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Original Research Article

Role of BMI as a Risk Factor for the Development of Diabetic Retinopathy

Dr Archana Vilas Manekar[1], Dr Neha Chandrashekhar Yerawar[2]

[1]Associate Professor, [2]Junior Resident,
Dr Panjabrao Deshmukh Medical College, Amravati.

Corresponding Author: Dr Neha Chandrashekhar Yerawar

ABSTRACT

Introduction: Diabetic retinopathy is the most common cause of preventable blindness in working aged adults. It has been shown that obesity is a risk factor for diabetes mellitus. Thus, obese people are more vulnerable to DR. Hence, we conducted a study to assess the association between BMI and the risk of DR.
Materials And Method: A cross sectional study was conducted on a minimum of 95 patients in department of Ophthalmology over a period of 6 months who were diagnosed with diabetes mellitus type 2 for more than five years with their BMI and waist circumference recorded and their Fundus evaluated for DR changes.
Result: The study had 95 patients screened of which 27 had retinopathy. The mean age group of patients with retinopathy was 58.63+/-11.18.Maximum (51.9%) were found to have a mild non-proliferative DR. The mean BMI of these patients was 24.8+/-4.2 and patients without retinopathy showed a BMI of 24.13+/-4.08. An unpaired t test was applied to check for statistical correlation between BMI and Diabetic retinopathy and was found to be not significant (p=0.43)
Conclusion: The study proves to show no relation between BMI as a risk factor for development of DR.
Keywords: BMI: Body mass index, DR: Diabetic Retinopathy.

INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. [1] It has various consequences on the different parts of the body majorly comprising of nephropathy, retinopathy and neuropathy. Diabetic retinopathy occurs when changes in blood glucose levels cause changes in retinal blood vessels. In some cases, these vessels will swell up (macular oedema) and leak fluid into the rear of the eye. In other cases, abnormal blood vessels will grow on the surface of the retina. Unless treated, diabetic retinopathy can gradually become more serious and progress from 'background retinopathy' to seriously affecting vision and can lead to blindness. [2]

Diabetic retinopathy is an important cause of blindness and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. 2.6% of global blindness can be attributed to diabetes. [3] The absolute number of the over 60 population in India will increase from 76 million in 2000 to 137 million by 2021. [4] It is estimated that the number of diabetics in India will increase from 19 million to 57 million between 1995 and 2025 (19.5% increase). [5] A quarter of the world's blind population is estimated to be in India, about 9-12 million; [6] increase in chronic disease prevalence and their complications will add drastically to this number.

As diabetes is a dependent on the dietary intake, exercise and stress of the individual, these factors contribute as a modifiable risk factor of the disease. Thus

obesity and a sedentary life style could further hasten the progress of the disease and must be kept under regular check. The WHO *"Global strategy on diet, physical activity and health"* complements WHO's diabetes work by focusing on population-wide approaches to promote healthy diet and regular physical activity, thereby reducing the growing global problem of overweight people and obesity. [7] Epidemiological surveys use body mass index (BMI) as an indicator of ‘‘generalized’’ obesity and waist circumference (WC) or waist-to-hip ratio (WHR) as a measure of ‘‘central’’ or ‘‘abdominal’’ obesity. South Asians have greater predisposition to abdominal obesity and visceral fat. [8]

In this study, we assessed the relationship between obesity that is BMI, height, weight, waist circumference and the presence of DR and PDR in adults with type II diabetes.

MATERIALS AND METHODS

This cross-sectional study was carried out in a tertiary centre in Maharashtra, India. The study design was approved by the ethical committee of the medical college. Patients recruited in the study were diagnosed to have Type 2 Diabetes mellitus for a period of more than five years. A written informed consent was taken from these patients in accordance with the tenets of the Declaration of Helsinki.

A study cohort of 95 patients was selected after the exclusion criteria’s were taken care of and they were then examined and assessed. The patients had their anthropometric measurements taken and were examined for diabetic retinopathy.

