



THE RELATIONSHIP BETWEEN BLOOD GLUCOSE LEVELS AND VISUAL ACUITY IN DIABETES MELLITUS PATIENTS IN TOTO KABILA REGIONAL HOSPITAL

HUBUNGAN KADAR GLUKOSA DARAH DENGAN KETAJAMAN PENGLIHATAN PADA PENDERITA DIABETES MELITUS DI RSUD TOTO KABILA

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Abstract

Diabetes Mellitus (DM) is a chronic disease caused by a lack of insulin production by the pancreas or the insulin produced cannot be used effectively by the body . This causes the formation of microaneurysms in the retinal blood vessels which make the blood vessels fragile and easily ruptured, causing visual impairment in the form of decreased visual acuity. The general objective of this study was to determine the relationship between blood glucose levels and visual acuity in patients with diabetes mellitus at Toto Kabila Hospital. This research uses a quantitative research type with a research design. *descriptive analytical* using *cross sectional* approach method . The population in this study were DM patients who visited the Eye Polyclinic at Toto Kabila Hospital and the sample in this study used the technique *accidental sampling* with a total of 87 samples. The instrument in this study used an observation sheet. The data analysis technique used the *chi-square* test . obtained value $p\text{-value} = 0.000$ which means there is a relationship between blood glucose levels and visual acuity in diabetes mellitus patients at Toto Kabila Regional Hospital .

Keywords : Diabetes Mellitus, Blood Glucose Levels, Visual Acuity

Abstrak

Diabetes Mellitus (DM) merupakan salah satu penyakit kronik yang diakibatkan karena kekurangan produksi insulin oleh pankreas atau insulin yang diproduksi tidak dapat digunakan secara efektif oleh tubuh. Hal ini menyebabkan terbentuknya mikroaneurisma pada pembuluh darah retina yang membuat pembuluh darah rapuh dan mudah pecah sehingga menimbulkan gangguan penglihatan



berupa penurunan ketajaman penglihatan. Tujuan umum penelitian ini yaitu untuk mengetahui hubungan kadar glukosa darah dengan ketajaman penglihatan pada penderita diabetes melitus Di RSUD Toto Kabila. Penelitian ini menggunakan jenis penelitian kuantitatif dengan desain penelitian deskriptif analitik dengan menggunakan metode pendekatan cross sectional. Populasi dalam penelitian ini adalah penderita DM yang berkunjung di Poli Mata di RSUD Toto Kabila dan sampel dalam penelitian ini menggunakan teknik accidental Sampling dengan jumlah 87 sampel. Instrumen dalam penelitian ini menggunakan lembar observasi. Teknik Analisa data menggunakan uji chi-square diperoleh nilai pvalue = 0.000 yang berarti terdapat hubungan kadar glukosa darah dengan ketajaman penglihatan pada penderita diabetes melitus Di RSUD Toto Kabila.

Kata Kunci : Diabetes Melitus, Kadar Glukosa darah, Ketajaman penglihatan

1. INTRODUCTION

Diabetes Mellitus (DM) is a chronic disease caused by a lack of insulin production by the pancreas or insulin produced cannot be used effectively by the body. Insulin is a hormone that functions to maintain the balance of blood sugar levels. Lack of insulin in the body can result in an increase in glucose concentration in the blood (hyperglycemia). DM can be divided into two categories, namely type 1 and type 2. Type 1 DM is caused by a lack of insulin production, while type 2 is caused by less effective use of insulin (Donggala, 2019).

Based on data published by *the World Health Organization* (WHO), 2022 Diabetes will be one of the top 10 causes of death worldwide by 2022 (WHO, 2022) and *the International Diabetes Federation* shows that the prevalence of diabetes mellitus continues to increase every year, and also by 2021 worldwide there will be 537 million adults suffering from it. diabetes and will continue to increase. Diabetes has caused 6.7 million deaths in 2021 (*International Diabetes Federation*, 2022). Indonesia ranks fifth in the number of diabetes sufferers worldwide.

