

Correlation Between Duration of Diabetes Mellitus and Visual Acuity Among Patients with Diabetes Mellitus

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder that can lead to various complications, including diabetic retinopathy, which may result in decreased visual acuity. The duration of diabetes is considered an important factor influencing the development of such complications. **Objective:** This study aims to analyze the correlation between duration of diabetes mellitus and visual acuity among patients with diabetes mellitus. **Methods:** his study employed a correlational analytic design with a cross-sectional approach. The study was conducted from February to March 2024 in Ngunut Village, Tulungagung Regency. A total of 30 respondents were selected using purposive sampling. The independent variable was the duration of diabetes mellitus, while the dependent variable was visual acuity measured using a Snellen chart. Data were analyzed using the Chi-square test with a significance level of 0.05. **Results:** The majority of respondents had diabetes mellitus for more than 5 years (56.7%, n=17), and most experienced decreased visual acuity (60%, n=18). The Chi-square test showed a p-value of 0.001 ($p < 0.05$), indicating a significant association between the duration of diabetes mellitus and visual acuity. **Conclusion:** here is a significant correlation between the duration of diabetes mellitus and visual acuity. Patients with longer disease duration are more likely to experience visual impairment. Early detection and proper management are essential to prevent complications.

Keywords: diabetes mellitus; duration of diabetes; visual acuity

Background

Diabetes mellitus (DM) is a chronic metabolic disorder with multifactorial etiology characterized by hyperglycemia resulting from impaired insulin secretion and/or action. This condition is accompanied by disturbances in carbohydrate, lipid, and protein metabolism (1). Clinically, DM is classified into several types, including type 1 DM, characterized by absolute insulin deficiency; type 2 DM, caused by insulin resistance and impaired insulin secretion; gestational DM, which occurs during pregnancy; and other specific types resulting from certain conditions such as drug use or other diseases (2).

The increasing prevalence of DM is closely associated with unhealthy lifestyle changes, such as the consumption of high-fat and high-sugar foods and a lack of physical activity. These factors contribute to imbalances in blood glucose levels which, when persistent, can lead to various complications (3). Complications of DM generally occur after 5–10 years of disease progression due to continuous glucose accumulation in the bloodstream, affecting both macrovascular systems, such as myocardial infarction and stroke, and microvascular systems, including neuropathy, nephropathy, and diabetic retinopathy (4).

Diabetic retinopathy is one of the most common microvascular complications in patients with DM and can lead to decreased visual acuity. Visual acuity reflects the eye's ability to distinguish fine details and serves as an important indicator of visual function. Reduced visual acuity is often an early symptom in patients with poorly controlled blood glucose levels (5).

According to the World Health Organization (2020), approximately 422 million people worldwide are living with diabetes mellitus (6). In Indonesia, the Ministry of Health reported that the number of people with diabetes mellitus reached 19.47 million in 2020. Diabetes mellitus is the third leading cause of death in Indonesia, with a prevalence of 40.7 cases per 100,000 population (7). In East Java Province,

the number of diabetes cases reached 929,535 in 2021, while in Tulungagung Regency, there were 28,256 reported cases (8).

Preliminary study findings indicate that most patients with DM experience decreased vision, particularly those who have had the disease for a longer duration. This suggests a potential association between disease duration and visual impairment. If not properly managed, these complications may progress to more severe conditions such as vitreous hemorrhage, retinal detachment, glaucoma, and even blindness.

The management of DM involves four main pillars, namely dietary regulation, physical activity, pharmacological therapy, and health education. However, low patient awareness in disease management often results in complications not being detected early. Therefore, research examining the association between the duration of diabetes mellitus and decreased visual acuity is necessary as a basis for prevention and control of complications. Based on the above description, this study aims to analyze the correlation between duration of diabetes mellitus and visual acuity among patients with diabetes mellitus.

Methods

This study employed a correlational analytic design with a cross-sectional approach, in which both independent and dependent variables were measured at a single point in time. The study was conducted from February to March 2024 in Ngunut Village, Tulungagung Regency.

