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Analysis of Factors Influencing Cognitive Function Decline in Elderly Prolanis Patients with Type 2 Diabetes Mellitus in the Kedungjajang Community Health Center Working Area, Lumajang

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Abstract:
The complications of DM not only impact physical health but also cognitive function. Decreased cognitive function can start from the mildest form, such as being prone to forgetfulness, progress to mild cognitive impairment, and eventually to dementia, the most severe clinical form. This study aims to explore the cognitive function and characteristics of elderly patients in the working area of the Kedungjajang Community Health Center. This research used a correlational analytic method with a cross-sectional approach. The study was conducted in the Kedungjajang Community Health Center Working Area. The respondents were elderly patients suffering from type 2 diabetes mellitus. Purposive sampling was utilized in this study during June-July 2024. Interviews with patients were conducted using the Mini-Mental State Examination (MMSE) questionnaire. Among the 95 participants, the age group majority was 45-59 years (61.1%), with a predominant female gender distribution (83.2%). The duration of suffering from type 2 diabetes mellitus was most commonly less than 5 years (75.8%), with glucose levels over 200 mg/dl (53.7%). The analysis of this study used bivariate and subsequent multivariate tests, revealing a p-value (<0.25), indicating a significant correlation between the duration of illness and the decline in cognitive function. The results of this study are expected to educate about the importance of maintaining stable glucose levels to prevent worsening cognitive factors.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease characterized by hyperglycemia due to insulin resistance or decreased secretion by pancreatic beta cells (Jadon et al., 2023; Bakara et al., 2025). DM affects carbohydrate, protein, and fat metabolism and can lead to macrovascular, microvascular, and neurological complications. Additionally, DM often causes dysfunction in various organs such as the eyes, kidneys, heart, nerves, and blood vessels (Horton & Barrett, 2021; Widayati et al., 2024).

The complications of DM not only impact physical health but also cognitive function. Chronic hyperglycemia in DM patients can increase the risk of cognitive decline, ranging from mild forgetfulness to severe dementia (Husain et al., 2022). This decline often disrupts daily activities, social functions, and work performance, especially in the elderly (Sebastian et al., 2023).

Type 2 DM is closely linked to central nervous system disorders. DM can accelerate brain atrophy up to three times faster than normal aging, increasing the risk of neurodegenerative diseases

such as Alzheimer's and dementia (Szablewski, 2024). Changes in the nervous system, including neuron and oligodendrocyte degeneration, further impair cognitive function (Wątroba et al., 2022).

According to the International Diabetes Federation (IDF), the prevalence of DM in Indonesia continues to rise. In 2019, the number of DM cases was recorded at 10.7 million and is projected to increase to 13.7 million by 2030. Indonesia ranks seventh globally in the number of DM patients, making it one of Southeast Asia's largest contributors to DM prevalence (Milita et al., 2021).

East Java Province recorded more than 75,000 DM patients aged ≥15 years, with 36,877 males and 38,613 females (Simanjuntak, 2024). In Lumajang Regency, DM cases reached 21,846 in 2022. In the working area of UPT Puskesmas Kedungjajang, the number of DM patients in 2023 was recorded at 2,735, consisting of 698 males and 2,037 females.

The increasing prevalence of DM is caused by various factors, including heredity, obesity, sudden lifestyle changes, unhealthy diets, lack of exercise, smoking, stress, and non-adherence to medication (Fanelli et al., 2025; Kurniyawan et al., 2023). Modern dietary patterns rich in fat, sugar, and salt, as well as the high consumption of fast food, further exacerbate this condition (Takkellapati & Oroszi, 2024; Anggraeni et al., 2024).

Lack of public knowledge about a healthy lifestyle is one of the main reasons for the delayed detection of DM (Hossain et al., 2024). Many patients only become aware of their disease after severe complications arise. Unhealthy dietary habits embedded in society increase the risk of hyperglycemia and DM complications (Dziewa et al., 2022).

