DESCRIPTION OF COGNITIVE FUNCTION IN TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

Cognitive dysfunction is one of the complications of type 2 DM caused by insulin resistance, hyperglycemia, and hypoglycemia. Cognitive impairment in patients results in problems with memory, psychomotor speed, and frontal or executive lobe function. It affects patients' ability to manage self-care, including blood glucose monitoring and foot care. This study aims to identify the cognitive function of patients with type 2 DM. The research used descriptive design with quantitative methods and purposive sampling techniques. The population in this study was 46 patients with type 2 DM in RSUD Sumedang with a sample of 41 people. The instrument used is MoCA-INA to measure the cognitive function of patients with type 2 DM. Data analysis used univariate and frequency distribution The results of the study showed that type 2 DM patients had mild cognitive impairment of 26 (63.4%), severe cognitive impairments of 9 (22.0%), and normal cognitive function of 6 (14.6%). Cognitive impairment in diabetic patients has the potential to affect self-care management, so if not properly maintained, it can worsen the condition of diabetes patients and even lead to death. Therefore, nursing care should enhance education regarding cognitive impairments, regular monitoring and assistance, as well as the use of technology to remind patients of the timing of treatment and self-care.

Keywords: cognitive function; cognitive impairment; type 2 DM

INTRODUCTION

Diabetes mellitus is a serious, long-term, or chronic condition in which an increase in blood glucose levels occurs because the body cannot produce insulin hormones in adequate quantities or cannot use insulin effectively (International Diabetes Federation, 2021). By 2021, it is estimated that 537 million people will be suffering from diabetes, and this number is predicted to reach 643 million by 2030, and 783 million people by 2045 (International Diabetes Federation, 2021). In the world, Indonesia ranks fifth with 19.47 million cases of diabetes. According to the latest data from Open Data Jabar in 2022, the number of patients with diabetes mellitus in West Java is 644,704 people, as well as the district of Sumedang itself, is in the top 10 of the most people with diabetes mellitus in West Java, which is 23.340 people (Jumlah Penderita Diabetes Melitus Berdasarkan Kabupaten/Kota Di Jawa Barat, 2023).

The rising prevalence of diabetes mellitus is concerning due to the increased risk of complications, including cerebral issues that can affect various brain regions (Kemenkes, 2012). Among these complications, cerebral issues are significant, affecting different brain parts. Factors such as insulin resistance, hyperinsulinemia, glucose intolerance, and metabolic syndrome are linked to a higher risk of cognitive impairment and dementia (Biessels & Luchsinger, 2009). Cognitive functions involve the mental processes of acquiring knowledge and understanding through thought, experience, and senses (Aayush Dhakal & Bobrin Affiliations, 2023). Dementia, a severe and progressive intellectual decline, disrupts a person's social functioning, work, and daily activities (Biessels & Despa, 2018) Insulin plays a crucial role in the central nervous system, influencing eating behavior, energy storage, and the metabolism of glucose and fat, as well as various memory and cognition functions (Gray et al., 2014). Disruptions in brain insulin, such as insulin resistance seen in type 2 diabetes, can lead to memory and cognitive disturbances. Patients with type 2 diabetes mellitus often experience subcortical lacunar infarctions, cerebral atrophy, and periventricular white matter hyperintensities (Poretsky, 2017). The cognitive dysfunctions commonly associated with type 2 diabetes mellitus include impairments in memory, psychomotor speed, and executive functions of the frontal lobes (Kim, 2019).