The population consisted of all patients with diabetes mellitus in Ngunut Village. A total of 30 respondents were selected using purposive sampling based on predetermined inclusion and exclusion criteria. The inclusion criteria were patients with diabetes mellitus who were willing to participate in the study and were not illiterate. Meanwhile, the exclusion criteria included patients with diabetes mellitus who experienced complications other than diabetic retinopathy, individuals who had visual acuity disorders before being diagnosed with diabetes mellitus, patients with gestational diabetes mellitus, patients with other specific types of diabetes mellitus, and patients who had suffered from diabetes mellitus for less than 2 years.

The independent variable in this study was the duration of diabetes mellitus, while the dependent variable was visual acuity. Data on the duration of diabetes mellitus were collected using a checklist based on the history of diagnosis, while visual acuity was measured using a Snellen chart.

Data collection was carried out through direct observation and recording of examination results. The collected data were processed through editing, coding, and scoring stages. Data analysis was performed using the Chi-square test with a significance level of 0.05 to determine the correlation between the variables.

Results

General Data

Tabel 1. Frequency Distribution of Respondent Characteristics

Characteristics	Category	Frequency	Percentage (%)
Gender	Male	5	17
	Female	25	83
Age	29-39 year	10	33,3
	40-50 year	20	66,7
Total		30	100

Based on Table 1, it can be seen that the majority of respondents were female (83%), and most respondents were aged 40–50 years (66.7%).

Specific Data

Tabel 2. Frequency Distribution of Duration of Diabetes Mellitus and Visual Acuity

Variables	Category	Frequency	Percentage (%)
Duration of Diabetes Mellitus	< 5 tahun	13	43,3
	≥5 tahun	17	56,7
Visual Acuity	Normal	12	40
	Decreased	18	60

Based on Table 2, it can be seen that the majority of respondents had suffered from diabetes mellitus for more than 5 years, totaling 17 respondents (56.7%). In addition, most respondents experienced decreased visual acuity, totaling 18 respondents (60%).

Tabel 3. Cross-Tabulation Between Duration of Diabetes Mellitus and Visual Acuity

Duration of Diabetes Mellitus	Visual Acuity					
	Normal		Decreased		Total	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
<5 tahun	10	83,3	3	16,7	13	100
≥5 tahun	2	16,7	15	83,3	17	100

Based on Table 3, among respondents with a duration of diabetes mellitus of less than 5 years, the majority did not experience decreased visual acuity (83.3%, n=10). In contrast, among those with a duration of more than 5 years, most respondents experienced decreased visual acuity (83.3%, n=15). The results of the Chi-square statistical test showed a p-value of 0.001 ($< \alpha = 0.05$). Since the p-value is smaller than the significance level, the null hypothesis (H_0) is rejected. Therefore, there is a significant correlation between the duration of diabetes mellitus and visual acuity among patients with diabetes mellitus.

Discussion

Duration of Diabetes Mellitus Among Patients in Ngunut Village, Tulungagung Regency

Based on the findings presented in Table 2, out of 30 respondents, the majority (56.7%, n=17) had been living with diabetes mellitus for more than five years. This indicates that most respondents fall into the long-duration category, which is associated with an increased risk of complications. The duration of the disease is an important factor in determining the progression and severity of diabetes mellitus outcomes.

These findings are consistent with the study, which reported that the longer a person suffers from diabetes mellitus, the higher the risk of developing complications, particularly microvascular complications such as diabetic retinopathy (9). In addition, also found that disease duration is one of the main risk factors for complications in patients with type 2 diabetes mellitus (10).

Diabetes mellitus (DM) is a chronic metabolic disorder with multifactorial etiology, characterized by persistent hyperglycemia due to impaired insulin secretion and/or action. This condition is associated with disturbances in carbohydrate, lipid, and protein metabolism (11). DM is classified into several types, including type 1 diabetes (absolute insulin deficiency), type 2 diabetes (insulin resistance and impaired insulin secretion), gestational diabetes, and other specific types caused by factors such as medications or underlying diseases (12). Although DM cannot be completely cured, it can be effectively controlled through appropriate lifestyle modifications.

