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Descriptive Analysis of Diabetic Retinopathy in Central Java Province (Case Study at RSUP Dr. Kariadi)

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Abstract

Diabetic retinopathy is a serious complication of diabetes that affects the blood vessels in the retina, leading to nutritional disorders. In Central Java Province, the prevalence of diabetes mellitus increased from 10% in 2022 to 12.52% in the third quarter of 2023; this phenomenon has not reached the SDG's target of zero increase. This study analyzes the frequency distribution of diabetic retinopathy cases at RSUP Dr. Kariadi Semarang in 2023. Using a cross-sectional design, this observational descriptive research utilized electronic medical record data from RSUP Dr. Kariadi Semarang in 2023. The study examined various variables, including gender, age, education level, employment status, marital status, BMI, DM diet, duration of DM, hypertension, other diseases, current blood glucose, and HbA1c. Univariate analysis was used to determine the frequency distribution and present graphical representations of each variable. The study's findings showed the largest percentage of diabetic retinopathy patients were female (54.2%), aged 50-59 years (48.8%), with low education (38.0%), working (66.3%), married (92.8%), and obese (18.7%). Most patients had a duration of DM ≥ 5 years (51.2%), hypertension (73.5%), and other diseases such as azotemia, CKD, cataracts, and cardiomegaly; patients had blood glucose at ≥ 200 mg/dL (53.0%) and HbA1c ≥ 6.5% (88.0%).

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disease characterized by increased blood glucose levels, or hyperglycemia, with blood glucose levels ≥ 200 mg/dl and fasting blood glucose levels ≥ 126 mg/dl (Petersmann et al., 2019). Diabetes mellitus over a long period can lead to complications, both microvascular and macrovascular complications. Diabetic retinopathy is a common microvascular complication of diabetes mellitus (DM) that causes irreversible retinal microvasculopathy and nerve degeneration. This disease is still the main cause of visual impairment and even blindness if not detected early and treated (Shi et al., 2022).

The global SDGs target that there is no increase in diabetes prevalence by 0% (Kemenkes, 2019). The prevalence of diabetes in the world in 2019 was 9.3%, or 463 million people (Saeedi et al., 2019). Based on the International Diabetes Federation (IDF) in 2021, the prevalence of diabetes increased to 10.5%, or 537 million adults (aged 20–79 years) suffering from diabetes worldwide (International Diabetes Federation, 2021b). In 2020, it is estimated that about 103 million adults worldwide will be affected by diabetic retinopathy, which may increase to 160 million by 2045 (Teo et al., 2021). This phenomenon has not met the global SDG's target, namely that there is no increase in the prevalence of diabetes by 0% (Kemenkes, 2019).

Indonesia has increased in diabetes mellitus cases; in 2019, it ranked seventh, and in 2021, it ranked fifth. The number of diabetics in 2021 was 19.5 million (10.5%), an increase from 10.7 million in 2019 (International Diabetes Federation, 2021a). Based on data from Survey Kesehatan Indonesia (SKI) tahun 2023,

Indonesia has an increasing trend in the prevalence of diabetes mellitus diagnosed by doctors in the population aged ≥15 years, from 2.0% in 2018 to 2.2% in 2023, so it has not met the global SDG's target (SKI, 2023). The prevalence of diabetes mellitus in Central Java Province in 2022 increased by 10% to 12.52% in the third quarter of 2023. This phenomenon has not met the Ministry of Health's target in the P2PTM Program, namely that there is no increase in diabetes prevalence by 0%, while there is a gap in increasing diabetes prevalence by 2.52% (Dinas Kesehatan Provinsi Jawa Tengah, 2023).

RSUP Dr. Kariadi Semarang is a referral hospital for the people of Central Java Province that can provide services and treatment for diabetic retinopathy sufferers. The electronic medical record data of RSUP Dr. Kariadi Semarang has the availability of complete data regarding the variables to be studied. Based on electronic medical record data from RSUP Dr. Kariadi Semarang, 64 cases of diabetic retinopathy patients in 2021 increased to 133 cases in 2022. In 2023, cases of diabetic retinopathy have increased again to 166 cases (Medical Records Section of RSUP Dr. Kariadi, 2024). The increase in diabetic retinopathy cases occurs every year, requiring early detection, treatment, and proper management so as not to cause other complications.