The report of the results of the Basic Health Research (RISKESDAS) in 2018 by the Ministry of Health, there was an increase in the prevalence of DM to 8.5%, this increase is in line with the prevalence of obesity which is one of the risk factors for diabetes, which is 14.8% in the 2013 RISKESDAS data to 21.8% in 2018. The data above show that the number of DM sufferers in Indonesia is very large and is a heavy burden to be handled by specialist/subspecialist doctors or even by all health workers. In Indonesia, there are four provinces with the highest prevalence in 2013 and 2018, namely DI Yogyakarta, DKI Jakarta, North Sulawesi, and East Kalimantan. In 2018, Gorontalo was one of the areas that experienced the highest increase in prevalence of 0.9%, besides Riau, DKI Jakarta, Banten, and West Papua (Riskesdas, 2018).

The Gorontalo Provincial Health Service shows data that the prevalence of diabetes mellitus cases in Gorontalo Province has increased significantly. Based on the latest data in 2024, there were 10,735 DM sufferers in Gorontalo Province. Bone Bolango Regency is the regency with the first rank of Diabetes Mellitus sufferers, which is 3,574 sufferers. Based on data from Toto Kabila Hospital from January-June 2024, 147 sufferers visited Toto Hospital



in the eye clinic, while 87 people suffered from Diabetes Mellitus, including 23 people suffering from diabetic retinopathy.

People with Diabetes Mellitus will definitely experience hyperglycemia and will have an impact on complications, especially in the eyes, namely cataracts, glaucoma and diabetic retinopathy. This causes the formation of microaneurysms in the retinal blood vessels which make the blood vessels fragile and easily ruptured, causing visual impairment in the form of decreased visual acuity (Dewi, 2021) .

One of the eye diseases that can cause blindness is diabetic retinopathy. Diabetic retinopathy (DR) is one of the microvascular complications of diabetes mellitus due to uncontrolled blood sugar and prolonged occurrence. That the incidence of diabetic retinopathy will be higher in elderly diabetics. However, glycemic control factors, HDL, LDL, and blood pressure also have an important role. Age > 50 years is a significant risk factor for diabetic retinopathy. However, diabetic retinopathy which is very dangerous and causes blindness has a relatively low prevalence. The earlier a person has diabetes, the more likely they are to experience microvascular complications, including diabetic retinopathy (Aisyah, 2021)

Throughout the world, both in developed and developing countries, diabetes mellitus is a chronic metabolic problem. A person suffering from diabetes mellitus cannot oxidize carbohydrates because the normal insulin mechanism is disrupted. Microvascular such as abnormalities in the retina of the eye and the glomerulus of the kidneys and nerves, and macrovascular blockages in the myocardium and cerebral and peripheral blood vessels, are one of the many complications of diabetes mellitus. One of the most common complications of diabetes mellitus is diabetic retinopathy. This is a result of hyperglycemia that occurs in a short period of time, which causes physiological changes that cause endothelial damage. These physiological changes cause the endothelium to be fragile due to the thickness of the visible basal membrane of the endothelium as well as the retina when they pass through blood vessels (Lahayati, 2023) .

Based on the phenomenon that people with diabetes mellitus experience eye problems, such as many cases of cataracts, glaucoma, and diabetic neuropathy, it shows that age , gender, duration of diabetes mellitus sufferers, and hyperglycemia can affect these eye problems. Indonesia is one of the countries with the highest number of cataract sufferers, at 1.5 % . The number of cases of need in 2013 was 3.5% at the age of 55-64 years and 8.4% at the age of over 75 years, which is a public health problem. The number of blindness in East Java reached 141,132 in the last five years, with decreased visual acuity (Dela, 2019) . It is projected that the increase in the population of diabetes mellitus will reach 578 million in 2030 and 700 million in 2045. Diabetic retinopathy occurs in all people with diabetes mellitus along with age and duration of the disease. Between the ages of 20 and 64 years, diabetic retinopathy is a productive age. India has 18% of diabetic retinopathy and the United States is around 28.5 % . However, many studies have been conducted on the prevalence of diabetic retinopathy in various regions of Indonesia. In 2017, 43.1% of diabetic retinopathy cases were found in various regions in Indonesia (Reubun, 2022) .



