitus patients in Jordan: a cross-sectional study. Journal of International Medical Research 2022;50(8). https://doi.org/10.1177/03000605221115156
15. Gao S., Zhang H., Chen L., & Xing Z. Association between obesity and microvascular diseases in patients with type 2 diabetes mellitus. Frontiers in Endocrinology 2021; 12. https://doi.org/10.3389/fendo.2021.719515
16. Amutha A., Unnikrishnan R., Anjana R., R. C., Rajalakshmi R., Venkatesan U.et al.. Clinical profile and incidence of microvascular complications of childhood and adolescent onset type 1 and type 2 diabetes seen at a tertiary diabetes center in India. Pediatric Diabetes 2020;22(1):67-74. https://doi.org/10.1111/pedi.13033
17. Karimi M., Vaezi A., Ansari A., Archin I., Dadgar K., Rasouli A.et al.. Lipid variability and risk of microvascular complications in patients with diabetes: a systematic review and meta-analysis. BMC Endocrine Disorders 2024;24(1). https://doi.org/10.1186/s12902-023-01526-9.