Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 27 June 2026
Revised 27 July 2026
Accepted 10 Aug 2026

Natural Resources for Human Health 2026, Vol. 6 (18s): 1074–1078

KEYWORDS:
Body mass index, Diabetes Mellitus, Diabetic Retinopathy

Relation between Body Mass Index and severity of Diabetic Retinopathy in Indian patients with type 2 Diabetic patients.

Divya N[1], Pasupuleti Ashok Kumar [2]

Professor, PG Junior Resident
Saveetha Medical College & Hospital, Saveetha Institue of Medical and Technical sciences, Thandalam.
*Corresponding Author: ashokpasupuleti1168@gmail.com

ABSTRACT: **Background**: Increased body mass index has been found to be associated with microvascular as well as macrovascular complications of diabetes. Factors like insulin resistance, hypertension and dyslipidemia, are found to be strongly associated with elevated BMI and obesity; which in turn contribute to microvascular changes leading to the development of retinopathy. The objective is to study the association between Body mass index and the severity of retinopathy in patients with type 2 diabetes mellitus.

Methods: This study will be conducted in the Department of ophthalmology at Saveetha Medical College and Hospital, Thandalam. All diabetic patients above 30 years of age only Indian patients whose fundus can be visualized will be taken for the study after taking informed consent. A total of 100 patients will be included in the study.

Results: With increasing severity of retinopathy the proportion of patients contributing to highest tertile of BMI rises. NonDiabetic (22.75±3.82), No Retinopathy (23.21±4.86), Mild Retinopathy (23.79±4.87), Moderate Retinopathy (27.9±6.77), Severe Retinopathy (28.21±7.12).

Conclusion: This study observed a positive association of BMI with increasing severity of retinopathy. Larger studies keeping in mind the role of genetic predisposition and race might help in determining the role of body mass index in diabetic retinopathy.

INTRODUCTION

Diabetic retinopathy is one of the microvascular complications of diabetes and is a leading cause of visual morbidity. The prevalence of diabetic retinopathy is 17.6%.(1,2) Body mass index (BMI) is a measure of obesity, which is a risk factor for diabetes. (3) However the role of obesity in diabetic retinopathy is not clearly defined. (3,4) Indian studies also have found conflicting reports regarding the relation of body mass index and retinopathy.(5,6) The present study was undertaken to assess the link between body mass index and increasing severity of retinopathy in the rural areas in and around Thandalam.

MATERIALS AND METHODS

This cross sectional study was done in and around the rural areas of Thandalam. The study was approved by the Institutional Ethics Committee and conformed to the tenets of the declaration of Helsinki. A written informed consent was obtained from all patients. A total of 100 patients from the ophthalmology outpatient department were enrolled from July 2025 to July 2026. Of the total sample, 79 patients were diabetic, among whom, those with retinopathy were grouped into mild, moderate and severe retinopathy based on the modified ETDRS classification.(7) 21 patients were non –diabetic, who presented with noncontributory symptoms like headache, refractive errors, dry eye symptoms etc. Complete history and ocular examination was done for all patients. A dilated fundus examination with a Goldmann three mirror fundus contact blood pressure was recorded. The patients were grouped under- group A (non- diabetics), group B (diabetics without retinopathy), group C (mild

retinopathy), group D (moderate retinopathy) and group E (severe retinopathy). None of the patients in this study had proliferative retinopathy. Patients in whom fundus could not be visualized were excluded.

Anthropometric Parameters: Body mass index (BMI) was calculated as weight in kilograms divided by square of height in meters (kg/m2) Weight was measured using a balance-beam scale and height was measured using a wall-mounted stadiometer. Recommended values of BMI were considered as a normal range of 18.50- 24.99 kg/m 2, overweight range as 25.00- 29.99 kg/m2 and more than or equal to 30.00 kg/m2 as obese.

Statistical analysis

Parameters were presented as mean ± standard deviation. The data was analyzed using SPSS software version 11.5. Descriptive statistics were followed by an unpaired t test that was used to compare the groups with and without diabetic retinopathy. Analysis of variance test (ANOVA) was used for comparison between the groups for continuous variables. Multiple comparisons were conducted between the study groups by applying a post hoc test following ANOVA. The test used to compare the groups was Dunnett's test (2 sided) with a confidence interval of 95%. A p value of <0.05 was considered significant.