Cognitive impairment due to DM is often mistaken for part of normal aging. However, cognitive decline can serve as a predictor of poor general health, particularly in the elderly. Physical activity has been proven to significantly help maintain cognitive function and prevent dementia (Waissbluth & Delano, 2025; Hendrawati et al., 2024).

The role of family and healthcare professionals is crucial in preventing cognitive decline in elderly DM patients. Support through group activities, socialization, and activities that stimulate the brain, such as reading and listening to the news, can help maintain cognitive function. Adequate rest also plays a key role in maintaining brain health and improving the quality of life for the elderly (Xuefang et al, 2021).

METHOD

This study employs a correlational analytical method with a cross-sectional approach, where data collection is conducted once for each respondent. It is a descriptive quantitative study aimed at analyzing the factors influencing cognitive decline in patients with type 2 diabetes mellitus (DM) in the working area of UPT Puskesmas Kedungjajang. The study population consists of all type 2 DM patients, totaling 120 individuals, with a sample of 95 participants selected using purposive sampling. The inclusion criteria include type 2 DM patients who are willing to participate, are over 40 years old, and meet other eligibility requirements. In contrast, the exclusion criteria consist of patients with other comorbidities. Independent variables (age, gender, duration of DM, blood glucose levels) and the dependent variable (cognitive function) were measured using the Mini-Mental State Examination (MMSE) questionnaire.

The study was conducted from June to July 2024 at UPT Puskesmas Kedungjajang. The research procedure involved obtaining permission from relevant institutions, securing informed consent, and collecting data through questionnaires. Data processing included editing, coding, scoring, and analysis using logistic regression. This study has received ethical approval with Ethical Clearance Number 187/KEPK-UNHASA/VII/2024 to ensure compliance with health research ethical standards.

RESULT

Table 1. Respondent Characteristics (n=95)

Variable	Frequency	Percentage
Age		
45 – 59 years	58	61.1
60 – 74 years	36	37.9
75 – 90 years	1	1.1
Gender		
Male	16	16.8
Female	79	83.2
Duration of DM		
< 5 years	72	75.8
5 – 10 years	17	17.9
>10 years	6	6.3
Blood Glucose Levels		
< 100 mg/dl	2	2.1
100 – 200 mg/dl	42	44.2
>200 mg/dl	51	53.7
Cognitive Function		
Normal	76	80
Sedang	16	16.8
Berat	3	3.2

Based on the data, most respondents were aged 45–59 (61.1%), followed by those aged 60–74 (37.9%), and only 1.1% were aged 75–90. Most respondents were female (83.2%), while males accounted for only 16.8%. A total of 75.8% of respondents had suffered from diabetes mellitus (DM) for less than five years, 17.9% for 5–10 years, and 6.3% for more than 10 years. Most respondents had blood glucose levels >200 mg/dl (53.7%), followed by glucose levels of 100–200 mg/dl (44.2%), and only 2.1% had glucose levels <100 mg/dl. Regarding cognitive function, 80% of respondents were in the normal category, 16.8% were in the moderate category, and 3.2% experienced severe cognitive impairment.

Table 2. Analysis of Factors Affecting Cognitive Decline in Type 2 Diabetes Mellitus Patients in the Working Area of UPT Puskesmas Kedungjajang (n=95)

Influencing Factors		Cognitive Function			Chi-Square	P-Value	Conclusion
		Normal	Moderate	Severe			
Age	45 – 59	56	2	0	28.612	0.000	Significant Correlation
	60 – 74	20	13	3			
	75 – 90	0	1	0			
Gender	Male	14	2	0	0.958	0.619	Not Significant Correlation
	Female	62	14	3			
Duration of DM	< 5 years	67	5	0	44.143	0.000	Significant Correlation
	5 – 10 years	8	8	1			
	>10 years	1	1	2			
Blood Glucose Levels	< 100 mg/dl	1	1	0	8.091	0.088	Significant Correlation
	100 – 200 mg/dl	29	11	2			
	>200 mg/dl	46	4	1			