Research by Utami et al. (2017) stated that the HbA1c data was incomplete, suggesting that further research should add these variables in more depth. This study added the HbA1c variable to the research suggestion. The novelty in this study is the addition of other disease variables that have not been studied before. This study focuses more on cases of diabetic retinopathy by describing the frequency distribution of each variable and presenting it in
the form of graphs to make it easier for readers to understand the spread of diabetic retinopathy cases. Therefore, researchers are interested in research to find out the descriptive analysis of the incidence of diabetic retinopathy at RSUP Dr. Kariadi Semarang in 2023.

METHOD

This study is observational descriptive research with a cross-sectional design. The population in this study is 166 diabetic retinopathy patients undergoing treatment at RSUP Dr. Kariadi Semarang in 2023. The sample used was 166 respondents with a sampling technique, namely, all sampling. Data collection from electronic medical record data of RSUP Dr. Kariadi Semarang in 2023 was 166 cases of diabetic retinopathy. Data collection was carried out from July to August 2024, using

observation sheets. The independent variables in this study included gender, age, education level, employment status, marital status, BMI, DM diet, duration of DM, hypertension, other diseases, current blood glucose, and HbA1c. The dependent variable in this study is the incidence of diabetic retinopathy.

Variables of gender, age, education level, employment status, and marital status are observed from the social/demographic data of patients found in the hospital's electronic medical records (EMR). The BMI variable is obtained from the results of height and weight examinations recorded in the EMR before a diagnosis of diabetic retinopathy. The DM diet variable consists of a summary assessment by the doctor on whether or not the DM diet is implemented in the medical record data before the patient is diagnosed with diabetic retinopathy. The variable for the duration of DM is the period between when the patient is diagnosed with diabetes mellitus and when the study is conducted. The hypertension variable refers to the doctor's diagnosis of the patient's hypertension history recorded in the EMR before being diagnosed with diabetic retinopathy. The variables for other diseases are obtained from the doctor's diagnosis regarding any other diseases the patient experiences before being diagnosed with diabetic retinopathy. Current blood glucose variables are based on the data from blood glucose test results in EMR data before being diagnosed with diabetic retinopathy. The HbA1c variable was obtained from the results of laboratory examinations in the form of HbA1c levels of patients recorded in the EMR before being diagnosed with diabetic retinopathy.

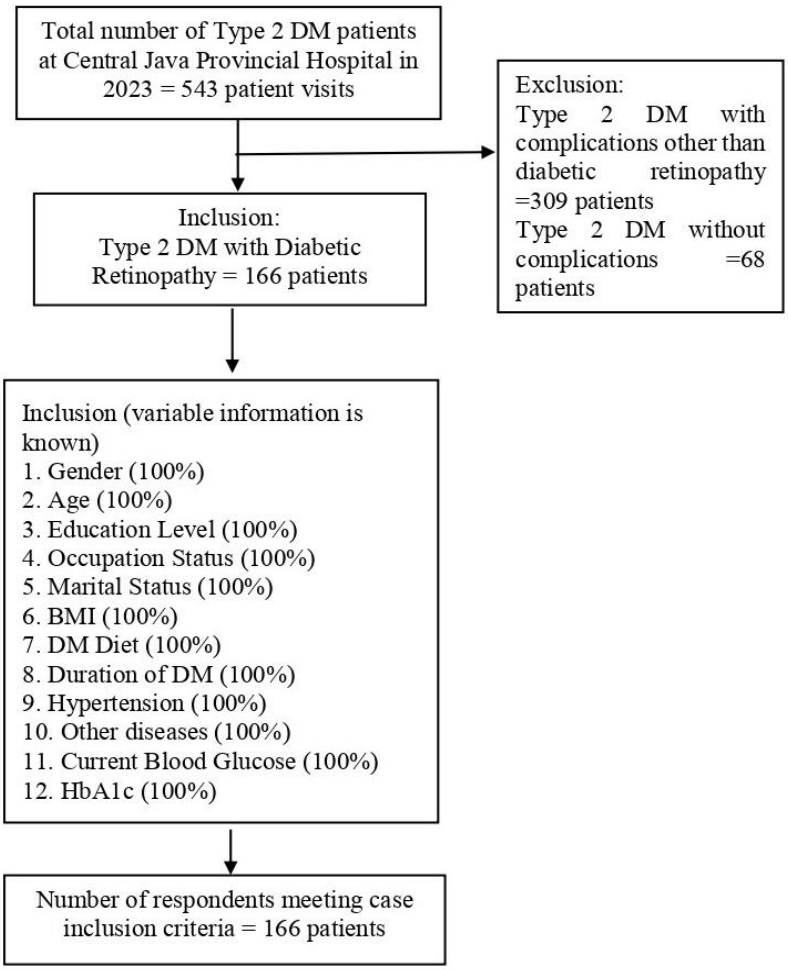

Figure 1. Flowchart of Data Collection
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