RESULTS

A total of 100 patients were part of this study of which 79 were diabetics. The mean age of diabetic patients was 56.71 ± 9.2 with a range of 36- 75 years. The non- diabetics had an age range of 36- 75 years with a mean of 58.95 ± 10.78. The diabetic patients consisted of 38 males and 41 females. Among the nondiabetics, males were 10 whereas females constituted the remaining 11.

Table 1: Represents the distribution of patients over the study groups

	Non Diabetics (A)	No Retinopathy (B)	Mild Retinopathy (C)	Moderate Retinopathy (D)	Severe Retinopathy (E)
Number of patients N (%)	21 (21))	19 (19)	21 (21)	22 (22)	17 (17)

The distribution of patients in the study groups is depicted in Fig. 1

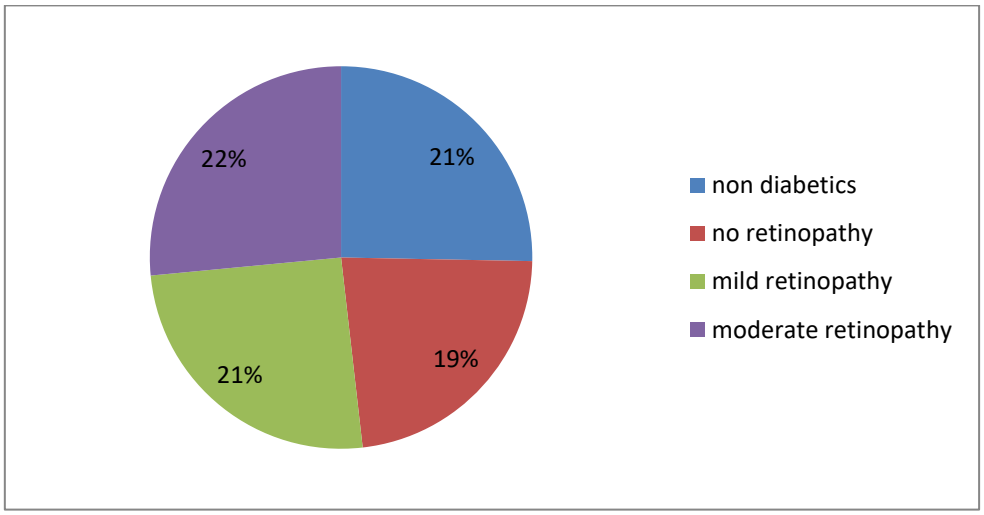


Fig. 1: Prevalence of types of Retinopathy

ANOVA test was used to determine whether body mass index and severity of retinopathy were associated. P value was <0.01 and indicated that BMI is strongly associated with retinopathy.

Table 2: BMI presented as mean ± SD for the study groups

	Non Diabetic (A)	No Retinopathy (B)	Mild Retinopathy (C)	Moderate Retinopathy (D)	Severe Retinopathy (E)	p value
Mean BMI	22.75±3.82	22.75±3.82	23.79±4.87	27.9±6.77	28.21±7.12	0.001

