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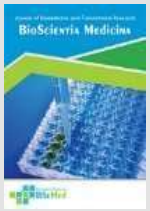

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Prevalence and Risk Factors of Diabetic Retinopathy in a Tertiary Hospital in Padang, Indonesia

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A B S T R A C T

Background: Diabetic retinopathy (DR) is a prevalent microvascular complication of diabetes, leading to vision impairment and blindness. This study aimed to determine the prevalence and risk factors associated with DR among patients attending a tertiary care center in Padang, Indonesia. **Methods:** A cross-sectional study was conducted at the eye polyclinic of Dr. M. Djamil General Hospital, Padang, Indonesia, from October 2020 to March 2021. Patients diagnosed with diabetes who underwent a comprehensive ophthalmological examination were included. Data collected included demographics, duration of diabetes, cholesterol levels, and DR status (classified as non-proliferative diabetic retinopathy (NPDR) or proliferative diabetic retinopathy (PDR)). **Results:** A total of 200 patients with diabetes were included. The prevalence of DR was 55%, with 40% having NPDR and 15% having PDR. Multivariate analysis revealed that longer diabetes duration (odds ratio [OR] 1.8, 95% confidence interval [CI] 1.2-2.7, p=0.004), higher cholesterol levels (OR 2.5, 95% CI 1.5-4.1, p=0.001), and older age (OR 1.1, 95% CI 1.0-1.2, p=0.03) were independently associated with the presence of DR. **Conclusion:** DR is highly prevalent among diabetic patients in tertiary care center Padang, Indonesia. Longer diabetes duration, elevated cholesterol, and older age are significant risk factors for DR. Early detection and management of these risk factors are crucial to prevent vision loss in this population.

1. Introduction

Diabetic retinopathy (DR) is a prevalent microvascular complication of diabetes that can lead to vision impairment and blindness. This study aims to determine the prevalence and risk factors associated with DR among patients attending a tertiary care center in Indonesia. DR is a leading cause of vision loss globally, particularly among adults of working age. It is a microvascular complication of diabetes that affects the retinal blood vessels, leading to changes such as microaneurysms, hemorrhages, exudates, and neovascularization. These changes can result in vision loss due to macular edema, vitreous hemorrhage, and retinal detachment. The prevalence of DR is increasing worldwide, primarily due to the rising prevalence of diabetes and longer life expectancy. The International Diabetes Federation (IDF) estimates that approximately 537 million adults will be living with diabetes in 2021, and this number is projected to rise to 643 million by 2030 and 783 million by 2045. The prevalence of DR among individuals with diabetes varies depending on the population studied, the duration of diabetes, and the diagnostic criteria used. However, it is estimated that approximately one-third of people with diabetes have some degree of DR, and one-third of those have vision-threatening DR.[1-4]

Several risk factors have been associated with the development and progression of DR, including duration of diabetes, glycemic control, hypertension,

dyslipidemia, and smoking. Longer duration of diabetes is a well-established risk factor for DR, with the prevalence and severity of DR increasing with the duration of diabetes. Poor glycemic control, as indicated by elevated HbA1c levels, is also a significant risk factor for DR. Hypertension and dyslipidemia are additional risk factors that can contribute to the development and progression of DR. Smoking has also been shown to increase the risk of DR and its progression. Early detection and management of DR are crucial to prevent vision loss. Regular ophthalmological examinations are recommended for all individuals with diabetes to detect DR at its early stages when treatment is most effective. Treatment options for DR include glycemic control, blood pressure management, lipid-lowering therapy, laser photocoagulation, and intravitreal injections of anti-vascular endothelial growth factor (VEGF) agents.[5-7] In Indonesia, the prevalence of diabetes is increasing at an alarming rate. The prevalence of diabetes among adults in Indonesia was estimated to be 10.7% in 2021, and this number is projected to rise to 12.4% by 2030 and 13.7% by 2045. The increasing prevalence of diabetes in Indonesia is likely to lead to a corresponding increase in the prevalence of DR, making it a significant public health concern.[8-10] This study aimed to determine the prevalence and risk factors associated with DR among patients attending a tertiary care center in Padang, Indonesia.