The increasing prevalence of diabetes mellitus is strongly associated with unhealthy lifestyle patterns, such as excessive consumption of high-fat and high-sugar foods and low levels of physical

activity. Persistent hyperglycemia can lead to tissue damage, particularly in small blood vessels (microvascular complications), through the formation of glycosylated proteins that weaken vascular walls and cause vascular obstruction. As a result, complications such as neuropathy, nephropathy, and diabetic retinopathy may occur (13).

In addition to microvascular complications, diabetes mellitus also contributes to macrovascular disorders, including atherosclerosis, which increases the risk of myocardial infarction and stroke. These complications generally develop after 5–10 years of disease progression, depending on the patient's ability to maintain glycemic control and a healthy lifestyle. Therefore, the duration of diabetes mellitus is closely associated with the risk of complications, although other factors such as disease severity and lifestyle also play important roles.

Visual Acuity Among Patients with Diabetes Mellitus in Ngunut Village, Tulungagung Regency

Based on the findings presented in Table 2, out of 30 respondents, the majority (56.7%, n=17) experienced decreased visual acuity. Visual acuity refers to the ability of the eye to clearly see objects at both near and far distances under normal conditions, typically measured at a standard distance of 6 meters (10). This finding indicates that visual impairment is a common condition among patients with diabetes mellitus.

In this study, decreased visual acuity was also influenced by respondent characteristics such as age and gender. Most respondents were female (83%) and aged 40–50 years (66.7%). Increasing age is associated with degenerative changes in the eye, including reduced elasticity of the lens and decreased retinal function, which may contribute to visual impairment. In addition, women are reported to have a higher risk of developing diabetes-related complications due to hormonal changes and metabolic factors that may affect glycemic control. The cross-tabulation results also showed that respondents with a longer duration of diabetes mellitus were more likely to experience decreased visual acuity. These findings indicate that both demographic characteristics and duration of illness contribute to the occurrence of visual impairment among patients with diabetes mellitus.

These findings are consistent with the study, which stated that diabetic retinopathy is one of the leading causes of decreased visual acuity among patients with diabetes mellitus (13). Reported that individuals with diabetes mellitus have a significantly higher risk of visual impairment compared to those without diabetes (14).

Several factors influence the decline in visual acuity, one of which is age. Increasing age leads to decreased elasticity of the eye lens, resulting in difficulty focusing on objects at various distances (15). Age-related changes in the eye include iris degeneration, reduced pupil diameter, changes in fundus appearance, and a decline in photoreceptor cells. These changes result in slower adaptation to light and dark conditions and narrowing of the visual field, which are considered part of the normal aging process.

In addition to age, comorbid conditions such as diabetes mellitus also play a significant role in visual impairment. Chronic hyperglycemia can damage the retinal microvasculature, leading to diabetic retinopathy. This condition involves structural and biochemical changes, including damage to the basement membrane and pericyte cells within retinal capillaries. Patients with diabetes mellitus are up to 12 times more likely to experience visual impairment compared to non-diabetic individuals, mainly due to retinal damage such as vascular leakage and edema (16).

The findings of this study are consistent with theoretical perspectives stating that diabetes mellitus significantly contributes to decreased visual acuity. This is supported by the data showing that 60% of respondents experienced visual impairment. Both aging and prolonged hyperglycemia contribute to the development of diabetic retinopathy, which, if not properly managed through regular screening and glycemic control, may lead to severe complications such as vitreous hemorrhage, retinal detachment, glaucoma, and blindness. Ultimately, visual impairment negatively affects patients' quality of life.

Analisis Correlation Between Duration of Diabetes Mellitus and Visual Acuity Among Patients in Ngunut Village, Tulungagung Regency

Based on the findings presented in Table 2, among respondents with a duration of diabetes mellitus

of less than 5 years, the majority (76.9%, n=10) did not experience decreased visual acuity. In contrast, among respondents with a duration of more than 10 years, most (82.4%, n=14) experienced decreased visual acuity. These results indicate that the longer a person has diabetes mellitus, the greater the likelihood of experiencing visual impairment.

These findings are consistent with the study, which reported that complications of diabetes mellitus, including diabetic retinopathy, generally occur after 5–10 years of disease progression (17). Approximately 60% of patients develop diabetic retinopathy after 10 years of having diabetes mellitus (5).