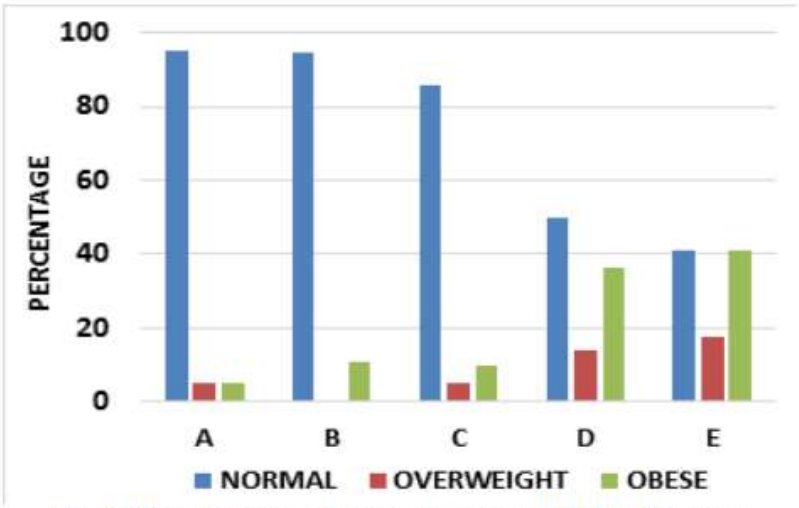


Fig. 2 Distribution of patients under BMI subgroups

Fig. 2 Epicts the percentage distribution of each group into three categories based on BMI values. With increasing severity of retinopathy the proportion of patients contributing to highest tertile of BMI rises. The percentage of patients with normal BMI decreases with severity of retinopathy on relative comparison. Multiple comparisons were conducted between the study groups by applying a post hoc test following ANOVA. The test used to compare the groups was Dunnett's test (2 sided) with a confidence interval of 95%. P value of <0.05 was considered significant. It was found that the significance of association was stronger with moderate and severe retinopathy than mild or moderate retinopathy.

DISCUSSION

Diabetic retinopathy is a microvascular complication of diabetes which also serves as a major cause of blindness and visual morbidity worldwide. Obesity and diabetes share a complex relationship. The role of body mass index, which is a measure of obesity, is an often debated subject. Increased body mass index has been found to be associated with microvascular as well as macrovascular complications of diabetes. Elevated BMI is associated with increased levels of adipokines and pro inflammatory cytokines which lead to oxidative stress and eventually endothelial damage. It is also associated with increased platelet function and increased blood viscosity. Factors like insulin resistance, hypertension and dyslipidemia, are found to be strongly associated with elevated BMI and obesity; which in turn contribute to microvascular changes leading to the development of retinopathy. The present study has shown a positive association of body mass index with increase in severity of retinopathy, with the highest tertile of BMI values mostly constituted by higher grades of retinopathy. Some studies have found that BMI is strongly associated with severity of retinopathy, (8) regardless of other factors like dyslipidemia and hypertension. BMI may serve as a predictive factor of visual loss in diabetics.(9)

A study that assessed the severity of retinopathy 10 years following diagnosis, found BMI to contribute positively to retinopathy.(10) Patients receiving early diagnosis and treatment had a strong link between BMI and retinopathy.(11)

Tuomilehto et al have shed light on the importance of controlling BMI to slow down the progression of the disease.(12) However, this finding has to be confirmed as different studies have reported varying degrees of association of retinopathy with BMI.(13,14) The difference in these findings could be due to relatively higher genetic predisposition and prevalence of obesity in the Indian sub-continent.(15) Franz et al suggested that obesity with a genetic predisposition is more likely to cause diabetes and its complications rather than patients without genetic predisposition.(14,15) Some Indian studies found an inverse association between diabetic retinopathy and BMI.(16) Elevated BMI was found to offer a protective role in diabetic retinopathy.(17,18) A few studies have even noted a link between high prevalence of retinopathy in diabetics with small body mass. (19,20) One of the reasons for the disparity in these results could be that the weight of a patient tends to rise before development of diabetes and fall once diabetes sets in.(21,22) Although the involvement of obesity is well researched in the development of diabetes, its role in the development and progression of complications both microvascular and macrovascular remains in doubt. The strength of this study lies in its well matched population and the uniformity of the socioeconomic background and of course the race and ethnicity of patients. The limitation of this study would be the lack of adjustment for factors like treatment- duration effect on the patient's weight.

CONCLUSION

This study observed a positive association of BMI with increasing severity of retinopathy. Larger studies keeping in mind the role of genetic predisposition and race might help in determining the role of body mass index in diabetic retinopathy.

REFERENCES

[1] Kaštelan S, Tomić M, Gverović Antunica A, Ljubić S, Salopek Rabatić J, Karabatić M. Body mass index: a risk factor for retinopathy in type 2 diabetic patients. Mediators Inflamm. 2013; Epub 2013 Nov 20.

[2] De Block CEM, De Leeuw IH, Van Gaal LF. Impact of Overweight on Chronic Microvascular Complications in Type 1 Diabetic patients. Diabetic Care 2005 July;28:1649-55.

[3] Narendran V, John RK, Raghuram A, Ravindran RD, Nirmalan PK, Thulasiraj RD et al. Diabetic retinopathy among self reported diabetics in southern India: a population based assessment. Br J Ophthalmol 2002;86:1014-18.

[4] Maberley DA, King W, Cruess AF, Koushik A. Risk factors for diabetic retinopathy in the Cree of James Bay. Ophthalmic Epidemiol 2002 July;9:153-67.

