

## The Relationship Between Blood Sugar And Severity Of Diabetic Retinopathy In Type 2 Diabetes Mellitus Patients

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Article Info	ABSTRACT
<b>Keywords:</b> Blood sugar, Diabetic retinopathy, Diabetes mellitus	DM will trigger the emergence of complications, both macrovascular and microvascular. Diabetic retinopathy is one of the most common eye complications in diabetes mellitus patients. The research was carried out by collecting secondary data from various research journal sources for 2020-2024. The results of the study show that there is a relationship between blood sugar and the severity of diabetic retinopathy in type 2 Diabetes Mellitus patients, so by controlling glycemia, namely HbA1c, it can prevent the severity of diabetic retinopathy.
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### INTRODUCTION

DM will trigger the emergence of complications, both macrovascular and microvascular. Complications in diabetes mellitus are broadly divided into two, namely macro vascular and micro vascular complications. 3,4 Macro vascular complications include diseases of the cardiovascular system, cerebro vascular system and peripheral blood vessels. Micro vascular complications are complications that occur in small blood vessels such as diabetic retinopathy and diabetic nephropathy.

Diabetic retinopathy is one of the most common eye complications in diabetes mellitus patients in Indonesia which causes blindness and is one of the current priorities of the vision impairment prevention program by the Indonesian Ministry of Health. and there is a big risk of causing blindness. Behind macular degeneration, glaucoma and cataracts as the main causes of blindness worldwide, diabetic retinopathy is in fourth place. 6 Diabetic retinopathy (DR) is the second most frequent cause of microvascular complications, namely 33.33% besides gangrene (50%) , gastritis (5.56%), and heart disease (11.11%).

Diabetic retinopathy can be predicted to occur, although around 80% of diabetes patients will experience diabetic retinopathy. 8 The World Health Organization (WHO) reports that 422 million people globally suffer from diabetes mellitus as of May 2020. Countries in the Arab-North African region and the Western Pacific occupy the rankings. first and second with the highest prevalence of diabetes in the population aged 20-79 years among 7 regions in the world, namely 12.2% and 11.4%. The Southeast Asia region, where Indonesia is located, is ranked 3rd with a prevalence of 11.3%. Indonesia is ranked

7th among the 10 countries with the highest number of diabetes mellitus sufferers. Indonesia is the only country in Southeast Asia on the list, so it is estimated that Indonesia's contribution to the prevalence of diabetes mellitus cases in Southeast Asia is very large. The World Health Organization (WHO) estimates that the number of diabetes mellitus sufferers in Indonesia is high, namely 8.4 million in 2000, experiencing a spike of around 21.3 million in 2030. Likewise, according to the World Diabetes Association, there will be an increase in the prevalence of diabetes mellitus in Indonesia, namely 9.1 million in 2014 to 14.1 million in 2035.

Carrying out blood sugar checks can be an effort to overcome diabetes mellitus. Apart from that, it can also avoid complications between Non-Proliferative Diabetic Retinopathy (NPDR) and Proliferative Diabetic Retinopathy (PDR). When checking blood sugar levels, patients are advised to fast. The check cannot be used as a measure of the average blood sugar level in the last three months.

## METHOD

In patients with Type 2 Diabetes Mellitus, the management of blood sugar levels is crucial in preventing complications, including diabetic retinopathy, a leading cause of vision loss. Diabetic retinopathy occurs when prolonged high blood sugar levels cause damage to the blood vessels in the retina, leading to vision impairment. Literature reviews on this topic highlight a significant correlation between poor glycemic control and the severity of diabetic retinopathy. Studies suggest that maintaining blood sugar levels within recommended ranges can significantly reduce the risk and progression of this condition. Effective management strategies, such as consistent monitoring, medication adherence, and lifestyle modifications, are essential to prevent the advancement of diabetic retinopathy in diabetic patients.

The literature also emphasizes the importance of early detection and regular eye examinations for individuals with Type 2 Diabetes Mellitus. Early-stage diabetic retinopathy often presents without symptoms, making routine screenings vital for timely intervention. Research indicates that patients with better-controlled blood sugar levels are less likely to develop severe forms of retinopathy. This underscores the need for comprehensive diabetes management programs that focus not only on blood sugar control but also on regular eye health assessments. By integrating these approaches, healthcare providers can better manage and mitigate the impact of diabetic retinopathy, improving the overall quality of life for diabetic patients.