Cognitive dysfunction such as Mild Cognitive Impairment (MCI) to dementia has a big impact on a person's life, one of them in self-care management. Self-care management in diabetes mellitus sufferers such as regular blood sugar monitoring, medication compliance, symptom surveillance, recognition and management of symptoms, self-care on the legs, diet, and exercise (Care & Suppl, 2019). The primary cognitive dimensions are related to self-care management in diabetics, i.e. delayed recall related to blood glucose monitoring; visuospatial abilities, executive functions, and abstract related to diabetic foot care (Yang et al., 2020). In line with a study conducted by Świątoniowska-Lonc et al. (2021), type 2 diabetes mellitus patients who suffer from a disturbance in their cognitive function are most likely to experience difficulties in self-care management. If the management of self-care in patients with DM gets worse, it will worsen the condition of the patient leading to a variety of complications and the worst possible death. Based on several types of research and various reasons, this study aims to identify cognitive function in patients with type 2 diabetes mellitus in RSUD Sumedang.

METHOD
This study used quantitative descriptive research methods to identify cognitive function in patients with type 2 diabetes mellitus. The population of this study were patients with type 2 diabetes RSUD Sumedang, who were inpatient and outpatient during the period (July-December 2023). The sampling technique used was purposive sampling with the criteria of inclusion 1) had a type 2 diabetes mellitus, 2) age >35 years, and 3) good general condition. The exclusion criteria in this study were having disabilities and being illiterate (such as alphabet and Latin numbers). The samples were obtained from 41 patients with type 2 diabetes in RSUD Sumedang. The variable in this study was cognitive function. The instrument used is the Montreal Cognitive Assessment in Indonesian which consists of 7 aspects (executive and visuospatial functions; nomination; attention; language; abstraction; delayed recall; and orientation). There are three categories of cognitive impairment: severe, mild, and normal. The instrument was standardized and validated using Pearson correlation tests of r=0,529 and p-0,046, realism tests using test-retest methods, and Pearson correlation tests with r=0,963 and p=0,000 (Panentu & Irfan, 2013). Data was analyzed using univariate analysis and frequency distribution tables.

RESULTS

Table 1.
Respondent characteristics (n= 41)

Respondent characteristics	f	%
Age		
Middle Age	37	90.2
Elderly	4	9.8
Gender		
Male	13	31.7
Female	28	68.3
Educational Level		
Elementary School	15	36.6
Junior High School	8	19.5
High School	9	22.0
Vocational High School	1	2.4
Diploma 1	1	2.4
Bachelor	7	17.1
Occupation		
Housewife	21	51.2
Sivil servant	2	4.9
Entrepreneur	11	26.8
Retired	7	17.1
BMI		
Obesity	13	31.7
Fat	5	12.2
Normal	22	53.7
Thin	1	2.4
Duration of Type 2 Diabetes Mellitus		
<5 years	19	46.3
5-10 years	14	34.1
>10 years	8	19.5
Control Frequency per Month		
Never	3	7.3
Seldom	4	9.8
Recent	3	7.3
1x	29	70.7
2x	2	4.9
Smoking		
Yes	13	31.7
No	28	68.3
Comorbid Diseases		
Not Having	12	29.3
Heart disease	4	9.8
Cholesterol	2	4.9
Hypertension	15	36.6
Etc	8	19.5
Random Blood Glucose (mg/dL)		
80-130	12	29.3
>130	29	70.7

Table 1 shows that out of 41 patients with type 2 diabetes in RSUD Sumedang, three quarters were in middle age (90.2%) with an average age of 55 years. The results also showed that the majority were female (68.3%), had an education level in elementary school (36.6%), and housewives (51.2%). In addition, the majority of respondents had normal BMI (53.7%) and non-smoking (68.3%). Patients mostly had diabetes <5 years (46.3%), frequency of control was 1x per month (70.7%), with hypertension (36.6%), and random blood sugar >130 mg/dL (70.7%).

Table 2.
Frequency Distribution of Cognitive Function in Type 2 Diabetes Mellitus Patients (n= 41)

Cognitive Function	f	%
Severe	9	22.0
Mild	26	63.4
Normal	6	14.6

Table 2 shows that among 41 patients with type 2 diabetes mellitus in RSUD Sumedang, half of them had mild cognitive impairment (63.4%).