Based on the bivariate analysis, age, duration of diabetes mellitus, and blood glucose levels were significantly associated with cognitive decline in type 2 diabetes mellitus patients in the working area of UPT Puskesmas Kedungjajang. The p-values for age and duration of diabetes were both

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0.000, while the p-value for blood glucose levels was 0.088, indicating that older age, longer duration of diabetes, and higher blood glucose levels increase the risk of cognitive decline. Meanwhile, gender did not show a significant relationship with cognitive function (p-value = 0.619), meaning there was no significant difference between males and females regarding cognitive decline.

DISCUSSION

Analysis of Factors Influencing Cognitive Decline (Age, Gender, Duration of Illness)

1. Age

Based on the research results in Table 1, the highest percentage of respondents was aged 45–59 years (58 people, 61.1%), followed by 60–74 years (36 people, 37.9%), and only one person (1.1%) was aged 75–90 years. Older adults enter the final stage of life, where the aging process affects various bodily functions. Age is a factor that can impact cognitive decline due to physical degeneration over time. The Wear and Tear Aging Theory explains that body cells experience tissue damage due to continuous use over time (De Magalhães, 2025).

Individuals over 45 years old are at higher risk of developing diabetes mellitus (DM) and glucose intolerance due to degenerative factors, particularly the declining function of pancreatic beta cells in insulin production for glucose metabolism. Most type 2 DM patients are over 45 years old, due to reduced insulin production by pancreatic beta cells as part of the aging process (Tudurí et al., 2022).

The researchers assume that as individuals age, they experience a decline in functional capacity at both the cellular and organ levels, along with cognitive changes. The aging process leads to a decline in physical and psychological abilities, affecting organ function and immune response. Over time, older adults frequently face various declines in organ function, caused by a decrease in anatomical cells, reduced activity, and insufficient nutrient intake. All these factors contribute to structural and physiological changes in organs during aging.

2. Gender

As shown in Table 1, 16 respondents (16.8%) were male, while 79 respondents (83.2%) were female. Diabetes mellitus can affect anyone, regardless of gender, due to factors such as genetics, unhealthy diet, stress, and obesity (Ciarambino et al., 2021). Based on these findings, the researchers assume that gender does not have a significant relationship with cognitive decline in diabetes mellitus patients, meaning there is no significant difference between males and females regarding cognitive decline related to diabetes mellitus.

3. Duration of Illness

Regarding the duration of diabetes mellitus, the study found that: 72 respondents (75.8%) had diabetes for less than 5 years, 17 respondents (17.9%) had diabetes for 5–10 years, and six respondents (6.3%) had diabetes for more than 10 years. Diabetes mellitus significantly affects patient health, particularly due to deteriorating glucose control, likely caused by beta-cell damage, which worsens as the disease progresses (Aloke et al., 2022).

The researchers assume that the longer a person has diabetes, the greater the psychological distress they may experience. However, patients who have had diabetes for a long time tend to have lower levels of distress because they develop better coping mechanisms and adaptation skills. Long-term diabetes patients are more knowledgeable about their physical, psychological, social, and environmental conditions, making them better prepared to manage potential complications or emergencies due to their experience with the disease.

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4. Blood Glucose Levels

Based on Table 1, the distribution of blood glucose levels among respondents was as follows: <100 mg/dl: 2 respondents (2.1%), 100–200 mg/dl: 42 respondents (44.2%), >200 mg/dl: 51 respondents (53.7%). Chronic high blood sugar levels can lead to cognitive impairment. Increased fasting blood glucose levels in diabetes patients can cause ischemic cerebrovascular disease, leading to neuron apoptosis and brain atrophy due to impaired blood flow to neurovascular units. This indicates that diabetes-related cognitive decline results from vascular brain injury, eventually leading to cognitive dysfunction (Yu et al., 2025).