Syawal's research (2019) found that 78% of cataract sufferers in Diabetes Mellitus patients experienced a sharp decrease in vision. Sartiwi's research (2018) found that 53.2 % of post-diabetic cataract surgery patients had abnormal blood sugar levels, and more than half, or 53.2%, experienced poor vision. In Sidorejo Village, Jabung District, Malang Regency, there was a phenomenon of sharp decrease in vision in Type 2 Diabetes Mellitus patients, who also had high blood glucose levels .

The impact of decreased visual acuity can provide changes in living habits that have various impacts such as elderly people who have impaired vision and will also limit their intensity in joining their friends and later have an impact on the lack of social involvement in interacting. Unable to respond to signals in the function of vision so that they cannot respond properly and can endanger themselves and also have an impact on daily life, especially social (Novita, 2023) .

Based on initial observations, it was found that 3 people with diabetes mellitus were found in the eye clinic of Toto Kabila Hospital, all three experienced decreased visual acuity accompanied by the use of eyeglasses . In addition, the three patients also complained that the decreased visual acuity they felt greatly affected their daily activities.

Based on these problems, the researcher is interested in conducting research related to "The Relationship between Blood Glucose Levels and Visual Acuity in Diabetes Mellitus Patients at Toto Kabila Regional Hospital".

2. RESEARCH METHOD

In the discussion of this paper, the type of research used is the Sharia legal approach. The data used in this paper is by using references from journals, books, and other articles related to the title of the paper to be discussed.

3. RESULTS AND DISCUSSION

Research result

Respondent Characteristics

In this study, 87 respondents were selected from Toto Kabila Regional Hospital. From all the respondents, a description of their characteristics including gender, age, education and occupation is obtained . This can be seen in the following table:

Table 4.1 Respondent Characteristics by Gender

No	Gender	Amount (n)	Percentage (%)
1	Man	35	40.2
2	Woman	52	59.8
Total		87	100

Source: Primary Data, 2024



From the results of the study on the distribution of respondents based on gender, it is known that of the 87 respondents, the largest gender was female with a total of 52 respondents (59.8 %).

Table 4.2 Respondent Characteristics by Age

No	Age	Amount (n)	Percentage (%)
1	26-35 Years	1	1.1
2	36-45 Years	30	34.5
3	46-55 Years	33	37.9
4	56-65 Years	18	20.7
5	>65 Years	5	5.8
Total		87	100

Source: Primary Data, 2024

From the results of the study on the distribution of respondents based on age, it is known that of the 87 respondents, the largest age group was 46-55 years with a total of 33 respondents (37.9 %).

Table 4.3 Respondent Characteristics by Occupation

No	Work	Amount (n)	Percentage (%)
1	Laborer	6	6.9
2	Teacher	4	4.6
3	Self-employed	8	9.2
4	Farmer	21	24.1
5	Housewife	48	55.2
Total		87	100

Source: Primary Data, 2024

From the results of the study on the distribution of respondents based on their occupation, it is known that of the 87 respondents, the largest occupation was housewife with a total of 48 respondents (55.2 %).

Table 4.4 Respondent Characteristics based on Education

No	Education	Amount (n)	Percentage (%)
1	SD	63	72.4
2	JUNIOR HIGH SCHOOL	13	14.9
3	SENIOR HIGH SCHOOL	6	6.9
4	Bachelor	5	5.8
Total		87	100

Source: Primary Data, 2024



From the results of the study on the distribution of respondents based on education, it is known that of the 87 respondents, the largest education was elementary school with a total of 63 respondents (72.4 %).

Univariate Analysis

Table 4.5 Univariate Analysis of Blood Glucose Levels

No	Blood Glucose Levels	Amount (n)	Percentage (%)
1	Controlled	47	54.9
2	Not controlled	40	45.1
Total		87	100

Source: Primary Data, 2024

From the research results based on blood glucose levels, it is known that of the 87 respondents, the highest blood glucose level was Controlled (<126 mg/dl) with a total of 47 respondents (54.9 %).

Table 4.6 Univariate Analysis of Visual Acuity

No	Visual Acuity	Amount (n)	Percentage (%)
1	Normal	30	34.5
2	Abnormal	57	65.5
Total		87	100

Source: Primary Data, 2024

From the research results based on visual acuity, it was found that of the 87 respondents, the most visual acuity was abnormal, with a total of 57 respondents (65.5 %).