The inclusion criteria for this study are type 2 DM patients with complications in the form of diabetic retinopathy with ICD-10 E11.3 (non-insulin-dependent diabetes mellitus with ophthalmic complications) and patients receiving treatment at RSUP Dr. Kariadi Semarang residing in Central Java Province in 2023. Electronic medical record data is recorded in complete 2023, including gender, age, educational level, employment status, marital status, BMI, DM diet, duration of DM, hypertension, other diseases, current blood glucose, and HbA1c, while the exclusion criteria are patients who do not have diabetic retinopathy and patients who have died.

The data analysis in this study is a univariate analysis to find out the frequency distribution of each variable. The frequency distribution of each variable is also presented in a graph to make it easier for readers to understand this study. This research protocol has been approved by the Health Research Ethics Committee of Universitas Negeri Semarang, with number 318/KEPK/FK/KLE/2024.

RESULTS AND DISCUSSIONS

Based on the results from 166 patients, they were processed using univariate analysis. Table 1 shows that of the 166 patients, the majority were female (54.2%) compared to male (45.8%). The majority of patients are in the age range of 50-59 years (48.8%). The largest percentages of diabetic retinopathy are low education (38.0%), employment (66.3%), marriage (92.8%), obesity (18.7%), not following a DM diet (39.8%), duration of DM ≥ 5 years (51.2%), hypertension (73.5%), and other diseases such as azotemia (19.3%), CKD (13.3%), cataracts (12.0%), cardiomegaly (7.9%), glaucoma (6.0%), CHD (4.2%), stroke (2.4%), UTI (urinary tract infection) (1.8%), bronchopneumonia (1.8%), and kidney failure (0.6%). Patients with current blood glucose ≥ 200 mg/dL (53.0%) and HbA1c ≥ 6.5% (88.0%).

Based on Figure 2, the majority of diabetic retinopathy sufferers are female at 54.2% compared to males at 45.8%. The results of this study are in line with Annisa & Romdhoni (2017), who stated that retinopathy patients are

Table 1. Univariate Analysis Results

Variable	N	%
Gender		
Female	90	54.2
Male	76	45.8
Age		
≥ 70 years	7	4.2
60-69 years	34	20.5
50-59 years	81	48.8
< 50 years	44	26.5
Education Level		
Low (SD-SMP)	63	38.0
High (SMA-PT)	103	62.0
Occupation Status		
Employment	110	66.3
Unemployment	56	33.7
Marital Status		
Married	154	92.8
Divorce	7	4.2
Unmarried	5	3.0
Body Mass Index (BMI)		
≥ 28 (Obesity)	31	18.7
24.0—27.9 (Overweight)	42	25.3
18.5-23.9 (Normal weight)	80	48.2
<18.5 (Underweight)	13	7.8
DM Diet		
No	66	39.8
Yes	100	60.2
Duration of DM		
≥ 5 years	85	51.2
< 5 years	81	48.8
Hypertension		
Yes	122	73.5
No	44	26.5
Other Diseases		
Cataracts	20	12.0
Glaucoma	10	6.0
CKD (Chronic Kidney Disease)	22	13.3
Kidney Failure	1	0.6
Azotemia	32	19.3
CHD (Coronary Heart Disease)	7	4.2
Cardiomegaly	13	7.9
Stroke	4	2.4
UTI (Urinary Tract Infection)	3	1.8
Bronchopneumonia	3	1.8
None	51	30.7
Current Blood Glucose		
≥200 mg/dL	88	53.0
<200 mg/dL	78	47.0
HbA1c		
≥6.5%	146	88.0
<6.5%	20	12.0

Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

more common in females, namely 60%, or as many as 54 people, while in males, 40%, or as many as 36 people. Research by Abuhay et al. (2024) also stated that the percentage of retinopathy patients was greater in females (55.63%) than in males (44.37%).

Females will experience menopause, so there is a decrease in estrogen levels that affects insulin secretion. Estrogen helps in the regulation of glucose metabolism and decreases insulin secretion. When insulin secretion decreases, the body can become more susceptible to insulin resistance, a condition in which the body's cells do not respond to insulin effectively. Insulin resistance is a major risk factor in the development of diabetic retinopathy (Ren et al., 2023).