A detailed history of the type of diabetes, number of years of the diagnosed disease and the type of treatment taken were accounted. Anthropometric measurements of height, weight and waist circumference were taken. Height was measured in meters used a wall fitted stadiometer with the patient’s shoes removed and chin parallel to the ground and their feet together. Weight was measured in kilograms using a Richard Salter weighing scale with the shoes of the patients removed and the patient wearing light clothing. Waist circumference was measured with a standardised measuring tape at the level of the umbilicus.

BMI was calculated using the formula weight (kgs) divide by square of the height(meters).BMI was graded as 16 kg/m2 (severe underweight), 16·0–16·9 kg/m2 (moderate underweight), 17·0–18·49 kg/m2 (mild underweight), 18·5–24·9 kg/m2 (normal range), 25 (overweight), 25–29·9 kg/m2 (preobese), 30 kg/m2 (obesity). 30–39·9 kg/m2 (obese class I), 35–39·9 kg/m2 (obese class II), 40 kg/m2 (obese class III) should be retained as international classification. [9]

Complete ophthalmological examination was carried out for the patients enrolled in the study. The patients BCVA and IOP were taken into account. The fundus examination was carried out under full mydriasis with tropicamide 0.8% and phenylephrine 5%. Fundus was examined with an indirect ophthalmoscope and/or a slit lamp with non-contact 90D lens. The diabetic retinopathy if present was graded according to the ETDRS classification. [10] Statistical analysis was carried out with SPSS software. The unpaired t test was applied to the data. The data was appropriately laid out on excel charts to which the tests were applied and analysed. The result was considered significant with a p value of < 0.05.

STATISTICS AND RESULTS

The cross-sectional study was carried out on a population of 95 type two diabetics with 46 males and 49 females. Out of these 27 were identified to be having diabetic retinopathy and 68 had no retinopathy.

Table 1

Age in Years	Sex		Total
	Male	female	
25-34	2	2	4
35-44	6	1	7
45-54	7	10	17
55-64	12	16	28
65 & above	19	20	39
Total	46	49	95

The group having retinopathy had a mean age of 58.63 +/-11.18 and the ones without retinopathy had a mean age of 58.59 +/-11.41. Maximum population that is 41% was of or above 65 years of age.

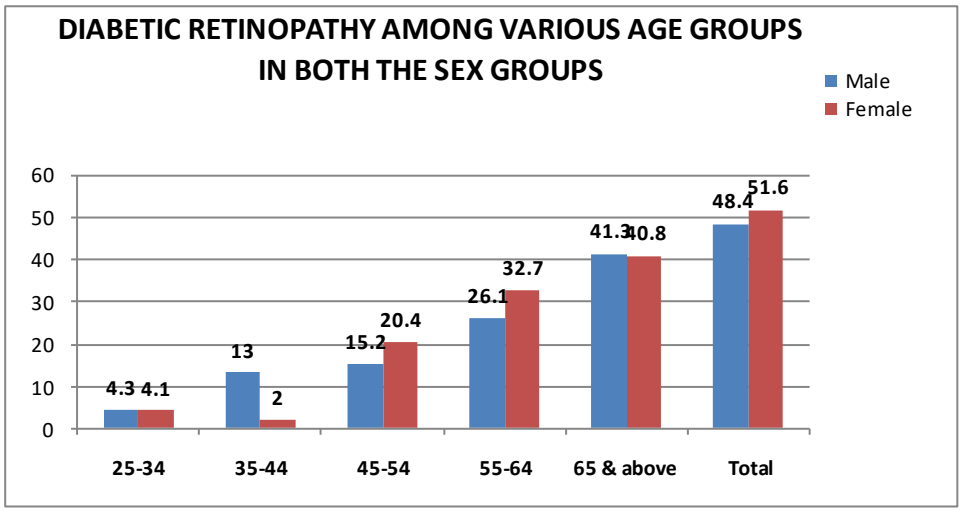
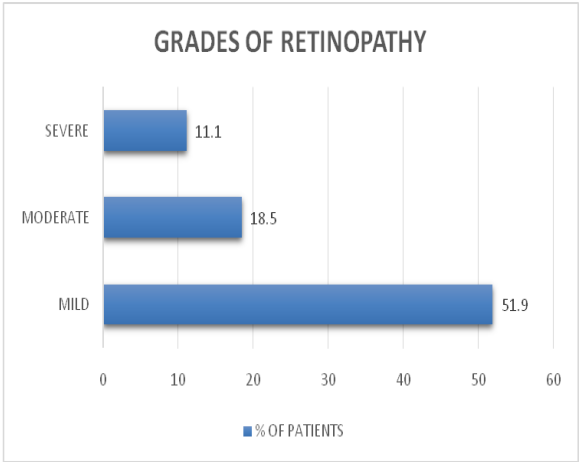