Bivariate Analysis

Table 4.7 Relationship between Blood Glucose Levels and Visual Acuity in Diabetes Mellitus Patients at Toto Kabila Regional Hospital

Blood Glucose Levels	Visual Acuity				n	%	P value
	Normal		Abnormal				
	n	%	n	%			
Controlled	30	34.5	57	20.7	57	55.2	0,000
Not controlled							
Total	30	34.5	57	65.8	87	100	

Source: Primary Data, 2024



Based on the results of the study, it shows that blood glucose levels and visual acuity in patients with diabetes mellitus at Toto Kabila Regional Hospital obtained *chi-square* test results of 0.000 (< 0.05), which means that there is a relationship between blood glucose levels and visual acuity in patients with diabetes mellitus at Toto Kabila Regional Hospital.

Discussion

Blood Glucose Levels in Diabetes Mellitus Patients at Toto Kabila Regional Hospital

Based on the results The research conducted on 87 respondents found the highest blood glucose levels, namely Controlled (< 126 mg/dl) with a total of 47 respondents (54.9 %). And uncontrolled (≥ 126 mg/dl) with a total of 40 respondents.

Blood glucose levels are influenced by various factors including lifestyle, diet, physical activity, and medication. This is in line with Khartini's research (2019), stating that the increase in control of blood sugar levels in patients was due to respondents appearing to have an average increase in subject knowledge, compliance with the diet given, physical activity recommendations and taking medication.

In this study, the occupation of patients with type II diabetes mellitus was as a housewife (IRT). The results of this study are supported by Isnaini and Ratnasari (2018), who stated that work is related to physical activity and sports activities. Housewives do several activities at home such as washing, cooking and cleaning the house and many activities that cannot be described. Physical activity will affect the increase in insulin so that blood sugar levels will decrease. If insulin is not enough to convert glucose into energy, DM will occur. work as a housewife is included in light activities. In line with research conducted by Maharani, Suryono and Ardiyanto (2018), that people with poor physical activity (54.8%) have a greater risk of suffering from type II DM compared to people who have good activity.

The blood glucose levels are not Controlled (> 126 mg/dl) as many as 40 respondents (45.1 %). Blood sugar levels are high (uncontrolled) in respondents. Uncontrolled blood glucose levels in diabetes mellitus patients can trigger various complications of the disease. Complications of the disease The diseases that are generally caused are diseases related to the worsening of blood vessel conditions such as cardiovascular disease, kidney disorders, and stroke. Furthermore, uncontrolled blood glucose levels can cause several unexpected clinical symptoms such as dizziness, tingling, pain, fatigue, blurred vision, etc. Unwanted complications of the disease and clinical symptoms due to uncontrolled blood glucose levels can affect the patient's quality of life. The patient's quality of life will worsen if blood glucose levels cannot be controlled within the normal range.

In this study, blood glucose levels were influenced by age factors. DM sufferers were found to be 46-55 years old (early elderly). The elderly experience a decline in cognitive function in elderly people with DM quite strongly, and women experience a more significant decline in cognitive function than men. Another study proved that elderly people with good blood sugar control are slower to experience cognitive dysfunction. The results of this study are in accordance with Fatimah's research (2015), showing that age > 45 years is susceptible to DM, Masrurroh (2018) there is a correlation between age and blood glucose levels in patients



with DMT2 at the Internal Medicine Polyclinic of Dr. Iskak Tulungagung Hospital. High blood glucose levels are found in the elderly, also found in the majority of certain genders.

Females were more likely to have type II diabetes mellitus than males in this study. Other studies also say the same thing. The results of this study are supported by Susanti (2019), which was conducted from 89 people with type II DM, 68 people (76.4%) were women. Akhsyari and Rahayuningsih (2017), in their study, found that from a sample of 99 people, 54.5 % were women. The number of women suffering from DM compared to men is greater. This is because the estrogen hormone is a hormone that women have, which if decreased can affect blood glucose levels.

This is in line with research conducted by Komariah 2020. The results of the study showed that age was related to blood sugar levels ($p\text{-value} = 0.004$).

