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Original Research Paper

The Relationship between Body Mass Index and Degree of Diabetic Retinopathy in Type II Diabetes Mellitus Patients in Mataram Prolanis Community

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Abstract: Diabetes mellitus is silent killer disease which if it is not treated further, diabetes can cause complications such as diabetic retinopathy. Diabetic retinopathy is the first cause of blindness in productive age. BMI is known to be a risk factor for diabetic retinopathy. Aim of this study was to determine the relationship between BMI and the degree of diabetic retinopathy in type 2 DM patients in the Prolanis Community. The research design uses an observational study with a cross-sectional approach. The sample was type 2 DM patients in Mataram Prolanis Community. Sampling technique used consecutive sampling with minimum sample 29 people. The research results will be analyzed using the Spearman test. Based on the research results, it was found that 46 people had type 2 DM. From 46 people, 7 of them suffered from DR, 5 people had mild NPDR and 2 people had moderate NPDR. From the statistical test results, it was found that there was no relationship between BMI and the degree of diabetic retinopathy with a p value of 0.996 ($p > 0.05$) and a correlation coefficient of 0.001, which means that the strength of the relationship is very weak between these two variables. The conclusion of the study is that there is no relationship between BMI and the degree of diabetic retinopathy in type 2 DM patients because diabetic retinopathy is a multifactorial disease.

Keywords: Body Mass Index, diabetic retinopathy, diabetes mellitus, prolanis community.

Introduction

Diabetes mellitus, also known as the silent killer, is a chronic disease characterized by blood glucose levels exceeding normal, which can cause complications (Hestiana, 2017). One of the microvascular complications of diabetes mellitus is diabetic retinopathy (Edwina et al., 2015). RD is an eye disease that causes the first blindness in adults of productive age (Center for Disease Control and Prevention, 2021). In 2020, the number of adult RD cases was around 103.12 million and in 2045 it is predicted to increase to 160.5 million (Teo et al., 2021). However, until now there is no specific data regarding the prevalence of RD in Indonesia. According to a study in Yogyakarta, the prevalence of RD in the type 2 DM population is 43.1% (Halim et al., 2022). Body mass index is known to play a role as a risk factor for diabetic retinopathy. Where overweight or obesity has been evaluated as a risk factor for RD in several studies (Sabanayagam et al., 2022).

The underlying mechanism BMI acts as a risk factor for diabetic retinopathy is through an increase in BMI >31 in men and >32 in women, which can elevate the risk of developing this condition (Wahyu & Syumarti, 2019). Another mechanism involves hyperglycemia and hyperlipidemia associated with obesity. Hyperglycemia causes endothelial damage, a decrease in pericytes, and thickening of the basement membrane. This thickening leads to capillary occlusion

and ischemia, which can ultimately result in retinal edema (Yusran, 2017). Furthermore, the excessive accumulation of fat in obesity can lead to insulin resistance (Aprian et al., 2021). Obesity causes pancreatic beta cells to be less responsive to increased blood glucose levels, reducing both the number and sensitivity of insulin receptors in the body (Masi & Oroh, 2018).

Various studies on the relationship between BMI and diabetic retinopathy (DR) have been conducted in different countries, with diverse results. A study by Chan et al. (2018) showed that a high BMI is associated with an increased incidence of diabetes, but it demonstrated a lower incidence of diabetic retinopathy. This is because both BMI and diabetic retinopathy are complex issues that can be influenced by many factors, including genetic and environmental factors. On the other hand, a study by Divya N & Kanmani K (2017) found that as BMI increases, the degree of diabetic retinopathy also increases. This is related to the elevated levels of adipokines and pro-inflammatory cytokines, which contribute to oxidative stress.

In recent years, several studies have been conducted on diabetic retinopathy. However, there are still few studies that examine the relationship between BMI and the degree of diabetic retinopathy, especially within the Prolanis community. Based on this issue, diabetic retinopathy is a significant concern in the field of ocular health, as it can lead to blindness in individuals of working age. This disease is also not well recognized by the public, despite the increasing prevalence of cases each year. Therefore, this study aims to investigate the relationship between BMI and the degree of diabetic retinopathy in patients with type 2 diabetes in the Prolanis community of Mataram City. The findings of this research are expected to be beneficial in increasing awareness about diabetic retinopathy and reducing the risk of this disease in diabetes mellitus patients.