Table 2

BMI (kg/m2)	Duration of DM (Years)				
	<10	11-20	21-30	>30	
<18.5	8	0	0	0	8
18.5-24.99	34	9	2	2	47
>25	31	7	1	1	40
	73	16	3	3	95

Maximum number of patients that is 74 had diabetics detected for less than 10 years. As the duration of Diabetes increased the patient was found to have a BMI of normal range or to be overweight.

Out of the 27 patients found to have retinopathy, 51.9 % had mild grade ,18.5 % having moderate grade and 11.1 % with severe grade of retinopathy.



Mean waist circumference of 90.11+/-16.22 was seen in patients with diabetic retinopathy and 89.57+/-17.23 in patients with no retinopathy. There was no co-relation between waist circumference and development of diabetic retinopathy.

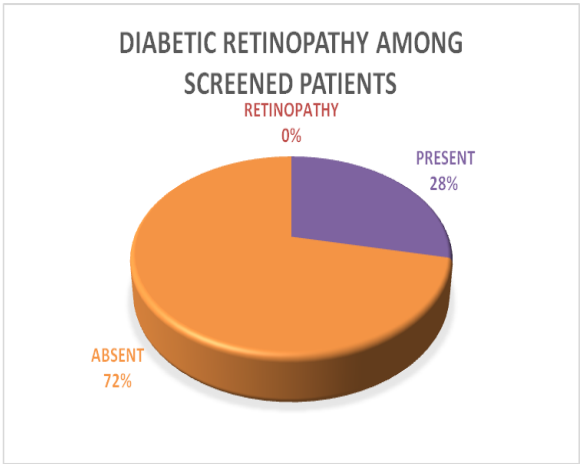
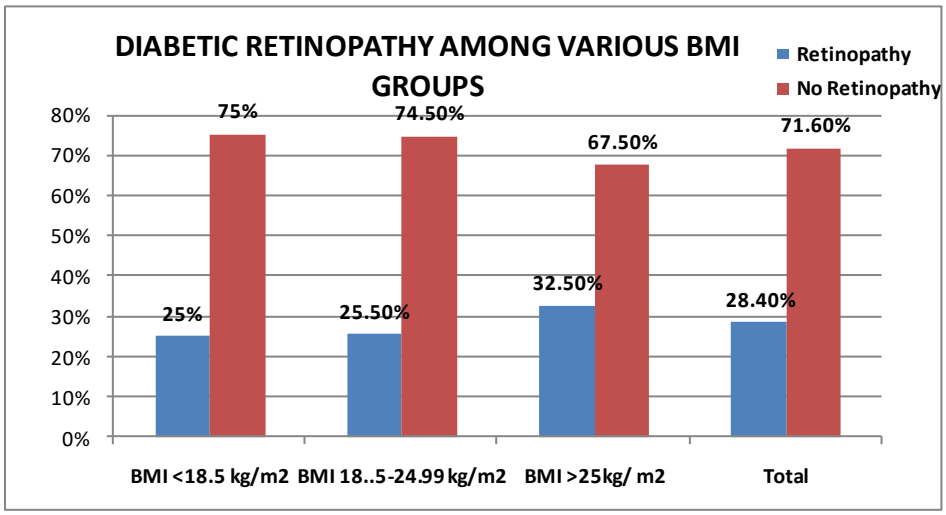


Table 3

BMI (kg/m2)	Retinopathy		Total
	Present	Absent	
<18.5	2	6	8
18.5-24.99	12	35	47
>25	13	27	40
Total	27	68	95



49% (47) were within a normal range of BMI out of which 12 had retinopathy. Only 2 people out of the 27 who developed retinopathy were found to be underweight. Mean BMI in patients with DR was 24.86 +/- 4.08.