Visual Acuity in Diabetes Mellitus Patients at Toto Kabila Regional Hospital

From the research results based on visual acuity, it is known that of the 87 respondents, the most visual acuity was abnormal with a total of 57 respondents (65.5%) and normal with 30 respondents (34.5%).

Diabetes is the main cause of visual acuity in people aged 40-60 years. The risk of vision loss in people with diabetes is 25 times higher than in people without diabetes. Some risk factors that can cause decreased visual acuity include; duration of diabetes mellitus, occupation, eye disease, age (Lahayati, 2023).

This is in line with research conducted by Juniar Anungrah in 2013 with the results that a person with DM is 12 times at risk of experiencing visual acuity disorders with the results of the *chi-square test* $P = 0.015$ showing that there is a significant relationship between age and visual acuity.

According to the 2018 Basic Health Research, age is one of the natural risk factors. Age factors clearly affect a person's health condition. This also affects eye behavior. According to the 2018 Basic Health Research, the higher the age of a patient with DM, the greater the risk of experiencing a sharp decline in vision. This is because the older a person is, the slower the process of regenerating eye cells and there is a decrease in the function of body organs that support the supply of nutrients to the eyes such as impaired digestion in absorbing vitamin sources, inadequate cardiovascular to reach parts of the eye organs that are exacerbated by arteriosclerosis.

Meanwhile, according to research conducted by Dela (2019), it was found that the increase in the incidence of visual acuity decline at the age of 40-60 years was 50%. The various research results above are continuously in line with the results of this study with the results that there is a significant relationship between age and visual acuity in DM patients.

Based on the results of the study, it was stated that in this study, most of those who experienced blood sugar instability experienced abnormal vision, where the visual assessment was in the range of $\leq 6/6$. The majority of respondents had diabetes mellitus for a long time, where the longer a person has diabetes mellitus, the greater the risk of complications from Diabetes Mellitus, including Diabetic retinopathy. This is in line with Sudirman's research,



2020, which states that the factors that influence the occurrence of diabetic retinopathy are the duration of diabetes mellitus, the longer diabetes is suffered, the greater the likelihood of diabetic retinopathy.

Based on the research results, it was stated that in this study, 30 respondents (34.5%) had normal visual acuity. Visual acuity examination is an examination of eye function. Visual impairment requires examination to determine the cause of the eye disorder that causes decreased visual acuity. Usually, visual acuity examination is determined by looking at the eye's ability to read letters of various sizes at standard distances for the Snellen Card.

The results are expressed in fractional numbers such as 20/20 for normal vision. In this condition the eye can see letters at a distance of 20 feet that should be visible at that distance. Average normal visual acuity varies between 6/24 to 6/6 (20/15 or 20/20 feet) (Setyadi., 2024)

Another factor that is thought to trigger a decrease in visual acuity is work, namely outdoor work which allows for more frequent exposure to sunlight. People whose jobs involve a lot of exposure to sunlight, such as farmers and laborers, are at greater risk of experiencing a sharp decline in vision.

Relationship Between Blood Sugar Levels and Visual Acuity in Diabetes Mellitus Patients at Toto Kabila Regional Hospital

Based on the results of the study, it was found that 40 uncontrolled blood glucose levels with abnormal visual acuity, there were 30 controlled blood glucose levels with normal vision, while 57 respondents with controlled blood glucose levels with abnormal visual acuity obtained *chi-square* test results of 0.000 (< 0.05) which means that there is a relationship between Blood Glucose Levels and Visual Acuity in Diabetes Mellitus Patients at the Eye Polyclinic of Toto Kabila Hospital.

In this study, there were 40 respondents with uncontrolled blood glucose levels and abnormal visual acuity. High blood glucose levels can affect visual acuity due to the accumulation of sorbitol and accumulation of protein in the lens of the eye which is increasingly concentrated as a result of the activation of the polyol pathway (change of Glucose to fructose) which occurs due to increased activity of the aldose reductase enzyme found in nerve tissue, retina, lens, glomerulus, and blood vessel walls. Cell damage occurs due to the accumulation of hydrophilic sorbitol causing cells to swell due to the osmotic process, causing decreased visual acuity. This is in accordance with the results of Rizkawati's research which states that diabetics are seven times more at risk of experiencing visual impairment.