2. Methods

This study employed a cross-sectional design, which is well-suited for investigating the prevalence and associated factors of a health condition within a specific population at a particular point in time. Cross-sectional studies provide a snapshot of the health status of a population and can generate hypotheses about potential risk factors, although they cannot establish causality. The study was conducted at the eye polyclinic of Dr. M. Djamil General Hospital Padang, a tertiary care center located in Padang, Indonesia. As a tertiary care center, Dr. M. Djamil General Hospital Padang receives referrals from primary and secondary care facilities, serving a diverse population with a wide range of medical conditions, including diabetes and its complications. The hospital's eye polyclinic provides comprehensive ophthalmological services, including diagnosis, treatment, and management of DR. The study period spanned from October 2020 to March 2021, encompassing a six-month timeframe. This duration was considered sufficient to capture a representative sample of patients with diabetes attending the eye polyclinic.

The study population comprised all patients diagnosed with diabetes who attended the eye polyclinic of Dr. M. Djamil General Hospital Padang during the study period. Diabetes was diagnosed based on the criteria established by the American Diabetes Association (ADA), which includes a fasting plasma glucose level of ≥126 mg/dL, a 2-hour plasma glucose level of ≥200 mg/dL during an oral glucose tolerance test, or a glycated hemoglobin (HbA1c) level of ≥6.5%. Patients who underwent a comprehensive ophthalmological examination at the eye polyclinic were eligible for inclusion in the study. This examination included visual acuity testing, intraocular pressure measurement, and dilated fundus examination. The dilated fundus examination is the gold standard for diagnosing DR, allowing for direct visualization of the retinal vasculature and identification of any abnormalities. Patients with a history of other ocular diseases that could confound the assessment of DR were excluded from the study. These exclusion criteria included glaucoma, macular degeneration, uveitis, and other retinal disorders not related to diabetes. A consecutive sampling method was employed to recruit participants for the study. This method involves enrolling all eligible patients who attend the clinic during the study period, ensuring that the sample is representative of the population of patients with diabetes attending the eye polyclinic. Informed consent was obtained from all participants before their enrollment in the study. The study procedures were explained to the participants in their native language, and they were given the opportunity

to ask questions before providing their consent.

Data were collected using a combination of methods, including a structured questionnaire and a review of medical records. This multi-faceted approach ensured the comprehensiveness of the data collected. The structured questionnaire was designed to collect information on demographics, duration of diabetes, history of hypertension and dyslipidemia, and current medications. The questionnaire was administered by trained interviewers who were fluent in the local language. The review of medical records provided additional information on the participants' medical history, including their diabetes diagnosis, glycemic control, and any previous treatment for DR. The medical records also provided information on other potential risk factors for DR, such as hypertension, dyslipidemia, and smoking.

All participants underwent a comprehensive ophthalmological examination performed by an experienced ophthalmologist. The examination included the following components; Visual acuity testing: Visual acuity was measured using a Snellen chart, which assesses the ability to see letters or symbols at a standard distance. Visual acuity is an important indicator of overall visual function and can be affected by DR; Intraocular pressure measurement: Intraocular pressure was measured using a tonometer, which assesses the fluid pressure within the eye. Elevated intraocular pressure is a risk factor for glaucoma, another leading cause of vision loss; Dilated fundus examination: The dilated fundus examination is the cornerstone of DR diagnosis. It involves dilating the pupils with eye drops to allow for a wider view of the retina. The ophthalmologist then uses a slit lamp biomicroscope and a 78-diopter lens to examine the retinal vasculature, including the blood vessels, macula, and optic disc. The DR status was classified according to the International Clinical Diabetic Retinopathy Severity Scale, a widely used and validated tool for grading the severity of DR. This scale categorizes DR into the following stages; No DR: No evidence of DR; Mild NPDR: Microaneurysms only. Microaneurysms are small outpouchings in the retinal capillaries, which are the earliest signs of DR; Moderate NPDR: More than microaneurysms but less than severe NPDR. This stage is characterized by the presence of additional retinal abnormalities, such as dot and blot hemorrhages, hard exudates, and cotton wool spots; Severe NPDR: Hemorrhages and microaneurysms in all four quadrants. Venous beading in at least two quadrants. Venous beading refers to irregular dilation and constriction of the retinal veins. Intraretinal microvascular abnormalities (IRMA) in at least one quadrant. IRMA are abnormal vascular patterns that develop in response to retinal ischemia; PDR: Presence of neovascularization of the disc or elsewhere. Neovascularization is the formation of new, abnormal blood vessels on the retina or optic disc. These vessels are fragile and prone to bleeding, leading to severe vision loss.