Table 3.
Domain Cognitive Function in Type 2 Diabetes Mellitus Patients (n= 41)

Domain	f	%
Executive and Visuospatial Functions		
0	3	7.3
1	3	7.3
2	4	9.8
3	11	26.8
4	7	17.1
5	13	31.7
Naming		
0	0	0.0
1	1	2.4
2	8	19.5
3	32	78.0
Attention		
0	0	0.0
1	1	2.4
2	3	7.3
3	4	9.8
4	10	24.4
5	17	41.5
6	6	14.6
Language		
0	5	12.2
1	11	26.8
2	15	36.6
3	10	24.4
Abstraction		
0	17	41.5
1	15	36.6
2	9	22.0
Delayed Recall		
0	12	29.3
1	7	17.1
2	11	26.8
3	3	7.3
4	7	17.1
5	1	2.4
Orientation		
0	0	0.0
1	0	0.0
2	0	0.0
3	1	2.4
4	4	9.8
5	6	14.6
6	30	73.2

Table 3, shows that the executive and visuospatial functions domains in patients with type 2 diabetes obtained the highest score of 3 (26.8%), naming at a score of 3 (31.7%), attention at a score of 5 (41.5%), language at score of 2 (36.6%), abstraction at score of 0 (41.5%), delayed recall at score of 0 (29.3%), and orientation at score of 6 (73.2%).

Table 4.
Cognitive Function Based on Respondent Characteristics (n= 41)

	Cognitive Function							
	Severe		Mild		Normal		Total	
	f	%	f	%	f	%	f	%
Age								
Middle Age	7	17.1	24	58.5	6	14.6	37	90.2
Elderly	2	4.9	2	4.9	0	0.0	4	9.8
Total	9	22.0	26	63.4	6	14.6	41	100.0
Gender								
Male	3	7.3	10	24.4	0	0.0	13	31.7
Female	6	14.6	16	39.0	6	14.6	28	68.3
Total	9	22.0	26	63.4	6	14.6	41	100.0
Educational Level								
Elementary School	7	17.1	7	17.1	1	2.4	15	36.6
Junior High School	1	2.4	5	12.2	2	4.9	8	19.5
High School	0	0.0	7	17.1	2	4.9	9	22.0
Vocational High School	0	0.0	1	2.4	0	0.0	1	2.4
Diploma 1	0	0.0	1	2.4	0	0.0	1	2.4
Bachelor	1	2.4	1	2.4	1	2.4	7	17.1
Total	9	22.0	26	63.4	6	14.6	41	100.0
Occupation								
Housewife	4	9.8	13	31.7	4	9.8	21	51.2
Civil servant	0	0.0	1	2.4	1	2.4	2	4.9
Entrepreneur	4	9.8	7	17.1	0	0.0	11	26.8
Retired	1	2.4	5	12.2	1	2.4	7	17.1
Total	9	22.0	26	63.4	6	14.6	41	100.0
BMI								
Obesity	2	4.9	9	22.0	2	4.9	13	31.7
Fat	2	4.9	3	7.3	0	0.0	5	12.2
Normal	5	12.2	14	34.1	3	7.3	22	53.7
Thin	0	0.0	0	0.0	1	2.4	1	2.4
Total	9	22.0	26	63.4	6	14.6	41	100.0
Duration of Type 2 Diabetes Mellitus								
<5 years	5	12.2	12	29.3	2	4.9	19	46.3
5-10 years	2	4.9	9	22.0	3	7.3	14	34.1
>10 years	2	4.9	5	12.2	1	2.4	8	19.5
Total	9	22.0	26	63.4	6	14.6	41	100.0
Control Frequency per Month								
Never	2	4.9	1	2.4	0	0.0	3	7.3
Seldom	0	0.0	3	7.3	1	2.4	4	9.8
Recent	2	4.9	1	2.4	0	0.0	3	7.3
1x	4	9.8	20	48.8	5	12.2	29	70.7
2x	1	2.4	1	2.4	0	0.0	2	4.9
Total	9	22.0	26	63.4	6	14.6	41	100.0
Smoking								
Yes	3	7.3	10	24.4	0	0.0	13	31.7
No.	6	14.6	16	39.0	6	14.6	28	68.3
Total	9	22.0	26	63.4	6	14.6	41	100.0
Comorbid Diseases								
Not Having	3	7.3	7	17.1	2	4.9	12	29.3
Heart disease	1	2.4	3	7.3	0	0.0	4	9.8