## DISCUSSION

### Blood Sugar Levels

Throughout the day glucose levels in the blood will fluctuate and increase after consuming food. Glucose levels are at their lowest levels in the morning before eating or before the first meal of the day. At that time, the pancreas will continue to secrete insulin in small amounts, while glucagon is released when blood glucose levels decrease and stimulates it to release its glucose reserves so that insulin and glucagon communicate to maintain blood

sugar levels together.

Checking blood glucose levels can be used as a benchmark to establish a person's diabetes status. Apart from that, checking blood glucose levels is also used to monitor blood glucose levels. The recommended blood glucose level check is using venous blood plasma. However, checking blood glucose levels can also be done by checking capillary blood glucose with a glucometer. Capillary blood glucose examination can be carried out if it is not possible and there are no facilities to carry out venous plasma blood glucose examination.

The World Health Organization (WHO), states that the prevalence of normal instantaneous blood glucose (GDS) 2 hours after eating ranges from 80-180 mg/dl. ideal conditions are 80-144 mg/dl. Temporary blood glucose (GDS) in adequate conditions is 145-179 mg/dl. Temporary blood glucose (GDS) in bad conditions is 180 mg/dl (still in the safe category).

The reference value for normal blood glucose is <110 mg/dl. For diabetes above 200 mg/dl. However, actually whether blood glucose levels are normal or not in the blood can change over time, such as before eating and after eating. The normal value of blood sugar levels at any time when not eating for 8 hours (fasting) is <100 mg/dl, before eating 70-130 mg/dl, after eating (1-2 hours) <180 mg/dl and before going to bed 100- 140 mg/dl. Methods for checking fasting blood glucose (GDP), random blood glucose (GDS) and glucose 2 hours after eating are used to check instant blood sugar. Blood glucose levels need to be checked. Blood glucose examination can be carried out using enzymatic, chemical and strip methods.

Uncontrolled blood glucose levels in diabetes mellitus patients will cause various complications, both acute and chronic. At very high blood glucose levels (at KAD 300-600 mg/dL, at SHH 600-1200 mg/dL), acute complications of the patient are usually unconsciousness with a high death rate, and acute complications such as macroangiopathy, heart attack, stroke, diabetic retinopathy (affecting the retina of the eye) and diabetic nephropathy (affecting the kidneys), eyes, glaucoma, decreased sense of smell, susceptibility to tuberculosis (TB), and diabetic foot/ulcers. Therefore, it is very important for patients to monitor their blood glucose levels regularly.

### **Diabetic Retinopathy**

Diabetic Retinopathy (RD) is an eye disorder experienced by diabetes patients, caused by damage to retinal capillaries at various levels. Retinopathy is progressive and is associated with prolonged hyperglycemia which will ultimately cause visual impairment and even blindness. Epidemiological research in America, Australia, Europe and Asia reports that the number of diabetic retinopathy sufferers will increase from 100.8 million in 2012 to 154.9 million in 2030 with 30% of them at risk of blindness. In Indonesia itself, The Diab Care Asia 2008 Study involving 1,785 diabetes mellitus sufferers at 18 primary and secondary health centers in Indonesia reported that 42% of diabetes mellitus sufferers will experience retinopathy complications and 6.4% of them will have proliferative diabetic retinopathy.

Diabetic retinopathy is classified into several stages, namely the non-proliferative

stage and the proliferative stage. The non-proliferative diabetic retinopathy (NPDR) stage is characterized by changes in intraretinal vascularization, while the proliferative diabetic retinopathy (PDR) stage is characterized by the presence of neovascularization due to ischemia. Diabetic retinopathy that develops progressively will cause various symptoms that usually affect both eyes. The symptoms according to the American Academy of Ophthalmology are an increase in the number of floaters, namely shadows like spots or lines in the vision, blurry vision, vision that can change periodically from blurry to clear, blank or dark areas in the field of vision, decreased vision at night. days, disturbances in color vision and decreased or loss of vision.