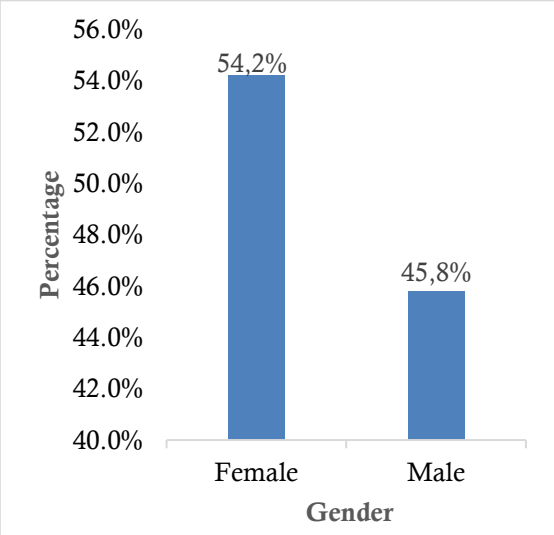

Figure 2. Frequency Distribution Chart of Gender
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 3, the majority of diabetic retinopathy patients aged 50-59 years are 48.8%, compared to the age < 50 years (26.5%), age 60-69 years (20.5%), and age ≥ 70 years (4.2%). The results of this study are in line with Ashoor et al. (2023) that the majority of diabetic retinopathy patients occur at the age of 50-59 by 31.0% compared to the age of 30-39 years (11.2%), the age of 40-49 years (25.9%), the age of 60-69 years (21.7%), and the age of ≥ 70 years (3.2%).

Age is closely related to the increase in blood glucose levels; this is because the older the pancreas, the less insulin production by the pancreas there will be, so the older you get, the higher the prevalence of diabetes mellitus and glucose tolerance disorders. Patients in the age group of 50-64 years are more prone to developing diabetic retinopathy because, with age, glucose intolerance also increases. In individuals with a long history of diabetes mellitus, the risk of developing diabetic retinopathy is even higher after the age of 50 years. After the age of 50, the body's metabolism and cell structure are more difficult to adapt and work more slowly (Paschou et al., 2024).

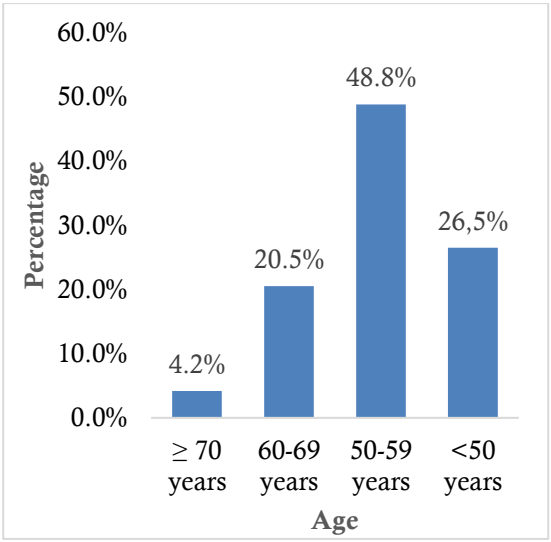

Figure 3. Frequency Distribution Chart of Age
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 4, the majority of diabetic retinopathy sufferers have a higher education level (SMA-PT) of 62.0% compared to primary education (SD-SMP) of 38.0%. The results of this study are in line with Eszes et al. (2016), stating that the majority of patients have a higher education level greater than 52.3%.

Diabetic retinopathy lasts for a long period from the diagnosis of diabetes mellitus due to the persistent increase in glycemic levels and endothelial damage in the retina that leads to diabetic retinopathy. This long course of the disease makes patients neglect blood glucose control, even though the patient has a high level of education. Increased awareness and knowledge about eye complications related to diabetic retinopathy can lower the risk of developing diabetic retinopathy (Venugopal et al., 2017).

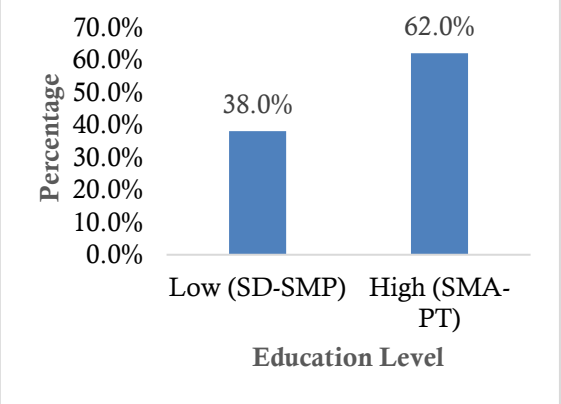

Figure 4. Frequency Distribution Chart of Education Level
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 5, the majority of diabetic retinopathy sufferers in employment are 66.3%, compared to unemployed patients at 33.7%. The results of this study are in line with Mersha et al. (2021), stating that the majority of diabetic retinopathy patients are employed (76.8%), compared to 23.2% unemployed.