Data were analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA), a comprehensive statistical software package widely used in health research. Descriptive statistics were used to summarize the characteristics of the study participants. This included measures of central tendency, such as mean and median, and measures of dispersion, such as standard deviation and range. The prevalence of DR and its subtypes was calculated as the percentage of participants with each DR category. This provided an estimate of the burden of DR within the study population. Bivariate analysis was performed to assess the association between potential risk factors and the presence of DR. This involved comparing the prevalence of DR between different groups of participants based on their characteristics. The chi-square test was used for categorical variables, such as gender, hypertension, and dyslipidemia. The independent samples t-test was used for continuous variables, such as age and duration of diabetes. Multivariate logistic regression analysis was performed to identify independent risk factors associated with the presence of DR. This statistical technique allows for the simultaneous assessment of multiple risk factors while controlling for their potential confounding effects. Variables with

a p-value < 0.05 in the bivariate analysis were included in the multivariate model. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the strength of association between risk factors and DR.

3. Results

Table 1 presents the demographic and clinical characteristics of the 200 participants included in the study. The mean age of the participants was 55.2 years, with a standard deviation of 10.5 years. The age range was 20 to 75 years, indicating a diverse age distribution. The majority of the participants were female (60%), suggesting a potential gender disparity in the prevalence or presentation of diabetic retinopathy. Most participants had type 2 diabetes (90%), which is the most common form of diabetes globally. The mean duration of diabetes was 8.5 years, with a standard deviation of 5.2 years. The duration ranged from 1 to 25 years, indicating a wide range of diabetes duration among the participants. A significant proportion of the participants had hypertension (40%), a known risk factor for diabetic retinopathy and other microvascular complications of diabetes. Dyslipidemia, another risk factor for diabetic retinopathy, was present in 30% of the participants. The participants had varying levels of education, with 5% having no formal education, 15% having primary education, 40% having secondary education, and 40% having tertiary education. The participants were engaged in various occupations, with 15% being unemployed, 25% engaged in manual labor, 30% in clerical/service jobs, and 30% in professional occupations.

Table 1. Participants characteristics.

Characteristic	Number	Percentage (%)
Age (years)		
Mean ± SD	55.2 ± 10.5	-
Range	20-75	-
Gender		
Female	120	60
Male	80	40
Diabetes type		
Type 1	20	10
Type 2	180	90
Duration of diabetes (years)		
Mean ± SD	8.5 ± 5.2	-
Range	1-25	-
Hypertension		
Yes	80	40
No	120	60
Dyslipidemia		
Yes	60	30
No	140	70
Education level		
No formal education	10	5
Primary	30	15
Secondary	80	40
Tertiary	80	40
Occupation		
Unemployed	30	15
Manual labor	50	25
Clerical/service	60	30
Professional	60	30

Table 2 presents the prevalence of diabetic retinopathy (DR) and its subtypes among the 200 study participants. 55% of the participants had some form of DR. This indicates a high prevalence of this sight-threatening complication among the diabetic population attending this tertiary care center in Indonesia. 45% of the participants did not show any signs of DR. This highlights that a significant proportion of individuals with diabetes can maintain healthy retinal vasculature, especially with proper diabetes management and regular eye care. Among those with DR, the majority (39% of the total participants) had non-proliferative diabetic retinopathy (NPDR). NPDR is the earlier stage of DR, characterized by microaneurysms, hemorrhages, and exudates in the retina. While vision may be affected in some cases, it is generally less severe than PDR. 16% of the total participants had proliferative diabetic retinopathy (PDR). PDR is the more advanced stage of DR, where new, fragile blood vessels grow on the retina. These vessels are prone to bleeding and can lead to severe vision loss if left untreated. The high prevalence of DR (55%) underscores the significant burden of this condition in Indonesia and the need for effective prevention and management strategies. The relatively high proportion of PDR cases (16%) is concerning, as PDR can lead to severe vision loss and blindness. This emphasizes the importance of early detection and timely intervention.

Table 2. The prevalence of DR and its subtypes.

Diabetic retinopathy (DR)	**Number**	**Percentage (%)**
No DR	90	45
DR present	**110**	**55**
NPDR	80	39
PDR	30	16
Total	**200**	**100**

NPDR = Non-Proliferative Diabetic Retinopathy, PDR = Proliferative Diabetic Retinopathy.