Management of diabetic retinopathy is divided into two, namely non-proliferative and proliferative diabetic retinopathy. Mild-moderate non-proliferative diabetic retinopathy generally does not have a specific treatment, but to reduce the risk of becoming advanced retinopathy by routinely controlling blood sugar, blood pressure, fat and observing every year to see its progress. Then, in the severe stage of non-proliferative diabetic retinopathy, observation is carried out every six months to see whether there are signs of progression from non-proliferative to proliferative. In addition, to prevent progression with a high risk of proliferative retinopathy, pan-retinal laser photocoagulation (PRP) therapy can be performed but taking into account the patient's condition.

c. The relationship between blood sugar and the severity of Diabetic Retinopathy in type 2 Diabetes Mellitus patients

Over time, chronic damage to blood vessels and body tissues due to high blood sugar levels can cause various pathological changes in the eyes. 17 The laboratory indicator used is the average Fasting Blood Sugar (GDP) level in the last 3 examinations (normal: average average GDP <126 mg/dl, abnormal: average GDP  $\geq$ 126 mg/dl), so if blood sugar is within normal limits for a long time it will accelerate the severity of DR. 19 Several mechanisms explain the relationship between duration of DM and The risk of RD involves damage to blood vessels (angiopathy) with the mechanism of prolonged exposure to high blood glucose which can damage the walls of small blood vessels in the retina. This can cause structural changes, such as thickening or widening of blood vessels, which can trigger RD. Then through inflammatory and oxidative processes that can damage endothelial cells and trigger inflammatory reactions in retinal blood vessels, which ultimately contributes to the development of RD. Besides that. Retinal vascular proliferation occurs due to prolonged exposure to diabetes, causing retinal vascular proliferation, namely the growth of new, abnormal blood vessels. These blood vessels can leak easily and cause edema and bleeding in the eye.

Research conducted by Kristin W, et al (2020) in her research entitled Analysis of Comorbid Factors for Type II Diabetes Mellitus Based on HbA1c Parameters found that there is a correlation between HbA1c levels and the severity of diabetic retinopathy (RD) in type 2 diabetes patients. 18, this study found that there was a correlation between the number of diabetic retinopathy (RD) incidents and the progression to proliferative diabetic retinopathy (PDR).

Research conducted by Nafia NK, et al (2021), found that there was a significant

relationship between blood sugar control in research subjects and the incidence of diabetic retinopathy in people with type 2 diabetes mellitus ( $p=0.014$ ). The results of this study confirm previous studies by Rajalakshmi et al and Na Li et al, which proved that controlling blood sugar is related to the incidence of diabetic retinopathy. This happens because in respondents whose blood sugar is high (hyperglycemia) and is not even controlled, it can trigger an increase in free radicals such as Advanced Glycation End-products (AGE), sorbitol, and Reactive Oxygen Species (ROS). This increase in free radicals can disrupt circulation, cause hypoxia and retinal inflammation. In addition, high levels of ROS will activate poly-(ADP-ribose)-polymerase (PARP). Then PARP inhibits glyceraldehyde phosphate dehydrogenase (GAPDH), resulting in accumulation of glycolytic metabolites. These metabolites then activate AGE, Protein Kinase C (PKC), polyol, and hexosamine pathways, thus worsening the retinopathy condition. Respondents who suffer from diabetic retinopathy with uncontrolled blood sugar are due to the respondent not paying attention to their diet and the respondent's lack of compliance with taking medication.

One factor that can be changed to prevent the severity of RD is by controlling glycemic regularly. HbA1c is defined as glycated hemoglobin which is used to evaluate a person's glucose levels, so that diabetes mellitus patients can be monitored properly. Blood sugar levels (HbA1c) and the severity/grade of diabetic retinopathy are significantly related in type 2 diabetes mellitus patients. The higher the HbA1c level will increase the severity of the degree of diabetic retinopathy.

## CONCLUSION

Diabetic Retinopathy (RD) is an eye disorder experienced by diabetes patients, caused by damage to retinal capillaries at various levels. In this discussion, it has been identified that there is a relationship between blood sugar and the severity of Diabetic Retinopathy in type 2 Diabetes Mellitus patients, so by controlling glycemia, namely HbA1c, it can prevent the severity of diabetic retinopathy.

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