Employment often results in a lack of attention to a healthy diet, such as consuming foods high in cholesterol and sugar, as well as increasing stress that worsens blood glucose levels, increasing the risk of developing diabetic retinopathy. Limited time to choose healthy foods and lack of exercise can also worsen the condition of diabetic retinopathy. A healthy diet and exercise in combination can reduce the incidence of diabetic retinopathy by 47% (Geng et al., 2023).

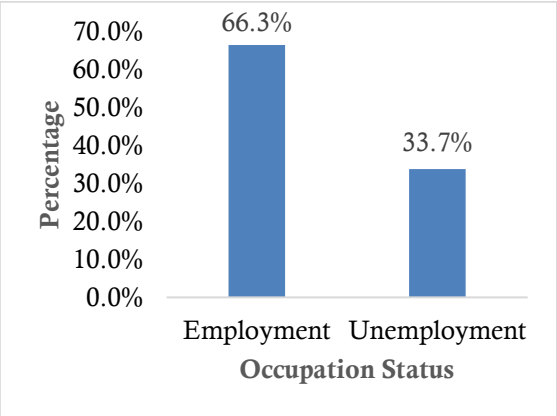

Figure 5. Frequency Distribution Chart of Occupation Status
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 6, it shows that the majority of patients with diabetic retinopathy are married patients (92.8%) compared to divorced (4.2%) or unmarried patients (3.0%). The results of this study are in line with Mersha et al. (2021), stating that the majority of diabetic retinopathy patients are married at 66.3% compared to unmarried at 33.7% (Mersha et al., 2021).

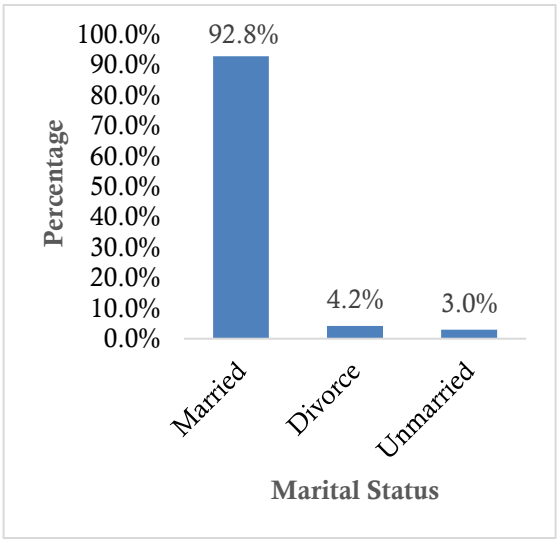

Figure 6. Frequency Distribution Chart of Marital Status
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 7, the majority of diabetic retinopathy sufferers are patients with a normal-weight BMI of 48.2%, compared to obesity (18.7%), overweight (25.3%), and underweight (7.8%). The results of this study are in line with Aprian et al. (2021), stating that retinopathy patients who have a normal-weight BMI of 57.6% compared to obese patients are 42.4% (Aprian et al., 2021).

Patients with non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR) can occur in a person with a normal body mass index and underweight, but the course of the disease toward further severity is influenced by other factors such as poor glycemic control and the length of time a person has diabetes mellitus (Aprian et al., 2021). Obesity affects an increased risk of conditions such as hypertension, stroke, atherosclerotic coronary heart disease, and type 2 diabetes. In addition, the influence of obesity on eye diseases has also occurred a lot, including in the case of

retinopathy, glaucoma, maculopathy, and cataracts, so the higher the BMI, the greater the risk of a patient's proliferative diabetic retinopathy (PDR) (Shu et al., 2023).