Table 3 presents the results of both bivariate and multivariate analyses examining the association between various risk factors and the presence of diabetic retinopathy (DR). Bivariate analysis examines the relationship between each risk factor and DR individually. A p-value less than 0.05 indicates a statistically significant association. Older age was significantly associated with DR (p=0.01). This suggests that as age increases, so does the likelihood of having DR. Longer duration of diabetes was strongly associated with DR (p=0.001). This indicates that the longer a person has diabetes, the higher their risk of developing DR. Elevated cholesterol levels were significantly associated with DR (p=0.002). This implies that individuals with higher cholesterol have an increased risk of DR. Hypertension showed a significant association with DR (p=0.02). This indicates that individuals with high blood pressure are more likely to have DR. Dyslipidemia also showed a significant association with DR (p=0.04). This suggests that individuals with abnormal blood lipid levels have an increased risk of DR. Multivariate analysis considers all the potential risk factors simultaneously, allowing researchers to identify which factors are independently associated with DR after accounting for the influence of other factors. It provides Odds Ratios (OR) with 95% Confidence Intervals (CI) to quantify the strength of the association. Older age remained an independent predictor of DR (OR 1.1, 95% CI 1.0-1.2, p=0.03). For each year increase in age, the odds of having DR increase by 1.1 times. Longer duration of diabetes was a strong independent predictor of DR (OR 1.8, 95% CI 1.2-2.7, p=0.004). This means that for each year increase in diabetes duration, the odds of having DR increase by 1.8 times. Higher cholesterol levels were also an independent predictor of DR (OR 2.5, 95% CI 1.5-4.1, p=0.001). This indicates that for each unit increase in cholesterol level, the odds of

having DR increase by 2.5 times. These were not found to be independent predictors of DR in the multivariate analysis. This suggests that their initial association with DR in the bivariate analysis might be explained by their relationship with other factors, such as age and duration of diabetes.

Table 3. Risk factors associated with diabetic retinopathy.

Risk factor	Bivariate analysis (p-value)	Multivariate analysis (OR, 95% CI, p-value)
Age (years)	0.01	1.1 (1.0-1.2), 0.03
Duration of diabetes (years)	0.001	1.8 (1.2-2.7), 0.004
Cholesterol level (mg/dL)	0.002	2.5 (1.5-4.1), 0.001
Hypertension	0.02	-
Dyslipidemia	0.04	-

4. Discussion

The high prevalence of diabetic retinopathy (DR) observed in this study (55%) is a significant public health concern, especially in developing countries like Indonesia. This finding aligns with numerous studies conducted in similar settings, underscoring the substantial burden of this sight-threatening complication. The increasing prevalence of diabetes is a major global health concern and a significant driver of the high rates of diabetic retinopathy (DR). Diabetes is reaching epidemic proportions worldwide, with a particularly alarming rise in developing nations. Modern lifestyles, characterized by decreased physical activity, unhealthy diets, and increased urbanization, are major contributors to the rise of diabetes. Technological advancements, automation, and changes in occupational patterns have led to a significant reduction in physical activity levels. Sedentary behaviors, such as prolonged sitting and lack of exercise, are strongly associated with an increased risk of type 2 diabetes. The consumption of unhealthy diets rich in processed foods, sugary drinks, and saturated fats has become increasingly prevalent. These dietary patterns contribute to weight gain, obesity, and insulin resistance, increasing the risk of developing type 2 diabetes. Rapid urbanization, particularly in developing countries, has led to changes in living environments, food choices, and activity patterns. Urban dwellers often have limited access to green spaces and recreational facilities, contributing to reduced physical activity. Additionally, the availability of inexpensive, processed foods in urban areas further promotes unhealthy dietary habits. The global population is aging, with a growing proportion of individuals in older age groups. As people age, their bodies become less sensitive to insulin, the hormone that regulates blood sugar levels. This insulin resistance can lead to elevated blood sugar levels and eventually type 2 diabetes. Aging is often associated with an increase in visceral fat, the fat that accumulates around the internal organs. Visceral fat is particularly harmful as it releases hormones and other substances that promote insulin resistance and inflammation, increasing the risk of diabetes. Older adults tend to be less physically active than younger individuals, further contributing to the risk of diabetes. Genetic factors play a significant role in the development of diabetes. Certain populations and ethnic groups have a higher genetic susceptibility to diabetes, making them more prone to developing the disease even with moderate lifestyle risk factors. Individuals with a family history of diabetes are at a significantly increased risk of developing the disease themselves. This is because genes related to insulin production, insulin sensitivity, and other metabolic processes can be passed down from parents to their offspring. Certain ethnic groups, such as African Americans, Hispanic Americans, Native Americans, and Asian Americans, have a higher prevalence of diabetes compared to Caucasians. This is likely due to