In another study conducted by Juniar Anugrah (2013), the result was that someone with DM is 12 times more at risk of experiencing visual impairment than those without a history. The various research results above are continuously in line with the results of this study with the conclusion that there is a significant relationship between blood sugar levels and decreased visual acuity in DM patients.

In this study there were 30 respondents with controlled blood glucose levels and normal visual acuity. The results of the study conducted by Fajar (2015), vision or visual acuity is an examination of eye function, the presence of visual impairment requires examination to



determine the cause of eye disorders that result in decreased vision or distance of vision in the eyes. Vision examination is carried out on the eyes without or with glasses, vision examination is best carried out at a distance of 5-6 meters because at this distance the eyes will see objects at rest without accommodation.

According to Riordan and Whitcher (2012), many factors can reduce vision, one of which is systemic diseases such as diabetes mellitus which can cause damage to the optic nerve, macular edema, but if the patient controls blood glucose levels and adheres to therapy, vision will improve. Good blood sugar control is by paying attention to blood sugar within normal limits, diabetics must pay attention to factors that can change blood sugar status such as diet, physical activity and use of drugs/pharmacological. With good blood sugar control, DM patients will avoid various complications (Sartiwi, 2019) .

According to the assumption of researchers, patients with normal blood glucose levels with good (normal) vision because patients routinely control their blood sugar levels so that there is no decrease in visual function in patients. Patients with normal blood sugar but vision worsens because the patient has long suffered from diabetes and is already advanced in age, more than 70 years. Increasing age causes the eye lens to lose its elasticity so that it is difficult to see at close or far distances. There is a relationship between blood sugar levels and vision, patients with high blood sugar levels have poor vision, this is caused by several things including lens swelling due to high blood glucose, macular edema and diabetic retinopathy.

In this study, there were also 57 respondents with controlled blood glucose levels but abnormal visual acuity. Well-controlled blood glucose levels but still abnormal vision can be caused by several factors, especially those related to diabetes complications or other eye problems. Here are some possible causes: diabetic retinopathy, cataracts, glaucoma, vision problems that are not related to diabetes such as eye infections, age-related macular degeneration . The most DM sufferers are found in the elderly. The age of respondents included early elderly, ranging from 45-55 years. At that age , there is a progressive decline in organ function, endurance including the eyes. The lens feels uncomfortable when doing something at close or far distances. Meanwhile, according to research conducted by Mannulang 2013, the results showed that the increase in the incidence of visual acuity decline at the age of 40-60 years was 50%, in line with the results of this study.

According to researchers, the higher the blood sugar level of a DM patient, the higher the risk of experiencing decreased visual acuity, this is caused by hyperglycemia which has an impact on metabolic disorders that inhibit cell regeneration in the eyes, and arteriosclerosis which disrupts blood flow to the eyes and causes blood vessels in the eyes to become fragile so that DM patients with hyperglycemic blood sugar levels over a long period of time can experience decreased visual acuity, cataracts, and even blindness.

According to the researcher's assumption, controlling and checking blood glucose levels is very important to determine whether the patient's blood glucose levels are within normal limits or not. Patients with normal blood glucose levels because they routinely check their blood glucose levels at least 4 times a week so that the impact is not too great.



4. CONCLUSION

Blood glucose levels in diabetes mellitus patients at the Eye Clinic of Toto Kabila Hospital, it was found that out of 87 respondents, the highest blood glucose levels were controlled with a total of 47 respondents (54.9 %).

Visual acuity in patients with diabetes mellitus at the Eye Clinic of Toto Kabila Hospital, it was found that out of 87 respondents, the most visual acuity was abnormal with a total of 57 respondents (65.5 %).

The results of the study showed that blood glucose levels and visual acuity in patients with diabetes mellitus at the Toto Kabila Hospital Eye Clinic obtained chi - square test results of 0.000 (<0.05), which means that there is a relationship between blood glucose levels and visual acuity in patients with diabetes mellitus at the Toto Kabila Hospital Eye Clinic.

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