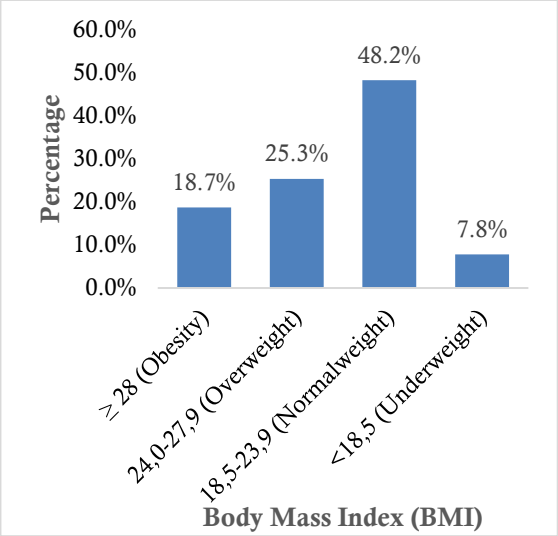

Figure 7. Frequency Distribution Chart of Body Mass Index (BMI)
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 8, the majority of patients with diabetic retinopathy are patients who follow the DM diet (60.2%) compared to patients who do not follow the DM diet (39.8%). Patients who adhere to the diet will have better control of blood sugar (glycemic levels); with good and continuous glycemic control, they will be able to prevent acute complications and reduce the risk of long-term complications. Improved glycemic control is associated with a decrease in the incidence of diabetic retinopathy (Matsushita et al., 2021).

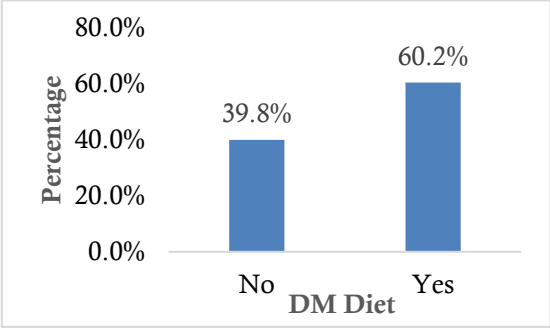

Figure 8. Frequency Distribution Chart of DM Diet
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 9, the majority of diabetic retinopathy sufferers have had a duration of DM ≥ 5 years (51.2%), compared to DM < 5 years (48.8%). The results of this study are in line with Aprian et al. (2021), which stated that the majority of patients' duration of DM ≥ 5 years was 71.2%. The longer a person's duration of DM, the more likely they are to experience further severity. Prolonged hyperglycemia triggers the formation of free radicals such as AGEs, sorbitol, ROS, and protein kinase C, which affect the neurovascular retina. Hyperglycemia plays a role in microvascular damage and diabetic retinopathy through activation of polyol pathways, non-enzymatic glycation, activation of protein kinase C, and inflammation (Aprian et al., 2021).

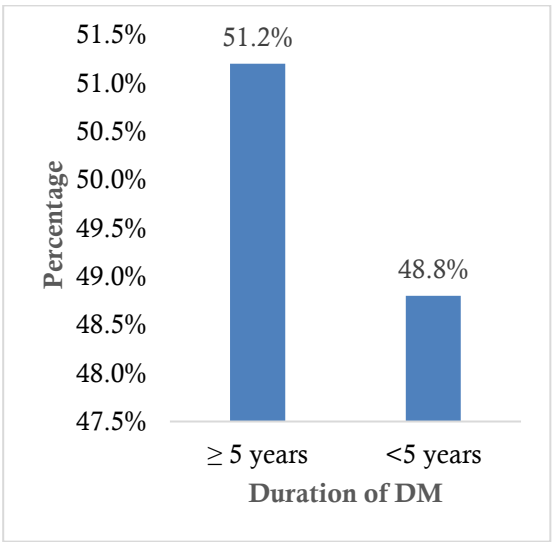

Figure 9. Frequency Distribution Chart Duration of DM
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 10, it shows that the majority of diabetic retinopathy sufferers in hypertensive patients are 73.5%, compared to non-hypertensive patients at 26.5%. The results of this study are in line with Ashoor et al. (2023), stating that the majority of diabetic retinopathy patients experience hypertension of 54.2% compared to non-hypertension of 45.8%.

Patients with type 2 DM with hypertension have a lower ability to regulate retinal blood flow compared to people who do not suffer from hypertension (Li et al., 2024). The angiotensin

renin system is involved in the control of blood pressure in the retina, which is seen in pathological processes in the retina (Mersha et al., 2022). In diabetics, hypertension can cause endothelial damage to retinal blood vessels and increase the expression of VEGF receptors. VEGF can bind directly to vascular endothelial cells, causing increased vascular permeability and forming ischemic neovascularization in diabetic retinopathy (Nafia et al., 2021). VEGF will also stimulate the expression of intracellular adhesion molecule-I (ICAM-I), which triggers the formation of bonds between leukocytes and vascular endothelium. These bonds cause retinal blood barrier damage, thrombosis, and retinal capillary occlusion (Dewi et al., 2019).