The researchers assume that uncontrolled blood glucose levels, influenced by an unhealthy diet and lack of participation in Prolanis (chronic disease management program) activities, play a key role in cognitive decline. UPT Puskesmas Kedungjajang provides scheduled Prolanis activities, and if diabetes patients regularly participate and adhere to a proper diet, their blood glucose levels can be better controlled, reducing the risk of cognitive decline.

5. Cognitive Function in Diabetes Mellitus Patients

Based on the research results in Table 1, the distribution of cognitive function among respondents was as follows: 76 respondents (80.0%) had normal cognitive function, 16 respondents (16.8%) experienced moderate cognitive decline, and three respondents (3.2%) had severe cognitive impairment. The dependent variable, cognitive function, was analyzed against independent variables, yielding the following p-values: age (p = 0.000), gender (p = 0.619), duration of illness (p = 0.000), and blood glucose levels (p = 0.088). From these p-values, three variables had p-values <0.25, namely Age, Duration of Illness, and Blood Glucose Levels. Thus, it can be concluded that age, duration of illness, and blood glucose levels each have a significant relationship with cognitive function.

Cognitive status can affect the functional ability of type 2 diabetes patients, and patients with dementia tend to be unable to manage diabetes independently. Several studies also show a significant correlation between the duration of diabetes mellitus (DM) and cognitive decline. Cognitive function includes various aspects such as attention, comprehension, learning, memory, problem-solving, and decision-making. Individual and environmental factors can influence cognitive decline. Individual factors that affect cognitive decline include age, gender, duration of DM, and blood glucose levels (Aderinto et al., 2023).

The researchers assume that elderly individuals should maintain physical activity and engage in other activities that help preserve cognitive function. Health centers are expected to develop more programs that involve the elderly and provide greater attention to them to support better health management.

Analysis of the Dominant Factor Affecting Cognitive Decline

Based on the research results, the p-values were as follows: age (0.000), gender (0.619), duration of illness (0.000), and blood glucose levels (0.088). After further multivariate analysis, the results showed age (p = 0.410), gender (p = 0.783), blood glucose levels (p = 0.000), and duration of illness (p = 0.023). Having type 2 DM for ≥10 years increases the risk of cognitive impairment.

A longer duration of DM is associated with chronic hyperglycemia, which can alter the function and structure of the microvascular system in the central nervous system (Li et al., 2023). The differences in the findings of this study may be because most participants had type 2 diabetes mellitus for less than 10 years, whereas complications generally appear after more than 10 years. Differences in sample sizes and methods for assessing cognitive status may also contribute to differing conclusions across studies. The researchers assume that the longer a person has diabetes

mellitus, the greater the vascular damage. Diabetes mellitus patients are advised to adopt a healthy lifestyle to prevent long-term complications such as cognitive impairment.

CONCLUSION

Based on the research results, age, duration of diabetes mellitus, and blood glucose levels were found to have a significant relationship with cognitive decline. The study indicates that older age, particularly above 45 years, is associated with a higher risk of cognitive impairment due to the aging process and decreased body functional capacity.

The duration of diabetes also plays a role, as patients who have had diabetes for more than 10 years are at a greater risk of cognitive decline due to vascular damage and chronic hyperglycemia. Additionally, uncontrolled blood glucose levels are directly related to cognitive decline through their impact on microvascular disturbances in the brain.

Gender, although more commonly observed in females, was not found to have a significant relationship with cognitive decline. Therefore, it is recommended that diabetes mellitus patients maintain a healthy lifestyle, participate in disease management programs, and regulate their blood glucose levels to prevent complications, including cognitive impairment. The suggestion or recommendation can be added after the conclusion (included in this section). The suggestion or recommendation can be added after the conclusion (included in this section).

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research. This study was conducted independently, with no external funding or influence from any organization that could potentially affect the results or interpretation of the findings.

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