[5] Laurence SL, Shyong T, Mitchell P, Wang JJ, Wan TT, Lamoureux E et al. C- reactive protein, Body Mass Index and Diabetic Retinopathy. Invest ophthalmol Vis Sci. 2011 Jun;52:4416-21.

[6] Raman R, Rani PK, Gnanamoorthy P, Sudhir RR, Kumaramanikavel G, Sharma T. Association of obesity with diabetic retinopathy: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular genetics Study (SN-DREAMS Report no.8).Acta Diabetol 2010 Sep; 47:209-15.

[7] Dirani M, Xie J, Fenwick E, Benarous R, Rees G, Wong TY et al. Are obesity and anthropometry risk factors for diabetic retinopathy? The diabetes management project. Invest Ophthalmol Vis Sci 2011 Jun;52:4416-21.

[8] Leiden HAV, Dekker JM, Moll AC, Nijpels G, Heine RJ, Bouter LM et al. The Hoorn study- Blood pressure, Lipids and Obesity are associated with Retinopathy. Diabetes Care 2002 Aug;25:1320-5.

[9] Mohammed D, Jing X, Eva F, Benarous R, Gwyneth R, Wong TY et al. Are Obesity and Anthropometry Risk factors for Diabetic Retinoathy? Invest ophthalmol Vis Sci. 2011 Jun;52:4416-21.

[10] Tomic M, Poljicanin T, Pavlic-Renar I, Metelko Z. Obesity- a risk factor for Microvascular and Neuropathic Complications in Diabetes? Diabetologia Croatia 2003;32:73-8.

[11] Katusic D, Tomic M, Jukic T, Koadic R, Sikic J, Vukojevic N et al. Obesity- a risk factor for Diabetic Retinopathy in type 2 Diabetes? Coll. Anthropol2005;29:47-50.

[12] N. Friedman and E. L. Fanning, "Overweight and obesity: an overview of prevalence, clinical impact, and economic impact," Disease Management, vol. 7, no. 1, pp. S1– S6,2004.

[13] M. Dirani, J. Xie, E. Fenwick et al., "Are obesity and anthropometry risk factors for diabetic retinopathy? The diabetes management project," Investigative Ophthalmology & Visual Science, vol. 52, no. 7, pp. 4416–4421, 2011.

[14] H.A. VanLeiden, J.M. Dekker, A. C. Moll et al., "Riskfactors for incident retinopathy in a diabetic and nondiabetic population: the Hoorn study," Archives of Ophthalmology, vol. 121, no. 2, pp. 245–251,2003.

[15] Haffner SM, Fong D, Stern MP, et al. Diabetic retinopathy in Mexican Americans and non-Hispanic whites. Diabetes 1988;37:878–884. [PubMed: 3384186]

[16] C. E. M. De Block, I. H. De Leeuw, and L. F. Van Gaal, "Impact of overweight on chronic microvascular complications in type 1 diabetic patients," Diabetes Care, vol. 28, no. 7, pp. 1649–1655.
[17] Hamman RF, Mayer EJ, Moo-Young GA, Hildebrandt W, Marshall JA, Baxter J. Prevalence and risk factors of diabetic retinopathy in non-Hispanic whites and Hispanics with NIDDM: San Luis Valley Diabetes Study. Diabetes 1989;38:1231–1237. [PubMed: 2792575]
[18] Narayan KM, Boyle JP, Thompson TJ, Sorensen SW, Williamson DF. Lifetime risk for diabetes mellitus in the United States. JAMA 2003;290:1884–1890. [PubMed: 14532317]
[19] Ruderman N, Chisholm D, Pi-Sunyer X, Schneider S. The metabolically obese, normal-weight individual revisited. Diabetes. 1998;47:699–713.
[20] Wilkinson CP, Ferris FL 3rd, Klein RE, et al. Proposed international clinical diabetic retinopathy and diabetic macular edema disease severity scales. Ophthalmology. 2003;110(9):1677–1682.
[21] Dowse GK, Humphrey AR, Collins VR, et al. Prevalence and risk factors for diabetic retinopathy in the multiethnic population of Mauritius. Am J Epidemiol. 1998;47:448– 457.
[22] Rema M, Premkumar S, Anitha B, et al. Prevalence of diabetic retinopathy in urban India: the Chennai Urban Rural Epidemiology Study (CURES) eye study, Invest Ophthalmol Vis Sci. 2005;46:2328–2333.