The progression and impact of diabetes mellitus are strongly influenced by lifestyle and glycemic control. Effective blood glucose management is essential to maintain a better quality of life, whereas poor control accelerates the development of complications (18). Blood glucose is the primary energy source for body cells; however, chronic hyperglycemia leads to metabolic disturbances. The clinical manifestations of diabetes mellitus may initially be mild or even asymptomatic, but the disease tends to progress over time, with varying individual responses to complications (19).

Prolonged hyperglycemia can lead to both macrovascular and microvascular complications. Macrovascular complications include myocardial infarction and stroke, while microvascular complications include neuropathy, nephropathy, and diabetic retinopathy (20). Diabetic retinopathy, as a microvascular complication, develops progressively due to chronic metabolic disturbances in the retina. Structural changes such as thickening of the retinal capillary basement membrane and damage to pericyte cells impair retinal circulation, ultimately affecting macular function and leading to decreased visual acuity.

Previous studies support these findings, that approximately 60% of patients develop diabetic retinopathy after 10 years of diabetes (5). Stated that complications typically arise after 5–10 years due to continuous glucose accumulation in the bloodstream. The findings of this study are consistent with those results, indicating that patients with longer disease duration are more likely to experience decreased visual acuity (21). This suggests that the duration of diabetes mellitus is an important factor influencing visual function, although other factors such as age, glycemic control, and the presence of complications may further exacerbate visual impairment.

Conclusions and Recommendations

Based on the results of the study involving 30 respondents, the majority of patients with diabetes mellitus had a disease duration of more than 5 years (56.7%, n=17), and most respondents experienced decreased visual acuity (60%, n=18). Statistical analysis showed a p-value of 0.001 ($p < 0.05$), indicating a significant correlation between the duration of diabetes mellitus and visual acuity, where patients with a longer duration of the disease were more likely to experience visual impairment. These findings suggest that the duration of diabetes mellitus is an important factor in the development of complications, particularly diabetic retinopathy. Therefore, patients with diabetes mellitus are advised to maintain optimal blood glucose control through a healthy lifestyle, adherence to therapy, and regular eye examinations for early detection of complications. In addition, healthcare providers are expected to enhance education and implement routine screening programs to prevent visual impairment among patients with diabetes mellitus.

Ethical Consideration and Competing interest

In terms of research ethics, this study adhered to fundamental ethical principles, including informed consent, confidentiality, and voluntary participation. The authors declare that there is no conflict of interest regarding the publication of this study.