Cholesterol	0	0.0	1	2.4	1	2.4	2	4.9
Hypertension	3	7.3	10	24.4	2	4.9	15	36.6
Etc	2	4.9	5	12.2	1	2.4	8	19.5
Total	9	22.0	26	63.4	6	14.6	41	100.0
Random Blood Glucose (mg/dL)								
80-130	1	2.4	9	22.0	2	4.9	12	29.3
>130	8	19.5	17	41.5	4	9.8	29	70.7
Total	9	22.0	26	63.4	6	14.6	41	100.0

Type 2 diabetes mellitus in RSUD Sumedang in table 4, the average had mild cognitive impairment. Middle age (58.5%), female (39.0%), housewives (31.7%), both educational level of elementary school and high school (17.1%), normal BMI (34.1%), duration of diabetes <5 years (29.3%), frequency of control 1x per month (48.8%), non-smoking (39.0%), had hypertension (24.4%), and random blood glucose in the range of >130 mg/dL (70.7%). Furthermore, in this study, it was also found that patients experienced severe cognitive impairment at the elementary school education level.

DISCUSSION
Cognitive Function in Patients with Type 2 Diabetes Mellitus
Cognitive dysfunction is one of the chronic complications of DM, but the pathophysiology is uncertain. Intermediate and modulating factors that may occur include glycemic control effects: hyperglycemia, insulin resistance (hyperinsulinemia), and hypoglycemia as a result of treatment (Larner, 2014). Cognitive impairment in patients with diabetes can lead to worse self-treatment of diabetics, thus further worsening cognitive impairment (Poretsky, 2017). Based on the results of studies in patients with type 2 diabetes mellitus in RSUD Sumedang showed that the majority of patients had mild cognitive impairment (63.4%). According to a study conducted by (Abdel-Latif et al. (2020), type 2 diabetes was significantly associated with mild cognitive impairment (MCI) and increased the risk of MCI almost three times. Type 2 diabetes patients may show punctate white matter lesions, decreased brain volume, changes in blood vessel function, oxidative stress, and accumulation of glycation end products (Sun et al., 2020).

The impairment of cognitive function in diabetic patients will certainly impact their self-care management. Self-care management in diabetes patients includes monitoring blood glucose, medication adherence, physical activity, diet, and diabetes foot care (Paudel et al., 2022). Certainly, these self-care management tasks require several cognitive abilities, so if a patient's self-care management is poor, it has the potential to worsen their condition. According to research by Yang et al. (2020), patients experiencing mild cognitive impairment showed disrupted cognitive function domains in delayed recall (85.0%), language (73.6%), visuospatial and executive function (50.7%), attention (18.6%), abstraction (11.4%), and orientation (11.4%). A study conducted at RSUD Sumedang found that diabetic type 2 patients exhibited impaired cognitive function domains specifically in abstraction and delayed recall. Delayed recall is associated with blood glucose monitoring, while visuospatial ability, executive function, and abstraction are linked to diabetes foot care (Yang et al., 2020).