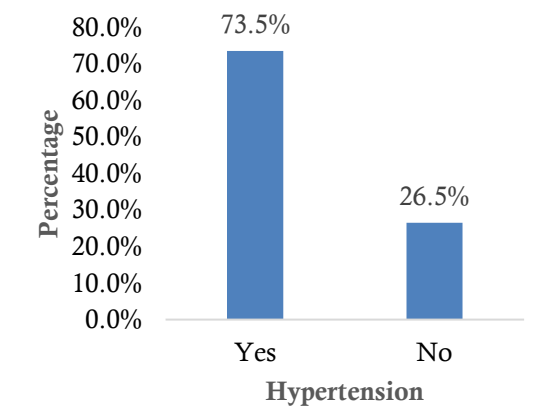

Figure 10. Frequency Distribution Chart of Hypertension
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 11, the majority of patients with diabetic retinopathy have other diseases such as azotemia (19.3%), CKD (13.3%), cataracts (12.0%), cardiomegaly (7.9%), glaucoma (6.0%), CHD (4.2%), stroke (2.4%), bronchopneumonia (1.8%), UTI (urinary tract infection) (1.8%), and kidney failure (0.6%). The three highest orders are with other diseases in the form of azotemia, CKD, and cataracts. Azotemia is an increase or accumulation of blood urea nitrogen products (BUN) in the kidneys. Research by Jianting et al. (2023) states the BUN/Cr ratio as an indicator to assess kidney damage. The BUN/Cr ratio was used to assess prerenal azotemia, acute tubule necrosis, and dehydration. The prevalence of diabetic retinopathy increases along with the increase in the BUN/Cr ratio (Jianting et al., 2023).

The severity of diabetic retinopathy is related to an increased decrease in glomerular filtration (eGFR), especially in patients with non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR). Patients with more severe diabetic retinopathy experienced a faster decrease in eGFR. There are similarities in pathophysiological mechanisms between complications of diabetic retinopathy and chronic kidney disease (CKD), such as arterial endothelial dysfunction caused by increased blood glucose, leukocyte activation, blood clotting disorders, and increased platelet clotting. This leads to a lack of blood supply (ischemia) in the kidneys and eyes (Figueroa et al., 2023).

Patients who have had DM for more than 10 years are also more likely to develop various eye diseases, especially if they have a thin retina (tessellated retina), which usually occurs in people with cataracts. In cataract surgery patients with diabetes, the risk of developing non-proliferative diabetic retinopathy is 1.48–4.11 times higher compared to patients without cataracts (Yao et al., 2021).

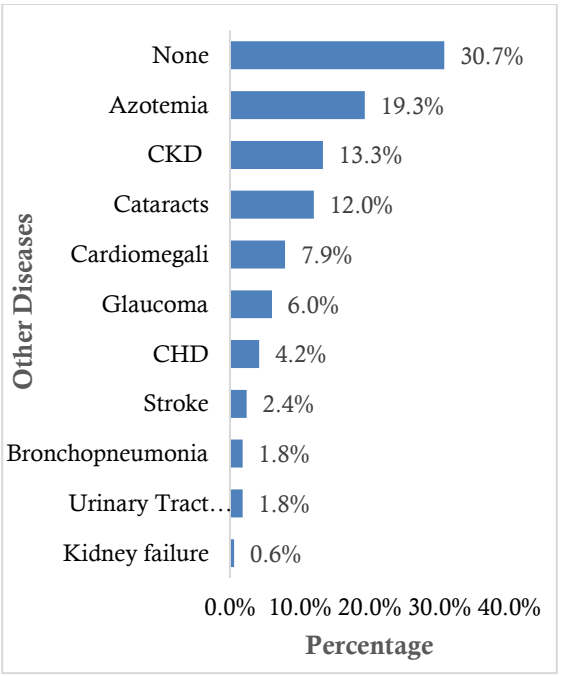

Figure 11. Frequency Distribution Chart of Other Diseases
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 12, it is shown that the majority of patients with diabetic retinopathy in patients with blood glucose ≥ 200 mg/dL is 53.0%, compared to patients with blood glucose < 200 mg/dL at 47.0%. The results of this study are in line with Shaniaputri et al. (2022), stating that the majority of diabetic retinopathy patients have blood glucose ≥ 200 mg/dL of 61.63%. Diabetic retinopathy occurs as a result of prolonged exposure to hyperglycemia, which can cause biological and chemical changes that occur in the endothelium of blood vessels. Current blood glucose levels are an indicator of whether a person has controlled blood sugar levels or not. Controlled blood sugar levels can reduce the risk of diabetic retinopathy by about 30% (Utami et al., 2017). Uncontrolled blood glucose is 3.28 times at risk of developing diabetic retinopathy (Mersha et al., 2022).