Table 4: Comparison of variables.

Variables	Retinopathy	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
Age	Present	27	58.63	11.184	2.152	0.01	0.98
	Absent	68	58.59	11.413	1.384		
Weight	Present	27	63.24	11.256	2.166	1.38	0.17
	Absent	68	59.50	12.176	1.477		
Height	Present	27	158.44	8.590	1.653	0.63	0.52
	Absent	68	157.04	10.101	1.225		
BMI	Present	27	24.867	4.2218	.8125	0.77	0.43
	Absent	68	24.135	4.0871	.4956		
Waist circumference	Present	27	90.11	16.220	3.122	0.14	0.88
	Absent	67	89.57	17.238	2.106		

The unpaired t test was applied to check for statistical co relation and a p value of 0.43 was found, which was not significant (as p >0.05). Hence, no co-relation was seen between Diabetic retinopathy and BMI.

DISCUSSION

Diabetic Retinopathy is a microvascular complication that develops over a period of time in a diabetic individual. It develops with a longer duration of DM and is associated with poor control of blood sugar, blood pressure and blood lipids. However, good glycemic and blood pressure control does not reduce the risk of DR. Obesity and diabetes share a complex relationship. The role of BMI, which is a measure of obesity, is also found to be associated with its microvascular or macrovascular complications.

According to Zahra Saraffan et. al, BMI showed an inverse relationship with DR. [11] In Cheol Hwang et al also showed that BMI of a higher grade showed a lower consecutive risk of vision threatening DR. [12] Whereas Keen H et al [13] and Tolonen N et al [14] showed BMI as a predisposing factor for the development of DR.

Analogous findings with our study showing no association of BMI with DR were also seen in studies carried out by Araki et. al. [15] and Lima V et al. [16]

Although the underlying pathophysiology has not been found between DR and BMI, but various theories have been put forth. An increase in BMI also correlated significantly with the deterioration of HbA_1c, a decrease in HDL-cholesterol, an increase in triglycerides as well as a higher prevalence of hypertension. Increased levels of angiogenic factors including VEGF have been observed partially owing to the presence of oxidative stress in obese patients which has also been

seen in patients of PDR. [17] Increased levels of (ICAM 1) intracellular adhesion marker 1 which has been associated with endothelial dysfunction has also been found in obese patients. Adipose tissue is considered to be an active endocrine and paracrine proinflammatory organ that releases a large number of cytokines and bioactive mediators, namely, leptin, adiponectin, interleukin-6 (IL-6), tumour necrosis factor-α (TNF-α) that influence not only body weight homeostasis but also lipid levels, coagulation, atherosclerosis and diabetes occurrence, insulin resistance, inflammation, oxidative stress, and DR development. [18]

Plasma leptin levels are seen to be elevated in obesity and correlate positively with both visceral and subcutaneous fat areas. High plasma leptin levels have been found to relate to both hypertensive and diabetic retinopathy. Leptin promotes vascular endothelial cell proliferation and angiogenesis in vitro and neovascularization. [19] Furthermore, physical activity and weight loss as lifestyle factors provide some additional evidence to support the relationship between high BMI and DR, whereby weight loss has been seen to delay the onset of diabetic complications including DR. [20]

The strength of our study was that it was carried out among a cohort which was diagnosed to have Diabetes since five years confirming a definitive diagnosis and also no errors due to the newly undiagnosed sugar levels. The weakness of the study being that it does have a very small sample size and does not have fundus camera to evident the diabetic changes.

In our investigated group, the mean duration of diabetes was 5 years with prevalence of any form of retinopathy being 46% whilst 19% of the patients had severe to very severe NPDR and 5% of them had PDR.

CONCLUSION

Thus, it was inferred from the study that BMI is not a dependent factor for the development of diabetic retinopathy. Although, further study in the matter is necessary for a conclusive result.

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