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References

1. ADA. Introduction:Standars of medical care in diabets-2021. Diabetes Care. 2020;44:1–2. <https://doi.org/10.2337/dc21-Sint>
2. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care [Internet]. 2014;37(1):81–90. <https://doi.org/10.2337/dc14-S081>
3. Kunaryanti, Annisa A & RW. Hubungan Tingkat Pengetahuan Tentang Diabetes Mellitus Dengan Perilaku Mengontrol Gula Darah Pada Pasien Diabetes Mellitus Rawat Jalan Di RSUD Dr. Moewardi Surakarta. J Kesehat. 2018;11(1). <https://doi.org/10.23917/jk.v11i1.7007>
4. Hermawan. Diabetes Mellitus Di Indonesia Buku Ajar Ilmu Penyakit Dalam IV. Jakarta: Pusat Penerbitan Penyakit Dalam; 2016.
5. Robaszkievicz J. Diabetes Epidemiology vs. Diabetic Changes in the Retina of the Eye. Ophthalmology. 2023;21(3). <https://doi.org/10.5114/oku/178038>
6. World Health Organization (WHO). Strengthening diagnosis and treatment of diabetic retinopathy in the SEA Region [Internet]. New Delhi; 2020. Available from: <https://www.who.int/publications/i/item/9789290227946>
7. Kemenkes RI. pusat data dan informasi kementerian kesehatan RI. Tetap Produktif, Cegah, dan Atasi Diabetes Mellitus. 2020.
8. Dinas Kesehatan Provinsi Jawa Timur. Profil Kesehatan Provinsi Jawa Timur 2020 [Internet]. 2021. Available from: www.dinkesjatengprov.go.id
9. Esmiralda N et al. HUBUNGAN LAMANYA MENDERITA DIABETES MELLITUS DENGAN DERAJAT RETINOPATI DIABETIK DI POLI MATA RS BUDI KEMULIAAN KOTA BATAM TAHUN 2020-2022. Zo Kedokt . 2023;13(1):351–61. <https://doi.org/10.37776/zked.v13i1.1154>
10. Agustiningrum, R., & Kusbaryanto K. Efektifitas Diabetes Self Management Education terhadap Self Care Penderita Diabetes Mellitus: A Literature Review. J Keperawatan Respati Yogyakarta. 2019;6(2):558–63. <https://doi.org/10.35842/jkry.v6i2.309>
11. Yahya & Nadjibah. Hidup Sehat Dengan Diabetes. Surakarta: PT Tiga Serangkai Pustaka Mandiri; 2018. 10 p.
12. Nursalam, Rondhianto, Kusnanto, & Melaniani S. Panduan Pengelolaan Mandiri Diabetes Mellitus Tipe 2 di Rumah : Panduan Bagi Perawat. 2021.
13. Syawal, Hamzatun et al. Faktor yang Berhubungan dengan Ketajaman Penglihatan Pasien Diabetes Melitus Tipe 2 di Wilayah Kerja Puskesmas Kecamatan Biringkanaya. Media Keperawatan [Internet]. 2018;9(2):106–12. Available from: <https://doi.org/10.32382/jmk.v9i2.463>
14. Sudirman. Pengaruh Diabetes Melitus Terhadap Tajam Penglihatan. J Kesehat Qamarul Huda [Internet]. 2020;8(1):1–7. <https://doi.org/10.37824/jkqh.v8i1.2020.178>
15. Sukma Purqoti N et al. Health Belief Model yang Berkembang di Masyarakat pada Kasus Paliatif Care (DM Tipe 2). J Kesehat Qamarul Huda [Internet]. 2023;11(1):250–5. <https://doi.org/10.37824/jkqh.v11i1.2023.447>
16. Weni Sartiwi RNY. EFEKTIFITAS PEMERIKSAAN KADAR GULA DARAH DENGAN HASIL VISUS PASIEN PASCA OPERASI KARATAK DIABETIKUM DI RSUD SAWAHLUNTO EFFECTIVITIES BLOOD GLUCOSE WITH VISUAL ACUITY PATIENTS AFTER CATARACT DIABETICUM SURGERY IN SAWAHLUNTO HOSPITAL. J Kesehat Saintika Meditory [Internet]. 2019;2–1:53–61. Available from: <https://jurnal.syedzasaintika.ac.id/index.php/meditory/article/view/444>
17. Sumiyati. Pengaruh Diabetes Melitus Terhadap Mata. J mata Opt. 2021;2(2):1–9. <https://doi.org/10.54363/jmo.v2i2.36>
18. Petersen M. Economic costs of Diabetes in the U.S. Diabetes Care. 2016;39(7):1033–46.
19. Arifin Z et al. Identifikasi Faktor Risiko Melalui Finnish Diabetes Risk Score Sebagai Prediktor

-
- Risiko Terjadinya Diabetes Mellitus Tipe 2. J Kesehat Qamarul Huda. 2023;11(1). <https://doi.org/10.37824/jkqh.v11i1.2023.453>
20. Admaja Bagas Virgiansyah R et al. Analisis Hubungan Antara Lama Sakit Dengan Kualitas Hidup Pasien Diabetes Melitus di RS dr. Soepraoen Malang. urnal Kesehat Qamarul Huda. 2023;12(1):21–5. <https://doi.org/10.37824/jkqh.v12i1.2024.601>
21. Santoso, D. B. ., Doringin, F. ., Simarmata, M. M., & Sasia K. Hubungan Kejadian Katarak dengan Diabetes Melitus di Puskesmas Tanjung Harapan, Marga Tiga, Lampung Timur. J Mata Opt. 2022;3(2):37–44. <https://doi.org/10.54363/jmo.v3i2.86>