a combination of genetic, lifestyle, and socioeconomic factors. Limited access to healthcare, particularly in developing countries, is a major barrier to diabetes prevention, early diagnosis, and effective management. This lack of access contributes to the increasing prevalence of diabetes and its complications, including DR. Access to preventative care, such as regular health checkups, screening for diabetes risk factors, and lifestyle counseling, is essential for identifying individuals at risk of diabetes and implementing early interventions. However, in many developing countries, preventative care services are limited or unavailable, particularly in rural areas and among underserved populations. Effective diabetes management involves regular monitoring of blood sugar levels, medication adherence, lifestyle modifications, and education on self-care practices. However, limited access to healthcare can hinder these efforts, leading to suboptimal glycemic control and an increased risk of developing complications like DR. Limited access to healthcare is a critical challenge in many developing countries, posing a significant barrier to the prevention and management of diabetic retinopathy (DR). This restricted access contributes to delayed diagnosis, inadequate treatment, and ultimately, an increased risk of vision loss among individuals with diabetes. Geographic barriers present a formidable obstacle to accessing healthcare, particularly for those living in rural and remote areas of developing countries. Healthcare facilities are often concentrated in urban centers, requiring individuals in rural areas to travel long distances to access care. This can be particularly challenging for those with limited mobility, chronic conditions like diabetes, and those who require frequent follow-up appointments. Reliable and affordable transportation options are often scarce in rural areas. This lack of transportation infrastructure can make it difficult for individuals to reach healthcare facilities, especially for those who rely on public transportation or have limited financial resources. Poor road conditions, inadequate communication networks, and limited access to electricity and clean water can further hinder access to healthcare in remote areas. These infrastructural challenges can make it difficult for healthcare providers to reach communities in need and for individuals to travel to healthcare facilities. The cost of healthcare, including consultations, diagnostic tests, and treatment, can be a significant barrier for many people in developing countries. Many developing countries lack comprehensive health insurance systems, leaving individuals to bear a significant portion of healthcare costs out-of-pocket. These high out-of-pocket costs can be prohibitive for those with limited financial resources, leading to delayed or forgone care. The cost of medications, including insulin and other essential drugs for diabetes management, can be a substantial financial burden for individuals with diabetes. This can lead to poor adherence to treatment regimens, increasing the risk of complications like DR. In addition to direct medical costs, individuals may also incur indirect costs associated with seeking healthcare, such as transportation expenses, lost wages due to time off from work, and childcare costs. These indirect costs can further exacerbate financial constraints and limit access to care. Many developing countries face a shortage of healthcare professionals, including doctors, nurses, and specialists, particularly in rural and underserved areas. This shortage limits the availability of quality healthcare and contributes to delayed diagnosis and treatment of DR. Healthcare professionals tend to be concentrated in urban centers, leaving rural areas with limited access to qualified personnel. This uneven distribution of healthcare workers exacerbates the challenges faced by those living in remote areas. The migration of healthcare professionals from developing countries to developed countries, seeking better opportunities and working conditions, further contributes to the shortage of healthcare workers. This "brain drain" deprives developing countries of much-needed expertise and resources. Limited training opportunities for healthcare professionals in specialized areas, such as ophthalmology and diabetes care, can further restrict access to specialized care for

DR. This lack of specialized training can lead to delayed diagnosis, misdiagnosis, and inadequate treatment. Inadequate awareness of diabetic retinopathy (DR) and its risk factors is a significant public health challenge, particularly in developing countries. This lack of awareness can lead to delayed diagnosis, suboptimal treatment, and an increased risk of vision loss among individuals with diabetes. Many people with diabetes lack a basic understanding of DR, its potential consequences, and the importance of early detection and intervention. Individuals with diabetes may not be aware of DR as a potential complication of their condition. They may not recognize the early signs and symptoms of DR or understand the potential for vision loss if left untreated. Even those who have heard of DR may underestimate its severity and the potential impact on their quality of life. They may not realize that DR is a leading cause of blindness among working-age adults. Some individuals may hold misconceptions about DR, such as believing that it only affects older adults or that it is not a serious condition. These misconceptions can lead to a lack of urgency in seeking medical attention. Many individuals with diabetes are unaware of the risk factors that can increase their likelihood of developing DR. Individuals may not be aware of the modifiable risk factors for DR, such as poor glycemic control, hypertension, dyslipidemia, and smoking. This lack of awareness can hinder their ability to take preventative measures and reduce their risk. Individuals may also be unaware of the non-modifiable risk factors for DR, such as duration of diabetes, age, and family history. This lack of awareness can lead to a false sense of security or a belief that they are not at risk. Individuals may not have received a personalized risk assessment for DR from their healthcare provider. This lack of personalized information can make it difficult for them to understand their individual risk and take appropriate action. Cultural beliefs and practices can influence health behaviors and attitudes towards seeking medical care, potentially contributing to a lack of awareness and a reluctance to address DR. In some cultures, there may be misconceptions about diabetes and its complications, leading to a lack of awareness and a reluctance to seek medical care. For example, some individuals may believe that diabetes is a punishment or a curse, leading to feelings of shame and a reluctance to disclose their condition. Some individuals may rely on traditional healing practices rather than seeking conventional medical care. While traditional practices may have a role in healthcare, they should not replace regular medical checkups and evidence-based treatment for DR. In some cultures, there may be a stigma associated with diabetes and its complications, leading to a reluctance to seek medical attention or disclose their condition to others. This stigma can prevent individuals from receiving the timely care they need. Health education programs on diabetes and its complications, including DR, may be limited in developing countries. This contributes to a lack of awareness and understanding of the importance of prevention and early intervention. Health education programs may be limited due to a lack of resources, such as funding, personnel, and educational materials. This can restrict the reach and effectiveness of these programs. Language barriers can hinder the delivery of health education, particularly in communities where multiple languages are spoken. This can limit individuals' access to information about DR and its prevention. Health education materials may not be culturally appropriate or tailored to the specific needs of different communities. This can reduce their effectiveness in raising awareness and promoting behavior change.[11-14]