Materials and Methods

This research design uses a correlation analytical observational study with cross sectional approach. This research was conducted at the Lombok Eye Clinic from July 2022 – May 2023. Sampling used a non-probability sampling method with consecutive sampling technique and the minimum sample size was 29 people. The sample for this research was type II DM patients in the Mataram Prolanis community who visited the Lombok Eye Clinic in 2022-2023. Inclusion criteria were patients who had type 2 DM, were more than 40 years old, had complete anthropometric data, and were willing to become research participants. Exclusion criteria were patients who could not stand. The independent variable in this research is BMI and the dependent variable is the degree of diabetic retinopathy. This research uses primary data obtained from the results of questionnaires regarding patient identity, height, weight, and the results of patient eye examinations taken at the Lombok Eye Clinic. Data analysis used the SPSS program with the Spearman test.

Result and Discussion

Demographic Characteristics of Type 2 DM Patients

Research conducted at the Lombok Eye Clinic was found the final total sample 46 people who had the inclusion criteria. These respondents were type 2 DM sufferers in the Prolanis Community from several public health centers, such as Puskesmas Dasan Agung, Puskesmas Pagesangan Health, and Klinik Asy-Syifa. Next, respondents were classified based on their demographic characteristics such as age, gender, duration of suffering from diabetes mellitus, education, occupation, comorbidities, and HbA1c levels.

Table 1. Respondents' Demographic Characteristics

Variable	N = 46 (100%)
Age	
40-50	9 (19,6)
51-60	13 (28,3)
61-70	17 (37)
>70	7 (15,2)
Gender	
Male	14 (30,4)
Female	32 (69,6)
DM Duration	
<5 years	14 (30,4)
5-10 years	12 (26,1)
>10 years	20 (43,5)
Last Education	

No school	6 (13)
Elementary school	6 (13)
Junior high school	4 (8,7)
Senior high school	13 (28,3)
Diploma	6 (13)
Bachelor	11 (23,9)
Job	
Doesn't work	22 (47,8)
Retired	17 (37)
Private work	7 (15,2)
Number of comorbidities	
No comorbidities	9 (19,6)
1 comorbidity	22 (47,8)
2 comorbidities	13 (28,3)
>2 comorbidities	2 (4,3)
HbA1c level	
No data	15 (32,6)
Controlled (<7%)	7 (15,2)
Not controlled (≥7%)	24 (52,2)

Table 2. Distribution of respondents' BMI

Body Mass Index	N = 46 (100%)
Heavy Thin	1 (2,2)
Light Thin	3 (6,5)
Normal	17 (37)
Light Fat	8 (17,4)
Heavy Fat	17 (37)

Table 3. Distribution of Respondents' Degree of Diabetic Retinopathy

RD Degrees	N = 46 (100%)
No RD	39 (84,8)
Mild NPDR	5 (10,9)
Moderate NPDR	2 (4,3)
Severe NPDR	0 (0)
PDR	0 (0)

Table 4. Distribution of RD Degrees based on Classification of BMI in Indonesia

BMI	No RD	Mild NPDR	Moderate NPDR	Severe NPDR	PDR
	n (%)	n (%)	n (%)	n (%)	n (%)
Kurus berat	1 (2,2)	0 (0)	0 (0)	0 (0)	0 (0)
Kurus ringan	3 (6,5)	0 (0)	0 (0)	0 (0)	0 (0)
Normal	14 (30,4)	2 (4,3)	1 (2,2)	0 (0)	0 (0)
Gemuk ringan	6 (13)	1 (2,2)	1 (2,2)	0 (0)	0 (0)
Gemuk berat	15 (32,6)	2 (4,3)	0 (0)	0 (0)	0 (0)

Table 5. Relationship between BMI and RD Degree

	RD Degrees
Body Mass Index	P *value* = 0,996 r (correlation coefficient) = 0,001 N = 46

Relationship Between Body Mass Index and Degree of Diabetic Retinopathy

The data obtained was tested using the Spearman correlation test and it was found that the relationship between BMI and degree of RD had a P value of 0.996, which means it was greater than the P value of 0.05. The relationship between the two variables is said to be significant if the P value is < 0.05, whereas if the P value is > 0.05 so the relationship between the variables is not significant. Besides that, the correlation coefficient obtained is 0.001, which means the relationship between these two variables is very weak because r is between 0.00 – 0.25.