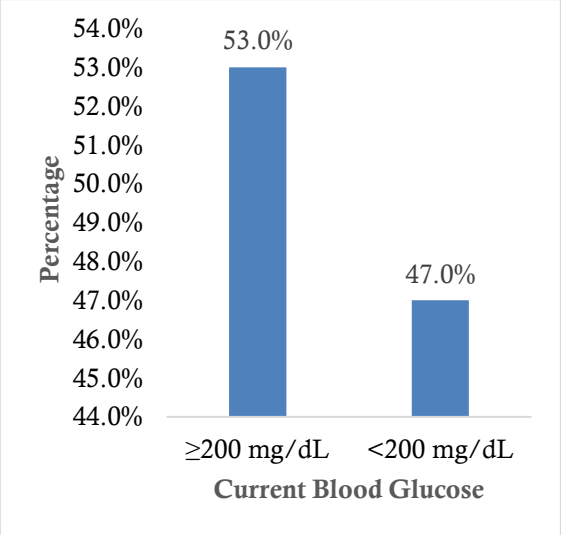

Figure 12. Frequency Distribution Chart of Current Blood Glucose
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

Based on Figure 13, it shows that the majority of patients with diabetic retinopathy in patients with HbA1c levels ≥ 6.5% is 88.0%, compared to patients with HbA1c levels < 6.5% at 12.0%. The results of this study are in line with Gelcho & Gari (2022); the majority of HbA1c ≥ 6.5% at 70.7%. HbA1c assessment in DM patients is used to identify early complications and assess DM control compliance. HbA1c testing is the gold standard in measuring glycemic rate. A decrease in HbA1c from 8% to 7% can reduce the risk of retinopathy by 30%–40%, suggesting that good glycemic control can slow the progression of diabetic retinopathy (Gong et al., 2023).

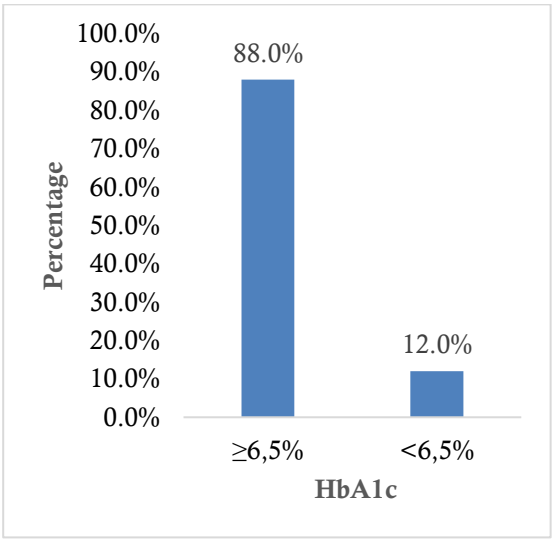

Figure 13. Frequency Distribution Chart of HbA1c
Source: Electronic Medical Records of RSUP Dr. Kariadi, 2023

CONCLUSION

Based on the frequency distribution in this study, the majority of patients suffering from diabetic retinopathy at RSUP Dr. Kariadi Semarang in 2023 are female (54.2%), patients in the age range of 50-59 years (48.8%), low education (38.0%), employed (66.3%), married (92.8%), obese (18.7%), not on a DM diet (39.8%), duration of DM ≥ 5 years (51.2%), hypertension (73.5%), and there are other diseases such as azotemia (19.3%), CKD (13.3%), cataracts (12.0%), cardiomegaly (7.9%), glaucoma (6.0%), CHD (4.2%), stroke (2.4%), UTI (urinary tract infection) (1.8%), bronchopneumonia (1.8%), and kidney failure (0.6%). Patients with current blood glucose ≥ 200 mg/dL (53.0%) and HbA1c ≥ 6.5% (88.0%).

This research is expected to be information for diabetic retinopathy patients at RSUP Dr. Kariadi regarding the spread of the case. Recommendations for policymakers in the hospital internal medicine service unit of RSUP Dr. Kariadi can make follow-up efforts for the

management of type 2 DM patients, such as HbA1c screening, current blood glucose control, monitoring the patient's blood pressure, and strictly controlling glucose so that DM patients do not experience complications of diabetic retinopathy. The limitation of this study is that it does not examine the variables of LDL, total cholesterol, and fasting glucose levels because the data available in the electronic medical records of RSUP Dr. Kariadi is incomplete.

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