Diabetic retinopathy (DR) is a leading cause of vision loss and blindness globally, with a significant impact on individuals, families, and healthcare systems. The risk of developing DR is strongly associated with the duration of diabetes, highlighting the importance of early diagnosis and effective diabetes management in mitigating this risk. The relationship between diabetes duration and DR is well-established, with numerous studies demonstrating a clear correlation between the length

of time a person has diabetes and the likelihood of developing this sight-threatening complication. The longer a person lives with diabetes, the more likely they are to experience microvascular changes in the retina, which can lead to DR. Chronic hyperglycemia, or persistently elevated blood sugar levels, is a hallmark of diabetes and a key driver of microvascular complications, including DR. Over time, chronic hyperglycemia leads to a series of metabolic and cellular changes that damage blood vessels, particularly the small blood vessels in the retina. Hyperglycemia increases the production of reactive oxygen species (ROS), which are highly reactive molecules that damage cells and tissues. ROS can damage the endothelial cells lining blood vessels, leading to inflammation, increased permeability, and impaired blood flow. Advanced Glycation End Products (AGEs) are formed when glucose reacts with proteins and lipids in the body. AGEs can accumulate in blood vessels, causing thickening, stiffness, and dysfunction. This can lead to reduced blood flow to the retina, contributing to the development of DR. Hyperglycemia activates Protein Kinase C (PKC), an enzyme that plays a role in various cellular processes. PKC activation can lead to increased vascular permeability, inflammation, and neovascularization, all of which contribute to the development and progression of DR. Over time, individuals with diabetes may develop other metabolic and hemodynamic abnormalities, such as dyslipidemia, hypertension, and impaired kidney function. These abnormalities can further contribute to the development and progression of DR. Dyslipidemia, characterized by abnormal blood lipid levels, can accelerate the development of atherosclerosis, a condition in which plaque builds up inside blood vessels. Atherosclerosis can narrow or block blood vessels, reducing blood flow to the retina and contributing to DR. Hypertension, or high blood pressure, can damage blood vessels and increase the risk of microvascular complications, including DR. Hypertension can also worsen existing DR and accelerate its progression. Impaired kidney function, also known as diabetic nephropathy, is another common complication of diabetes. Diabetic nephropathy can contribute to the development of DR by increasing blood pressure and promoting fluid retention, which can lead to macular edema, a swelling of the central retina that can cause vision loss. Certain risk factors for DR are directly related to the duration of diabetes. The risk of developing DR increases with age, and older individuals are more likely to have a longer duration of diabetes. The longer a person has diabetes, the higher their risk of developing DR. This is because the cumulative effects of chronic hyperglycemia and other metabolic abnormalities increase over time. Individuals who have previously been diagnosed with DR are at an increased risk of developing more severe forms of DR, such as proliferative DR, which can lead to blindness. The strong association between diabetes duration and DR underscores the importance of early diagnosis and effective diabetes management in minimizing the risk of developing this sight-threatening complication. Early diagnosis of diabetes is crucial to initiate timely treatment and prevent or delay the onset of complications, including DR. Healthcare providers should be vigilant in screening for diabetes, particularly in individuals with risk factors such as obesity, family history of diabetes, and certain ethnic backgrounds. Maintaining good glycemic control is essential for preventing and slowing the progression of DR. This involves regular monitoring of blood sugar levels, adherence to medication regimens, lifestyle modifications, and education on self-care practices. Effective management of comorbidities, such as hypertension, dyslipidemia, and diabetic nephropathy, is also crucial for reducing the risk of DR. This may involve lifestyle modifications, such as diet and exercise, and pharmacological interventions, such as antihypertensive medications and statins. Regular eye exams by an ophthalmologist or other qualified eye care professional are essential for detecting DR in its early stages, when treatment is most effective. The frequency of eye exams may vary depending on individual risk factors, but annual

exams are generally recommended for most individuals with diabetes.[15,16]