Body mass index is an anthropometric measurement that can be used to assess individual nutritional status (Nurhasanah et al., 2022). Excessive body weight can experience oxidative stress which increases levels of angiogenic factors such as VEGF. This adipose tissue is a pro-inflammatory factor that releases cytokines such as leptin, adiponectin, IL-6, TNF-α influences lipid levels, coagulation, atherosclerosis, inflammation, and the development of diabetic retinopathy. High plasma leptin levels in obesity can increase vascular endothelial cell proliferation, angiogenesis, and neovascularization (Manekar & Yerawar, 2019).

Based on the research results, it was found that there was no significant relationship between BMI and the degree of RD. This is in accordance to Zhou et al.'s research which showed result that increasing BMI did not increase the risk of diabetic retinopathy. However, overweight and obesity are risk factors for various diseases, so it is important to maintain an ideal body weight (Zhou et al., 2017). In addition, research by Chan et al. stated that higher BMI was associated with

an increased incidence of DM, but showed a low incidence of diabetic retinopathy. This is because body weight and diabetic retinopathy are complex things so they can be influenced by many or multifactorial factors, both environmental and genetic. Several other influencing factors are age, gender, ethnicity, duration of suffering from DM, and HbA1c levels (Chan et al., 2018).

On the other hand, the result of this research is not in accordance to other researches which also examined the relationship between BMI and the degree of diabetic retinopathy. Research by Divya et al. also found a relationship between BMI and the degree of diabetic retinopathy. The higher the tertile of the BMI value, the higher the degree of diabetic retinopathy. This increase in BMI was found to be associated with increased levels of adipokines and pro-inflammatory cytokines which cause oxidative stress and end in endothelial damage. BMI also acts as a predictive factor for determining vision loss in diabetes mellitus sufferers (Divya N & Kanmani K, 2017).

Factors Causing Differences in Research Results

Blood Pressure

Differences in research results can be caused by several factors. Diabetic retinopathy is a complex disease with various risk factors so it is difficult to prove the role of one risk factor as a determining factor in the degree of RD in this research. Another factor that can increase the risk of diabetic retinopathy is hypertension, which is one of the dominant comorbidities in respondents. High blood pressure can cause vascular damage which increases the risk of diabetic retinopathy (Liu et al., 2020). According to Zhang et al.'s research., it was found that blood pressure >120/80 mmHg in both patients with and without hypertension can increase the prevalence of diabetic retinopathy. Therefore, it is important to control blood pressure in individuals who have diabetes mellitus (Zhang et al., 2023).

Cholesterol

Another comorbidity in respondents was cholesterol. High cholesterol can cause pathological changes in the retinal blood vessels. Modification of LDL can affect Human Retinal Capillary Pericytes (HRCP) so that the number of pericytes will decrease and end in leakage of the Blood Retinal Barrier. Modification of LDL in the form of oxidized LDL can stimulate the production of Reactive Oxygen Species (ROS), causing oxidative stress which can damage and kill retinal capillary cells (Mursi et al., 2018).

Glycemic Control

Poor glycemic control can also increase the incidence and progression of diabetic retinopathy in type 2 DM patients (Kaštelan et al., 2013). It was proven in this research that there are still many DM patients who have high HbA1c levels. Further high HbA1c levels increases the risk of complications. Reducing HbA1c is very useful because a 1% reduction in HbA1c can reduce the risk of death from DM by 21% and microvascular complications by 37%. Therefore, DM sufferers are targeted to have HbA1c levels <7% (Hartini, 2016). Data HbA1c levels patients in this research is also incomplete so it cannot describe the actual distribution of HbA1c levels among all respondents.

Physical Activity

Physical activity is also a factor that influences the development and severity of diabetic retinopathy. Based on the results of anamnesis, it was discovered that several respondents routinely carried out morning exercises every week at the clinic or health center where they live. This physical exercise has a protective effect on retinal health because it has been shown to reduce the risk of age-related macular degeneration and can improve vision. Exercise is also useful in reducing an individual's susceptibility to chronic inflammation because when moving, IL-6 is released by skeletal muscles and acts as an anti-inflammatory by suppressing pro-inflammatory cytokines such as TNF-α and IL-1β (AlQabandi et al., 2022).

Other Factors

Differences in research results can also be caused by other factors that were not studied further, such as the diet adopted by the patient. This eating pattern includes the amount, schedule, frequency, type and method of processing food. Diet is closely related to the incidence of overweight or obesity. From the research results, it was known that the majority

of respondents were severely obese were 16 people (34.8%). Obesity is caused by excessive food intake and not balanced with sufficient physical activity to burn energy. The excess energy will be stored in the form of fat (Rumida & Doloksaribu, 2021). Moreover, patient compliance in taking medication also influences the risk of developing complications due to DM. Behavior that does not comply with medication can worsen the disease suffered. Good compliance is an important factor in treatment because it will influence the success of therapy (Ningrum, 2020).