Cognitive Function in Characteristic of Patients with Type 2 Diabetes Mellitus
Based on the results of studies in patients with type 2 diabetes mellitus in RSUD Sumedang showed that middle-aged had mild cognitive impairment (58,5%). A study conducted by Sakib et al. (2023) showed that type 2 diabetes mellitus was associated with worse performance in simple processing speed, executive function, and memory tests in middle age and older. Cognitive decline in diabetes is not only in older people but may begin to appear in middle age (Pelimanni & Jehkonen, 2019). Diabetes is associated with an increased risk of

structural abnormalities in the brain, especially cerebral gaps and cerebral atrophy, in women but not in men. (Thomas et al., 2022). In addition, women traditionally have a variety of socially expected roles such as being wives, daughters, and nieces. Research has found that women are often responsible for household work, family activities, and providing physical care and psychological support to their partners because it can protect their partner's cognitive function (Yu et al., 2022). Based on the results of studies in patients with type 2 diabetes mellitus in RSUD Sumedang showed that females had mild cognitive impairment (39,0%). This is in line with research conducted by Chen et al. (2023) that women with diabetes in Taiwan show more potential to have cognitive deficits than men.

Based on the results of this study, elementary school had severe cognitive impairment (17.1%) and mild cognitive impairment (17.1%). In high school, they had mild cognitive impairment (17.1%). According to research conducted by Naguib et al. (2020), low educational levels are six times more likely to be associated with severe cognitive impairment. Achieving a higher level of education is linked to a lower risk of experiencing cognitive impairment (Prakash et al., 2011). Based on the results of this study, housewives had mild cognitive impairment (31.7%). A person who is unemployed or has no job is exposed to less challenging situations with minimal cognitive activity resulting in lower maintenance and improvement of cognition than those who work (Madhavan et al., 2022).

Based on this study, a normal BMI of respondents had a mild cognitive impairment (34.1%), The results of this study are inconsistent with the research carried out by Muza et al. (2023) showing a significant relationship between BMI and cognitive function. Obesity is associated with cortical atrophy, white matter integrity disorder, and cognitive dysfunction in early-stage type 2 diabetes (Yoon et al., 2017). Based on this study, respondents who had a duration of diabetes <5 years had mild cognitive impairment (29.3%), This study is inconsistent with what was done by Sun et al. (2020) showed that cognitive impairment in patients with type 2 diabetes had a positive correlation with long-term suffering from diabetes, increasing the risk of cognitional impairments in patients who have been diagnosed with Type 2 diabetes for more than 15 years.Based on this study, frequency of control 1x per month respondents had mild cognitive impairment (48.8%). This study is inconsistent with a study conducted by Widie Nugroho et al. (2016) showed that uncontrolled blood sugar can increase cognitive dysfunction in middle-aged type 2 diabetes patients compared to controlled blood glucose levels. Based on this study, non-smoking respondents had mild cognitive impairment (39.0%). This was because most of the patients were female and some of them had already quit smoking. A study conducted by Siman et al. (2019) found that the non-smoking group had a cognitive impairment of 53 people.

Based on this study, respondents with hypertension had mild cognitive impairment (24.4%). Hypertension can interfere with the structure and function of the blood vessels of the brain, causing ischemic damage to the part of white matter that is important for cognition, and can increase Alzheimer's pathology (Iadecola et al., 2016). A study conducted by Jamalnia et al. (2020) suggested that hypertension may be associated with the development of cognitive dysfunction in individuals with diabetes. Based on this study, respondents with random blood glucose >130 mg/dL had mild cognitive impairment (41.5%). This study is consistent with what Olivia Salim & Hasibuan (2018) did, which stated that there was a significant difference in proportion to cognitive dysfunction between normal and high blood glucose levels. Random blood glucose levels ≥ 140 mg/dL would have an increase of 1.68 times greater risk of cognitive dysfunction compared to random blood glucose <140 mg/dL levels.

CONCLUSION
Based on research conducted on 41 type 2 diabetes mellitus patients at RSUD Sumedang, it was found that the majority of patients experienced mild cognitive impairment, with disrupted cognitive function domains in abstraction and delayed recall.

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