Elevated cholesterol levels, often associated with dyslipidemia, have been identified as a significant and independent risk factor for the development and progression of diabetic retinopathy (DR). Dyslipidemia, characterized by abnormal blood lipid levels, including elevated total cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides, is a well-established risk factor for various microvascular complications of diabetes, with DR being a prominent one. The association between elevated cholesterol levels and DR is supported by a growing body of evidence from clinical studies and experimental research. The endothelium, a thin layer of cells lining the inner surface of blood vessels, plays a crucial role in regulating vascular tone, permeability, and inflammation. Dyslipidemia can impair endothelial function, leading to a series of events that contribute to the development of DR. Elevated cholesterol levels, particularly oxidized LDL cholesterol, can increase the production of reactive oxygen species (ROS), which are highly reactive molecules that damage cells and tissues. ROS can damage the endothelium, leading to inflammation, increased permeability, and impaired blood flow. Dyslipidemia can trigger inflammation in the blood vessels, further contributing to endothelial dysfunction. Inflammatory mediators can promote the adhesion of white blood cells to the endothelium, leading to the release of additional ROS and further damage to the blood vessels. Nitric oxide (NO) is a potent vasodilator that helps to regulate blood flow and maintain vascular health. Dyslipidemia can reduce NO availability, leading to vasoconstriction, impaired blood flow, and increased oxidative stress. The blood-retinal barrier (BRB) is a semi-permeable barrier that separates the circulating blood from the retina, protecting the delicate retinal tissues from harmful substances. Dyslipidemia can disrupt the integrity of the BRB, leading to leakage of fluid and macromolecules into the retina, contributing to macular edema, a swelling of the central retina that can cause vision loss. Elevated cholesterol levels can increase the permeability of retinal blood vessels, allowing fluid and other substances to leak into the retinal tissue. This can lead to macular edema, a common cause of vision loss in DR. Inflammation associated with dyslipidemia can further disrupt the BRB, exacerbating vascular permeability and contributing to macular edema. Elevated cholesterol levels can lead to the deposition of lipids in the walls of retinal blood vessels, contributing to atherosclerosis, a condition in which plaque builds up inside blood vessels. Atherosclerosis can narrow or block blood vessels, reducing blood flow to the retina and contributing to the development of DR. The accumulation of lipids and inflammatory cells in the retinal blood vessels can lead to microvascular occlusion or blockage of the small blood vessels. This can result in retinal ischemia, or lack of oxygen supply to the retina, which can trigger the growth of new, abnormal blood vessels (neovascularization), a hallmark of proliferative DR. Retinal ischemia can stimulate the production of vascular endothelial growth factor (VEGF), a protein that promotes the growth of new blood vessels. In DR, VEGF can lead to the formation of fragile, leaky blood vessels that can bleed into the retina or vitreous, causing severe vision loss. The recognition of elevated cholesterol levels as an independent risk factor for DR emphasizes the importance of managing dyslipidemia in individuals with diabetes to reduce the risk of developing this sight-threatening complication. Lifestyle modifications, such as diet and exercise, are essential for managing dyslipidemia and reducing the risk of DR. A healthy diet low in saturated and trans fats, cholesterol, and simple sugars can help to lower cholesterol levels and improve overall cardiovascular health. Regular physical activity can help to lower LDL cholesterol, raise high-density lipoprotein (HDL) cholesterol, and improve insulin sensitivity, all of which can contribute to reducing the risk of DR. In some cases, lifestyle modifications alone may not be sufficient to manage dyslipidemia. Pharmacological interventions, such as statin therapy, may be necessary to lower cholesterol levels and reduce the

risk of DR. Statins are a class of medications that inhibit the enzyme HMG-CoA reductase, which is involved in cholesterol synthesis. Statins are effective in lowering LDL cholesterol and have been shown to reduce the risk of cardiovascular events in individuals with diabetes. Other lipid-lowering medications, such as fibrates and bile acid sequestrants, may also be used in conjunction with statins or as alternative therapies for managing dyslipidemia. Regular monitoring of blood lipid levels is essential for individuals with diabetes, particularly those with dyslipidemia. This allows for timely adjustments to lifestyle modifications or pharmacological interventions to ensure optimal cholesterol control.[17,18]