Conclusion

In this research it can be concluded that there were 17 people (37%) respondents who had a normal BMI and 29 people (63%) had an abnormal BMI. Respondents with type 2 DM with diabetic retinopathy were 7 people (15.2%) and the majority had mild non-proliferative type diabetic retinopathy, 5 people (10.9%). Based on the research results, it can be concluded that there is no significant relationship between body mass index and the degree of diabetic retinopathy in type 2 DM patients in the Mataram Prolanis Community.

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References

AlQabandi, Y., Nandula, S. A., Boddepalli, C. S., Gutlapalli, S. D., Lavu, V. K., Abdelwahab Mohamed Abdelwahab, R., Huang, R., Potla, S., Bhalla, S., & Hamid, P. (2022). Physical Activity Status and Diabetic Retinopathy: A Review. *Cureus*, *14*(8), 1–6. https://doi.org/10.7759/cureus.28238

Aprian, Fatmawati, N. K., & Bakhtiar Rahmat. (2021). Hubungan Indeks Massa Tubuh dengan Derajat Retinopati Diabetik. *J. Ked. Mulawarman*, *8*(2), 49–56. https://dx.doi.org/10.30872/jkm.v8i2.6388

Center for Disease Control and Prevention. (2021, May 7). *Diabetes and Vision Loss*.

Chan, J. C. Y., Chee, M. L., Tan, N. Y. Q., Cheng, C. Y., Wong, T. Y., & Sabanayagam, C. (2018). Differential effect of body mass index on the incidence of diabetes and diabetic retinopathy in two Asian populations. *Nutrition and Diabetes*, *8*(16), 1–11. https://doi.org/10.1038/s41387-018-0018-0

Divya N, & Kanmani K. (2017). Association of body mass index with severity of retinopathy in patients with type 2 diabetes mellitus. *Indian Journal of Clinical and Experimental Ophthalmology*, *3*(2), 118–121. https://doi.org/10.18231/2395-1451.2017.0030

Edwina, D. A., Manaf, A., & Efrida. (2015). Pola Komplikasi Kronis Penderita Diabetes Melitus Tipe 2 Rawat Inap di Bagian Penyakit Dalam RS. Dr. M. Djamil Padang Januari 2011 - Desember 2012. *Jurnal Kesehatan Andalas*, *4*(1), 102–106. https://dx.doi.org/10.25077/jka.v4i1.207

Fitriani, Sihotang, A. D., & Delfi. (2017). Prevalensi Retinopati Diabetik. *Jurnal Kesehatan Prima*, *11*(2), 137–140. DOI: 10.32807/jkp.v11i2.7

Halim, A., Syumarti, Rini, M., Ratnaningsih, N., Iskandar, E., Sovani, I., Virgana, R., & Dahlan, M. R. (2022). Prevalence and Associated Factors of Diabetic Retinopathy in People with Type 2 Diabetes Attending Community Based Diabetic Retinopathy Screening in Greater Bandung, Indonesia. *International Journal of Retina (IJRETINA)*, *5*(1), 1–9. https://doi.org/10.35479/ijretina.2022.vol005.iss001.172

Hartini, S. (2016). Hubungan HBA1c Terhadap Kadar Glukosa Darah Pada Penderita Diabetes Mellitus Di RSUD. Abdul Wahab Syahranie Samarinda Tahun 2016. *Jurnal Husada Mahakam*, *4*(3), 171–180. Retrieved from https://husadamahakam.poltekkes-kaltim.ac.id/ojs/index.php/Home/article/view/13

Hestiana, D. W. (2017). Faktor - Faktor yang Berhubungan dengan Kepatuhan dalam Pengelolaan Diet pada Pasien Rawat Jalan

Diabetes Melitus Tipe II di Kota Semarang. *Journal of Health Education*, *2*(2), 138–145. https://doi.org/10.1515/labmed-2018-0016

Kaštelan, S., Tomic, M., Antunica, A. G., Ljubic, S., Rabatic, J. S., & Karabatic, M. (2013). Body Mass Index : A Risk Factor for Retinopathy in Type 2 Diabetic Patients. *Mediators of Inflammation*, 1–9. DOI: 10.1155/2013/436329

Liu, L., Quang, N. D., Banu, R., Kumar, H., Tham, Y. C., Cheng, C. Y., Wong, T. Y., & Sabanayagam, C. (2020). Hypertension, blood pressure control and diabetic retinopathy in a large population-based study. *PLoS ONE*, *15*(3), 1–15. https://doi.org/10.1371/journal.pone.0229665

Manekar, A. V., & Yerawar, N. C. (2019). Role of BMI as a Risk Factor for the Development on Diabetic Retinopathy. *International Journal of Research and Review*, *6*(9), 322–327.

Masi, G., & Oroh, W. (2018). Hubungan Obesitas dengan Kejadian Diabetes Melitus di Wilayah Kerja Puskesmas Ranomut Kota Manado. *Jurnal Keperawatan*, *6*(1), 1–6. https://doi.org/10.35790/jkp.v6i1.25183

Mursi, Z. A., Hendriati, & Isrona, L. (2018). Hubungan Kolesterol LDL dengan Derajat Retinopati Diabetik di Bagian Mata RSUP Dr. M. Djamil Padang Periode Januari-Desember 2015. *Jurnal Kesehatan Andalas*, *7*(4), 498–503. http://jurnal.fk.unand.ac.id

Ningrum, D. K. (2020). Kepatuhan Minum Obat pada Penderita Diabetes Melitus Tipe II. *HIGEIA*, *4*(3), 492–505. https://doi.org/10.15294/higeia.v4iSpecial%203/36213

Nurhasanah, Wahyuni, S., Nauli, F., Farras, R. M., Sari, J., Rofi, M. B. N., Okvalita, I., & Fathony, M. L. (2022). Correlation Between Body Mass Index and Biological Age in Young Adults. *4th Riau Medical Scientific and Expo*, 63–65. https://doi.org/10.11594/nstp.2022.2811

Rumida, & Doloksaribu, L. G. (2021). Hubungan Pola Makan Dengan Kejadian Obesitas Pada Orang Dewasa : Studi Literatur. *Wahana Inovasi*, *10*(2), 272–279.

Sabanayagam, C., Sultana, R., Banu, R., Rim, T., Tham, Y. C., Mohan, S., Chee, M. L., Wang, Y. X., Nangia, V., Fujiwara, K., Tai, E. S., Song, S. J., Bikbov, M. M., Raman, R., Cheng, C. Y., Wong, T. Y., & Jonas, J. B. (2022). Association between body mass index and diabetic retinopathy in Asians: The Asian Eye Epidemiology Consortium (AEEC) study. *British Journal of Ophthalmology*, *106*(7), 980–986. https://doi.org/10.1136/bjophthalmol-2020-318208

Teo, Z. L., Tham, Y. C., Yu, M., Chee, M. L., Rim, T. H., Cheung, N., Bikbov, M. M., Wang, Y. X., Tang, Y., Lu, Y., Wong, I. Y., Ting, D. S. W., Tan, G. S. W., Jonas, J. B., Sabanayagam, C., Wong, T. Y., & Cheng, C. Y. (2021). Global Prevalence of Diabetic Retinopathy and Projection of Burden through 2045: Systematic Review and Meta-analysis. *Ophthalmology*, *128*(11), 1580–1591. https://doi.org/10.1016/j.ophtha.2021.04.027

Wahyu, T., & Syumarti. (2019). The Epidemiology of Diabetic Retinopathy. In *Community Ophthalmology*. https://doi.org/10.4093/kcd.2009.10.3.139

World Health Organization. (2020). Strengthening Diagnosis and Treatment of Diabetic Retinopathy in the South-East Asia Region. In *World Health Organisation Library* (Vol. 69, Issue June). https://apps.who.int/iris/handle/10665/334224

Yusran, M. (2017). Retinopati Diabetik: Tinjauan Kasus Diagnosis dan Tatalaksana. *JK Unila*, *1*(3), 578–582. https://doi.org/10.23960/jkunila13578-562

Zhang, M., Wu, J., Wang, Y., Wu, J., Hu, W., Jia, H., & Sun, X. (2023). Associations between blood pressure levels and diabetic retinopathy in patients with diabetes mellitus: A population-based study. *Heliyon*, *9*(6), 1–9. https://doi.org/10.1016/j.heliyon.2023.e16830

Zhou, Y., Zhang, Y., Shi, K., & Wang, C. (2017). Body mass index and risk of diabetic retinopathy. *Medicine (United States)*, *96*(22), 1–7. https://doi.org/10.1097/MD.0000000000006754