Older age is a well-established and independent risk factor for the development and progression of diabetic retinopathy (DR). The prevalence of DR increases steadily with age, reflecting the cumulative impact of diabetes and other age-related factors on the delicate retinal vasculature. As individuals age, their blood vessels undergo various changes that make them more susceptible to damage, increasing the risk of microvascular complications such as DR. Additionally, older individuals often have a longer duration of diabetes, further compounding their risk. The association between older age and DR is supported by extensive epidemiological data and clinical observations. Aging is associated with a variety of vascular changes that can increase the risk of DR. As people age, their blood vessels lose elasticity and become less flexible. This reduced flexibility can impair blood flow, particularly in the small blood vessels of the retina, making them more prone to damage and leakage. Aging can also lead to increased stiffness of blood vessels, further compromising blood flow and increasing the risk of microvascular complications. The endothelium, the thin layer of cells lining the inner surface of blood vessels, plays a crucial role in regulating vascular tone, permeability, and inflammation. Aging can impair endothelial function, leading to increased oxidative stress, inflammation, and reduced nitric oxide availability, all of which contribute to the development of DR. Older individuals with diabetes often have a longer duration of diabetes, which increases their exposure to the chronic hyperglycemia and metabolic abnormalities that drive the development of DR. Chronic hyperglycemia, or persistently elevated blood sugar levels, is a hallmark of diabetes and a key driver of microvascular complications, including DR. Over time, chronic hyperglycemia leads to a series of metabolic and cellular changes that damage blood vessels, particularly the small blood vessels in the retina. Older individuals with diabetes may also have a higher prevalence of other metabolic abnormalities, such as dyslipidemia, hypertension, and impaired kidney function. These abnormalities can further contribute to the development and progression of DR. Older adults are more likely to have other age-related comorbidities, such as cardiovascular disease, kidney disease, and cognitive impairment, which can further increase their risk of DR. Cardiovascular disease, including coronary artery disease, stroke, and peripheral artery disease, is a major cause of morbidity and mortality in older adults. Cardiovascular disease can also increase the risk of DR by impairing blood flow and promoting inflammation. Kidney disease, including diabetic nephropathy, is another common comorbidity in older adults with diabetes. Kidney disease can contribute to the development of DR by increasing blood pressure and promoting fluid retention, which can lead to macular edema. Cognitive impairment, including dementia, can affect an individual's ability to manage their diabetes effectively, leading to poor glycemic control and an increased risk of complications, including DR. As people age, their physiological reserve, or the body's ability to adapt to stress and maintain homeostasis, declines. This reduced reserve can make older adults more vulnerable to the damaging effects of diabetes and other age-related factors on the retinal vasculature. Aging can impair the body's natural repair mechanisms, making it more difficult to recover from damage to the retinal blood vessels. Older adults may have a reduced capacity to

neutralize reactive oxygen species (ROS), increasing their susceptibility to oxidative stress and its damaging effects on the retinal vasculature. Implications for DR Management and Prevention in Older Adults The increased risk of DR in older adults highlights the importance of proactive and comprehensive management strategies to prevent vision loss and improve quality of life. Older adults with diabetes should undergo more frequent and comprehensive eye exams to detect DR in its early stages. This may involve the use of advanced imaging techniques, such as optical coherence tomography (OCT) and fluorescein angiography, to assess the extent of retinal damage. Maintaining optimal glycemic control is crucial for preventing and slowing the progression of DR in older adults. This may require individualized treatment plans and close monitoring of blood sugar levels. Effective management of age-related comorbidities, such as cardiovascular disease, kidney disease, and cognitive impairment, is essential for reducing the risk of DR and its progression. Lifestyle modifications, such as diet and exercise, can help to improve cardiovascular health, reduce oxidative stress, and enhance physiological reserve, potentially mitigating the risk of DR in older adults. Patient education and empowerment are crucial for promoting self-care practices and adherence to treatment regimens. Older adults with diabetes should be actively involved in their care and encouraged to adopt healthy lifestyle habits.[19,20]

5. Conclusion

This study conducted at a tertiary care center in Padang, Indonesia revealed a high prevalence of diabetic retinopathy (DR) among diabetic patients. The study identified several key risk factors for DR, including longer diabetes duration, elevated cholesterol levels, and older age. These findings underscore the critical importance of early detection and effective management of DR to prevent vision loss in this population.

6. References

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